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THE

ENCYCLOPÆDIA BRITANNICA

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INITIALS USED IN VOLUME XXVII. TO IDENTIFY INDIVIDUAL CONTRIBUTORS,[1] WITH THE HEADINGS OF THE ARTICLES IN THIS VOLUME SO SIGNED.

A. B. Go.	Alfred Bradley Gough, M.A., Ph.D. Sometime Casberd Scholar of St John's College, Oxford. English Lector at the University of Kiel, 1896–1905.	**Trier.**
A. C. S.	Algernon Charles Swinburne. See the biographical article: Swinburne, Algernon Charles.	**Tourneur, Cyril.**
A. E. H. L.	Augustus Edward Hough Love, M.A., D.Sc., F.R.S. Sedleian Professor of Natural Philosophy in the University of Oxford. Secretary to the London Mathematical Society. Hon. Fellow of Queen's College, Oxford; formerly Fellow of St John's College, Cambridge.	**Variations, Calculus of.**
A. F. L.	Arthur Francis Leach, M.A. Barrister-at-Law, Middle Temple. Charity Commissioner for England and Wales. Formerly Assistant Secretary to the Board of Education. Fellow of All Souls College, Oxford, 1874–1881. Author of *English Schools at the Reformation*; &c.	**Udal, Nicholas.**
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A. Ge.	Sir Archibald Geikie, K.C.B. See the biographical article: Geikie, Sir Archibald.	**Vesuvius** (*in part*).
A. Go.*	Rev. Alexander Gordon, M.A. Lecturer on Church History in the University of Manchester.	**Unitarianism;** **Valdes, Juan de.**
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A. H.-S.	Sir A. Houtum-Schindler, C.I.E. General in the Persian Army. Author of *Eastern Persian Irak*.	**Urmia, Lake of.**
A. J.	Alexander Johnston. See the biographical article: Johnston, Alexander.	**United States:** *History* (*in part*).
A. J. G.	Rev. Alexander James Grieve, M.A., B.D. Professor of New Testament and Church History, Yorkshire United Independent College, Bradford. Sometime Registrar of Madras University, and Member of Mysore Educational Service.	**Ursula, St** (*in part*).
A. J. L.	Andrew Jackson Lamoureux. Librarian, College of Agriculture, Cornell University. Editor of the *Rio News* (Rio de Janeiro), 1879–1901.	**Venezuela:** *Geography and Statistics.*
A. L.	Andrew Lang. See the biographical article: Lang, Andrew.	**Totemism.**
A. Lo.	Auguste Longnon. Professor at the Collège de France, Paris. Director of the École des Hautes Études. Chevalier of the Legion of Honour. Author of *Livre des vassaux du Comté de Champagne et de Brie*; *Géographie de la Gaule au VI siècle*; *Atlas historique de la France depuis César jusqu'à nos jours*; &c.	**Troyes:** *Counts of Troyes*; **Vermandois.**
A. M.*	Rev. Allan Menzies, M.A., D.D. Professor of Divinity and Biblical Criticism, St Mary's College, St Andrews. Author of *History of Religion*; &c. Editor of *Review of Theology and Philosophy*.	**United Free Church of Scotland.**
A. M.-Fa.	Alfred Morel-Fatio. Professor of Romance Languages at the Collège de France, Paris. Member of the Institute of France; Chevalier of the Legion of Honour. Secretary of the École des Chartes, 1885–1906. Author of *L'Espagne au XVIe et au XVIIe siècles*.	**Vega Carpio** (*in part*).

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[1] A complete list, showing all individual contributors, appears in the final volume.

A. N.	Alfred Newton, F.R.S. See the biographical article: Newton, Alfred.	**Toucan; Touracou; Tree-creeper; Trogon; Tropic-bird; Trumpeter; Turkey; Turnstone.**
A. P. H.	Alfred Peter Hillier, M.D., M.P. Author of *South African Studies*; *The Commonweal*; &c. Served in Kaffir War, 1878–1879. Partner with Dr L. S. Jameson in South Africa till 1896. Member of Reform Committee, Johannesburg, and political prisoner at Pretoria, 1895–1896. M.P. for the Hitchin Division of Herts, 1910.	**Transvaal:** *History* (*in part*).
A. R. B.	The Rev. Augustus Robert Buckland, M.A. Secretary of the Religious Tract Society, London. Morning Preacher, Foundling Hospital, London. Author of *The Heroic in Missions*; &c.	**Tract:** *Tract Societies.*
A. Sp.	Archibald Sharp. Consulting Engineer and Chartered Patent Agent.	**Tricycle.**
A. Sy.	Arthur Symons. See the biographical article: Symons, Arthur.	**Verlaine, Paul.**
A. W. H.*	Arthur William Holland. Formerly Scholar of St John's College, Oxford. Bacon Scholar of Gray's Inn, 1900.	**Utrecht, Treaty of.**
A. W. R.	Alexander Wood Renton, M.A., LL.B. Puisne Judge of the Supreme Court of Ceylon. Editor of *Encyclopaedia of the Laws of England.*	**Trade Marks** (*in part*).
B. M.	Brander Matthews, A.M., LL.D., Litt.D., D.C.L. Professor of Dramatic Literature, Columbia University, New York. President of the Modern Language Association of America (1910). Author of *French Dramatists of the 19th Century*; &c.	**Twain, Mark.**
B. R.	Sir Boverton Redwood, D.Sc., F.R.S. (Edin.), F.I.C., Assoc.Inst.C.E., M.Inst.M.E. Adviser on Petroleum to the Admiralty, Home Office, India Office, Corporation of London, and Port of London Authority. President of the Society of Chemical Industry. Member of the Council of the Chemical Society. Member of Council of the Institute of Chemistry. Author of *Cantor Lectures on Petroleum*; *Petroleum and its Products*; *Chemical Technology*; &c.	**Vaseline.**
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C. C. W.	Charles Crawford Whinery, A.M. Cornell University. Assistant Editor 11th Edition of the *Encyclopaedia Britannica.*	**United States:** *History* (*in part*).
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C. M.	Carl Theodor Mirbt, D.Th. Professor of Church History in the University of Marburg. Author of *Publizistik im Zeitalter Gregor VII.*; *Quellen zur Geschichte des Papsttums*; &c.	**Trent, Council of; Ultramontanism; Vatican Council, The**
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C. W. W.	Sir Charles William Wilson, K.C.B., K.C.M.G., F.R.S. (1836–1907). Major-General, Royal Engineers. Secretary to the North American Boundary Commission. Director-General of the Ordnance Survey, 1886–1894. Director-General of Military Education, 1895–1898. Author of *From Korti to Khartoum*; *Life of Lord Clive*; &c.	**Van:** ***Turkey (in part).***
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D. F. T.	Donald Francis Tovey. Author of *Essays in Musical Analysis*: comprising *The Classical Concerto*, *The Goldberg Variations*, and analyses of many other classical works.	**Variations.**
D. G. H.	David George Hogarth, M.A. Keeper of the Ashmolean Museum, Oxford, and Fellow of Magdalen College. Fellow of the British Academy. Excavated at Paphos, 1888; Naucratis, 1899 and 1903; Ephesus, 1904–1905; Assiut, 1906–1907. Director, British School at Athens, 1897–1900. Director, Cretan Exploration Fund, 1899.	**Tralles;** **Tripoli:** ***Syria;*** **Troy and Troad** ***(in part).***
D. H.	David Hannay. Formerly British Vice-Consul at Barcelona. Author of *Short History of the Royal Navy*; *Life of Emilio Castelar*; &c.	**Toulon;** **Tourville, Comte de;** **Trafalgar, Battle of.**
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E. C. B.	Rt. Rev. Edward Cuthbert Butler, O.S.B., M.A., D.Litt. Abbot of Downside Abbey, Bath. Author of "The Lausiac History of Palladius," in *Cambridge Texts and Studies*, vol. vi.	**Trappists;** **Trinitarians;** **Vallombrosians.**
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E. G.	Edmund Gosse, LL.D., D.C.L. See the biographical article: Gosse, Edmund.	**Topelius, Zakris; Triolet;** **Troubadour; Trouvère;** **Usk, Thomas;** **Vers de Société; Verse.**
E. Ga.	Emile Garcke, M.Inst.E.E. Managing Director of the British Electric Traction Co., Ltd. Author of *Manual of Electrical Undertakings*; &c.	**Tramway.**
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E. K. C.	Edmund Kerchever Chambers. Assistant Secretary, Board of Education. Sometime Scholar of Corpus Christi College, Oxford. Chancellor's English Essayist, 1891. Author of *The Medieval Stage*. Editor of the "Red Letter" *Shakespeare*; Donne's *Poems*; Vaughan's *Poems*.	**Vaughan, Thomas.**
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F. D. A.	Frank Dawson Adams, Ph.D., D.Sc., F.G.S., F.R.S. Dean of the Faculty of Applied Science and Logan Professor of Geology, McGill University, Montreal. President of the Canadian Mining Institute. Author of Papers dealing with problems of Metamorphism; &c.	**Vancouver Island.**
F. G. M. B.	Frederick George Meeson Beck, M.A. Fellow and Lecturer of Clare College, Cambridge.	**Vandals** (*in part*).
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F. J. T.	Frederick Jackson Turner, M.A., LL.D., Litt.D., Ph.D. Professor of History, Harvard University. Formerly Professor of American History at the University of Wisconsin. Author of *Rise of the New West*; &c.	**United States:** *History* (*in part*).
F. Po.	Sir Frederick Pollock, Bart., LL.D., D.C.L. See the biographical article: Pollock (Family).	**Tort.**
F. R. C.	Frank R. Cana. Author of *South Africa from the Great Trek to the Union.*	**Transvaal:** *Geography and Statistics* and *History* (*in part*); **Tripoli:** *North Africa* (*in part*); **Tsana** (*in part*); **Tuat.**
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F. S. P.	Francis Samuel Philbrick, A.M., Ph.D. Formerly Fellow of Nebraska State University and Scholar and Resident Fellow of Harvard University. Member of the American Historical Association.	**United States:** *Population and Social Conditions*; *Industries and Commerce*; *Finance and Army.*
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G. Re.	Sir George Reid, LL.D. See the biographical article: Reid, Sir George.	**Turner.**

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H. De.	Rev. Hippolyte Delehaye, S.J. Bollandist. Joint-editor of the *Acta Sanctorum* and the *Analecta Bollandiana*.	**Valentine;** **Veronica, St.**
H. E. A.	Henry Edward Armstrong, Ph.D., LL.D., F.R.S. Professor of Chemistry at the City and Guilds of London Central Institute, South Kensington. Author of *Introduction to the Study of Organic Chemistry*.	**Valency.**
H. F. B.	Horatio Robert Forbes Brown, LL.D. Editor of the *Calendar of Venetian State Papers*, for the Public Record Office. Author of *Life on the Lagoons*; *Venetian Studies*; *John Addington Symonds, a Biography*; &c.	**Venice.**
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H. Ha.	Heber Leonidas Hart, LL.D. Barrister-at-law.	**Valuation and Valuers.**
H. H. F.	H. Hamilton Fyfe. Special Correspondent of the *Daily Mail*; Dramatic Critic of *The World*. Author of *A Modern Aspasia*; *The New Spirit in Egypt*; &c.	**Tricoupis, Charilaos.**
H. H. J.	Sir Harry Hamilton Johnston, G.C.M.G., K.C.B., D.Sc., LL.D. See the biographical article: Johnston, Sir H. H.	**Tunisia;** **Uganda; Unyoro.**
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H. L. H.	Harriet L. Hennessy, M.D. (Brux.), L.R.C.P.I., L.R.C.S.I.	**Tuberculosis.**
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H. M. C.	Hector Munro Chadwick, M.A. Fellow and Librarian of Clare College, Cambridge. Author of *Studies on Anglo-Saxon Institutions*.	**Týr;** **Valkyries.**
H. M. R.	Hugh Munro Ross. Formerly Exhibitioner of Lincoln College, Oxford. Editor of *The Times Engineering Supplement*. Author of *British Railways*.	**Typography:** *Modern Practical Typography* (*in part*).
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H. St.	Henry Sturt, M.A. Author of *Idola Theatri*; *The Idea of a Free Church*; *Personal Idealism*.	**Utilitarianism.**
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I. M. A.	Rev. Isaac Morgan Atwood, M.A., D.D., LL.D. Secretary of the Universalist General Convention. Associate-editor of the *Universalist Leader*, Boston. General Superintendent of the Universalist Church, 1898–1906. Author of *Latest Word of Universalism*; &c.	**Universalist Church.**
J. An.	Joseph Anderson, LL.D. Keeper of the National Museum of Antiquities, Edinburgh, and Assistant Secretary of the Society of Antiquaries of Scotland. Honorary Professor of Antiquities to the Royal Scottish Academy. Author of *Scotland in Early Christian and Pagan Times*.	**Tumulus.**

INITIALS AND HEADINGS OF ARTICLES

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J. A. H.	John Allen Howe. Curator and Librarian of the Museum of Practical Geology, London. Author of *The Geology of Building Stones.*	**Torridonian;** **Triassic System.**
J. Br.	Right Hon. James Bryce, D.C.L., D.Litt. See the biographical article: Bryce, James.	**Tribonian;** **United States:** *Constitution and Government.*
J. Bt.	James Bartlett. Lecturer on Construction, Architecture, Sanitation, Quantities, &c., at King's College, London. Member of the Society of Architects. Member of the Institute of Junior Engineers.	**Ventilation.**
J. B. M.	James Bass Mullinger, M.A. Lecturer in History, St John's College, Cambridge. Formerly University Lecturer in History and President of the Cambridge Antiquarian Society. Birkbeck Lecturer in Ecclesiastical History at Trinity College, Cambridge, 1890–1894. Author of *History of the University of Cambridge*; *The Schools of Charles the Great*; &c.	**Universities.**
✠J. C. H.	Right Rev. John Cuthbert Hedley, O.S.B., D.D. R.C. Bishop of Newport. Author of *The Holy Eucharist*; &c.	**Transubstantiation.**
J. F.-K.	James Fitzmaurice-Kelly, Litt.D., F.R.Hist.S. Gilmour Professor of Spanish Language and Literature, Liverpool University. Norman McColl Lecturer, Cambridge University. Fellow of the British Academy. Member of the Royal Spanish Academy. Knight Commander of the Order of Alphonso XII. Author of *A History of Spanish Literature*; &c.	**Translation;** **Valera y Alcalá Galiano, Juan;** **Vega Carpio** (*in part*).
J. F. W.	John Forbes White, M.A., LL.D (d. 1904). Joint-author of the *Life and Art of G. P. Chalmers, R.S.A.*; &c.	**Velazquez** (*in part*).
J. G. H.	Joseph G. Horner, A.M.I.Mech.E. Author of *Plating and Boiler-Making*; *Practical Metal-Turning*; &c.	**Tool.**
J. G. M.	John Gray M'Kendrick, M.D., LL.D., F.R.S., F.R.S. (Edin.). Emeritus Professor of Physiology in the University of Glasgow. Professor of Physiology, 1876–1906. Author of *Life in Motion*; *Life of Helmholtz*; &c.	**Touch;** **Vascular System:** *History of Discovery.*
J. H. H.	John Henry Hessels, M.A. Author of *Gutenberg: an Historical Investigation.*	**Typography:** *History.*
J. H. M.	John Henry Middleton, M.A., Litt.D., F.S.A., D.C.L. (1846–1896). Slade Professor of Fine Art in the University of Cambridge, 1886–1895. Director of the Fitzwilliam Museum, Cambridge, 1889–1892. Art Director of the South Kensington Museum, 1892–1896. Author of *The Engraved Gems of Classical Times*; *Illuminated Manuscripts in Classical and Mediaeval Times.*	**Verona** (*in part*), **Verrocchio, Andrea del;** **Vesta** (*in part*).
J. H. R.	John Horace Round, M.A., LL.D. Balliol College, Oxford. Author of *Feudal England*; *Studies in Peerage and Family History*; *Peerage and Pedigree*,	**Vere** (*Family*).
J. J. T.	Sir Joseph John Thomson, F.Sc., LL.D., Ph.D., F.R.S. Cavendish Professor of Experimental Physics and Fellow of Trinity College, Cambridge. President of the British Association, 1909–1910. Author of *A Treatise on the Motion of Vortex Rings*; *Application of Dynamics to Physics and Chemistry*; *Recent Researches in Electricity and Magnetism*; &c.	**Vacuum Tube.**
J. L.*	Sir Joseph Larmor, M.A., D.Sc., LL.D., F.R.S. Fellow of St John's College, Cambridge, and Lucasian Professor of Mathematics in the University. Secretary of the Royal Society. Professor of Natural Philosophy, Queen's College, Galway, 1880–1885. Author of *Ether and Matter*, and various memoirs on Mathematics and Physics.	**Units, Dimensions of.**
J. L. E. D.	John Louis Emil Dreyer. Director of Armagh Observatory. Author of *Planetary Systems from Thales to Kepler*; &c.	**Transit Circle.**
J. L. W.	Jessie Laidlay Weston. Author of *Arthurian Romances unrepresented in Malory*	**Tristan.**
J. O.	Josiah Oldfield, M.A., D.C.L., M.R.C.S., L.R.C.P. Barrister-at-law. Senior Physician of the Lady Margaret Fruitarian Hospital, Bromley. Author of *Myrrh and Amaranth*; *The Voice of Nature*; &c.	**Vegetarianism.**
J. O. B.	John Oliver Borley, M.A. Gonville and Caius College, Cambridge.	**Trawling, Seining and Netting.**
J. P.-B.	James George Joseph Penderel-Brodhurst. Editor of the *Guardian*, London.	**Vernis, Martin.**
J. P. Pe.	Rev. John Punnett Peters, Ph.D., D.D. Canon Residentiary, Protestant Episcopal Cathedral of St John the Divine in New York City. Formerly Professor of Hebrew, University of Pennsylvania. In charge of the Expedition of the University of Pennsylvania to Nippur, 1888–1895. Author of *Scriptures, Hebrew and Christian*; *Nippur, or Explorations and Adventures on the Euphrates*; &c.	**Ur.**

J. So.	John Southward. Author of *A Dictionary of Typography and its Accessory Arts*; *Practical Printing*; &c.	**Typography:** *Modern Practical Typography* (*in part*).
J. S. F.	John Smith Flett, D.Sc., F.G.S. Petrographer to the Geological Survey. Formerly Lecturer on Petrology in Edinburgh University. Neill Medallist of the Royal Society of Edinburgh. Bigsby Medallist of the Geological Society of London.	**Tonalite; Trachyte;** **Tuff; Variolites;** **Veins** (*Geology*).
J. S. N.	Joseph Shield Nicholson, M.A., Sc.D. Professor of Political Economy at Edinburgh University. Fellow of the British Academy. Author of *Principles of Political Economy*; *Money and Monetary Problems*; &c.	**Usury;** **Value.**
J. S. R.	James Smith Reid, M.A., LL.D., Litt.D. Professor of Ancient History and Fellow and Tutor of Gonville and Caius College, Cambridge. Hon. Fellow, formerly Fellow and Lecturer of Christ's College. Browne's and Chancellor's Medals. Editor of editions of Cicero's *Academia*; *De Amicitia*; &c.	**Trajan;** **Tribune;** **Varro, Marcus Terentius.**
J. T. Be.	John Thomas Bealby. Joint-author of Stanford's Europe. Formerly Editor of the *Scottish Geographical Magazine*. Translator of Sven Hedin's *Through Asia*, *Central Asia and Tibet*; &c.	**Transbaikalia** (*in part*); **Transcaspian Region** (*in part*); **Turgai** (*in part*); **Turkestan** (*in part*); **Ufa** (*Government*) (*in part*); **Ural Mountains** (*in part*).
J. W.	James Williams, M.A., D.C.L., LL.D. All Souls Reader in Roman Law in the University of Oxford, and Fellow of Lincoln College. Author of *Wills and Succession*; &c.	**Torture.**
J. W. He.	James Wycliffe Headlam, M.A. Staff Inspector of Secondary Schools under the Board of Education, London. Formerly Fellow of King's College, Cambridge. Professor of Greek and Ancient History at Queen's College, London. Author of *Bismarck and the Foundation of the German Empire*; &c.	**Treitschke, Heinrich von.**
J. W. J.	Jeremiah Whipple Jenks. See the biographical article: Jenks, Jeremiah Whipple.	**Trusts.**
K. S.	Kathleen Schlesinger. Editor of *The Portfolio of Musical Archaeology*. Author of *The Instruments of the Orchestra*.	**Trigonon; Tromba Marina;** **Trombone** (*in part*); **Trumpet** (*in part*); **Tuba; Valves.**
L. C.*	Louis Courtauld, M.A., M.R.C.S., L.R.C.P. Formerly Research Scholar, Middlesex Hospital Cancer Laboratories. Author of *Life-History of Pneumococcus*; &c.	**Tumour.**
L. Du.	Louis Duncan, Ph.D., M.Am.Inst.E.E. Late Associate Professor of Applied Electricity at the Johns Hopkins University, Baltimore, Md. Head of the Department of Electrical Engineering, Massachusetts Institute of Technology.	**Traction.**
L. E. H.	Leonard Erskine Hill, F.R.S., M.R.C.S., L.R.C.P. Lecturer on Physiology at the London Hospital. Formerly Demonstrator of Physiology in the University of Oxford; and Assistant Professor of Physiology, University College, London. Author of *Manual of Physiology*; &c.	**Vascular System:** *Physiology*.
L. J.*	Lionel James, F.R.G.S. *The Times* Special Correspondent in South Africa, 1899–1901. Reuter's Special Correspondent in the Chitral Campaign, 1894–1895. Author of *With the Chitral Relief Force*; *On the Heels of De Wet*; &c. &c.	**Transvaal:** *History* (*in part*).
L. J. S.	Leonard James Spencer, M.A. Assistant in the Department of Mineralogy, British Museum. Formerly Scholar of Sidney Sussex College, Cambridge, and Harkness Scholar. Editor of the *Mineralogical Magazine*.	**Torbernite; Tremolite;** **Tridymite; Vanadinite;** **Vesuvianite.**
L. V.*	Luigi Villari. Italian Foreign Office (Emigration Department). Formerly Newspaper Correspondent in the east of Europe. Italian Vice-Consul in New Orleans, 1906; Philadelphia, 1907; and Boston, 1907–1910. Author of *Italian Life in Town and Country*; &c.	**Tuscany:** *History*; **Vespers, Sicilian.**
M. Br.	Margaret Bryant.	**Tourneur, Cyril:** *Introduction and Bibliography*.
M. G.	Moses Gaster, Ph.D. Chief Rabbi of the Sephardic Communities of England. Vice-President, Zionist Congress, 1898, 1899, 1900. Ilchester Lecturer at Oxford on Slavonic and Byzantine Literature, 1886 and 1891. Author of *A New Hebrew Fragment of Ben-Sira*; *The Hebrew Version of the Secretum Secretorum of Aristotle*.	**Vacarescu.**
M. N. T.	Marcus Niebuhr Tod, M.A. Fellow and Tutor of Oriel College, Oxford. University Lecturer in Epigraphy. Joint-author of *Catalogue of the Sparta Museum*.	**Vaphio.**
M. O. B. C.	Maximilian Otto Bismarck Caspari, M.A. Reader in Ancient History at London University. Lecturer in Greek at Birmingham University, 1905–1908.	**Trachis;** **Umbria** (*Ancient*).
N. D. M.	Newton Dennison Mereness, A.M., Ph.D. Author of *Maryland as a Proprietary Province*	**United States:** *Fauna and Flora*.

O. Ba.	Oswald Barron, F.S.A. Editor of the *Ancestor*, 1902–1905. Hon. Genealogist to Standing Council of the Honourable Society of the Baronetage.	**Tournament;** **Tudor** (*Family*).
P. A. K.	Prince Peter Alexeivitch Kropotkin. See the biographical article: Kropotkin, Prince P. A.	**Transbaikalia** (*in part*); **Transcaspian Region** (*in part*); **Turgai** (*in part*); **Turkestan** (*in part*); **Ufa** (*Government*) (*in part*); **Ural Mountains** (*in part*).
P. C. M.	Peter Chalmers Mitchell, M.A., F.R.S., F.Z.S., D.Sc., LL.D. Secretary of the Zoological Society of London. University Demonstrator in Comparative Anatomy and Assistant to Linacre Professor at Oxford, 1888–1891. Author of *Outlines of Biology*; &c.	**Variation and Selection;** **Vertebrata.**
P. C. Y.	Philip Chesney Yorke, M.A. Magdalen College, Oxford. Editor of *Letters of Princess Elizabeth of England*.	**Vane, Sir H.**
P. Gi.	Peter Giles, M.A., LL.D., Litt.D. Fellow and Classical Lecturer of Emmanuel College, Cambridge, and University Reader in Comparative Philology. Formerly Secretary of the Cambridge Philological Society.	**U.** **V.**
P. G. K.	Paul George Konody. Art Critic of the *Observer* and the *Daily Mail*. Formerly Editor of the *Artist*. Author of *The Art of Walter Crane*; *Velasquez: Life and Work*; &c.	**Van Dyck** (*in part*); **Velazquez** (*in part*).
P. La.	Philip Lake, M.A., F.G.S. Lecturer on Physical and Regional Geography in Cambridge University. Formerly of the Geological Survey of India. Author of *Monograph of British Cambrian Trilobites*. Translator and Editor of Kayser's *Comparative Geology*.	**Venezuela:** *Geology*.
R. A.*	Robert Anchel. Archivist of the Département de l'Eure.	**Vendée, Wars of the.**
R. A. S.	Richard Alexander Streatfeild. Assistant in the Department of Printed Books, British Museum. Musical Critic of the *Daily Graphic*. Author of *Masters of Italian Music*; *The Opera*; &c.	**Verdi, Guiseppe.**
R. C. J.	Sir Richard Claverhouse Jebb, LL.D., D.C.L., Litt.D. See the biographical article: Jebb, Sir Richard C.	**Troy and Troad** (*in part*).
R. D. S.	Rollin D. Salisbury, A.M., LL.D. Geologist in charge of Pleistocene Geology of New Jersey. Dean of Ogden (Grad.) School of Science and Head of the Department of Geography in the University of Chicago.	**United States:** *Geology* (*in part*).
R. I. P.	Reginald Innes Pocock, F.Z.S. Superintendent of the Zoological Gardens, London.	**Trilobites.**
R. J. M.	Ronald John McNeill, M.A. Christ Church, Oxford. Barrister-at-law. Formerly Editor of the *St James's Gazette* (London).	**Tone, Theobald Wolfe;** **Tyler, Wat;** **Ulster, Earls of.**
R. K. D.	Sir Robert Kennaway Douglas. Formerly Keeper of Oriental Printed Books and MSS. at the British Museum; and Professor of Chinese, King's College, London. Author of *The Language and Literature of China*; &c.	**Tsêng Kuo-fan.**
R. L.*	Richard Lydekker, M.A., F.R.S., F.G.S., F.Z.S. Member of the Staff of the Geological Survey of India, 1874–1882. Author of *Catalogues of Fossil Mammals, Reptiles and Birds in the British Museum*; *The Deer of All Lands*; *The Game Animals of Africa*; &c.	**Toxodontia;** **Tylopoda;** **Ungulata.**
R. N. B.	Robert Nisbet Bain (d. 1909). Assistant Librarian, British Museum, 1883–1909. Author of *Scandinavia: the Political History of Denmark, Norway and Sweden, 1513–1900*; *The First Romanovs, 1613–1725*; *Slavonic Europe: the Political History of Poland and Russia from 1469 to 1796*; &c.	**Tordenskjold, Peder;** **Torstensson, Count;** **Valdemar I., II. and IV. of Denmark;** **Verboczy, Istvan.**
R. P. S.	R. Phené Spiers, F.S.A., F.R.I.B.A. Formerly Master of the Architectural School, Royal Academy, London. Past President of Architectural Association. Associate and Fellow of King's College, London. Corresponding Member of the Institute of France. Editor of *Fergusson's History of Architecture*. Author of *Architecture: East and West*; &c.	**Tower;** **Tracery;** **Triumphal Arch;** **Vault.**
R. S. C.	Robert Seymour Conway, M.A., D.Litt. (Cantab.). Professor of Latin and Indo-European Philology in the University of Manchester. Formerly Professor of Latin in University College, Cardiff; and Fellow of Gonville and Caius College, Cambridge. Author of *The Italic Dialects*.	**Veneti;** **Vestini.**
R. Tr.	Roland Truslove, M.A. Fellow, Dean and Lecturer in Classics at Worcester College, Oxford.	**Troyes.**
S. A. C.	Stanley Arthur Cook, M.A. Editor for the Palestine Exploration Fund. Lecturer in Hebrew and Syriac, and formerly Fellow, Gonville and Caius College, Cambridge. Examiner in Hebrew and Aramaic, London University, 1904–1908. Author of *Glossary of Aramaic Inscriptions*; *The Laws of Moses and the Code of Hammurabi*; *Critical Notes on Old Testament History*; *Religion of Ancient Palestine*; &c.	**Tree-Worship;** **Uzziah.**

S. M. C.	Sydney Moncton Copeman, M.A., M.D., F.R.C.P., M.R.C.S., F.R.S. Medical Inspector to H.M. Local Government Board, London. Medical Lecturer on Public Health at Westminster Hospital. Lt.-Col. and Divisional Sanitary Officer, 1st London Division, Territorial Force. Milroy Lecturer, Royal College of Physicians, London, 1898. Author of *Vaccination, its Natural History and Pathology*; &c.	**Vaccination.**
S. M. E.-W	Sir Sydney Marow Eardley-Wilmot. Rear-Admiral (retired). Commanded H.M.S. "Dolphin" in Red Sea, 1885–1886, and assisted in the defence of Suakin. Superintendent of Ordnance Stores, 1902–1909. Author of *Life of Vice-Admiral Lord Lyons*; *Our Navy for a Thousand Years*; &c.	**Torpedo.**
S. N.	Simon Newcomb, LL.D., D.Sc. See the biographical article: Newcomb, Simon.	**Uranus** (*Astronomy*); **Venus** (*Astronomy*).
T. As.	Thomas Ashby, M.A., D.Litt. Director of the British School of Archaeology at Rome. Formerly Scholar of Christ Church, Oxford. Craven Fellow, 1897. Conington Prizeman, 1906. Member of the Imperial German Archaeological Institute. Author of *The Classical Topography of the Roman Campagna*.	**Tortona; Trapani; Trasimene, Lake; Trebula; Turin; Turris Libisonis; Tuscany:** *Geography*; **Tusculum; Tyndaris; Udine; Umbria** (*Modern*); **Valeria, Via; Varia; Vasto; Veii; Veleia; Velia; Velletri; Venafrum; Venusia; Vercelli; Verona** (*in part*); **Vesuvius** (*in part*).
T. A. A.	Thomas Andrew Archer, M.A. Author of *The Crusade of Richard I.*; &c.	**Ursula, St** (*in part*).
T. A. I.	Thomas Allan Ingram, M.A., LL.D. Trinity College, Dublin.	**Unemployment; Vagrancy**
T. C. C.	Thomas Chrowder Chamberlin, A.M., Ph.D., LL.D., Sc.D., F.G.S., F.A.A.S., &c. Professor and Head of Department of Geology and Director of the Walker Museum, University of Chicago. Investigator of Fundamental Problems of Geology at the Carnegie Institute. Consulting Geologist, United States and Wisconsin Geological Survey. Author of *Geology of Wisconsin*; *General Treatise on Geology* (with R. D. Salisbury); &c.	**United States:** *Geology* (*in part*).
T. E. H.	Thomas Erskine Holland, M.A., D.C.L., LL.D., K.C. Fellow of the British Academy. Fellow of All Souls College, Oxford. Professor of International Law and Diplomacy in the University of Oxford, 1874–1910. Bencher of Lincoln's Inn. Author of *Studies in International Law*; *The Elements of Jurisprudence*; *Alberici Gentilis de jure belli*; *The Laws of War on Land*; *Neutral Duties in a Maritime War*; &c.	**Treaties;** **Vacarius.**
T. F. C.	Theodore Freylinghuysen Collier, Ph.D. Assistant Professor of History, Williams College, Williamstown, Mass.	**Urban VII. and VIII.**
T. H.	Thomas Hodgkin, D.C.L., Litt.D. See the biographical article: Hodgkin, Thomas.	**Vandals** (*in part*).
T. S.	The Right Honourable Lord Shaw of Dunfermline. Lord of Appeal. M.P. for Hawick District, 1892–1909. Lord Advocate for Scotland, 1905–1909.	**Vergniaud, Pierre.**
T. Se.	Thomas Seccombe, M.A. Balliol College, Oxford. Lecturer in History, East London and Birkbeck Colleges, University of London. Stanhope Prizeman, Oxford, 1887. Assistant Editor of *Dictionary of National Biography*, 1891–1901. Author of *The Age of Johnson*; &c.	**Vanbrugh, Sir John.**
V. C.*	Sir Vincent Henry Penalver Caillard. Director of Vickers, Sons & Maxim, Ltd.; and the London, Chatham & Dover Railway. Formerly President of the Ottoman Public Debt Council, and Financial Representative of England, Holland and Belgium in Constantinople. Author of *Imperial Fiscal Reform*.	**Turkey:** *Geography and Statistics*.
V. M.	Victor Charles Mahillon. Principal of the Conservatoire Royal de Musique at Brussels. Chevalier of the Legion of Honour.	**Trombone** (*in part*); **Trumpet** (*in part*).
W. A. B. C.	Rev. William Augustus Brevoort Coolidge, M.A., F.R.G.S. Fellow of Magdalen College, Oxford. Professor of English History, St David's College, Lampeter, 1880–1881. Author of *Guide to Switzerland*; *The Alps in Nature and in History*; &c. Editor of the *Alpine Journal*, 1880–1889.	**Töpffer, Rodolphe; Trent; Tschudi; Unterwalden; Uri; Valais; Var; Vaud.**
W. A. He.	William Abbot Herdman, D.Sc., F.R.S. Professor of Natural History in the University of Liverpool. President of the Linnean Society, 1904. Author of *Report upon the Tunicata collected during the Voyage of the "Challenger"*; &c.	**Tunicata.**
W. A. P.	Walter Alison Phillips, M.A. Formerly Exhibitioner of Merton College and Senior Scholar of St John's College, Oxford. Author of *Modern Europe*; &c.	**Utrecht:** *Province* (*in part*); **Valet; Vavassor; Verona, Congress of; Vestments.**
W. Bo.	Wilhelm Bousset, D.Th. Professor of New Testament Exegesis in the University of Göttingen. Author of *Das Wesen der Religion*; *The Antichrist Legend*; &c.	**Valentinus and the Valentinians.**

W. E. G.	Sir William Edmund Garstin, G.C.M.G. Governing Director, Suez Canal Co. Formerly Inspector-General of Irrigation, Egypt, and Adviser to the Ministry of Public Works in Egypt.	**Tsana** (*in part*).
W. F. C.	William Feilden Craies, M.A. Barrister-at-Law, Inner Temple. Lecturer on Criminal Law, King's College, London. Editor of Archbold's *Criminal Pleading* (23rd edition).	**Trade Marks** (*in part*); **Treason; Trial; Venue.**
W. G.*	Walcot Gibson, D.Sc., F.G.S. Geologist on H.M. Geological Survey. Author of *The Gold-bearing Rocks of the S. Transvaal*; *Mineral Wealth of Africa*; *The Geology of Coal and Coal Mining*; &c.	**Transvaal:** *Geology.*
W. L. F.	Walter Lynwood Fleming, A.M., Ph.D. Professor of History in Louisiana State University. Editor of *Documentary History of Reconstruction*; &c.	**Union League of America, The.**
W. McD.	William McDougall, M.A. Wilde Reader in Mental Philosophy in the University of Oxford. Formerly Fellow of St John's College, Cambridge.	**Trance.**
W. MacD.*	William MacDonald, LL.D. Professor of American History in Brown University, Providence, R.I. Professor of History and Political Science at Bowdoin, 1893-1901. Author of *History and Government of Maine*; &c. Editor of *Select Documents illustrative of the History of the United States*; &c.	**Tyler, John;** **Van Buren, Martin.**
W. M. D.	William Morris Davis, D.Sc., Ph.D. Professor of Geology in Harvard University. Formerly Professor of Physical Geography. Author of *Physical Geography*; &c.	**United States:** *Physical Geography* and *Climate.*
W. P. C.	William Prideaux Courtney. See the biographical article: Courtney, L. H. Baron.	**Tooke, John Horne.**
W. R. M.	William Richard Morfill, M.A. (d. 1910). Formerly Professor of Russian and the other Slavonic Languages in the University of Oxford. Curator of the Taylorian Institution, Oxford. Author of *Russia: Slavonic Literature*; &c.	**Turgueniev, Ivan.**
W. R. S.	William Robertson Smith, LL.D. See the biographical article: Smith, William Robertson.	**Tyre** (*in part*).

PRINCIPAL UNSIGNED ARTICLES

Tonga.
Tongking.
Toronto.
Toul.
Toulouse.
Touraine.
Tours.
Townshend, Charles.
Townshend, Viscount.
Trade, Board of.
Trade Organization.
Trade Unions (*in part*).
Transylvania.
Transylvanian Mountains.
Trap.
Trenck, Franz.
Trendelenburg, Friedrich.
Trenton (N.J.).
Tresham, Francis.
Trespass.
Triazines.
Trieste.
Trinidad.
Tristan da Cunha.
Trollope, Anthony.
Tromp.
Tropine.
Troy (N.Y.).
Truffle.
Trust and Trustees.
Tschaikovsky, Peter.
Tuareg.
Tuke (*Family*).
Tulip.
Tungsten.
Tunis.
Turgot, Anne Robert Jacques.
Turkey: *History.*
Turpentine.
Tweeddale, Marquesses of.
Tyndale, William.
Tyndall, John.
Tynemouth.
Typewriter.
Typhoid Fever.
Typhus Fever.
Tyrone.
Ulfeldt, Korfits.
Ulm.
Ulrich.
Umbelliferae.
United Kingdom of Great Britain and Ireland.
United Presbyterian Church.
United Provinces of Agra and Oudh.
United States Naval Academy.
Upsala.
Uranium.
Urbino.
Urea.
Urinary System.
Ursins, Princess des.
Urticaceae.
Uruguay.
Usher, James.
Uskoks.
Utah.
Utica (N.Y.).
Uxmal.
Valencia (*Province*).
Valencia (*City*).
Valens.
Valentinian I.-II.
Valerian.
Valla, Lorenzo.
Valladolid.
Valtellina.
Vanadium.
Vanderbilt, Cornelius.
Vane, Sir Henry.
Vanilla.
Vauban.
Vaughan, Henry.
Vauvenargues, Marquis de.
Venezuela: *History.*
Venus's Fly-trap.
Verdun.
Vermont.
Vernet (*Family*).
Verney (*Family*).
Vernon, Edward.
Versailles.
Vespasian.

ENCYCLOPÆDIA BRITANNICA

ELEVENTH EDITION

VOLUME XXVII

TONALITE, in petrology, a rock of the diorite class, first described from Monte Adamello near Tonale in the Eastern Alps. It may be described as a quartz-diorite containing biotite and hornblende in nearly equal proportions. The principal felspar is plagioclase, but orthoclase occurs also, usually in small amount. Those varieties which are rich in orthoclase, in addition to plagioclase, have been called quartz-monzonites or adamellites, but a better term is grano-diorite, which has been very generally adopted in America for rocks which are intermediate in character between the granites and the diorites. The hornblende of the diorites is green, sometimes with a tinge of brown; the biotite is always brown and strongly pleochroic. Often these two minerals are clustered together irregularly or in parallel growths. They have generally a fairly strong tendency to idiomorphism, but may sometimes enclose plagioclase felspar in ophitic manner. Both of them decompose to chlorite, epidote and carbonates. The plagioclase felspar, which may form more than one-half of the rock, is andesine or oligoclase; simple crystals are rare, the majority being complex growths with centres of felspar rich in lime, while in the external zones the proportion of soda felspar increases greatly. The inner portions have often well-defined, but very irregular, boundaries, and are sometimes sponge-like, with the cavities filled up with a later, more acid deposit. This seems to indicate that growth has taken place in stages, alternating with periods when the crystallized felspar was eroded or partly dissolved. The orthoclase sometimes forms irregular plates enclosing individuals of plagioclase. Quartz occurs both in irregular simple grains and as micropegmatite. Occasionally pale green pyroxene is visible in the centre of crystals of dark green hornblende. The accessory minerals apatite, magnetite and zircon are always present, and very common also are orthite in coffee-coloured zonal prisms practically always encircled by yellow epidote, and reddish-brown crystals of sphene, simple or twinned.

In external appearance the tonalites are very like the granites but usually darker in colour. Tonalite-porphyrites often accompany them, having the same composition but with phenocrysts of felspar, quartz, hornblende and biotite in a fine-grained groundmass. Veins and threads of fine grey rock, mainly composed of quartz and felspar, often intersect tonalite-masses and have been called tonalite-aplites, seeing that they bear the same relations to aplites as the aplites do to the granites. They contain more soda-lime felspar than the normal aplites. Towards their margins the larger alpine masses of tonalite often assume banded or gneissic facies, due apparently to movement during intrusion.

In eastern Tirol another tonalite occurs at Rieserferner; there is also a well-known mass of this rock near Traversella. In the south of Scotland (Galloway district) tonalites accompany hornblende- and biotite-granites, hornblende- and augite-diorites. The newer granites of the Highlands of Scotland in many places pass into tonalites, especially near their margins, and similar rocks occur in Ireland in a few places. Grano-diorites have been described from California, and rocks of very similar character occur in the Andes, Patagonia and the lesser Antilles. Tonalites are also said to be frequent among the igneous rocks of Alaska. (J. S. F.)

TONAWANDA, a city of Erie county, New York, U.S.A., about 11 m. by rail N. of Buffalo on the Niagara River at the mouth of Tonawanda Creek (opposite North Tonawanda), and on the Erie Canal. Pop. (1900), 7421, of whom 1834 were foreign-born; (1910 census), 8290. Tonawanda is served by the New York Central & Hudson River and the Erie railways, and is connected with Buffalo, Niagara Falls and Lockport by electric lines. The industries depend chiefly on electric power generated by the Niagara Falls, 11 m. distant. There are rolling-mills, planing-mills, ship-yards, and blast-furnaces, and among the manufactures are wooden ware, flour and paper. The surrounding region was the scene of hostilities during the Seven Years' War, and the War of 1812. The first permanent white settlement was made about 1809, and Tonawanda was incorporated as a village in 1854 and was chartered as a city in 1903. The name of the city is an Indian word said to mean "swift water"

TONBRIDGE [TUNBRIDGE], a market town in the Tonbridge or south-western parliamentary division of Kent, England, 29½ m. S.S.E. of London by the South Eastern & Chatham railway. Pop. of urban district (1901), 12,736. It is situated on rising ground above the river Medway, which is crossed by a stone bridge erected in 1775. The church of St Peter and St Paul, chiefly Decorated and Perpendicular, with some portions of earlier date, was completely restored in 1879. There are remains of an ancient castle, consisting chiefly of a finely preserved gateway, of the Early Decorated period, flanked by two round towers. The castle was formerly defended by three moats, one of them formed by the Medway. Tonbridge School was founded by Sir Andrew Judd, lord mayor of London in the time of Edward VI., and was rebuilt in 1865, remodelled in 1880, and extended subsequently. Ornamental articles of inlaid wood, called Tonbridge ware, chiefly sold at Tunbridge Wells, are largely manufactured. There are gunpowder mills on the banks of the Medway, and wool-stapling, brewing and tanning are carried on. There is some traffic on the Medway, which is navigable for barges.

Tonbridge owed its early importance to the castle built by Richard, earl of Clare, in the reign of Henry I. The castle was besieged by William Rufus, was taken by John in the wars with the barons, and again by Prince Edward, son of Henry III. After being in the possession of the earls of Clare and Hertford, and of the earls of Gloucester, it became the property of the Staffords, and on the attainder of the duke of Buckingham in the reign of Henry VIII. was taken by the Crown. It was dismantled during the Civil War. The lords of the castle had the right of attending the archbishops of Canterbury on state occasions as chief butlers.

TONDERN, a town of Germany, in the Prussian province of Schleswig-Holstein, on the Widane, 8 m. from the North Sea at Hoyer, opposite the island of Sylt, and 42 m. by rail N.W. from Flensburg. Pop. (1900), 4244. Tondern was in early days a seaport, but since the reclamation of the marshes and the dredging of the Widane navigation has ceased, and vessels load and unload at Hoyer, with which the place has direct railway communication. The trade consists chiefly in agricultural produce and cattle, and there is an important horse market.

In the village of Galhus, lying about 4 m. N., were discovered, in 1639 and 1734 respectively, two golden horns of the Scandinavian period; these were stolen in 1802 from the Museum of Northern Antiquities in Copenhagen, where they had been treasured, and have never been recovered.

See Karstens, *Die Stadt Tondern* (Tondern, 1861).

TONE, THEOBALD WOLFE (1763–1798), Irish rebel, the son of Peter Tone, a Dublin coachmaker, was born in Dublin on the 20th of June 1763. His grandfather was a small farmer in county Kildare, and his mother was the daughter of a captain in the merchant service. Though entered as a student at Trinity College, Dublin, Tone gave little attention to study, his inclination being for a military career; but after eloping with Matilda Witherington, a girl of sixteen, he took his degree in 1786, and read law in London at the Middle Temple and afterwards in Dublin, being called to the Irish bar in 1789. Though idle, Tone had considerable ability. Chagrined at finding no notice taken of a wild scheme for founding a military colony in the South Seas which he had submitted to Pitt, he turned to Irish politics. An able pamphlet attacking the administration of the marquess of Buckingham in 1790 brought him to the notice of the Whig club; and in September 1791 he wrote a remarkable essay over the signature "A Northern Whig," of which 10,000 copies are said to have been sold. The principles of the French Revolution were at this time being eagerly embraced in Ireland, especially among the Presbyterians of Ulster, and two months before the appearance of Tone's essay a great meeting had been held in Belfast, where republican toasts had been drunk with enthusiasm, and a resolution in favour of the abolition of religious disqualifications had given the first sign of political sympathy between the Roman Catholics and the Protestant dissenters of the north. The essay of "A Northern Whig" emphasized the growing breach between the Whig patriots like Flood and Grattan, who aimed at Catholic emancipation and parliamentary reform without disloyalty to the connexion with England, and the men who desired to establish a separate Irish republic. Tone expressed in his pamphlet unqualified contempt for the constitution which Grattan had so triumphantly extorted from the English government in 1782; and, himself a Protestant, he urged co-operation between the different religious sects in Ireland as the only means of obtaining complete redress of Irish grievances.

In October 1791 Tone converted these ideas into practical policy by founding, in conjunction with Thomas Russell (1767–1803), Napper Tandy (*q.v.*) and others, the society of the "United Irishmen." The original purpose of this society was no more than the formation of a political union between Roman Catholics and Protestants, with a view to obtaining a liberal measure of parliamentary reform; it was only when that object appeared to be unattainable by constitutional methods that the majority of the members adopted the more uncompromising opinions which Wolfe Tone held from the first, and conspired to establish an Irish republic by armed rebellion. Tone himself admitted that with him hatred of England had always been "rather an instinct than a principle," though until his views should become more generally accepted in Ireland he was prepared to work for reform as distinguished from revolution. But he desired to root out the popular respect for the names of Charlemont and Grattan, and to transfer to more violent leaders the conduct of the national movement. Grattan was a reformer and a patriot without a tincture of democratic ideas; Wolfe Tone was a revolutionary whose principles were drawn from the French Convention. Grattan's political philosophy was allied to that of Edmund Burke; Tone was a disciple of Danton and Thomas Paine.

Democratic principles were gaining ground among the Roman Catholics as well as the Presbyterians. A quarrel between the moderate and the more advanced sections of the Roman Catholic Committee led, in December 1791, to the secession of sixty-eight of the former, led by Lord Kenmare; and the direction of the committee then passed to more violent leaders, of whom the most prominent was John Keogh, a Dublin tradesman. The active participation of the Roman Catholics in the movement of the United Irishmen was strengthened by the appointment of Tone as paid secretary of the Roman Catholic Committee in the spring of 1792. When the legality of the Roman Catholic Convention in 1792 was called in question by the government, Tone drew up for the committee a statement of the case on which a favourable opinion of counsel was obtained; and a sum of £1500 with a gold medal was voted to Tone by the Convention when it dissolved itself in April 1793. Burke and Grattan were anxious that provision should be made for the education of Irish Roman Catholic priests at home, to preserve them from the contagion of Jacobinism in France; Wolfe Tone, "with an incomparably juster forecast," as Lecky observes, "advocated the same measure for exactly opposite reasons." He rejoiced that the breaking up of the French schools by the revolution had rendered necessary the foundation of Maynooth College, which he foresaw would draw the sympathies of the clergy into more democratic channels. In 1794 the United Irishmen, persuaded that their scheme of universal suffrage and equal electoral districts was not likely to be accepted by any party in the Irish parliament, began to found their hopes on a French invasion. An English clergyman named William Jackson, a man of infamous notoriety who had long lived in France, where he had imbibed revolutionary opinions, came to Ireland to negotiate between the French committee of public safety and the United Irishmen. For this emissary Tone drew up a memorandum on the state of Ireland, which he described as ripe for revolution; the paper was betrayed to the government by an attorney named Cockayne to whom Jackson had imprudently disclosed his mission; and in April 1794 Jackson was arrested on a charge of treason. Several of the leading United Irishmen, including Reynolds and Hamilton Rowan, immediately fled the country, the papers of the United Irishmen were seized; and for a time the organization was broken up. Tone, who had not attended meetings of the society since May 1793, remained in Ireland till after the trial and suicide of Jackson in April 1795. Having friends among the government party, including members of the Beresford family, he was enabled to make terms with the government, and in return for information as to what had passed between Jackson, Rowan and himself he was permitted to emigrate to America, where he arrived in May 1795. Taking up his residence at Philadelphia, he wrote a few months later to Thomas Russell expressing unqualified dislike of the American people, whom he was disappointed to find no more truly democratic in sentiment and no less attached to order and authority than the English; he described George Washington as a "high-flying aristocrat," and he found the aristocracy of money in America still less to his liking than the European aristocracy of birth.

Tone did not feel himself bound in honour by his compact with the government at home to abstain from further conspiracy; and finding himself at Philadelphia in the congenial company of Reynolds, Rowan and Napper Tandy, he undertook a mission to Paris to persuade the French government to send an expedition to invade Ireland. In February 1796 he arrived in Paris and had interviews with De La Croix and L. N. M. Carnot, who were greatly impressed by his energy, sincerity and ability. A commission was given him as adjutant-general in the French army, which he hoped might protect him from the penalty of treason in the event of capture by the English; though he himself claimed the authorship of a proclamation said to have been issued by the United Irishmen, enjoining that all Irishmen taken with arms in their hands in the British service should be instantly shot; and he supported a project for landing a thousand criminals in England, who were to be commissioned to burn Bristol and commit any other atrocity in their power. He drew up two memorials representing that the landing of a considerable French force in Ireland would be followed by a general rising of the people, and giving a detailed account of the condition of the country. The French directory, which possessed information from Lord Edward Fitzgerald (*q.v.*) and Arthur O'Connor confirming Tone, prepared to despatch an expedition under Hoche. On the 15th of December 1796 the expedition, consisting of forty-three sail and carrying about 15,000 men with a large supply of war material for distribution in Ireland, sailed from Brest. Tone, who accompanied it as "Adjutant-general Smith," had the greatest contempt for the seamanship of the French sailors, which was amply justified by the disastrous result of the invasion. Returning to France without having effected anything, Tone served for some months in the French army under Hoche; and in June 1797 he took part in preparations for a Dutch expedition to Ireland, which was to be supported by the French. But the Dutch fleet was detained in the Texel for many weeks by unfavourable weather, and before it eventually put to sea in October, only to be crushed by Duncan in the battle of Camperdown, Tone had returned to Paris; and Hoche, the chief hope of the United Irishmen, was dead. Bonaparte, with whom Tone had several interviews about this time, was much less disposed than Hoche had been to undertake in earnest an Irish expedition; and when the rebellion broke out in Ireland in 1798 he had started for Egypt. When, therefore, Tone urged the directory to send effective assistance to the Irish rebels, all that could be promised was a number of small raids to descend simultaneously on different points of the Irish coast. One of these under Humbert succeeded in landing a force in Killala Bay, and gained some success in Connaught before it was subdued by Lake and Cornwallis, Wolfe Tone's brother Matthew being captured, tried by court-martial, and hanged; a second, accompanied by Napper Tandy (*q.v.*), came to disaster on the coast of Donegal; while Wolfe Tone took part in a third, under Admiral Bompard, with General Hardy in command of a force of about 3000 men, which encountered an English squadron near Lough Swilly on the 12th of October 1798. Tone, who was on board the "Hoche," refused Bompard's offer of escape in a frigate before the action, and was taken prisoner when the "Hoche" was forced to surrender. When the prisoners were landed a fortnight later Sir George Hill recognized Tone in the French adjutant-general's uniform. At his trial by court-martial in Dublin, Tone made a manly straightforward speech, avowing his determined hostility to England and his design "by fair and open war to procure the separation of the two countries," and pleading in virtue of his status as a French officer to die by the musket instead of the rope. He was, however, sentenced to be hanged on the 12th of November; but on the 11th he cut his throat with a penknife, and on the 19th of November 1798 he died of the wound.

Although Wolfe Tone had none of the attributes of greatness, "he rises," says Lecky, "far above the dreary level of commonplace which Irish conspiracy in general presents. The tawdry and exaggerated rhetoric; the petty vanity and jealousies; the weak sentimentalism; the utter incapacity for proportioning means to ends, and for grasping the stern realities of things, which so commonly disfigure the lives and conduct even of the more honest members of his class, were wholly alien to his nature. His judgment of men and things was keen, lucid and masculine, and he was alike prompt in decision and brave in action." In his later years he overcame the drunkenness that was habitual to him in youth; he developed seriousness of character and unselfish devotion to what he believed was the cause of patriotism; and he won the respect of men of high character and capacity in France and Holland. His journals, which were written for his family and intimate friends, give a singularly interesting and vivid picture of life in Paris in the time of the directory. They were published after his death by his son, William Theobald Wolfe Tone (1791–1828), who was educated by the French government and served with some distinction in the armies of Napoleon, emigrating after Waterloo to America, where he died, in New York City, on the 10th of October 1828.

See *Life of Theobald Wolfe Tone by himself, continued by his son, with his political writings*, edited by W. T. Wolfe Tone (2 vols., Washington, 1826), another edition of which is entitled *Autobiography of Theobald Wolfe Tone*, edited with introduction by R. Barry O'Brien (2 vols., London, 1893); R. R. Madden, *Lives of the United Irishmen* (7 vols., London, 1842); Alfred Webb, *Compendium of Irish Biography* (Dublin, 1878); W. E. H. Lecky, *History of Ireland in the Eighteenth Century*, vols. iii., iv., v. (cabinet ed., 5 vols., London, 1892). (R. J. M.)

TONGA, or Friendly Islands (so called by Captain Cook), an archipelago in the South Pacific Ocean, about 350 m. S.S.W. of Samoa and 250 m. E.S.E. of Fiji. The long chain of islands, numbering about 150, though with a collective land area of only 385 sq. m., extends from 18° 5′ to 22° 29′ S. and 174° to 176° 10′ W., and is broken into three groups, viz. the Tonga to the south, Hapai (which again is divided into three clusters) in the centre and Vavau to the north. The largest island is Tongatabu (the Sacred Tonga, Tasman's Amsterdam) in the southern group, measuring about 25 by 10 m., and 165 sq. m. in area, which contains the capital, Nukualofa. The vegetation is rich and beautiful, but the scenery tame, the land seldom rising above 60 ft.; Eua (Tasman's Middelburg), 9 m. south-east and 67 sq. m. in area, is 1078 ft. in extreme height, and much more picturesque, being diversified by rocks and woods. Vavau, in the northern group, is 55 sq. m. in extent and 300 ft. high. Next to these come the coral islands Nomuka and Lifuka in the Hapai group; Tofua, 2846 ft., Late or Lette, 1800 ft. and Kao, 3020 ft. high, which are volcanic and smaller. The numerous islets of the central group are very fertile. It is along the western side of the northern half of the chain that the line of volcanic action is apparent; the islands here (of which some are active volcanoes) are lofty. To the east the whole chain is bounded by a profound trough in the ocean bed, which extends southwestward, east of the Kermadec Islands, towards New Zealand. The majority of the Tonga Islands, however, are level, averaging 40 ft. high, with hills rising to 600 ft.; their sides are generally steep. The surface is covered with a rich mould unusual in coral islands, mixed towards the sea with sand, and having a substratum of red or blue clay. The soil is thus very productive, although water is scarce and bad. Barrier reefs are rare; fringing reefs are numerous, except on the east side, which is nearly free, and there are many small isolated reefs and volcanic banks among the islands. If the reefs impede navigation they form some good harbours. The best is on the south-western side of Vavau; another is on the north of Tongatabu. Earthquakes are not infrequent. From 1845 to 1857 volcanic eruptions were very violent, and islands once fertile were devastated and nearly destroyed. A new island rose from the sea, and was at once named "Wesley," but disappeared again. In 1886 there was a serious volcanic eruption in the outlying island of Niuafoou, and at the same time Falcon Reef, normally awash at high water, discharged sufficient scoriae and pumice to form a new island 50 ft. high. In 1898 the island had been washed away, but in 1900 H.M.S. "Porpoise" found that a solid core of black rock had been extruded 6 ft. above high water. All the volcanoes in the group were then quiescent.

Geology.—The line of volcanic action extends along the western side of the northern half of the chain. Some of the islands are built of volcanic rocks alone; such are Hongu-tonga and Hongu-hapai, which appear to be fragments of a single ancient crater, Tofua, Kao, Late, Metis, Amargua and Falcon Island. The lava is a basic augite-andesite. Another group of islands consists of elevated masses of submarine volcanic deposits, upon some of which coral-reef limestone forms a more or less complete covering; such are Tonumeia and the Nomuka group (Mango, Tonua, Nomuka-iki). All the volcanic rocks of these islands are submarine stratified tuffs which are penetrated here and there by andesite or diabase dikes. The Vavau group consists entirely of coral limestone, which is occasionally crystalline, and contains stalactitic caves of great beauty.

Climate, Flora, Fauna.—The climate is healthy for Europeans, being dry and cool as compared with that of Samoa and Fiji. There are frequent alternations of temperature, which averages 75° to 77° F., though considerably higher in the wet season. Cool south-east trade winds blow, sometimes with great violence, from April to December. During the rest of the year the winds blow from west-north-west and north, with rain and occasional destructive hurricanes. A cyclone which devastated Vavau in April 1900 was the most destructive ever recorded in the group, but hurricanes are rare. The average rainfall for the year is about 80 ins. The vegetation is similar to that of Fiji, but more definitely Indo-Malayan in character; it embraces all the plants of the groups to the east with many that are absent there. Ferns abound, some of them peculiar, and tree ferns on the higher islands, and all the usual fruit trees and cultivated plants of the Pacific are found. There are several kinds of valuable timber trees. The only indigenous land mammalia are a small rat and a few curious species of bats. The dog and the pig were no doubt introduced by man. Of birds some 30 kinds are known, an owl being the only bird of prey; parrots, pigeons, kingfishers, honey-suckers, rails, ducks, and other water birds are numerous. There are snakes and small lizards, but no frogs or toads. Of insects there are relatively few kinds; but ants, beetles and mosquitoes abound. The fishes, of an Indo-Malay type, are varied and numerous. Turtle and sea-snakes abound, as do mollusca, of which a few are peculiar, and zoophytes.

Inhabitants.—The population of the archipelago is about 19,000, of whom about 370 are whites or half-castes. The natives, a branch of the Polynesian race, are the most progressive and most intellectual in the Pacific Islands, except the Hawaiians. They have exercised an influence over distant neighbours, especially in Fiji, quite out of proportion to their numbers. Their conquests have extended as far as Niué, or Savage Island, 200 m. east, and to various other islands to the north. In Captain Cook's time Poulaho, the principal chief, considered Samoa to be within his dominions. This pre-eminence may perhaps be due to an early infusion of Fijian blood: it has been observed that such crosses are always more vigorous than the pure races in these islands; and this influence seems also traceable in the Tongan dialect, and appears to have been partially transmitted thence to the Samoan. Various customs, traditions and names of places also point to a former relation with Fiji. Their prior conversion to Christianity gave the Tongans material as well as moral advantages over their neighbours. Crime is infrequent, and morality, always above the Polynesian average, has improved. The people have strict notions of etiquette and gradations of rank. In disposition they are amiable and courteous, but arrogant, lively, inquisitive and inclined to steal—their attacks in earlier days on Europeans, when not caused by misunderstandings, being due probably to their coveting property which to them was of immense value. They are brave and not unenergetic, though the soft climate and the abundance of food discourage industry. They value children, and seldom practised infanticide, and cannibalism was rare. Their women are kindly treated, and only do the lighter work. Agriculture, which is well understood, is the chief industry. They are bold and skilful sailors and fishermen; other trades, as boat and house building, carving, cooking, net and mat making, are usually hereditary. Their houses are slightly built, but the surrounding ground and roads are laid out with great care and taste.

There were formerly (till the early 18th century) two sovereigns; the higher of these, called Tui Tonga (chief of Tonga), was greatly reverenced but enjoyed little power. The real ruler and the chief officers of the state were members of the Tubou family, from which also the wife of the Tui Tonga was always chosen, whose descendants through the female line had special honours and privileges, under the title of *tamaha*, recalling the *vasu* of Fiji. The explanation of the dual kingship is probably this—the Tui Tonga were regarded as the direct descendants of the original head of the family from which the people sprang; regarded with reverence, and possessing unlimited power, they came to misuse this and discontent resulted, whereupon, to protect themselves, they appointed an executive deputy. Below these came the Eiki or chiefs, and next to them the class called Matabule. These were the hereditary counsellors and companions of the chiefs, and conveyed to the people the decisions formed at their assemblies. They also directed the national ceremonies, and preserved the popular traditions. While, under the control of Europeans, the Tongans have shown some aptitude for administration, they fail when left to themselves. They pick up superficial acquirements with astonishing ease, but seem to be incapable of mastering any subject. They write shorthand, but speak no English; they have a smattering of higher mathematics, yet are ignorant of book-keeping. Their government, effective enough when dealing with natives, breaks down in all departments concerned with Europeans, and becomes the prey of designing traders. Their ambition is to rank as a civilized state, and the flattery lavished on them by their teachers has spoiled them.

There are some ancient stone remains in Tongatabu, burial places (*feitoka*) built with great blocks, and a remarkable monument consisting of two large upright blocks morticed to carry a transverse one, on which was formerly a circular basin of stone.

Administration and Trade.—In May 1900 the group became a British protectorate under the native flag, the appointment of the consul and agent being transferred to the government of New Zealand. In 1904 the financial and legal administration was put into the hands of the British High Commissioner for the Western Pacific. The native king is assisted by a legislative assembly consisting, in equal numbers, of hereditary nobles and popular (elected) representatives. The wisdom of King George Tubou in refusing to alienate an acre of land, except upon lease, has resulted in Tonga having been the last native state in the Pacific to lose its independence. There is a revenue of about £21,000 annually derived chiefly from a poll-tax, leases and customs. The principal exports are copra, bananas, oranges and fungus, and the annual values of exports and imports are £80,000 and £70,000 respectively on an average, though both fluctuate considerably. British coin is legal tender (since 1905). There are five churches in Tonga—the Free Wesleyans, embracing the great majority of the inhabitants, Wesleyans, Roman Catholics, and Seventh Day Adventists. These last are few; a still smaller number of natives are nominally Anglicans.

History.—In 1616 the vessels of Jacob Lemaire and Willem Cornelis Schouten reached the island of Niuatobutabu, and had a hostile encounter with the natives. In 1643 Abel Tasman arrived at Tongatabu and was more fortunate. The next visit was that of Samuel Wallis in 1767, followed in 1773 by that of Captain Cook. In 1777 Cook returned, and stayed seven weeks among the islands. In 1799 a revolution, having its origin in jealousy between two natives of high rank, broke out. Civil war dragged on for many years—long after the deaths of the first leaders—but Taufaahau, who became king in 1845 under the name of George Tubou I., proved a strong ruler. In 1822 a Methodist missionary had arrived in the island, and others followed. The attempt to introduce a new faith led to renewed strife, this time between converts and pagans, but King George (who fully appreciated the value of intercourse with foreigners) supported the missionaries, and by 1852 the rebels were subdued. The missionaries, finding their position secure, presently began to take action in political affairs, and persuaded the king to grant a constitution to the Tongans, who welcomed it with a kind of childish enthusiasm, but were far from fitted to receive it. A triennial parliament, a cabinet, a privy council, and an elaborate judicial system were established, and the cumbrous machinery was placed in the hands of a "prime minister," a retired Wesleyan missionary, Mr Shirley Baker. Treaties of friendship were concluded with Germany, Great Britain, and the United States of America. Baker induced the king to break off his connexion with the Wesleyan body in Sydney, and to set up a state church. Persecution of members of the old church followed, and in 1890 the missionary-premier had to be removed from the group by the high commissioner. He afterwards returned to initiate a new sect called the "Free Church of England," which for a time created further divisions among the people.

King George Tubou died in 1893 at the age of ninety-six, and was succeeded by his great-grandson under the same title.

Mr Basil Thomson (who after Baker's deportation had carried out reforms which the natives, when left alone, were incapable of maintaining) was sent in 1900 to conclude the treaty by which the king placed his kingdom under British protection.

See Captain Cook's *Voyages* and other early narratives; Martin, *Mariner's account of the Tonga Islands* (Edinburgh, 1827); Vason, *Four Years in Tongatabu* (London, 1815); A. Monfort, *Les Tonga, ou Archipel des Amis* (Lyons, 1893); B. H. Thomson, *The Diversions of a Prime Minister* (London, 1894).

TONGKING,[1] a province of French Indo-China, and protectorate of France, situated between 20° and 23½° N. and 102° and 108½° E., and bounded N. by the Chinese provinces of Kwang-Tung, Kwang-Si and Yun-nan, W. by Laos, S. by Annam, and E. by the Gulf of Tongking. Area, about 46,000 sq. m. The population is estimated at 6,000,000, including 33,000 Chinese and about 4000 Europeans. Geographically, Tongking comprises three regions: (1) the delta of the Song-Koi (Red river), which, beginning at Son-Tay and coalescing with the delta of the Thai-Binh, widens out into the low-lying and fertile plain within which are situated the principal cities. (2) Two mountainous tracts, to the north and west of the delta, running approximately from north-west to south-east, one separating the basins of the Song-Koi and the Canton river, the other those of the Song-Koi and the Mekong. (3) A region of plateaus and low hills forming a transition between the delta and the mountains. The main geographical feature in the country is the Song-Koi, which, taking its rise near Tali Fu, in Yun-nan, enters Tongking at Lao-Kay (the Lao boundary), and flows thence in a south-easterly direction to the Gulf of Tongking. It was this river which mainly, in the first instance, attracted the French to Tongking, as it was believed by the explorers that, forming the shortest route by water to the rich province of Yun-nan, it would prove also to be the most convenient and expeditious means of transporting the tin, copper, silver and gold which are known to abound there. This belief, however, has proved fallacious. The upper course of the stream is constantly impeded by rapids, the lowest being about thirty miles above Hung-Hoa. Beyond Lao-Kay navigation is impracticable during the dry season, and at all other times of the year goods have to be there transferred into light junks. Below Lao-Kay larger junks, and in the summer months steam launches of shallow draught use the river. Within the limits of Yun-nan the navigation is still more difficult. Near Son-Tay the Song-Koi receives the waters of the Song-Bo (Black river) and the Song-Ka (Clear river), parallel affluents rising in Yun-nan, and from that point divides into a network of waterways which empty themselves by countless outlets into the sea. The Song-Cau rises in north-eastern Tongking and below the town of Sept Pagodes, where it is joined by the Song-Thuong to form the Thai-Binh, divides into numerous branches, communicating with the Song-Koi by the Canal des Rapides and the Canal des Bambous.

The coast line of Tongking from Mon-Kay on the Chinese frontier to Thanh-Hoa, near that of Annam, has a length of 375 m. From Mon-Kay as far as the estuary of the Song-Koi it is broken, rugged and fringed with islands and rocky islets. The bay of Tien-Hien, to the south of which lies the island of Ke-Bao, and the picturesque bay of Along, are the chief indentations. Beyond the island of Cac-Ba, south of the Bay of Along, the coast is low, flat and marshy, and tends to advance as the alluvial deposits of the delta accumulate.

The climate of Tongking is less trying to Europeans than that of the rest of French Indo-China. During June, July and August, the temperature ranges between 82° and 100° F., but from October to May the weather is cool. The country is subject to typhoons in August and September.

In the wooded regions of the mountains the tiger, elephant and panther are found, and wild buffalo, deer and monkeys are common. The delta is the home of ducks and many other varieties of aquatic birds. Tea, cardamom, and mulberry grow wild, and in general the flora approximate to that of southern China.

The Annamese (see Annam), who form the bulk of the population of Tongking, are of a somewhat better physique than those of the rest of Indo-China. Savage tribes inhabit the northern districts—the Muongs the mountains bordering the Black river, the Thôs the regions bordering the Clear river and the Thai-Binh. The Muongs are bigger and stronger than the Annamese. They have square foreheads, large faces and prominent cheek-bones, and their eyes are often almost straight.

Rice, which in some places furnishes two crops annually, is incomparably the most important product of the delta. Elsewhere there are plantations of coffee, tobacco, ramie, paper-tree (*Daphne odora*), cotton, jute, sugar-cane, pepper and mulberry. The cultivation of silkworms is of growing importance.

Gold, copper, tin, lead and other metals are found in the higher regions of Tongking, but only gold and tin are exploited, and these only to a very limited extent. There is a large output of coal of inferior quality from Hon-Gay on the bay of Along and there are coal-workings on the island of Ke-Bao.

Hanoi, Hai-phong and Nam-Dinh carry on cotton-spinning, and Hanoi and Nam-Dinh are well known for the manufacture of carved and inlaid furniture. The natives are skilful at enamelling and the chasing and ornamentation of gold and other metals. The manufacture of paper from the fibrous bark of the paper-tree is a widespread industry and there are numerous distilleries of rice-spirit.

The imports of Tongking, which in 1905 reached a value of £3,501,422, comprise railway material, cereals, flour, liquors, woven goods, petroleum, glassware, paper, prepared skins, clocks and watches, arms and ammunition, &c. Exports (valued at £1,393,674 in 1905) comprise rice, rubber, manila hemp, ramie, lacquer and badian oils, raw skins, silk-waste, coal, Chinese drugs, rattan, mats, gamboge.

The transit trade via Tongking between Hong-Kong and the province of Yun-nan in southern China is of considerable importance, reaching in 1905 a value of £1,146,000. This trade is entirely in the hands of Chinese houses, the tin of the Yun-nan mines and cotton yarns from Hong-Kong constituting its most important elements. Goods in transit enjoy a rebate of 80% of the customs duties. Goods are carried on the Song-Koi to Lao-Kay or Man-Hao, thence on mules. The waterways of the delta are lined with embankments, the causeways along which form the chief means of land communication of the region. (For railways, see Indo-China, French.)

The protectorate of Tongking approaches nearer to direct administration than that of Annam, where the conditions of the protectorate are more closely observed. Till 1897 the emperor of Annam was represented in Tongking by a viceroy (*kink-luoc*), but now the native officials are appointed by and are directly under the control of the resident-superior, who resides at Hanoi, presides over the protectorate council, and is the chief territorial representative of France. Tongking is divided into nineteen provinces, in each of which there is a resident or a vice-resident, and four military territories, the latter administered by commandants. In each province there is a council of native "notables," elected by natives and occupied with the discussion of the provincial budget and public works. There is also a deliberative council of natives (instituted 1907) for the whole of Tongking. The provincial administration, local government and educational system are analogous to those of Annam (*q.v.*). Two chambers of the court of appeal of Indo-China and a criminal court sit at Hanoi; there are tribunals of first instance and tribunals of commerce at Hanoi and Hai-Phong. When both parties to a suit are Annamese, it comes within the jurisdiction of the *An-Sat* or native judge of the province.

The following is a summary of the budgets of 1899 and 1904:—

	Receipts.	Expenditure.
	£	£
1899	461,235	427,993
1904	756,648	494,034

The chief source of revenue is the direct taxes (including especially the poll-tax and land-tax), which amounted in 1904 to £417,723, while the chief items of expenditure are the cost of the residencies and general staff, public works and the civil guard.

For the early history of Tongking, see Annam and Indo-China, French. Tongking was loosely united to Annam until 1801, when Gia-long, king of Annam, brought it definitely under his sway. Having, by the treaty of 1862 and the annexation of Cochin China, firmly established themselves in Annamese territory, the French began to turn their attention to Tongking, attracted by the reported richness of its mineral wealth. They found a pretext for interfering in its affairs in the disturbances arising from the invasion of its northern provinces by the disbanded followers of the Taiping rebels. The Franco-German War of 1870-71 put an end to the project for a time, but the return of peace in Europe was the signal for the renewal of hostilities in the East. The appearance of Garnier's work on his expedition up the Mekong again aroused an interest in Tongking, and the reported wealth of the country added the powerful motive of self-interest to the yearnings of patriotism. Already Jean Dupuis, a trader who in the pursuit of his calling had penetrated into Yun-nan, was attempting to negotiate for the passage up the Song-Koi of himself and a cargo of military stores for the Chinese authorities in Yun-nan. Meanwhile Captain Senez appeared from Saigon, having received instructions to open the route to French commerce. But to neither the trader nor the naval officer would the Tongkingese lend a favourable ear, and in default of official permission Dupuis determined to force his way up the river. This he succeeded in doing, but arrived too late, for he found the Taiping rebellion crushed and the stores no longer wanted.

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[1] See also Indo-China, French, and Annam.

On the return of Dupuis to Hanoi, the Tongkingese general at that place wrote to the king of Annam, begging him to induce the governor of Cochin-China to remove the intruder. An order was thereupon issued calling upon Dupuis to leave the country. This he declined to do, and, after some negotiations, Francis Garnier with a detachment was sent to Hanoi to do the best he could in the difficult circumstances. Garnier threw himself heart and soul into Dupuis's projects, and, when the Tongkingese authorities refused to treat with him except on the subject of Dupuis's expulsion, he attacked the citadel in November, 1873, and carried it by assault. Having thus secured his position, he sent to Saigon for reinforcements, and meanwhile sent small detachments against the five other important fortresses in the delta (Hung-yen, Phu-Ly, Hai-Duong, Ninh-Binh and Nam-Dinh), and captured them all. The Tongkingese now called in the help of Lu-Vinh-Phuoc, the leader of the "Black Flags,"[1] who at once marched with a large force to the scene of action. Within a few days he recaptured several villages near Hanoi, and so threatening did his attitude appear that Garnier, who had hurried back after capturing Nam-Dinh, made a sortie from the citadel. The movement proved a disastrous one, and resulted in the death of Garnier and of his second in command, Balny d'Avricourt.

Meanwhile the news of Garnier's hostilities had alarmed the governor of Saigon, who, having no desire to be plunged into a war, sent Philastre, an inspector of native affairs, to offer apologies to the king of Annam. When, however, on arriving in Tongking Philastre heard of Garnier's death, he took command of the French forces, and at once ordered the evacuation of Nam-Dinh, Ninh-Binh and Hai-Duong—a measure which, however advantageous it may have been to the French at the moment, was most disastrous to the native Christian population, the withdrawal of the French being the signal for a general massacre of the converts. In pursuance of the same policy Philastre made a convention with the authorities (March, 1874) by which he bound his countrymen to withdraw from the occupation of the country, retaining only the right to trade on the Song-Koi and at Hanoi and Hai-Phong, and agreed to put an end to Dupuis's aggressive action.

For a time affairs remained *in statu quo*, but in 1882 Le Myre de Villers, the governor of Cochin-China, sent Henri Rivière with a small force to open up the route to Yun-nan by the Song-Koi. With a curious similarity the events of Garnier's campaign were repeated. Finding the authorities intractable, Rivière stormed and carried the citadel of Hanoi, and then, with very slight loss, he captured Nam-Dinh, Hai-Duong, and other towns in the delta. And once again these victories brought the Black Flags into the neighbourhood of Hanoi. As Garnier had done, so Rivière hurried back from Nam-Dinh on news of the threatened danger. Like Garnier also he headed a sortie against his enemies, and like Garnier he fell a victim to his own impetuosity (May, 1883).

In the meantime the Annamese court had been seeking to enlist the help of the Chinese in their contest with the French. The tie which bound the tributary nation to the sovereign state had been for many generations slackened or drawn closer as circumstances determined, but it had never been entirely dissevered, and from the Annamese point of view this was one of the occasions when it was of paramount importance that it should be acknowledged and acted upon. With much more than usual regularity, therefore, the king despatched presents and letters to the court of Peking, and in 1880 he sent a special embassy, loaded with unusually costly offerings, and bearing a letter in which his position of a tributary was emphatically asserted. Far from ignoring the responsibility thrust upon him, the emperor of China ordered the publication of the letter in the *Peking Gazette*.

The death of Rivière and the defeat of his troops had placed the French in a position of extreme difficulty. M. Jules Ferry, who had become premier of France in February 1883, determined on a vigorous forward policy. But for the moment the outlying garrisons, except those of Nam-Dinh and Hai-Phong, had to be withdrawn and Hanoi itself was besieged by the Black Flags. Reinforcements brought by Admiral Courbet and General Bouet were insufficient to do more than keep them at bay. So continued was the pressure on the garrison that Bouet determined to make an advance upon Son-Tay to relieve the blockade. He attacked Vong, a fortified village, but he met with such resistance that, after suffering considerable loss, he was obliged to retreat to Hanoi. In the lower delta fortune sided with the French, and almost without a casualty Hai-Duong and Phu-Binh fell into their hands. Meanwhile, in order to put more effective pressure upon the court of Hué, Dr Harmand, commissary-general, supported by Courbet, proceeded with a naval force to the Hué river. They found that, though King Tu Duc was dead, his policy of resistance was maintained, and therefore stormed the city. After a feeble defence it was taken, and Harmand concluded a treaty with the king (August 1883) in which the French protectorate was fully recognized, the king further binding himself to recall the Annamese troops serving in Tongking, and to construct a road from Saigon to Hanoi.

Though this treaty was exacted from Annam under pressure, the French lost no time in carrying out that part of it which gave them the authority to protect Tongking, and Bouet again advanced in the direction of Son-Tay. But again the resistance he met with compelled him to retreat, after capturing the fortified post of Palan. Meanwhile, on the determination to attack Son-Tay becoming known in Paris, the Chinese ambassador warned the ministry that, since Chinese troops formed part of the garrison, he should consider it as tantamount to a declaration of war. But his protest met with no consideration. On the arrival of reinforcements an advance was again made; and on the 16th of December 1883, after some desperate fighting, Son-Tay fell.

During 1884 the French made themselves masters of the lower delta. Throughout the campaign Chinese regulars fought against the French, who thus found themselves involved in war with China. While hostilities were in progress M. Fournier, the French consul at Tientsin, had been negotiating for peace, so far as China was concerned, with Li Hung-chang, and in May 1884 had signed and sealed a memorandum by which the Chinese plenipotentiary agreed that the Chinese troops should evacuate the northern provinces of Tongking "*immédiatement*." In the following month another treaty, signed at Hué, confirmed the French protectorate over Annam and Tongking. It was not, however, followed by a cessation of military operations. A misunderstanding arose between the French and the Chinese as to the exact date for the evacuation of their posts by the Chinese, and in June General Millot, then commander-in-chief of the French forces, dispatched Colonel Dugenne at the head of a strong force to occupy Lang-Son. The expedition was badly arranged; the baggage train was far too unwieldy; and the pace at which the men were made to march was too quick for that scorching time of the year. They advanced, however, to Bac-Le, within 25 m. of Lang-Son, when they suddenly came upon a Chinese camp. An irregular engagement began, and, in the pitched battle which ensued, the Chinese broke the French lines, and drove them away in headlong flight. This brought the military operations for the season to a close.

During the rainy season fevers of all kinds became alarmingly prevalent, and the number of deaths and of men invalided was very large. In the meantime, however, an expedition, led by Colonel Donnier, against the Chinese garrison at Chu, about 10 m. south-east from Lang-kep, was completely successful; and in a battle fought near Chu the Chinese were defeated, with a loss of 3000 killed, the French loss being only 20 killed and 90 wounded. In the skirmishes which followed the French were generally victorious, but not to such a degree as to warrant any enlargement of the campaign.

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[1] Bands of Chinese rebels who infested the mountainous region of Tongking.

In January 1885 large reinforcements arrived and Brière de l'Isle, who had succeeded Millot as commander-in-chief, ordered an advance towards Lang-Son. The difficulties of transport greatly impeded his movements, still the expedition was successful. On the 6th of February three forts at Dong-Song, with large supplies of stores and ammunition, fell into the hands of the French. Three days' heavy fighting made them masters of a defile on the road, and on the 13th Lang-Son was taken, the garrison having evacuated the town just before the entrance of the conquerors. With his usual energy General Négrier, who commanded a division under Brière de l'Isle, pressed on in pursuit to Ki-Hea, and even captured the frontier town of Cua-Ai. But Brière de l'Isle had now to hurry back to the relief of Tuyen-Kwan, which was doggedly resisting the attacks of an overwhelming Chinese force, and Négrier was left in command at Lang-Son. The withdrawal of Brière de l'Isle's division gave the Chinese greater confidence, and, though for a time Négrier was able to hold his own, on the 22nd and 23rd of March he sustained a severe check between Lang-Son and That-Ke, which was finally converted into a complete rout, his troops being obliged to retreat precipitately through Lang-Son to Than-Moi and Dong-Song. Brière de l'Isle reached Tuyen-Kwan, the garrison of which was commanded by Colonel Dominé, on the 3rd of March, and effected its relief. The disaster at Lang-Son caused the downfall of the Ferry ministry (March 30). Shortly afterwards Sir Robert Hart succeeded in negotiating peace with China. By the terms agreed on at Tientsin (June, 1885), it was stipulated that France was to take Tongking and Annam under its protection and to evacuate Formosa and the Pescadores. (For further history, see INDO-CHINA.)

See J. Dupuis, *Le Tong-kin et l'intervention française* (Paris, 1898); C. B. Norman, *Tonkin or France in the Far East* (London, 1884); Prince Henri d'Orléans, *Autour du Tonkin* (Paris, 1896); J. Ferry, *Le Tonkin et la mère-patrie* (Paris, 1890); J. Chailley, *Paul Bert au Tonkin* (Paris, 1887); E. Lunet de Lajonquière, *Ethnographie du Tonkin Septentrional* (Paris, 1906); A. Gaisman, *L'Œuvre de la France au Tonkin* (Paris, 1906); also the bibliography under INDO-CHINA, FRENCH.

TONGS (O. Eng. *tange*, M. Eng. *tonge*, cf. Du. *tang*, Ger. *Zange*, from base *tang*, to bite, cf. Gr. *δάκνειν*), a gripping and lifting instrument, of which there are many forms adapted to their specific use. Some are merely large pincers or nippers, but the greatest number fall into three classes: the first, as in the common fire-tongs, used for picking up pieces of coal and placing them on a fire, which have long arms terminating in small flat circular grippers and are pivoted close to the handle; the second, as in the sugar-tongs, asparagus tongs, and the like, consisting of a single band of metal bent round or of two bands joined at the head by a spring, and third, such as the blacksmith's tongs or the crucible-tongs, in which the pivot or joint is placed close to the gripping ends. A special form of tongs is that known as the "lazy-tongs," consisting of a pair of grippers at the end of a series of levers pivoted together like scissors, the whole being closed or extended by the movement of the handles communicated to the first set of levers and thence to the grippers, the whole forming an extensible pair of tongs for gripping and lifting things at a distance.

TONGUE (O. Eng. *tunge*), in anatomy, a movable organ situated in the floor of the mouth, and serving for the sensation of taste besides helping in the mastication of food, in articulate speech, and in feeling the exact position of any structure within the mouth.

The tongue is divided into a main part or body, a base which looks backward toward the pharynx, a dorsum or upper surface, a root by which it is attached to the hyoid bone and floor of the mouth, a tip which is free and an inferior free surface in contact with the front part of the floor of the mouth and with the lower incisor teeth. Owing to the large amount of muscle in its composition the shape of the tongue varies considerably from time to time. The dorsum of the tongue is covered by stratified squamous epithelium, and, when at rest, is convex both antero-posteriorly and transversely; it is thickly studded with papillae, of which four kinds are recognized.

Filiform papillae are minute conical projections covering the whole of the dorsum, by which term the true upper surface is meant, as well as the tip and borders of the tongue. They are very numerous and contain a short core of subepithelial mucous membrane covered by a thick coating of epithelial cells, which coating may divide at its tip into a number of thread-like processes.

Fungiform papillae are less numerous than the last, and somewhat resemble "button mushrooms"; they generally contain special taste buds.

Circumvallate papillae are usually from seven to ten in number and are arranged in the form of a V, the apex of which points down the throat. They lie quite at the back of the upper surface of the tongue and each consists of a little flat central mound surrounded by a deep moat, the outer wall of which is slightly raised above the surface, and it is to this that the papillae owe their name. Both sides of the moat have taste buds embedded in them, while into the bottom small serous glands open.

Foliate papillae are only vestigial in man and consist of a series of vertical ridges occupying a small oval area on each side of the tongue near its base and just in front of the attachment of the anterior pillars of the fauces. (See PHARYNX.)

The posterior surface or base of the tongue forms part of the anterior wall of the pharynx and has a quite different appearance to that of the dorsum. On it are found numerous circular or oval elevations of the mucous membrane caused by lymphoid tissue (lymphoid follicles), on the summit of the most of which is a mucous crypt or depression. The division between the superior or oral surface of the tongue and the posterior or pharyngeal is sharply marked by a V-shaped shallow groove called the *sulcus terminalis* which lies just behind and parallel to the V-shaped row of circumvallate papillae. At the apex of this V is a small blind pit, the *foramen caecum*.

At the lower part of the pharyngeal surface three folds of mucous membrane, called *glosso-epiglottic folds*, run backward; the middle one passes to the centre of the front of the epiglottis, while the two lateral ones, in modern anatomy often called pharyngo-epiglottic folds, pass backward and outward to the fossa of the tonsil.

On the inferior free surface of the tongue, that is to say, the surface which is seen when the mouth is looked into and the tongue turned up, there is a median fold of mucous membrane called the *fraenum linguae*, which is attached below to the floor of the mouth. On each side of this the blue outlines of the ranine veins are seen, while close to these a little fold on each side, known as a *plica fimbriata*, is often found. It must not, however, be confused with the plica sublingualis described in the article MOUTH AND SALIVARY GLANDS.

The substance of the tongue is composed almost entirely of striped muscle fibres which run in different directions. Some of these bundles, such as the *superficial, deep, transverse* and *oblique linguales* are confined to the tongue and are spoken of as intrinsic muscles. Other muscles, such as the hyo-glossus, stylo-glossus, &c. come from elsewhere and are extrinsic; these are noticed under the head of MUSCULAR SYSTEM. The arteries of the tongue are derived from the lingual, a branch of the external carotid (see ARTERIES), while the veins from the tongue return the blood, by one or more veins on each side, into the internal jugular vein (see VEINS).

The nerves to the tongue are the (1) *lingual* or gustatory, a branch of the fifth (see NERVES: *Cranial*) which supplies the anterior two-thirds with ordinary sensation and also, by means of the chorda tymphani which is bound up with it, with taste sensation; (2) the glossopharyngeal which supplies the circumvallate papillae and posterior third of the tongue with taste and ordinary sensation; (3) a few twigs of the superior laryngeal branch of the vagus to the pharyngeal surface of the tongue; and (4) the hypoglossal which is the motor nerve to the muscles.

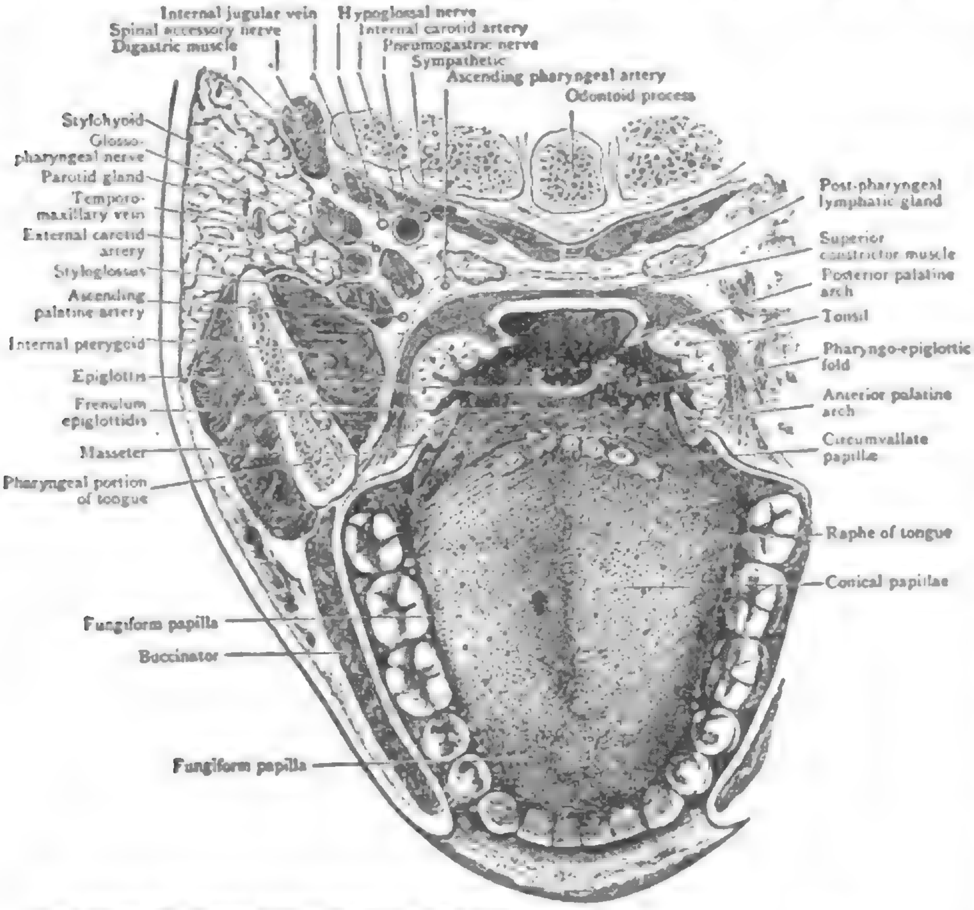
Embryology.

The mucous membrane covering the second and third visceral arches fuses to form the furcula (see RESPIRATORY SYSTEM). Just in front of this a rounded eminence appears at an early date in the ventral wall of the pharynx to form the *tuberculum impar* which is separated from the furcula by the depression known as the *sinus arcuatus*. This tuberculum impar gradually grows to form the central part of the tongue in front of the foramen cæcum, while the anterior part of the organ is derived from two lateral swellings which appear in the floor of the mouth and surround the tuberculum impar antero-laterally. The posterior third, or pharyngeal part, is developed from the anterior part of the furcula

in the middle line, that is to say from the third visceral arch. The sinus arcuatus becomes gradually shallower as these two parts of the tongue grow together and eventually is indicated by the *sulcus terminalis;* in the mid line, however, the isthmus of the thyroid grows down from it, forming the *thyro-glossal duct* the remains of which are seen in the foramen caecum (see DUCTLESS GLANDS). It will be seen that the tongue is developed in connexion with the first, second and third visceral arches, and it is therefore to be expected that the fifth, seventh and ninth nerves which supply those arches would help to supply it, but the vagus from the fourth arch reaches it in addition, while the fact that most of the muscular substance of the tongue is supplied by the hypoglossal nerve is explained on the theory that some of the cervical skeletal musculature has grown cephalad into the tongue and has carried its nerve with it.

Comparative Anatomy.

The tongue is present in fishes but it is an immovable swelling in the floor of the mouth and is practically devoid of muscles. In the hag (*Myxine*) among the Cyclostomata, and pike (*Esox*) among the Teleostei, teeth are developed on the tongue. In the Amphibia the tailed forms (Urodela) usually have tongues like fishes, though in the genus Spelerpes the organ is very free and can be protruded for a great distance. In the majority of the Anura the tongue is usually attached close to the front of the floor of the mouth so that it can be flapped forward with great rapidity. There are, however, two closely allied families of frogs (Xenopodidae and Pipidae) which form the order of Aglossa, because in them the tongue is suppressed.



(From Ambrose Birmingham in Cunningham's *Text Book of Anatomy*.)

Horizontal Section through Mouth and Pharynx at the Level of the Tonsils.

In the reptiles the tongue is generally very movable, though this is not the case in the Crocodilia and many of the Chelonia. The forked tongues of snakes and many lizards and the highly specialized telescopic tongue of the chameleon are familiar objects.

In birds the tongue is usually covered with horny epithelium and is poorly supplied with muscles. When it is very protrusible, as in the woodpecker, the movement is due to the hyoid, with the base of the tongue attached, moving forward.

In the Mammalia the tongue is always movable by means of well-developed extrinsic and intrinsic muscles, while papillae and glands are numerous. The filiform papillae reach their maximum in the feline family of the Carnivora where they convert the tongue into a rasp by which bones can be licked clean of all flesh attached to them.

Foliate papillae are best seen in the rodents, and when they are well developed the circumvallate papillae are few, often only one on each side.

In the lemurs an under tongue or *sub lingua* is found, which is probably represented by the *plicae fimbriatae* under the human tongue, and by some morphologists is regarded as the homologue of the whole tongue of the lower vertebrates, the greater part of the mammalian tongue being then looked upon as a new formation.

For further details and literature see R. Wiedersheim's *Comparative Anatomy of Vertebrates*, translated by W. N. Parker (London, 1907); C. Gegenbaur, *Vergleich. Anat. der Wirbelthiere* (Leipzig, 1901); A. Oppel, *Lehrb. vergleich. mikroskop. Anat. der Wirbelthiere*, Teil 3 (Jena, 1900); Parker and Haswell, *Text Book of Zoology* (London, 1897). (F. G. P.)

Surgery of the Tongue.

During infancy it is sometimes noticed that the little band of membrane (*fraenum*) which binds the under part of the tongue to the middle line of the floor of the mouth is unusually short. The condition will probably right itself as the front part of the tongue takes on its natural growth. In some children the tongue is so large that it hangs out of the mouth, scratching itself upon the teeth. This condition is likely to be associated with weak intellect.

Acute inflammation of the tongue may be caused by the sting of a wasp or by the entrance of septic germs through a wound, and the trouble may end in an abscess.

Chronic inflammation of the tongue may be caused by syphilis, by the irritation of decayed teeth or of a badly-fitting plate of artificial teeth, or by excessive smoking. The condition is one of danger in that it may lead eventually to the tongue becoming the seat of cancer. The treatment demands the removal of every source of irritation. The teeth must be made sound and smooth and must be kept so. Smoking must be absolutely and entirely given up, and salt, mustard, pickles, spirits, aerated waters, and everything else which is likely to be a cause of irritation must be avoided.

Cancer of the tongue is the result of chronic irritation which produces an excessive growth of the scaly covering of the tongue and causes an invasion of the deeper parts of the tongue by the scales. It is more often found in men than women and is usually associated with a hard swelling at one side of the tongue—perhaps near a jagged tooth or at the spot where the end of the pipe-stem approaches the tongue. The nerves of the tongue being caught and compressed in the growth, pain is constant and severe, and the movements during mastication cause great distress. The swelling gradually increases in size and, spreading to the floor of the mouth, hinders the free movements of the tongue. In due course it breaks down in the middle and a hard-walled ulcer appears. All this time the small scales of the cancer are finding their way along the lymph-channels and causing a secondary enlargement in the glands just below the jaw and along the side of the neck. Enlargement of the cervical glands is a very serious complication of cancer of the tongue.

The only treatment for cancer of the tongue which is at present known in surgery is the early removal by operation. It not seldom happens that because there is a certain amount of doubt as to the exact nature of the growth in the early weeks delay in operating is reasonably permitted, but during this time there is the risk of the cells of the disease finding their way to the lymphatic system. Still, inasmuch as there may be great difficulty in determining the diagnosis from tertiary syphilitic disease, a course of treatment by iodide of potassium may well be recommended. Syphilis is often the precursor of lingual cancer, and it is impossible to say exactly when the syphilitic lesion becomes malignant. In the case of a cancerous tumour of the tongue being so deeply or so widely attached that its removal cannot be recommended, relief may be afforded by the extraction of most, or all of the teeth, by limiting the food to the most simple and unirritating kinds, and possibly by dividing the great sensory nerves of the tongue.

Cancer of the tongue is now operated on in advanced cases such as in former years would not have been dealt with by a radical operation. An incision is made beneath the jaw and through the floor of the mouth, by which the tongue is drawn out and rendered easily accessible, the arteries being leisurely secured as the tissues are cut across. The upper part of the gullet is plugged by a sponge so that no blood can enter the lungs, and unimpeded respiration is provided for by the preliminary introduction of a tube into the windpipe. Through the incision which is made below the jaw the infected lymphatic glands are removed. To Dr Kocher of Berne the profession and the public are indebted for this important advance in the treatment of this disease. (E. O*.)

TONGUES, GIFT OF, or Glossolalia (γλῶσσα, tongue, λαλεῖν, speak), a faculty of abnormal and inarticulate vocal utterance, under stress of religious excitement, which was widely developed in the early Christian circles, and has its parallels in other religions. In the New Testament such experiences are recorded in Caesarea (Acts x. 46), at Corinth (Acts xix. 6; 1 Cor. xii., xiv.), Thessalonica (1 Thess. v. 19), Ephesus (Eph. v. 18), and universally (Mark xvi. 17). From the epistles of Paul, who thanked God that he spake with tongues more than all or any of his Corinthian converts, we can gather a just idea of how he regarded this gift and of what it really was.

Firstly, then, it was a grace (*charisma*) of the spirit, yet not of the holy or pure spirit only, but of evil spirits also who on occasions had been known to take possession of the larynx of a saint and exclaim, "Jesus is Anathema." As no one could curse Jesus except under the influence of a devilish afflatus, so none could say "Jesus is Lord" except he was inspired by the Holy Spirit. But, secondly, the pneumatic utterances technically known as speaking with tongues failed to reach this level of intelligibility; for Paul compares "a tongue" to a material object which should merely make a noise, to a pipe or harp twanged or blown at random without tune or time, to a trumpet blaring idly and not according to a code of signal notes. Unless, therefore, he that has the gift of tongues also possess the gift of interpreting his exclamations, or unless some one present can do so for him, he had not better exercise it in church. He is a barbarian to others and they to him, since they cannot understand what is spoken by him. Paul discriminates between the Spirit which during these paroxysms both talks and prays to God and the *nous* or understanding which informs a believer's psalm, teaching, revelation or prophesy, and renders them intelligible, edifying and profitable to the assembly. Accordingly Paul lays down rules which he regarded as embodying the Lord's commandment. A man "that speaketh in a tongue speaketh not unto men, but unto God; for no man understandeth;" and therefore it is expedient that he keep this gift for his private chamber and there pour out the mysteries. In church it is best that he should confine himself to prophesying, for that brings to others "edification and comfort and consolation." If, however, tongues must be heard in the public assembly, then let not more than three of the saints exhibit the gift, and they only in succession. Nor let them exhibit it at all, unless there is some one present who can interpret the tongues and tell the meeting what it all means. If the whole congregation be talking with tongues all at once, and an unbeliever or one with no experience of pneumatic gifts come in, what will he think, asks Paul. Surely that "you are mad" So at Pentecost on the occasion of the first outpouring of the Spirit the saints were by the bystanders accused of being drunk (Acts ii. 15). In the church meeting, says Paul, "I had rather speak five words with my understanding, that I might instruct others also, than ten thousand words in a tongue."

The writer of Acts ii., anxious to prove that Providence from the first included the Gentiles in the Messianic Kingdom, assumes that the gift of tongues was a miraculous faculty of talking strange languages without having previously learned them. Augustine accordingly held that each of the disciples talked all languages miraculously; Chrysostom that each talked one other than his own. The Pentecostal inspiration has been construed as a providential antithesis to the confusion of tongues—an idea which Grotius expressed in the words: "Poena linguarum dispersit homines; donum linguarum dispersos in unum populum collegit." Competent critics to-day recognize that such a view is impossible; and it has been suggested with much probability that in the second chapter of Acts the words in v. 5: "Now there were dwelling . . . under heaven" as well as vv. 6–11: "because that every man . . . mighty works of God" were interpolated by Luke in the document he transcribed.[1] The faithful talking with tongues were taken by bystanders for drunken men, but intoxicated men do not talk in languages of which they are normally ignorant.[2]

Paul on the whole discouraged glossolaly. "Desire earnestly the greater gifts," he wrote to the Corinthians. The gift of tongues was suitable rather to children in the faith than to the mature. Tongues were, he felt, to cease whenever the perfect should come; and the believer who spoke with the tongues of men and of angels, if he had not love, was no better than the sounding brass and clanging cymbal of the noisy heathen mysteries. It was clearly a gift productive of much disturbance in the Church (1 Cor. xiv. 23). He would not, however, entirely forbid and quench it (1 Thess. v. 19), so long as decency and order were preserved.

It is not then surprising that we hear little of it after the apostolic age. It faded away in the great Church, and probably Celsus was describing Montanist circles (though Origen assumed that they were ordinary believers) when he wrote[3] of the many Christians of no repute who at the least provocation, whether within or without their temples, threw themselves about like inspired persons; while others did the same in cities or among armies in order to collect alms, roaming about cities or camps. They were wont to cry out, each of himself, "I am God; I am the Son of God; or I am the divine Spirit." They would indulge in prophecies of the last judgment, and back their threats with a string of strange, half-frantic and utterly unmeaning sounds, the sense of which no one with any intelligence could discover; for they were obscure gibberish, and merely furnished any fool or impostor with an occasion to twist the utterances as he chose to his own purposes.

In the above we get a glimpse both of the glossalist and of his interpreter as they appeared to the outside world; and the impression made on them is not unlike that which Paul apprehended would be left on outsiders by an indiscriminate use of the gift. Tertullian early in the 3rd century testifies that glossolaly still went on in the Montanist Church which he had joined; for we must so interpret the following passage in his *De anima*, cap. ix.: "There is among us at the present time a sister who is endowed with the charismatic gift of revelations, which she suffers through ecstasy in the spirit during the Sunday service in church. She converses with angels, sometimes even with the Lord, and both hears and see mysteries." The magical papyri teem with strings of senseless and barbaric words which probably answer to what certain of the Fathers called the language of demons. It has been suggested that we here have recorded the utterances of glossolalists.

The attitude of Paul toward glossolaly among his converts strikingly resembles Plato's opinion as expressed in the *Timaeus*, p 72, of the enthusiastic ecstasies of the ancient μάντις (soothsayer). "God," he writes, "has given the art of divination not to the wisdom, but to the foolishness of man; for no man, when in his wits, attains prophetic truth and inspiration; but when he receives the inspired word either his intelligence is enthralled by sleep, or he is demented by some distemper or possession. And he who would understand what he remembers to have been said, whether in a dream or when he was awake, by the prophetic and enthusiastic nature, or what he has seen, must first recover his wits; and then he will be able to explain rationally what all such words and apparitions mean, and what indications they afford to this man or that, of past, present or future good and evil. But, while he continues demented, he cannot judge of the visions which he sees or the words which he utters. . . . And for this reason it is customary to appoint diviners or interpreters to be judges of the true inspiration."[1] From such passages as the above we infer that the gift of tongues and of their interpretation was not peculiar to the Christian Church, but was a repetition in it of a phase common in ancient religions. The very phrase γλώσσαις λαλεῖν, "to speak with tongues," was not invented by the New Testament writers, but borrowed from ordinary speech.

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[1] This misunderstanding of Acts ii. has influenced the official Roman doctrine of demoniacal possession. The *Sacerdotale* indicates as one of the symptoms of possession the ability of the possessed to talk other tongues than his own. Cf. the *Fustis daemonum*, cap. xi. Venetus (1606): "*Aliqui sermonem alienum a patria sua loquuntur etsi nunquam e laribus paternis recesserint.*"

[2] It is noteworthy that in Eph. v. 18 Paul contrasts the being filled with the Spirit with the foolishness of intoxication with wine, and remarks that those filled with the Spirit speak to themselves in psalms and hymns and spiritual songs and give thanks always for all things.

[3] Origen, *Contra Celsum*, vii. 9.

Virgil (*Aen.* vi. 46, 98) draws a life-like picture of the ancient prophetess "speaking with tongues." He depicts her quick changes of colour, her dishevelled hair, her panting breast, her apparent increase of stature as the god draws nigh and fills her with his divine afflatus. Then her voice loses its mortal's ring: "nec mortale sonans." The same morbid and abnormal trance utterances recur in Christian revivals in every age, *e.g.* among the mendicant friars of the 13th century, among the Jansenists, the early Quakers, the converts of Wesley and Whitefield, the persecuted protestants of the Cevennes, the Irvingites.

Oracular possession of the kind above described is also common among savages and people of lower culture; and Dr Tylor, in his *Primitive Culture*, ii. 14, gives examples of ecstatic utterance interpreted by the sane. Thus in the Sandwich Islands the god Oro gave his oracles through a priest who "ceased to act or speak as a voluntary agent, but with his limbs convulsed, his features distorted and terrific, his eyes wild and strained, he would roll on the ground foaming at the mouth, and reveal the will of the god in shrill cries and sounds violent and indistinct, which the attending priests duly interpreted to the people."

See E. B. Tylor, *Primitive Culture*; H. Weinel, *Die Wirkungen des Geistes und der Geister* (Freiburg, 1899); Shaftesbury's *Letter on Enthusiasm*; Mrs Oliphant, *Life of Irving*, vol. ii. (F. C. C.)

TONK, a native state of India, in the Rajputana agency. It consists of six isolated tracts, some of which are under the Central India agency. Total area, 2553 sq. m.; total population (1901), 273,201; estimated revenue £77,000. No tribute is payable. The chief, whose title is nawab, is a Mahommedan of Afghan descent. The founder of the family was Amir Khan, the notorious Pindari leader at the beginning of the 19th century, who received the present territory on submitting to the British in 1817. The nawab Mahommed Ibrahim Ali Khan, G.C.I.E., succeeded in 1867, and was one of the few chiefs who attended both Lord Lytton's Durbar in 1877 and the Delhi Durbar of 1903 as rulers of their states. The late minister, Sir Sahibzada Obeidullah Khan, was deputed on political duty to Peshawar during the Tirah campaign of 1897. Grain, cotton, opium and hides are the chief exports. Two of the outlying tracts of the state are served by two railways. Distress was caused by drought in 1899–1900. The town of Tonk is situated 1462 ft. above sea-level, 60 m. by road south from Jaipur, near the right bank of the river Banas. Pop. (1901), 38,759. It is surrounded by a wall, with a mud fort. It has a high school, the Walter female hospital under a lady superintendent, and a hospital for males.

There is another town in India called Tonk, or Tank, in Dera Ismail Khan district, North-West Frontier Province; pop. (1901), 4402. It is the residence of a nawab, who formerly exercised semi-independent powers. Here Sir Henry Durand, lieutenant-governor of the Punjab, was killed in 1870 when passing on an elephant under a gateway.

TONNAGE. The mode of ascertaining the tonnage of merchant ships is settled by the Merchant Shipping Acts. But before explaining the method by which this is computed, it is well to remark that there are several tonnages employed in different connexions. *Displacement tonnage* is that which is invariably used in respect of warships, and is the actual weight of water displaced by the vessel whose tonnage is being dealt with. Men-of-War are designed to carry all their weights, including coal, guns, ammunition, stores and water in tanks and in boilers, at a certain draught, and the tonnage attributed to them is the weight of water which at that designed draught they actually displace. This displacement tonnage is therefore a total made up of the actual weight of the ship's fabric and that of everything that is on board of her. It can be found by ascertaining the exact cubic space occupied by the part of her body which is immersed (including her rudder, propellers and external shafting) at the draught under consideration in cubic feet, and dividing this by 35, since 35 cubic feet of sea-water weigh one ton. Of course there is nothing to prevent displacement tonnage from being used in describing the size of merchant ships, and indeed in regard to the performances of fast steamships on trial it is usual to give their draught on the occasion when they are tested, and to state what was their actual displacement under these trial conditions. But it is obvious, from what has been said as to the components which go to make up the displacement at load draught, that this tonnage must, in respect of any individual ship, be the greatest figure which can be quoted in regard to her size. It is usual for dues to be assessed against merchant vessels in respect of their *registered tonnage*. This must therefore be fixed by authority, and at present vessels are measured by the officer of customs according to the rules laid down in the second schedule to the Merchant Shipping Act 1894. As will be seen from the explanation of the method adopted, this is a somewhat arbitrary process, and even the gross registered tonnage affords little indication of the actual size of the ship, whilst the under-deck and net tonnages are still less in accord with the extreme dimensions.

As to *length for tonnage*, the measurements start with the tonnage deck, which in vessels with less than three decks is the upper, and in vessels of three or more decks is the second from below. The length for tonnage is measured in a straight line along this deck from the inside of the inner plank at the bow to the inside of the inner plank at the stern, making allowance for the rake, if any, which the midship bow and stern timbers may have in the actual deck. When this is measured it is apparent into which of five classes the ship's tonnage-length places her. If she be under 50 ft. in length she falls into the first class, while if she be over 225 ft. in length she falls into the fifth class, the remaining three classes being intermediate to these. Vessels of the first class are measured as in four equal sections, and vessels of the larger class as in twelve equal sections, according to their length. Then at each of the points of division so marked off *transverse areas* are taken. This is done by measuring the depth in feet from a point at a distance of one-third of the round of the beam below the tonnage deck to the upper side of the floor timbers. Where the vessel has a ceiling and no water-ballast tanks at the point of measurement, 2½ in. is allowed for ceiling. But where there are such tanks the measurement is taken from the top of the tank and no allowance is made for ceiling, whether there in fact be any or not. If the midship depth so found exceeds 16 ft., each depth is divided into six equal parts, and the horizontal breadths are measured at each point of division and also at the upper and lower points of the depth, extending each measurement to the average thickness of that part of the ceiling which is between the points of measurement. They are then numbered from above, and the second, fourth and sixth multiplied by four, whilst the third and fifth are multiplied by two. The products are then added together. To the sum are added the first and the seventh breadths. This total having been multiplied by one-third the common interval between the breadths, the resultant is the transverse area. The transverse areas so obtained at each point of the vessel's length are numbered from the bow aft. Omitting the first and last, the second and every even area so obtained are multiplied by four, whilst the third and every odd area are multiplied by two. These products are added together, as are also those of the first and last areas if they yield anything, and the figure thus reached is multiplied by one-third of the common interval between the areas. This product is reckoned as the *cubical capacity of the*

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[1] Jowett's translation.

ship in feet. When divided by 100 the result is the *registered under-deck tonnage* of the ship—subject to the additions and deductions ordered by the act. Directions of a kind similar to those already set out are given whereby the tonnage in the space enclosed between the tonnage and upper decks may be ascertained, and also for the measuring of any break, poop or other permanent closed-in space on the upper deck available for stores, and the sum of the capacity of these must be added to the under-deck tonnage to arrive at the *gross registered tonnage*. But an express proviso is enacted that no addition shall be made in respect of any building erected for the shelter of deck passengers and approved by the board of trade. In the process of arriving at the *net tonnage* the main deduction allowed from the gross tonnage is that of machinery space in steamships. The method of measurement here is similar to that by which the under-deck tonnage is reached. Where the engines and boilers are fitted in separate compartments, each compartment is measured separately, as is the screw shaft tunnel in the case of steamships propelled by screws. The tonnage of these spaces is reckoned, not from the tonnage deck, but from the crown of the space; whilst, if it has previously been reckoned in the gross tonnage, there may be an allowance for the space above the crown, if enclosed for the machinery or for the admission of light and air. Allowances are only made in respect of any machinery space if it be devoted solely to machinery or to light and air. It must not be used for cargo purposes or for cabins. Further, by the act itself in the case of paddle steamships, where the machinery space is above 20% and under 30% of the gross tonnage, it is allowed to be reckoned as 37% of such gross tonnage; whilst similarly, in the case of screw steamships, where such machinery space is over 13 % and under 20% of the gross tonnage, it is allowed to be reckoned as 32%. Further deductions are also made in respect of space used solely for the accommodation of the master and the crew, and for the chart-room and signal-room, as well as for the wheel-house and chain cable locker and for the donkey-engine and boiler, if connected with the main pumps of the ship, and in sailing vessels for the sail locker. The space in the double bottom and in the water-ballast tanks, if these be not available for the carriage of fuel stores or cargo, is also deducted if it has been reckoned in the gross tonnage in the first instance.

From the rules above laid down it follows that it is possible for vessels, if built with a full midship section, to have a gross registered tonnage considerably below what the actual cubical capacity of the ship would give, whilst in the case of steam tugs of high power it is not unprecedented, owing to the large allowances for machinery and crew spaces, for a vessel to have a registered net tonnage of nil.

Suez Canal dues being charged on what is practically the registered tonnage (though all deductions permitted by the British board of trade are not accepted), it is usual, at all events in the British navy, for warships to be measured for what would be their registered tonnage if they were merchant ships, so that in case they may wish to pass through the canal a scale of payment may be easily reached. But such tonnage is never spoken of in considering their size relative to other vessels.

Two other tonnages are also made use of in connexion with merchant ships, especially when specifications for vessels are being made. The first of these is *measurement capacity*. This is found by measuring out the true cubic capacity of the holds, whereby it is found what amount of light measurement goods can be carried. The second is *deadweight capacity*. This is generally given as excluding what is carried in the coal bunkers, and it is therefore the amount of deadweight which can be carried in the holds at load draught when the vessel is fully charged with coals and stores. (B. W. G.)

TONNAGE AND POUNDAGE, in England, customs duties anciently imposed upon exports and imports, the former being a duty upon all wines imported in addition to prisage and butlerage, the latter a duty imposed *ad valorem* at the rate of twelvepence in the pound on all merchandise imported or exported. The duties were levied at first by agreement with merchants (poundage in 1302, tonnage in 1347), then granted by parliament in 1373, at first for a limited period only. They were considered to be imposed for the defence of the realm. From the reign of Henry VI. until that of James I. they were usually granted for life. They were not granted to Charles I., and in 1628 that king took the unconstitutional course of levying them on his own authority, a course denounced a few years later by 16 Car. I. c. 18 (1640), when the Long Parliament granted them for two months. After the Restoration they were granted to Charles II. and his two successors for life. By acts of Anne and George I. the duties were made perpetual, and mortgaged for the public debt. In 1787 they were finally abolished, and other modes of obtaining revenue substituted, by 27 Geo. III. c. 13 (1787).

Poundage also signifies a fee paid to an officer of a court for his services, *e.g.* to a sheriff's officer, who is entitled by 29 Eliz. c. 4 (1586–1587) to a poundage of a shilling in the pound on an execution up to £100, and sixpence in the pound above that sum.

TONNERRE, a town of north-central France, capital of an arrondissement in the department of Yonne, 52 m. S.E. of Sens on the Paris-Lyon railway. Pop. (1906), 3974. It is situated on a slope of the vineclad hills on the left bank of the Armançon. At the foot of the hill rises the spring of Fosse-Dionne, enclosed in a circular basin 49 ft. in diameter. The town has two interesting churches. That of St Pierre, which crowns the hill, possesses a fine lateral portal of the Renaissance period to which the church, with the exception of the choir (1351), belongs. The church of Notre-Dame is mainly Gothic, but the façade is a fine specimen of Renaissance architecture. The Salle des Malades, a large timber-roofed apartment in the hospital, dates from the end of the 13th century and is used as a chapel. It is 330 ft. long and contains the tombs of Margaret of Burgundy, wife of Charles of Anjou, king of Sicily, and foundress of the hospital, and of François-Michel Le Tellier, marquis of Louvois, war minister of Louis XIV. The hospital itself was rebuilt in the 19th century. The Renaissance Hôtel d'Uzès was built in the 16th century. Tonnerre is the seat of a sub-prefect and has a tribunal of first instance. The vineyards of the vicinity produce well-known wines. The trade of the town is chiefly in wine, in the good building-stone found in the neighbourhood and in Portland cement. Cooperage is carried on.

Its ancient name of *Tornodorum* points to a Gallic or Gallo-Roman origin for Tonnerre. In the 6th century it became the capital of the region of Tonnerrois and in the 10th century of a countship. After passing into the possession of several noble families, it was bought from a count of Clermont-Tonnerre by Louvois, by whose descendants it was held up to the time of the Revolution.

TONQUA BEAN. The Tonqua, Tonka or Tonquin bean, also called the coumara nut, is the seed of *Dipterix odorata*, a leguminous tree growing to a height of 80 ft., native of tropical South America. The drupe-like pod contains a single seed possessed of a fine sweet "new-mown hay" odour, due to the presence of coumarin (*q.v.*). Tonqua beans are used principally for scenting snuff and as an ingredient in perfume sachets and in perfumers' "bouquets."

TÖNSBERG, a fortified seaport of Norway, in Jarlsberg-Laurvik *amt* (county), situated on a bay on the south coast, near the entrance to Christiania Fjord, 72 m. S. by W. of Christiania on the Skien railway. Pop. (1900), 8620. It is one of the most ancient towns in Norway. It is the headquarters of a sealing and whaling fleet. The principal industries are refineries for preparing whale and seal oil and saw-mills. An interesting collection of antiquities and whaling implements is preserved in the Slotstaarn on Castle Hill.

TONSILLITIS, acute inflammation of the tonsils, or quinsy, due to the invasion of the tonsil, or tonsils, by septic micro-organisms which may have gained access through the mouth or by the blood-stream. Sometimes the attack comes on as the result of direct exposure to sewer gas, and it is not at all an uncommon affection of house surgeons, nurses and others who have to spend most of their time in a hospital. The association of quinsy with rheumatism may be the result of the infection of the tonsils by the micro-organisms or the toxins of that disease. Acute tonsillitis is very apt to run on to the formation of abscess. Quinsy may begin with a feeling of chilliness or with an attack of shivering. Then comes on a swelling in the throat with pain, tenderness and difficulty in swallowing. Indeed, if both tonsils are acutely inflamed it may be impossible to swallow even fluid and the breathing may be seriously embarrassed. The temperature may be raised several degrees. There is pain about the ear and about the jaw, and there is a swelling of the glands in the neck. The breath is offensive and the tongue is thickly coated. There may be some yellowish markings on the surface of the tonsil, but these differ from the patches of "false membrane" of diphtheria in that they can be easily brushed off by a swab, but often a true diagnosis can only be made by bacteriological examination. The treatment consists in giving a purgative, and in encouraging the patient to use an inhaler containing hot carbolized water. Hot compresses also may be applied to the neck. As regards medicines, the most trustworthy are salicylic acid, iron and quinine. As soon as abscess threatens, a slender-bladed knife should be thrust from before backward deeply into the swollen mass. And if, as most likely happens, matter then escapes, the patient's distress speedily ends. Convalescence having set in, a change of air and course of tonic treatment will be advisable.

Chronic tonsillitis is often associated with adenoid vegetations at the back of the throat of tuberculous or delicate children, such children being spoken of as being "liable to sore throat" Chronic enlargement of the tonsils may seriously interfere with a child's general health and vigour and, should the condition not subside under general measures such as a stay at a bracing seaside place and the taking of cod-liver oil and iron, it will be well to treat the tonsils by operation. (E. O.*)

TONSON, the name of a family of London booksellers and publishers. Richard and Jacob Tonson (*c.* 1656–1736), sons of a London barber-surgeon, started in 1676 and 1677 independently as booksellers and publishers in London. In 1679 Jacob, the better known of the two, bought and published Dryden's *Troilus and Cressida*, and from that time was closely associated with Dryden, and published most of his works. He published the *Miscellany Poems* (1684–1708) under Dryden's editorship, the collection being known indifferently as *Dryden's* or *Tonson's Miscellany*, and also Dryden's translation of Virgil (1697). Serious disagreements over the price paid, however, arose between poet and publisher, and in his *Faction Displayed* (1705) Dryden described Tonson as having "two left legs, and Judas-coloured hair." Subsequently the relations between the two men improved. The brothers jointly published Dryden's *Spanish Friar* (1683). Jacob Tonson also published Congreve's *Double Dealer*, Sir John Vanbrugh's *The Faithful Friend* and *The Confederacy*, and the pastorals of Pope, thus justifying Wycherly's description of him as "gentleman usher to the Muses." He bought also the valuable rights of *Paradise Lost*, half in 1683 and half in 1690. This was his first profitable venture in poetry. In 1712 he became joint publisher with Samuel Buckley of the *Spectator*, and in the following year published Addison's *Cato*. He was the original secretary and a prominent member of the Kit-Cat Club. About 1720 he gave up business and retired to Herefordshire, where he died on the 2nd of April 1736. His business was carried on by his nephew, Jacob Tonson, jun. (d. 1735), and subsequently by his grand-nephew, also Jacob (d. 1767).

TONSURE (Lat. *tonsura*, from *tondere*, to shave), a religious observance in the Roman Catholic and Orthodox Eastern Churches, consisting of the shaving or cutting part of the hair of the head as a sign of dedication to special service. The reception of the tonsure in these churches is the initial ceremony which marks admission to orders and to the rights and privileges of clerical standing. It is administered by the bishop with an appropriate ritual. Candidates for the rite must have been confirmed, be adequately instructed in the elements of the Christian faith, and be able to read and write. Those who have received it are bound (unless in exceptional circumstances) to renew the mark, consisting of a bare circle on the crown of the head, at least once a month, otherwise they forfeit the privileges it carries. The practice is not a primitive one, Tertullian simply advises Christians to avoid vanity in dressing their hair, and Jerome deprecates both long and closely cropped hair. According to Prudentius (Περισ xiii. 30) it was customary for the hair to be cut short at ordination. Paulinus of Nola (*c.* 400) alludes to the tonsure as in use among the (Western) monks, from them the practice quickly spread to the clergy. For Gaul about the year 500 we have the testimony of Sidonius Apollinaris (iv. 13), who says that Germanicus the bishop had his hair cut "in rotae speciem."

The earliest instance of an ecclesiastical precept on the subject occurs in can 41 of the Council of Toledo (A D. 633) "omnes clerici, detonso superius capite toto, inferius solam circuli coronam relinquant" Can 33 of the Quinisext council (692) requires even singers and readers to be tonsured. Since the 8th century three tonsures have been more or less in use, known respectively as the Roman, the Greek and the Celtic. The first two are sometimes distinguished as the tonsure of Peter and the tonsure of Paul. The Roman or St Peter's tonsure prevailed in France, Spain and Italy. It consisted in shaving the whole head, leaving only a fringe of hair supposed to symbolize the crown of thorns. Late in the middle ages this tonsure was lessened for the clergy, but retained for monks and friars. In the Eastern or St Paul's tonsure the whole head was shaven, but when now practised in the Eastern Church this tonsure is held to be adequately shown when the hair is shorn close. In the Celtic tonsure (tonsure of St John, or, in contempt, tonsure of Simon Magus) all the hair in front of a line drawn over the top of the head from ear to ear was shaven (a fashion common among the Hindus). The question of the Roman or Celtic tonsure was one of the points in dispute in the early British Church, settled in favour of the Roman fashion at the Council of Whitby (664). The tonsure at first was never given separately, and even children when so dedicated were appointed readers, as no one could belong to the clerical state without at least a minor order. From the 7th century, however, children were tonsured without ordination, and later on adults anxious to escape secular jurisdiction were often tonsured without ordination. Till the 10th century the tonsure could be given by priests or even by laymen, but its bestowal was gradually restricted to bishops and abbots.

TONTINE, a system of life insurance owing its name to Lorenzo Tonti, an Italian banker, born at Naples early in the 17th century, who settled in France about 1650. In 1653 he proposed to Cardinal Mazarin a new scheme for promoting a public loan. A total of 1,025,000 livres was to be subscribed in ten portions of 102,500 livres each by ten classes of subscribers, the first class consisting of persons under 7, the second of persons above 7 and under 14, and so on to the tenth, which consisted of persons between 63 and 70. The annual fund of each class was to be divided among the survivors of that class, and on the death of the last individual the capital was to fall to the state. This plan of operations was authorized under the name of "tontine royale" by a royal edict, but this the parlement refused to register, and the idea remained in abeyance till 1689, when it was revived by Louis XIV., who established a tontine of 1,400,000 livres divided into fourteen classes of 100,000 each, the subscription being 300 livres. This tontine was carried on till 1726, when the last beneficiary died—a widow who at the time of her decease was drawing an annual income of 73,500 livres. Several other government tontines were afterwards set on foot; but in 1763 restrictions were introduced, and in 1770 all tontines at the time in existence were wound up. Private tontines continued to flourish in France for some years, the "tontine Lefarge," the most celebrated of the kind, being opened in 1791 and closed in 1889.

The tontine principle has often been applied in Great Britain, at one time in connexion with government life annuities. Many such tontines were set on foot between the years 1773 and 1789, those of 1773, 1775 and 1777 being commonly called the Irish tontines, as the money was borrowed under acts of the Irish parliament. The most important English tontine was that of 1789, which was created by 29 Geo. III. c. 41. Under this act over a million was raised in 10,000 shares of £100, 5s. It was also often applied to the purchase of estates or the erection of buildings. The investor staked his money on the chance of his own life or the life of his nominee enduring for a longer period than the other lives involved in the speculation, in which case he expected to win a large prize. It was occasionally introduced into life assurance, more particularly by American life offices, but newer and more ingenious forms of contract have now made the tontine principle practically a thing of the past. (See NATIONAL DEBT; INSURANCE.)

TOOKE, JOHN HORNE (1736–1812), English politician and philologist, third son of John Horne, a poulterer in Newport Market, whose business the boy when at Eton happily veiled under the title of a "Turkey merchant," was born in Newport Street, Long Acre, Westminster, on the 25th of June 1736. After passing some time at school in Soho Square, and at a Kentish village, he went from 1744 to 1746 to Westminster School and for the next five or six years was at Eton. On the 12th of January 1754 he was admitted as sizar at St John's College, Cambridge, and took his degree of B.A. in 1758, as last but one of the *senior optimes*, Richard Beadon, his lifelong friend, afterwards bishop of Bath and Wells, being a wrangler in the same year. Horne had been admitted on the 9th of November 1756, as student at the Inner Temple, making the friendship of John Dunning and Lloyd Kenyon, but his father wished him to take orders in the English Church, and he was ordained deacon on the 23rd of September 1759 and priest on the 23rd of November 1760. For a few months he was usher at a boarding school at Blackheath, but on the 26th of September 1760 he became perpetual curate of New Brentford, the incumbency of which his father had purchased for him, and he retained its scanty profits until 1773. During a part of this time (1763–1764) he was absent on a tour in France, acting as the bear-leader of a son of the miser Elwes. Under the excitement created by the actions of Wilkes, Horne plunged into politics, and in 1765 brought out a scathing pamphlet on Lords Bute and Mansfield, entitled "The Petition of an Englishman." In the autumn of 1765 he escorted to Italy the son of a Mr Taylor. In Paris he made the acquaintance of Wilkes, and from Montpellier, in January 1766, addressed a letter to him which sowed the seeds of their personal antipathy. In the summer of 1767 Horne landed again on English soil, and in 1768 secured the return of Wilkes to parliament for Middlesex. With inexhaustible energy he promoted the legal proceedings over the riot in St George's Fields, when a youth named Allen was killed, and exposed the irregularity in the judge's order for the execution of two Spitalfields weavers. His dispute with George Onslow, member for Surrey, who at first supported and then threw over Wilkes for place, culminated in a civil action, ultimately decided, after the reversal of a verdict which had been obtained through the charge of Lord Mansfield, in Horne's favour, and in the loss by his opponent of his seat in parliament. An influential association, called "The Society for Supporting the Bill of Rights," was founded, mainly through the exertions of Horne, in 1769, but the members were soon divided into two opposite camps, and in 1771 Horne and Wilkes, their respective leaders, broke out into open warfare, to the damage of their cause. On the 1st of July 1771 Horne obtained at Cambridge, though not without some opposition from members of both the political parties, his degree of M.A. Earlier in that year he claimed for the public the right of printing an account of the debates in parliament, and after a protracted struggle between the ministerial majority and the civic authorities, the right was definitely established. The energies of the indefatigable parson knew no bounds. In the same year (1771) he crossed swords with Junius, and ended in disarming his masked antagonist. Up to this time Horne's fixed income consisted of those scanty emoluments attached to a position which galled him daily. He resigned his benefice in 1773 and betook himself to the study of the law and philology. An accidental circumstance, however, occurred at this moment which largely affected his future. His friend Mr William Tooke had purchased a considerable estate, including Purley Lodge, south of the town of Croydon in Surrey. The possession of this property brought about frequent disputes with an adjoining landowner, Thomas de Grey, and, after many actions in the courts, his friends endeavoured to obtain, by a bill forced through the houses of parliament, the privileges which the law had not assigned to him (February 1774). Horne, thereupon, by a bold libel on the Speaker, drew public attention to the case, and though he himself was placed for a time in the custody of the serjeant-at-arms, the clauses which were injurious to the interest of Mr Tooke were eliminated from the bill. Mr Tooke declared his intention of making Horne the heir of his fortune, and, if the design was never carried into effect, during his lifetime he bestowed upon him large gifts of money. No sooner had this matter been happily settled than Horne found himself involved in serious trouble. For his conduct in signing the advertisement soliciting subscriptions for the relief of the relatives of the Americans "murdered by the king's troops at Lexington and Concord," he was tried at the Guildhall on the 4th of July 1777, before Lord Mansfield, found guilty, and committed to the King's Bench prison in St George's Fields, from which he only emerged after a year's durance, and after a loss in fines and costs amounting to £1200. Soon after his deliverance he applied to be called to the bar, but his application was negatived on the ground that his orders in the Church were indelible. Horne thereupon tried his fortune, but without success, on farming some land in Huntingdonshire. Two tracts about this time exercised great influence in the country. One of them, *Facts Addressed to Landholders*, &c. (1780), written by Horne in conjunction with others, criticizing the measures of Lord North's ministry, passed through numerous editions; the other, *A Letter on Parliamentary Reform* (1782), addressed by him to Dunning, set out a scheme of reform, which he afterwards withdrew in favour of that advocated by Pitt. On his return from Huntingdonshire he became once more a frequent guest at Mr Tooke's house at Purley, and in 1782 assumed the name of Horne Tooke. In 1786 Horne Tooke conferred perpetual fame upon his benefactor's country house by adopting, as a second title of his elaborate philological treatise of Ἔπεα πτερόεντα, the more popular though misleading title of *The Diversions of Purley*. The treatise at once attracted attention in England and the Continent. The first part was published in 1786, the second in 1805. The best edition is that which was published in 1829, under the editorship of Richard Taylor, with the additions written in the author's interleaved copy.

Between 1782 and 1790 Tooke gave his support to Pitt, and in the election for Westminster, in 1784, threw all his energies into opposition to Fox. With Fox he was never on terms of friendship, and Samuel Rogers, in his *Table Talk*, asserts that their antipathy was so pronounced that at a dinner party given by a prominent Whig not the slightest notice was taken by Fox of the presence of Horne Tooke. It was after the election of Westminster in 1788 that Tooke depicted the rival statesmen (Lord Chatham and Lord Holland, William Pitt and C. J. Fox) in his celebrated pamphlet of *Two Pair of Portraits*. At the general election of 1790 he came forward as a candidate for that distinguished constituency, in opposition to Fox and Lord Hood, but was defeated; and, at a second trial in 1796, he was again at the bottom of the poll. Meantime the excesses of the French republicans had provoked reaction in England, and the Tory ministry adopted a policy of repression. Horne Tooke was arrested early on the morning of the 16th of May 1794, and conveyed to the Tower. His trial for high treason lasted for six days (17th to 22nd of November) and ended in his acquittal, the jury only taking eight minutes to settle their verdict. His public life after this event was only distinguished by one act of importance. Through the influence of the second Lord Camelford, the fighting peer, he was returned to parliament in 1801 for the pocket borough of Old Sarum. Lord Temple endeavoured to secure his exclusion on the ground that he had taken orders in the Church, and one of Gilray's caricatures delineates the two politicians, Temple and Camelford, playing at battledore and shuttlecock, with Horne Tooke as the shuttlecock. The ministry of Addington would not support this suggestion, but a bill was at once introduced by them and carried into law, which rendered all persons in holy orders ineligible to sit in the House of Commons, and Horne Tooke sat for that parliament only.

The last years of Tooke's life were spent in retirement in a house on the west side of Wimbledon Common. The traditions of his Sunday parties have lasted unimpaired to this day, and the most pleasant pages penned by his biographer describe the politicians and the men of letters who gathered round his hospitable board. His conversational powers rivalled those of Dr Johnson; and, if more of his sayings have not been chronicled for the benefit of posterity, the defect is due to the absence of a Boswell. Through the liberality of his friends, his last days were freed from the pressure of poverty, and he was enabled to place his illegitimate son in a position which soon brought him wealth, and to leave a competency to his two illegitimate daughters. Illness seized him early in 1810, and for the next two years his sufferings were acute. He died in his house at Wimbledon on the 18th of March 1812, and his body was buried with that of his mother at Ealing, the tomb which he had prepared in the garden attached to his house at Wimbledon being found unsuitable for the interment. An altar-tomb still stands to his memory in Ealing churchyard. A catalogue of his library was printed in 1813.

The *Life of Horne Tooke*, by Alexander Stephens, is written in an unattractive style and was the work of an admirer only admitted to his acquaintance at the close of his days. The notice in the *Quarterly Review*, June 1812, of W. Hamilton Reid's compilation, is by J. W. Ward, Lord Dudley. The main facts of his life are set out by Mr J. E. Thorold Rogers, in his *Historical Gleanings*, 2nd series. Many of Horne Tooke's wittiest sayings are preserved in the *Table Talk* of Samuel Rogers and S. T. Coleridge. (W. P. C.)

TOOKE, THOMAS (1774–1858), English economist, was born at St Petersburg on the 29th of February 1774. Entering a large Russian house in London at an early age, he acquired sound practical experience of commercial matters and became a recognized authority on finance and banking. He was one of the earliest advocates of free trade and drew up the *Merchants' Petition* presented to the House of Commons by Alexander Baring, afterwards Lord Ashburton. He gave evidence before several parliamentary committees, notably the committee of 1821, on foreign trade, and those of 1832, 1840 and 1848 on the Bank Acts. He was elected a fellow of the Royal Society in 1821. He died in London on the 26th of February 1858.

Tooke was the author of *Thoughts and Details on the High and Low Prices of the last Thirty Years* (1823), *Considerations on the State of the Currency* (1826), in both of which he showed his hostility to the policy afterwards carried out in the Bank Act of 1844, but he is best known for his *History of Prices and of the State of the Circulation during the Years 1793–1856* (6 vols., 1838–1857). In the first four volumes he treats (*a*) of the prices of corn, and the circumstances affecting prices; (*b*) the prices of produce other than corn; and (*c*) the state of the circulation. The two final volumes, written in conjunction with W. Newmarch (*q.v.*), deal with railways, free trade, banking in Europe and the effects of new discoveries of gold.

TOOL (O. Eng. *tól*, generally referred to a root seen in the Goth. *taujan*, to make, or in the English word "taw," to work or dress leather), an implement or appliance used by a worker in the treatment of the substances used in his handicraft, whether in the preliminary operations of setting out and measuring the materials, in reducing his work to the required form by cutting or otherwise, in gauging it and testing its accuracy, or in duly securing it while thus being treated.

For the tools of prehistoric man see such articles as ARCHAEOLOGY; FLINT IMPLEMENTS; and EGYPT, § *Art and Archaeology*.

In beginning a survey of tools it is necessary to draw the distinction between hand and machine tools. The former class includes any tool which is held and operated by the unaided hands, as a chisel, plane or saw. Attach one of these to some piece of operating mechanism, and it, with the environment of which it is the central essential object, becomes a machine tool. A very simple example is the common power-driven hack saw for metal, or the small high-speed drill, or the wood-boring auger held in a frame and turned by a winch handle and bevel-gears. The difference between these and a big frame-saw cutting down a dozen boards simultaneously, or the immense machine boring the cylinders of an ocean liner, or the great gun lathe, or the hydraulic press, is so vast that the relationship is hardly apparent. Often the tool itself is absolutely dwarfed by the machine, of which nevertheless it is the central object and around which the machine is designed and built. A milling machine weighing several tons will often be seen rotating a tool of but two or three dozen pounds' weight. Yet the machine is fitted with elaborate slides and self-acting movements, and provision for taking up wear, and is worth some hundreds of pounds sterling, while the tool may not be worth two pounds. Such apparent anomalies are in constant evidence. We propose, therefore, first to take a survey of the principles that underlie the forms of tools, and then pursue the subject of their embodiment in machine tools.

HAND TOOLS

The most casual observation reveals the fact that tools admit of certain broad classifications. It is apparent that by far the larger number owe their value to their capacity for cutting or removing portions of material by an incisive or wedge-like action, leaving a smooth surface behind. An analysis of the essential methods of operation gives a broad grouping as follows:—

I. The chisel group . .	Typified by the chisel of the woodworker.
II. The shearing group .	" " scissors.
III. The scrapers . . .	" " cabinet-maker's scrape.
IV. The percussive and detrusive group .	" " hammer and the punch.
V. The moulding group .	" " trowel.

The first three are generally all regarded as cutting tools, notwithstanding that those in II. and III. do not operate as wedges, and therefore are not true chisels. But many occupy a border-line where the results obtained are practically those due to cutting, as in some of the shears, saws, milling cutters, files and grinding wheels, where, if the action is not directly wedge-like, it is certainly more or less incisive in character.

Cutting Tools.—The cutting edge of a tool is the practical outcome of several conditions. Keenness of edge, equivalent to a small degree of angle between the tool faces, would appear at first sight to be the prime element in cutting, as indeed it is in the case of a razor, or in that of a chisel for soft wood. But that is not the prime condition in a tool for cutting iron or steel. Strength is of far greater importance, and to it some keenness of edge must be sacrificed. All cutting tools are wedges; but a razor or a chisel edge, included between angles of 15° or 20°, would be turned over at once if presented to iron or steel, for which angles of from 60° to 75° are required. Further, much greater rigidity in the latter, to resist spring and fracture, is necessary than in the former, because the resistance to cutting is much greater. A workman can operate a turning tool by hand, even on heavy pieces of metal-work. Formerly all turning, no matter how large, was done by hand-operated tools, and after great muscular exertion a few pounds of metal might be removed in an hour. But coerce a similarly formed tool in a rigid guide or rest, and drive it by the power of ten or twenty men, and it becomes possible to remove say a hundredweight of chips in an hour. Or, increase the size of the tool and its capacity for endurance, and drive by the power of 40 or 60 horses, and half a ton of chips may be removed in an hour.

All machine tools of which the chisel is the type operate by cutting; that is, they act on the same principle and by the same essential method as the knife, razor or chisel, and not by that of the grindstone. A single tool, however, may act as a cutting instrument at one time and as a scrape at another. The butcher's knife will afford a familiar illustration. It is used as a cutting tool when severing a steak, but it becomes a scrape when used to clean the block. The difference is not therefore due to the form of the knife, but to the method of its application, a distinction which holds good in reference to the tools used by engineers. There is a very old hand tool once much used in the engineer's turnery, termed a "graver." This was employed for cutting and for scraping indiscriminately, simply by varying the angle of its presentation. At that time the question of the best cutting angles was seldom raised or discussed, because the manipulative instinct of the turner settled it as the work proceeded, and as the material operated on varied in texture and degree of hardness. But since the use of the slide rest holding tools rigidly fixed has become general, the question of the most suitable tool formation has been the subject of much experiment and discussion. The almost unconscious experimenting which goes on every day in every workshop in the world proves that there may be a difference of several degrees of angle in tools doing similar work, without having any appreciable effect upon results. So long as certain broad principles and reasonable limits are observed, that is sufficient for practical purposes.

Clearly, in order that a tool shall cut, it must possess an incisive form. In fig. 1, *A* might be thrust over the surface of the plate of metal, but no cutting action could take place. It would simply grind and polish the surface. If it were formed like *B*, the grinding action would give place to scraping, by which some material would be removed. Many tools are formed thus, but there is still no incisive or knife-like action, and the tool is simply a scrape and not a cutting tool. But *C* is a cutting tool, possessing penetrative capacity. If now *B* were tilted backwards as at *D*, it would at once become a cutting tool. But its bevelled face would rub and grind on the surface of the work, producing friction and heat, and interfering with the penetrative action of the cutting edge. On the other hand, if *C* were tilted forwards as at *E* its action would approximate to that of a scrape for the time being. But the high angle of the hinder bevelled face would not afford adequate support to the cutting edge, and the latter would therefore become worn off almost instantly, precisely as that of a razor or wood-working chisel would crumble away if operated on hard metal. It is obvious therefore that the correct form for a cutting tool must depend upon a due balance being maintained between the angle of the front and of the bottom faces—"front" or "top rake," and "bottom rake" or "clearance"—considered in regard to their *method of presentation* to the work. Since, too, all tools used in machines are held rigidly in one position, differing in this respect from hand-operated tools, it follows that a constant angle should be given to instruments which are used for operating on a given kind of metal or alloy. It does not matter whether a tool is driven in a lathe, or a planing machine, or a sharper or a slotter; whether it is cutting on external or internal surfaces, it is always maintained in a direction perpendicularly to the point of application as in fig. 1, *F, G, H*, planing, turning and boring respectively. It is consistent with reason and with fact that the softer and more fibrous the metal, the keener must be the formation of the tool, and that, conversely, the harder and more crystalline the metal the more obtuse must be the cutting angles, as in the extremes of the razor and the tools for cutting iron and steel already instanced. The three figures *J, K, L* show tools suitably formed for wrought iron and mild steel, for cast iron and cast steel, and for brass respectively. Cast iron and cast steel could not be cut properly with the first, nor wrought iron and fibrous steel with the second, nor either with the third. The angles given are those which accord best with general practice, but they are not constant, being varied by conditions, especially by lubrication and rigidity of fastenings. The profiles of the first and second tools are given mainly with the view of having material for grinding away, without the need for frequent reforging. But there are many tools which are formed quite differently when used in tool-holders and in turrets, though the same essential principles of angle are observed.

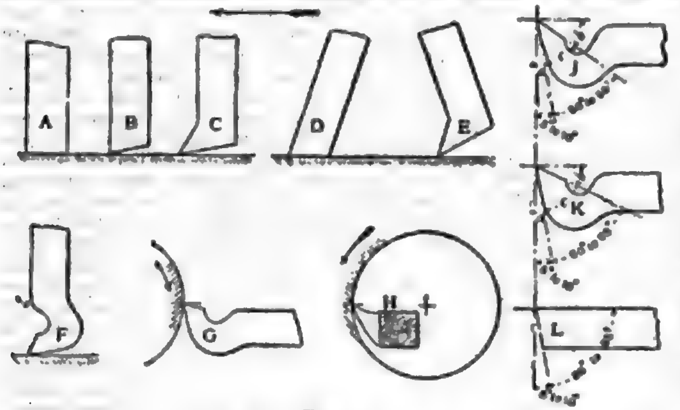


FIG. 1.

A, Tool which would burnish only.
B, Scrape.
C, Cutting tool.
D and *E*, Scraping and cutting tools improperly presented.
F, G, H, Presentations of tools for planing, turning and boring respectively.
J, K, L, Approximate angles of tools; *a*, clearance angle, or bottom rake; *b*, front or top rake; *c*, tool angle.

The *angle of clearance*, or *relief*, *a*, in fig. 1, is an important detail of a cutting tool. It is of greater importance than an exact angle of top rake. But, given some sufficient angle of clearance, its exact amount is not of much moment. Neither need it be uniform for a given cutting edge. It may vary from say 3° to 10°, or even 20°, and under good conditions little or no practical differences will result. Actually it need never vary much from 5° to 7°. The object in giving a clearance angle is simply to prevent friction between the non-cutting face immediately adjacent to the edge and the surface of the work. The limit to this clearance is that at which insufficient support is afforded to the cutting edge. These are the two facts, which if fulfilled permit of a considerable range in clearance angle. The softer the metal being cut the greater can be the clearance; the harder the material the less clearance is permissible because the edge requires greater *support*.

The *front*, or *top rake*, *b* in fig. 1, is the angle or slope of the front, or top face, of the tool; it is varied mainly according as materials are crystalline or fibrous. In the turnings and cuttings taken off the more crystalline metals and alloys, the broken appearance of the chips is distinguished from the shavings removed from the fibrous materials. This is a feature which always distinguishes cast iron and unannealed cast steel from mild steel, high carbon steel from that low in carbon, and cast iron from wrought iron. It indicates too that extra work is put on the tool in breaking up the chips, following immediately on their severance, and when the comminutions are very small they indicate insufficient top rake. This is a result that turners try to avoid when possible, or at least to minimize. Now the greater the slope of the top rake the more easily will the cuttings come away, with the minimum of break in the crystalline materials and absolutely unbroken over lengths of many feet in the fibrous ones. The breaking up, or the continuity of the cuttings, therefore affords an indication of the suitability of the amount of top rake to its work. But compromise often has to be made between the ideal and the actual. The amount of top rake has to be limited in the harder metals and alloys in order to secure a *strong tool angle*, without which tools would lack the endurance required to sustain them through several hours without regrinding.

The *tool angle*, *c*, is the angle included between top and bottom faces, and its amount, or thickness expressed in degrees, is a measure of the strength and endurance of any tool. At extremes it varies from about 15° to 85°. It is traceable in all kinds of tools, having very diverse forms. It is difficult to place some groups in the cutting category; they are on the border-line between cutting and scraping instruments.

Typical Tools.—A bare enumeration of the diverse forms in which tools of the chisel type occur is not even possible here. The grouped illustrations (figs. 2 to 6) show some of the types, but it will be understood that each is varied in dimensions, angles and outlines to suit all the varied kinds of metals and alloys and conditions of operation. For, as every tool has to be gripped in a holder of some kind, as a slide-rest, tool-box, turret, tool-holder, box, cross-slide, &c., this often determines the choice of some one form in preference to another. A broad division is that into roughing and finishing

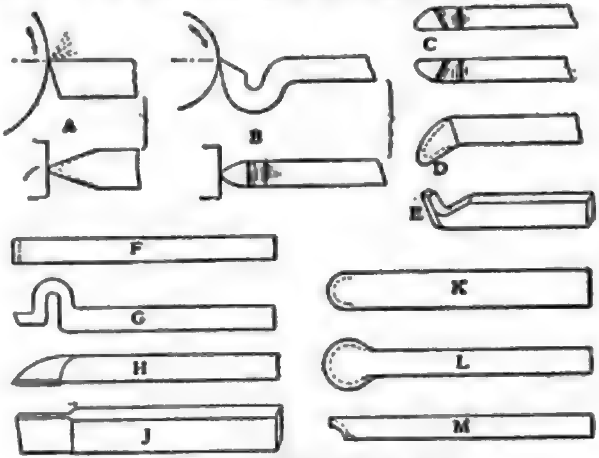


FIG. 2.—Metal-turning Tools.

A, Shape of tool used for scraping brass.
B, Straightforward tool for turning all metals.
C, Right- and left-hand tools for all metals.
D, A better form of same.
E, Diamond or angular-edge tool for cutting all metals.
F, Plan of finishing tool.
G, Spring tool for finishing.
H, Side or knife tool.
J, Parting or cutting-off tool.
K, L, Round-nose tools.
M, Radius tool.

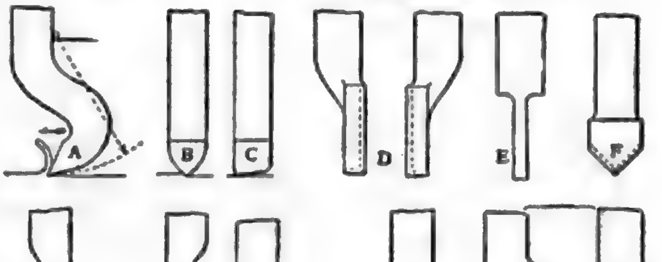


FIG. 3.—Group of Planer Tools.

A, Planer type of tool, cranked to avoid digging into the metal.
B, Face view of roughing tool.
C, Face view of finishing tool.
D, Right- and left-hand knife or side tools.
E, Parting or cutting-off or grooving tool.
F, V tool for grooves.
G, Right- and left-hand tools for V-slots.
H, Ditto for T-slots.
J, Radius tool held in holder.

tools. Generally though not invariably the edge of the first is narrow, of the second broad, corresponding with the deep cutting and fine traverse of the first and the shallow cutting and broad traverse of the second. The following are some of the principal forms. The round-nosed roughing tool (fig. 2) *B* is of straightforward type, used for turning, planing and shaping. As the correct tool angle can only occur on the middle plane of the tool, it is usual to employ cranked tools, *C*, *D*, *E*, right- and left-handed, for heavy and moderately heavy duty, the direction of the cranking corresponding with that in which the tool is required to traverse. Tools for boring are cranked and many for planing (fig. 3). The slotting tools (fig. 4) embody the same principle, but their shanks are in line with the direction of cutting. Many roughing and finishing tools are of knife type *H*. Finishing tools have broad edges, *F*, *G*, *H*. They occur in straightforward and right- and left-hand types. These as a rule remove less than $\frac{1}{16}$ in. in depth, while the roughing tools may cut an inch or more into the metal. But the traverse of the first often exceeds an inch, while in that of the second ½ in. is a very coarse amount of feed. Spring tools, *G*, used less now than formerly, are only of value for imparting a smooth finish to a surface. They are finishing tools only. Some spring tools are formed with considerable top rake, but generally they act by scraping only.

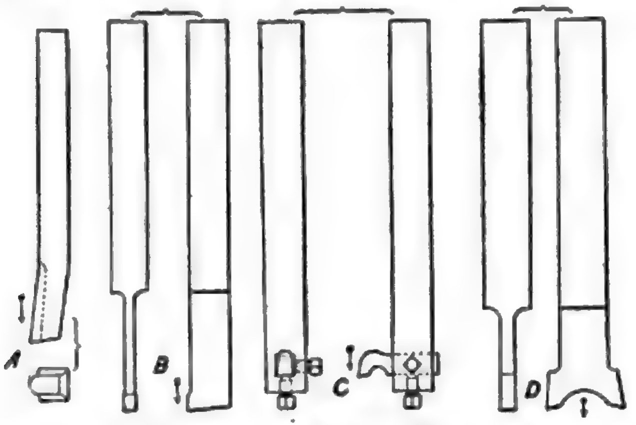


Fig. 4.—Group of Slotter Tools.

A, Common roughing tool. *B*, Parting-off or grooving tool. *C*, Roughing or finishing tool in a holder. *D*, Double-edged tool for cutting opposite sides of a slot.

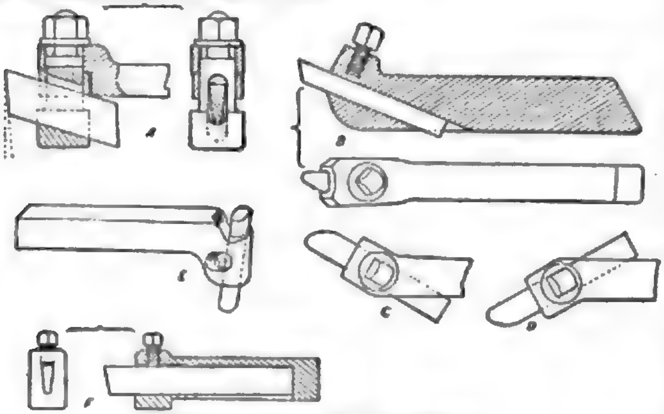


Fig. 5.—Group of Tool-holders.

A, Smith & Coventry swivelling holder. *B*, Holder for square steel. *C*, *D*, right- and left-hand forms of same. *E*, Holder for round steel. *F*, Holder for narrow parting-off tool.

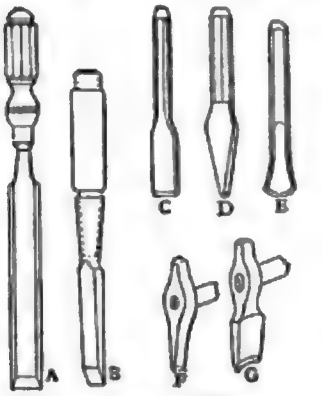


Fig. 6.—Group of Chisels.

A, Paring chisel.
B, Socket chisel for heavy duty.
C, Common chipping chisel.
D, Narrow cross-cut or cape chisel.
E, Cow-mouth chisel, or gouge.
F, Straight chisel or sett.
G, Hollow chisel or sett.

Solid Tools v. *Tool-holders*.—It will be observed that the foregoing are solid tools; that is, the cutting portion is forged from a solid bar of steel. This is costly when the best tool steel is used, hence large numbers of tools comprise *points* only, which are gripped in permanent holders in which they interchange. Tool steel usually ranges from about ¼ in. to 4 in. square; most engineers' work is done with bars of from ½ in. to 1½ in. square. It is in the smaller and medium sizes of tools that holders prove of most value. Solid tools, varying from 2½ in. to 4 in. square, are used for the heaviest cutting done in the planing machine. Tool-holders are not employed for very heavy work, because the heat generated would not get away fast enough from small tool points. There are scores of holders; perhaps a dozen good approved types are in common use. They are divisible into three great groups: those in which the top rake of the tool point is embodied in the holder, and is constant; those in which the clearance is similarly embodied; and those in which neither is provided for, but in which the tool point is ground to any angle. Charles Babbage designed the first tool-holder, and the essential type survives in several modern forms. The best-known holders now are the Tangye, the Smith & Coventry, the Armstrong, some by Mr C. Taylor, and the Bent. The Smith & Coventry (fig. 5), used more perhaps than any other single design, includes two forms. In one *E* the tool is a bit of round steel set at an angle which gives front rake, and having the top end ground to an angle of top rake. In the other *A* the tool has the section of a truncated wedge, set for constant top rake, or cutting angle, and having bottom rake or clearance angle ground. The Smith & Coventry round tool is not applicable for all classes of work. It will turn plain work, and plane level faces, but will not turn or plane into corners or angles. Hence the invention of the tool of V-section, and the swivel tool-holder. The round tool-holders are made right- and left-handed, the swivel tool-holder has a universal movement. The amount of projection of the round tool points is very limited, which impairs their utility when some overhanging of the tool is necessary. The V-tools can be slid out in their holders to operate on faces and edges situated to some considerable distance inwards from the end of the tool-holder.

Box Tools.—In one feature the box tools of the turret lathes resemble tool-holders. The small pieces of steel used for tool points are gripped in the boxes, as in tool-holders, and all the advantages which are derived from this arrangement of separating the point from its holder are thus secured (fig. 7). But in all other respects the two are dissimilar. Two or three tool-holders of different sizes take all the tool points used in a lathe, but a new box has to be devised in the case of almost every new job, with the exception of those the principal formation of which is the turning down of plain bars. The explanation is that, instead of a single point, several are commonly carried in a box. As complexity increases with the number of tools, new designs and dimensions of boxes become necessary, even though there may be family resemblances in groups. A result is that there is not, nor can there be, anything like finality in these designs. Turret work has become one of the most highly specialized departments of machine-shop practice, and the design of these boxes is already the work of specialists. More and more of the work of the common lathe is being constantly appropriated by the semi- and full-automatic machines, a result to which the magazine feeds for castings and forgings that cannot pass through a hollow spindle have contributed greatly. New work is constantly being attacked in the automatic machines that was deemed impracticable a short time before; some of the commoner jobs are produced with greater economy, while heavier castings and forgings, longer and larger bars, are tooled in the turret lathes. A great deal of the efficiency of the box tools is due to the support which is afforded to the cutting edges in opposition to the stress of cutting. V-blocks are introduced in most cases as in fig. 7, and these not only resist the stress of the cutting, but gauge the diameter exactly.

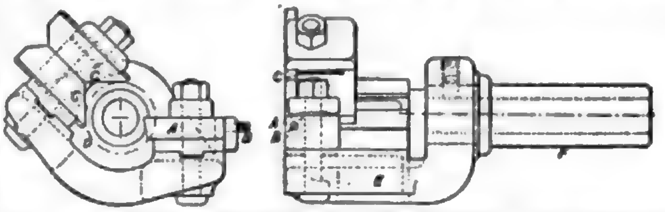


Fig. 7.—Box Tool for Turret Lathe. (Alfred Herbert, Ltd., Coventry.)

A, Cutting tool. *B*, Screw for adjusting radius of cut. *C C*, V-steadies supporting the work in opposition to *A*. *D*, Diameter of work. *E*, Body of holder. *F*, Stem which fits in the turret.

Shearing Action.—In many tools a shearing operation takes place, by which the stress of cutting is lessened. Though not very apparent, it is present in the round-nosed roughing tools, in the knife tools, in most milling cutters, as well as in all the shearing tools proper—the scissors, shears, &c.

Planes.—We pass by the familiar great chisel group, used by woodworkers, with a brief notice. Generally the tool angles of these lie between 15° and 25°. They include the chisels proper, and the gouges in numerous shapes and proportions, used by carpenters, cabinet-makers, turners, stone-masons and allied tradesmen. These are mostly thrust by hand to their work, without any mechanical control. Other chisels are used percussively, as the stout mortise chisels, some of the gouges, the axes, adzes and stone-mason's tools. The large family of planes embody chisels coerced by the mechanical control of the wooden (fig. 8) or metal stock. These also differ from the chisels proper in the fact that the face of the cutting iron does not coincide with the face of the material being cut, but lies at an angle therewith, the stock of the plane exercising the necessary coercion. We also meet with the function of the top or non-cutting iron in breaking the shaving and conferring rigidity upon the cutting iron. This rigidity is of similar value in cutting wood as in cutting metal though in a less marked degree.

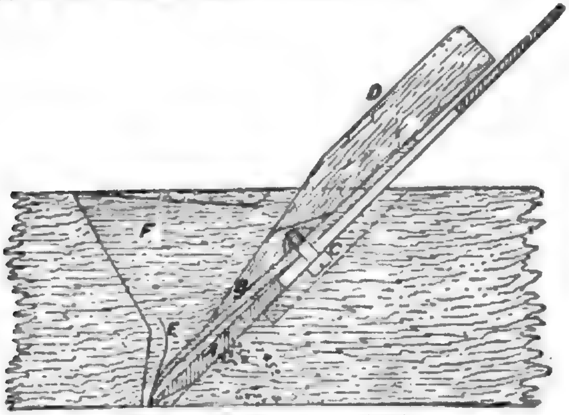


FIG. 8.—Section through Plane.

A, Cutting iron. *B*, Top or back iron. *C*, Clamping screw. *D*, Wedge. *E*, Broken shaving. *F*, Mouth.

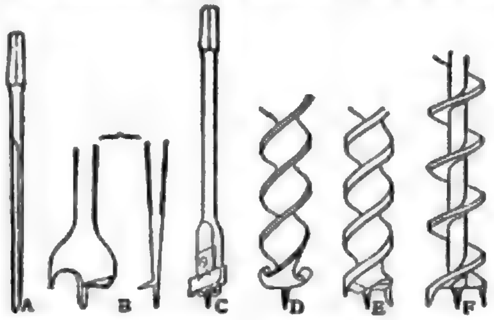


FIG. 9.—Group of Wood-boring Bits.

A, Spoon bit. *B*, Centre-bit. *C*, Expanding centre-bit. *D*, Gilpin or Gedge auger. *E*, Jennings auger. *F*, Irwin auger.

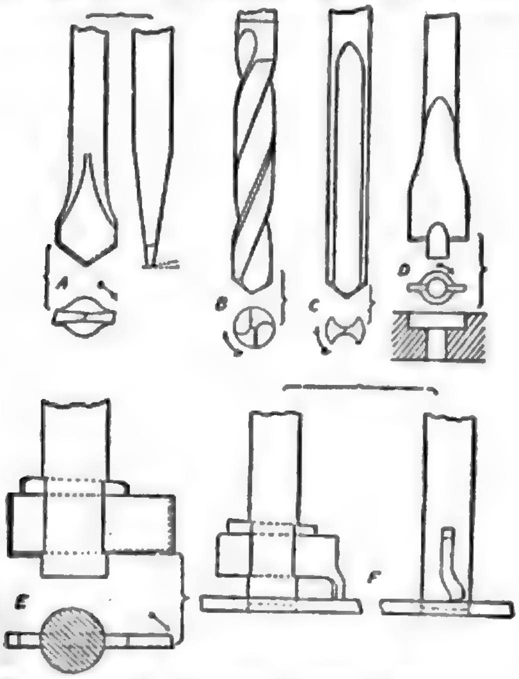


FIG. 10.—Group of Drills for Metal.

A, Common flat drill. *B*, Twist drill. *C*, Straight fluted drill. *D*, Pin drill for flat countersinking. *E*, Arboring or facing tool. *F* Tool for boring sheet-metal.

Drilling and Boring Tools.—Metal and timber are bored with equal facility; the tools (figs. 9 and 10) embody similar differences to the cutting tools already instanced for wood and metal. All the wood-working bits are true cutting tools, and their angles, if analysed, will be found not to differ much from those of the razor and common chisel. The drills for metal furnish examples both of scrapers and cutting tools. The common drill is only a scraper, but all the twist drills cut with good incisive action. An advantage possessed by all drills is that the cutting forces are balanced on each side of the centre of rotation. The same action is embodied in the best wood-boring bits and augers, as the Jennings, the Gilpin and the Irwin—much improved forms of the old centre-bit. But the balance is impaired if the lips are not absolutely symmetrical about the centre. This explains the necessity for the substitution of machine grinding for hand grinding of the lips, and great developments of twist drill grinding machines. Allied to the drills are the D-bits, and the reamers (fig. 11). The first-named both initiate and finish a hole; the second are used only for smoothing and enlarging drilled holes, and for correcting holes which pass through adjacent castings or plates. The reamers remove only a mere film, and their action is that of scraping. The foregoing are examples of tools operated from one end and unsupported at the other, except in so far as they receive support within the work. One of the objectionable features of tools operated in this way is that they tend to "follow the hole," and if this is cored, or rough-drilled out of truth, there is risk of the boring tools following it to some extent at least. With the one exception of the D-bit there is no tool which can be relied on to take out a long bore with more than an approximation to concentricity throughout. Boring tools (fig. 12) held in the slide-rest will spring and bend and chatter, and unless the lathe is true, or careful compensation is made for its want of truth, they will bore bigger at one end than the other. Boring tools thrust by the back centre are liable to wabble, and though they are variously coerced to prevent them from turning round, that does not check the to-and-fro wabbly motion from following the core, or rough bore. In a purely reaming tool this is permitted, but it is not good in tools that have to initiate the hole.

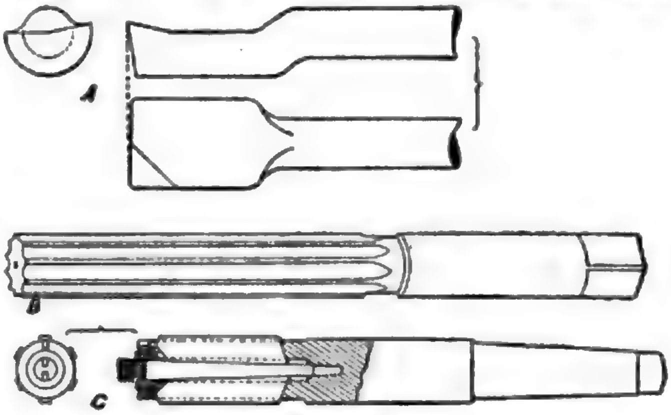


FIG. 11.

A, D-bit. *B*, Solid reamer. *C*, Adjustable reamer, having six flat blades forced outward by the tapered plug. Two lock-nuts at the end fix the blades firmly after adjustment.

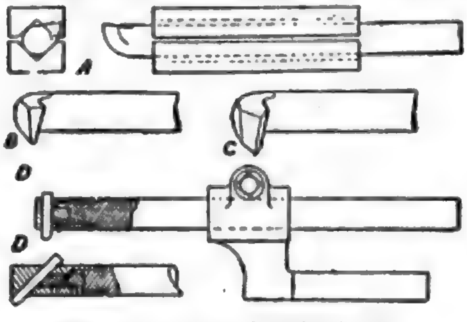


FIG. 12.—Group of Boring Tools.

A, Round boring tool held in V-blocks on slide-rest. *B*, *C*, Square and V-pointed boring tools. *D*, Boring bar with removable cutters, held straight, or angularly.

This brings us to the large class of boring tools which are supported at each end by being held in bars carried between centres. There are two main varieties: in one the cutters are fixed directly in the bar (fig. 13, *A* to *D*), in the other in a head fitted on the bar (fig. 13, *E*), hence termed a "boring head." As lathe heads are fixed, the traverse cannot be imparted to the bars as in boring machines. The boring heads can be traversed, or the work can be traversed by the mechanism of the lathe saddle. The latter must be done when cutters are fixed in bars. A great deal of difference exists in the details of the fittings both of bars and heads, but they are not so arbitrary as they might seem at first sight. The principal differences are those due to the number of cutters used, their shapes, and their method of fastening. Bars receiving their cutters direct include one, two or four, cutting on opposite sides, and therefore balanced. Four give better balance than two, the cutters being set at right angles. If a rough hole runs out of truth, a single cutter is better than a double-ended one, provided a tool of the roughing shape is used. The shape of the tools varies from roughing to finishing, and their method of attachment is by screws, wedges or nuts, but we cannot illustrate the numerous differences that are met with.

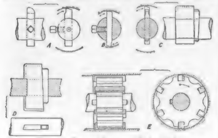


FIG. 13.—Group of Supported Boring Tools.

A, Single-ended cutter in boring bar.
B, Double-ended ditto.
C, Flat single-ended finishing cutter.
D, Flat double-ended finishing cutter.
E, Boring head with three cutters and three steady blocks.

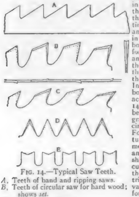


FIG. 14.—Typical Saw Teeth.

A, Teeth of band and ripping saws.
B, Teeth of circular saw for hard wood; shows *set*.
C, Ditto for soft wood.
D, Teeth of cross-cut saw.
E, M-teeth for ditto.

Saws.—The saws are a natural connecting link between the chisels and the milling cutters. Saws are used for wood, metal and stone. Slabs of steel several inches in thickness are sawn through as readily as, though more slowly than, timber planks. Circular and band saws are common in the smithy and the boiler and machine shops for cutting off bars, forgings and rolled sections. But the tooth shapes are not those used for timber, nor is the cutting speed the same. In the individual saw-teeth both cutting and scraping actions are illustrated (fig. 14). Saws which cut timber continuously with the grain, as rip, hand, band, circular, have incisive teeth. For though many are destitute of front rake, the method of sharpening at an angle imparts a true shearing cut. But all cross-cutting teeth scrape only, the teeth being either of triangular or of M-form, variously modified. Teeth for metal cutting also act strictly by scraping. The pitching of the teeth is related to the nature of the material and the direction of cutting. It is coarser for timber than for metal, coarser for ripping or sawing with the grain than for cross cutting, coarser for soft than for hard woods. The *setting* of teeth, or the bending over to right and left, by which the clearance is provided for the blade of the saw, is subject to similar variations. It is greatest for soft woods and least for metals, where in fact the clearance is often secured without set, by merely thinning the blade backwards. But it is greater for cross cutting than for ripping timber. Gulleting follows similar rules. The softer the timber, the greater the gulleting, to permit the dust to escape freely.

Milling Cutters.—Between a circular saw for cutting metal and a thin milling cutter there is no essential difference. Increase the thickness as if to produce a very wide saw, and the essential plain edge milling cutter for metal results. In its simplest form the milling cutter is a cylinder with teeth lying across its periphery, or parallel with its axis—the *edge mill* (fig. 15), or else a disk with teeth radiating on its face, or at right angles with its axis—the *end mill* (fig. 16). Each is used indifferently for producing flat faces and edges, and for cutting grooves which are rectangular in cross-section. These milling cutters invade the province of the single-edged tools of the planer, shaper and slotter. Of these two typical forms the

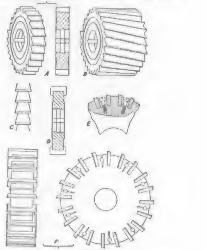


FIG. 15.—Group of Milling Cutters.

A, Narrow edge mill, with straight teeth.
B, Wide edge mill with spiral teeth.
C, Teeth on face and edges.
D, Cutter having teeth like *C*.
E, Flat teeth held in with screws and wedges.
F, Large inserted tooth mill; with taper pins secure cutters.

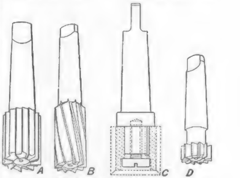


FIG. 16.—Group of End Mills.

A, End mill with straight teeth. *B*, Ditto with spiral teeth. *C*, Showing method of holding shell cutter on arbor, with screw and key. *D*, T-slot cutter.

changes are rung in great variety, ranging from the narrow slitting tools which saw off bars, to the broad cutters of 24 in. or more in width, used on plano-millers.

When more than about an inch in width, surfacing cylindrical cutters are formed with spiral teeth (fig. 15, B), a device which is essential to sweetness of operation, the action being that of shearing. These have their teeth cut on universal machines, using the dividing and spiral head and suitable change wheels, and after hardening they are sharpened on universal grinders. When cutters exceed about 6 in. in length the difficulties of hardening and grinding render the "gang" arrangement more suitable. Thus, two, three or more similar edge mills are set end to end on an arbor, with the spiral teeth running in reverse directions, giving a broad face with balanced endlong cutting forces. From these are built up the numerous gang mills, comprising plane faces at right angles with each other, of which the straddle mills are the best known (fig. 17, A). A common element in these combinations is the key seat type B having teeth on the periphery and on both faces as in fig. 15, C, D. By these combinations half a dozen faces or more can be tooled simultaneously, and all alike, as long as the mills retain their edge. The advantages over the work of the planer in this class of work are seen in tooling the faces and edges of machine tables, beds and slides, in shaping the faces and edges of caps to fit their bearing blocks. In a single cutter of the face type, but having teeth on back and edge also, T-slots are readily milled (fig. 16, D); this if done on the planer would require re-settings of awkwardly cranked tools, and more measurement and testing with templets than is required on a milling machine.

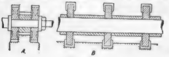


FIG. 17.

A, Straddle Mill, cutting faces and edges.
B, Set of three mills cutting grooves.

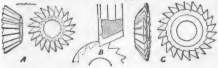


FIG. 18.—Group of Angular Mills.

A, Cutter with single slope.
B, Ditto, producing teeth in another cutter.
C, Double Slope Mill, with unequal angles.

When angles, curves and profile sections are introduced, the capacity of the milling cutter is infinitely increased. The making of the cutters is also more difficult. Angular cutters (fig. 18) are used for producing the teeth of the mills themselves, for shaping the teeth of ratchet wheels, and, in combination with straight cutters in gangs, for angular sections. With curves, or angles and curves in combination, taps, reamers and drills can be fluted or grooved, the teeth of wheels shaped, and in fact any outlines imparted (fig. 19). Here the work of the fitter, as well as that of the planing and allied machines, is invaded, for much of this work if prepared on these machines would have to be finished laboriously by the file.

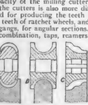


FIG. 19.

A, Convex Cutter.
B, Concave Cutter.
C, Profile Cutter.

There are two ways in which milling cutters are used, by which their value is extended; one is to transfer some of their work proper to the lathe and boring machine, the other is by duplication. A good many light circular sections, as wheel rims, hitherto done in lathes, are regularly prepared in the milling machine, gang mills being used for tooling the periphery and edges at once, and the wheel blank being rotated. Similarly, holes are bored by a rotating mill of the cylindrical type. Internal screw threads are done similarly. Duplication occurs when milling sprocket wheels in line, or side by side, in milling nuts on an arbor, in milling a number of narrow faces arranged side by side, in cutting the teeth of several spur-wheels on one arbor and in milling the teeth of racks several at a time.

One of the greatest advances in the practice of milling was that of making backed-off cutters. The sectional shape behind the tooth face is continued identical in form with the profile of the edge, the outline being carried back as a curve equal in radius to that of the cutting edge (fig. 20). The result is that the cutter may be sharpened on the front faces of the teeth without interfering with the shape which will be milled, because the periphery is always constant in outline. After repeated sharpenings the teeth would assume the form indicated by the shaded portion on two of the teeth. The limit of grinding is reached when the tooth becomes too thin and weak to stand up to its work. But such cutters will endure weeks or months of constant service before becoming useless. The chief advantage of backing-off or relieving is in its application to cutters of intricate curves, which would be difficult or impossible to sharpen along their edges. Such cutters, moreover, if made with ordinary teeth would soon be worn down, and be much weaker than the strong form of teeth represented in fig. 20. The relieving is usually done in special lathes, employing a profile tool which cuts the surface

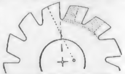


FIG. 20.—Relieved Teeth of Milling Cutter.

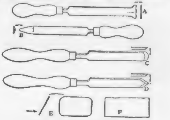


FIG. 21.—Group of Scrapes.

A, Metal-worker's scrape, pushed straightforward.
B, Ditto, operated laterally.
C, Round-nosed tool used by wood-turners.
D, Diamond point used by wood-turners.
E, *F*, Cabinet-makers' scrapes.

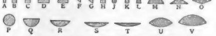


FIG. 22.—Cross-sectional Shapes of Files.

A, Warding.
B, Mill.
C, Flat.
D, Pillar.
E, Square.
F, *G*, Swaged reapers.
H, Mill.
J, Topping.
K, Reaper.
L, Knife.
M, Three-square.
N, Cant.
O, Slitting or feather-edge.
P, Round.
Q, Pit-saw or frame-saw.
R, Half-round.
S, *T*, Cabinet.
U, Tumbler.
V, Crossing.

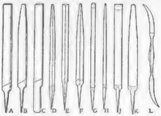


FIG. 23.—Longitudinal Shapes of Files.

A, Parallel or blunt.
B, Taper bellied.
C, Knife reaper.
D, Tapered square.
E, Parallel triangular.
F, Tapered triangular.
G, Parallel round.
H, Taper or rat-tail.
J, Parallel half-round.
K, Tapered half-round.
L, Riffler.

of the teeth back at the required radius. Relieved cutters can of course be strung together on a single arbor to form gang mills, by which very complicated profiles may be tooled, beyond the capacity of a single solid mill.

Scrapes.—The tools which operate by scraping (fig. 21) include many of the broad finishing tools of the turner in wood and metal (cf. fig. 2), and the scrape of the wood worker and the fitter. The practice of scraping surfaces true, applied to surface plates, machine slides and similar objects, was due to Sir Joseph Whitworth. It superseded the older and less accurate practice of grinding to a mutual fit. Now, with machines of precision, the practice of grinding has to a large extent displaced the more costly scraping. Scraping is, however, the only method available when the most perfect contact is desired. Its advantage lies in the fact that the efforts of the workman can be localized over the smallest areas, and nearly infinitesimal amounts removed, a mere fine dust in the last stages.

Files.—These must in strictness be classed with scrapes, for, although the points are keen, there is never any front rake. Collectively there is a shearing action because the rows of teeth are cut diagonally. The sectional forms (fig. 22) and the longitudinal forms (fig. 23) of the files are numerous, to adapt them to all classes of work. In addition, the method of cutting, and the degrees of coarseness of the teeth, vary, being single, or float cut, or double cut (fig. 24). The rasps are another group. Degrees of coarseness are designated as rough, middle cut, bastard cut, second cut, smooth, double dead smooth; the first named is the coarsest, the last the finest. The terms are relative, since the larger a file is the coarser are its teeth, though of the same name as the teeth in a shorter file, which are finer.

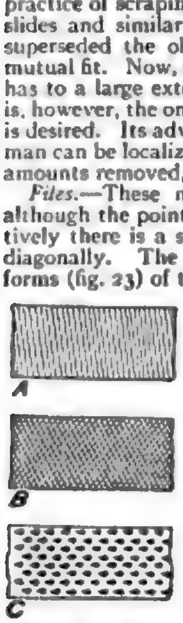


FIG. 24.—File Teeth.

A, Float cut.
B, Double cut.
C, Rasp cut.

Screwing Tools.—The forms of these will be found discussed under SCREW. They can scarcely be ranked among cutting tools, yet the best kinds remove metal with ease. This is due in great measure to the good clearance allowed, and to the narrowness of the cutting portions. Front rake is generally absent, though in some of the best screwing dies there is a slight amount.

Shears and Punches.—These may be of cutting or non-cutting types. Shears (fig. 25) have no front rake, but only a slight clearance. They generally give a slight shearing cut, because the blades do not lie parallel, but the cutting begins at one end and continues in detail to the other. But strictly the shears, like the punches, act by a severe detrusive effort; for the punch, with its bolster (fig. 26), forms a pair of cylindrical shears. Hence a shorn or punched edge is always rough, ragged, and covered with minute, shallow cracks. Both processes are therefore dangerous to iron and steel. The metal being unequally stressed, fracture starts in the annulus of metal. Hence the advantage of the practice of reamering out this annulus, which is completely removed by enlargement by about an ⅛ in. diameter, so that homogeneous metal is left throughout the entire unpunched section. The same results follow reamering both in iron and steel. Annealing, according to many experiments, has the same effect as reamering, due to the rearrangement of the molecules of metal. The perfect practice with punched plates is to punch, reamer, and finally to anneal. The effect of shearing is practically identical with that of punching, and planing and annealing shorn edges has the same influence as reamering and annealing punched holes.

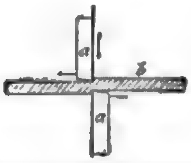


FIG. 25.—Shear Blades.

a, *a*, Blades.
b, Plate being sheared.

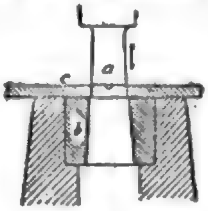


FIG. 26.—Punching.

a, Punch. *b*, Bolster.
c, Plate being punched.

Hammers.—These form an immense group, termed percussive, from the manner of their use (fig. 27). Every trade has its own peculiar shapes, the total of which number many scores, each with its own appropriate name, and ranging in size from the minute forms of the jeweler to the sledges of the smith and boiler maker and the planishing hammers of the coppersmith. Wooden hammers are termed mallets, their purpose being to avoid bruising tools or the surfaces of work. Most trades use mallets of some form or another. Hammer handles are rigid in all cases except certain percussive tools of the smithy, which are handled with withy rods, or iron rods flexibly attached to the tools, so that when struck by the sledge they shall not jar the hands. The fullering tools, and flatters, and setts, though not hammers strictly, are actuated by percussion. The dies of the die forgers are actuated percussively, being closed by powerful hammers. The action of caulking tools is percussive, and so is that of moulders' rammers.

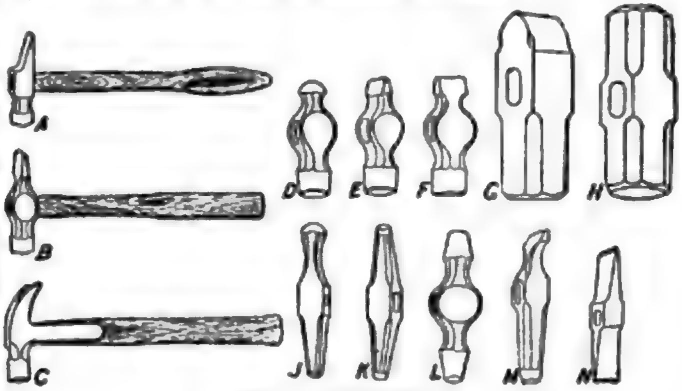


FIG. 27.—Hammers.

A, Exeter type.
B, Joiner's hammer.
C, Canterbury claw hammer (these are wood-workers' hammers).
D, Engineer's hammer, ball pane.
E, Ditto, cross-pane.
F, Ditto, straight pane.
G, Sledge hammer, straight pane.
H, Ditto, double-faced.
J, *K*, *L*, *M*, Boiler makers' hammers.
N, Scaling hammer.

Moulding Tools.—This is a group of tools which, actuated either by simple pressure or percussively, mould, shape and model forms in the sand of the moulder, in the metal of the smith, and in press work. All the tools of the moulder (fig. 28) with the exception of the rammers and vent wires act by moulding the sand into shapes by pressure. Their contours correspond with the plane and curved surfaces of moulds, and with the requirements of shallow and deep work. They are made in iron and brass. The fullers, swages and flatters of the smith, and the dies used with hammer and presses, all mould by percussion or by pressure, the work taking the counterpart of the dies, or of some portion of them. The practice of die forging consists almost wholly of moulding processes.

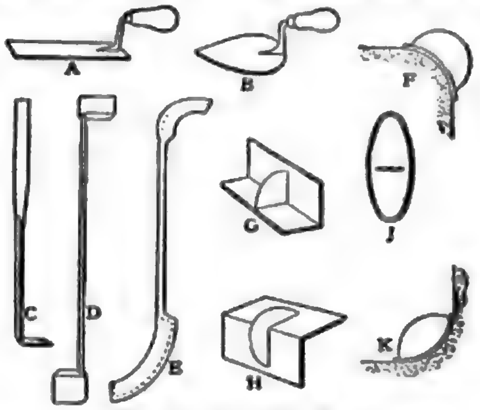


FIG. 28.—Moulding Tools.

A, Square trowel.
B, Heart trowel.
C, *D*, Cleaners.
E, Flange bead.
F, Hollow bead.
G, *H*, Square corner sleekers.
J, Button sleeker.
K, Pipe smoother.

Tool Steels.—These now include three kinds. The common steel, the controlling element in which is carbon, requires to be hardened and tempered, and must not be overheated, about 500° F. being the highest temperature permissible—the *critical* temperature. Actually this is seldom allowed to be reached. The disadvantage of this steel is that its capabilities are limited, because the heat generated by heavy cutting soon spoils the tools. The second is the Mushet steel, invented by R. F. Mushet in 1868, a carbon steel, in which the controlling element is tungsten, of which it contains from about 5 to 8%. It is termed *self-hardening*, because it is cooled in air instead of being quenched in water. Its value consists in its endurance at high temperatures, even at a low red heat. Until the advent of the high-speed steels, Mushet steel was reserved for all heavy cutting, and for tooling hard tough steels. It is made in six different tempers suitable for various kinds of duty. Tools of Mushet steel must not be forged below a red heat. It is hardened by reheating the end to a white heat, and blowing cold in an air blast. The third kind of steel is termed *high-speed*, because much higher cutting speeds are practicable with these than with other steels. Tools made of them are hardened in a blast of cold air. The controlling elements are numerous and vary in the practice of different manufacturers, to render the tools adaptable to cutting various classes of metals and alloys. Tungsten is the principal controlling element, but chromium is essential and molybdenum and vanadium are often found of value. The steels are forged at a yellow tint, equal to about 1850° F. They are raised to a white heat for hardening, and cooled in an air blast to a bright red. They are then often quenched in a bath of oil.

The first public demonstration of the capacities of high speed steels was made at the Paris Exhibition of 1900. Since that time great advances have been made. It has been found that the section of the shaving limits the practicable speeds, so that, although cutting speeds of 300 and 400 ft. a minute are practicable with light cuts, it is more economical to limit speeds to less than 100 ft. per minute with much heavier cuts. The use of water is not absolutely essential as in using tools of carbon steel. The new steels show to much greater advantage on mild steel than on cast iron. They are more useful for roughing down than for finishing. The removal of 20 lb of cuttings per minute with a single tool is common, and that amount is often exceeded, so that a lathe soon becomes half buried in turnings unless they are carted away. The horse-power absorbed is proportionately large. Ordinary heavy lathes will take from 40 to 60 h.p. to drive them, or from four to six times more than is required by lathes of the same centres using carbon steel tools. Many remarkable records have been given of the capacities of the new steels. Not only turning and planing tools but drills and milling cutters are now regularly made of them. It is a revelation to see these drills in their rapid descent through metal. A drill of 1 in. in diameter will easily go through 5 in. thickness of steel in one minute.

Machine Tools

The machine tools employed in modern engineering factories number many hundreds of well-defined and separate types. Besides these, there are hundreds more designed for special functions, and adapted only to the work of firms who handle specialities. Most of the first named and many of the latter admit of grouping in classes. The following is a natural classification:

I. *Turning Lathes.*—These, by common consent, stand as a class alone. The cardinal feature by which they are distinguished is that the work being operated on rotates against a tool which is held in a rigid fixture—the rest. The axis of rotation may be horizontal or vertical.

II. *Reciprocating Machines.*—The feature by which these are characterized is that the relative movements of tool and work take place in straight lines, to and fro. The reciprocations may occur in horizontal or vertical planes.

III. *Machines which Drill and Bore Holes.*—These have some features in common with the lathes, inasmuch as drilling and boring are often done in the lathes, and some facing and turning in the drilling and boring machines, but they have become highly differentiated. In the foregoing groups tools having either single or double cutting edges are used.

IV. *Milling Machines.*—This group uses cutters having teeth arranged equidistantly round a cylindrical body, and may therefore be likened to saws of considerable thickness. The cutters rotate over or against work, between which and the cutters a relative movement of travel takes place, and they may therefore be likened to reciprocating machines, in which a revolving cutter takes the place of a single-edged one.

V. *Machines for Cutting the Teeth of Gear-wheels.*—These comprise two sub-groups, the older type in which rotary milling cutters are used, and the later type in which reciprocating single-edged tools are employed. Sub-classes are designed for one kind of gear only, as spur-wheels, bevels, worms, racks, &c.

VI. *Grinding Machinery.*—This is a large and constantly extending group, largely the development of recent years. Though emery grinding has been practised in crude fashion for a century, the difference in the old and the new methods lies in the embodiment of the grinding wheel in machines of high precision, and in the rivalry of the wheels of corundum, carborundum and alundum, prepared in the electric furnace with those of emery.

VII. *Sawing Machines.*—In modern practice these take an important part in cutting iron, steel and brass. Few shops are without them, and they are numbered by dozens in some establishments. They include circular saws for hot and cold metal, band saws and hack saws.

VIII. *Shearing and Punching Machines.*—These occupy a border line between the cutting and non-cutting tools. Some must be classed with the first, others with the second. The detrusive action also is an important element, more especially in the punches.

IX. *Hammers and Presses.*—Here there is a percussive action in the hammers, and a purely squeezing one in the presses. Both are made capable of exerting immense pressures, but the latter are far more powerful than the former.

X. *Portable Tools.*—This large group can best be classified by the common feature of being readily removable for operation on large pieces of erection that cannot be taken to the regular machines. Hence they are all comparatively small and light. Broadly they include diverse tools, capable of performing nearly the whole of the operations summarized in the preceding paragraphs.

XI. *Appliances.*—There is a very large number of articles which are neither tools nor machine tools, but which are indispensable to the work of these; that is, they do not cut, or shape, or mould, but they hold, or grip, or control, or aid in some way or other the carrying through of the work. Thus a screw wrench, an angle plate, a wedge, a piece of packing, a bolt, are appliances. In modern practice the appliance in the form of a templet or jig is one of the principal elements in the interchangeable system.

XII. *Wood-working Machines.*—This group does for the conversion of timber what the foregoing accomplish for metal. There is therefore much underlying similarity in many machines for wood and metal, but still greater differences, due to the conditions imposed on the one hand by the very soft, and on the other by the intensely hard, materials operated on in the two great groups.

XIII. *Measurement.*—To the scientific engineer, equally with the astronomer, the need for accurate measurement is of paramount importance. Neither good fitting nor interchangeability of parts is possible without a system of measurement, at once accurate and of ready and rapid application. Great advances have been made in this direction lately.

I.—Lathes

The popular conception of a lathe, derived from the familiar machine of the wood turner, would not give a correct idea of the lathe which has been developed as the engineer's machine tool. This has become differentiated into nearly fifty well-marked types, until in some cases even the term lathe has been dropped for more precise definitions, as vertical boring machine, automatic machine, while in others prefixes are necessary, as axle lathe, chucking lathe, cutting-off lathe, wheel lathe, and so on. With regard to size and mass the height of centres may range from 3 in. in the bench lathes to 9 or 10 ft. in gun lathes, and weights will range from say 50 lb to 200 tons, or more in exceptional cases. While in some the mechanism is the simplest possible, in others it is so complicated that only the specialist is able to grasp its details.

Early Lathes.—Space will not permit us to trace the evolution of the lathe from the ancient bow and card lathe and the pole lathe, in each of which the rotary movement was alternately forward, for cutting, and backward. The curious thing is that the wheel-driven lathe was a novelty so late as the 14th and 15th centuries, and had not wholly displaced the ancient forms even in the West in the 19th century, and the cord lathe still survives in the East. Another thing is that all the old lathes were of *dead centre*, instead of *running mandrel* type; and not until 1794 did the use of metal begin to take the place of wood in lathe construction. Henry Maudslay (1771–1831) did more than any other man to develop the engineer's self-acting lathe in regard to its essential mechanism, but it was, like its immediate successors for fifty years after, a skeleton-like, inefficient weakling by comparison with the lathes of the present time.

Broad Types.—A ready appreciation of the broad differences in lathe types may be obtained by considering the differences in the great groups of work on which lathes are designed to operate. Castings and forgings that are turned in lathes vary not only in size, but also in relative dimensions. Thus a long piece of driving shafting, or a railway axle, is very differently proportioned in length and diameter from a railway wheel or a wheel tire. Further, while the shaft has to be turned only, the wheel or the tire has to be turned and bored. Here then we have the first cardinal distinction between lathes, viz. those admitting work *between centres* (fig. 29) and *face* and *boring* lathes. In the first the piece of work is pivoted and driven between the centres of head-stock and tail-stock or loose poppet; in the second, it is held and gripped only by the dogs or jaws of a face-plate, on the head-stock spindle, the loose poppet being omitted.

These, however, are broad types only, since proportions of length to diameter differ, and with them lathe designs are modified whenever there is a sufficient amount of work of one class to justify the laying down of a special machine or machines to deal with it. Then further, we have duplicate designs, in which, for example, provision is made in one lathe for turning two or three long shafts simultaneously, or for turning and boring two wheels or tires at once. Further, the position of the axis of a face lathe need not be horizontal, as is necessary when the turning of long pieces has to be done between centres. There are obvious advantages in arranging it vertically, the principal being that castings and forgings can be more easily set and secured to a horizontal chuck than to one the face of which lies vertically. The chuck is also better supported, and higher rates of turning are practicable. In recent years these *vertical lathes* or vertical turning and boring mills (fig. 30) have been greatly increasing in numbers; they also occur in several designs to suit either general or special duties, some of them being used for boring only, as *chucking lathes*. Some are of immense size, capable of boring the field magnets of electric generators 40 ft. in diameter.

Standard Lathes.—But for doing what is termed the general work of the engineer's turnery, the standard lathes (fig. 29) predominate, *i.e.* self-acting, sliding and surfacing lathes with headstock, loose poppet and slide-rest, centres, face plates and chucks, and an equipment by which long pieces are turned, either between centres or on the face chucks, and bored. One of the greatest objections to the employment of these standard types of lathes for indiscriminate duty is due to the limited height of the centres or axis of the headstock, above the face of the bed. This is met generally by providing a *gap* or deep recess in the bed next the fast headstock, deep enough to take face work of large diameter. The device is very old and very common, but when the volume of work warrants the employment of separate lathes for face-work and for that done between centres it is better to have them.

Screw-cutting.—A most important section of the work of the engineer's turnery is that of cutting screws (see SCREW). This has resulted in differentiation fully as great as that existing between centres and face-work. The slide-rest was designed with this object, though it is also used for plain turning. The standard "self-acting sliding, surfacing and screw-cutting lathe" is essentially the standard turning lathe, with the addition of the screw-cutting mechanism. This includes a master screw—the *lead* or *guide screw*, which is gripped with a *clasp nut*, fastened to the travelling carriage of the slide-rest. The lead-screw is connected to the headstock spindle by *change wheels*, which are the variables through which the relative rates of movement of the spindle and the lead-screw, and therefore of the screw-cutting tool, held and traversed in the slide-rest, are effected. By this beautiful piece of mechanism a guide screw, the pitch of which is permanent, is made to cut screw-threads of an almost infinite number of possible pitches, both in whole and fractional numbers, by virtue of rearrangements of the variables, the change wheels. The objection to this method is that the trains of change wheels have to be recalculated and rearranged as often as a screw of a different pitch has to be cut, an operation which takes some little time. To avoid this, the *nest* or *cluster system* of gears has been largely adopted, its most successful embodiment being in the Hendey-Norton lathe. Here all the change wheels are arranged in a series permanently on one shaft underneath the headstock, and any one of them is put into engagement by a sliding pinion operated by the simple movement of a lever. Thus the lead-screw is driven at different rates without removing any wheel from its spindle. This has been extensively applied to both small and large lathes. But a moment's thought will show that even this device is too cumbrous when large numbers of small screws are required. There is, for example, little in common between the screw, say of 5 or 6 ft. in length, for a massive penstock or valve, and ½-in. bolts, or the small screws required in thousands for electrical fittings. Clearly while the self-acting screw-cutting lathe is the best possible machine to use for the first, it is unsuitable for the last. So here at once, from the point of view of screw cutting only, an important divergence takes place, and one which has ultimately led to very high specialization.

Small Screws.—When small screws and bolts are cut in

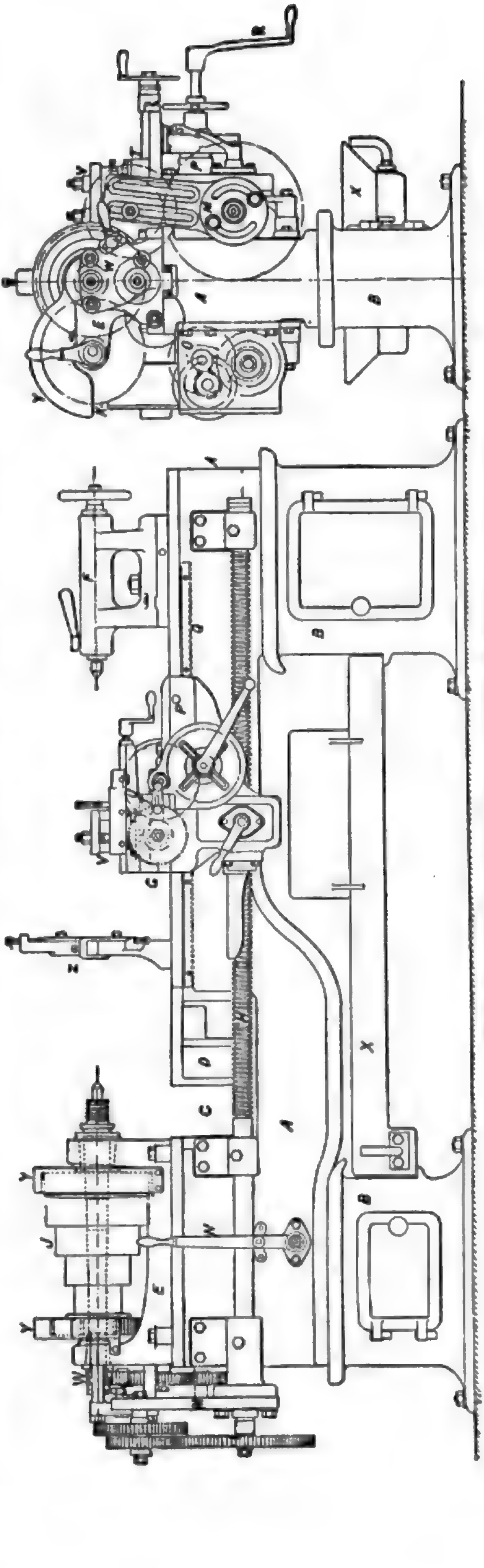


FIG. 29.—8-in. Centre Gap Lathe. (Webster & Bennett, Ltd., Coventry.)

A, Bed.
B, Cupboard legs or cabinets.
C, Gap.
D, Bridge piece.
E, Headstock.
F, Loose poppet.
G, Slide-rest.
H, Lead-screw.
J, Driving cones.
K, Back-gears.
L, Change wheels.
M, Swing plate for ditto.
N, Hand lever for changing speeds of sliding and surfacing through gears *O*.
P, Saddle or carriage.
Q, Rack.
R, Rack operating handle for sliding.
S, Clasp nut operating handle for screw cutting.
T, Cross-slide.
U, Swivel-slide.
V, Tool-holder.
W, Reversing plate.
X, Waste oil tray.
Y, Guards over gear wheels.
Z, Hinged steady to support work when boring.

large quantities, the guide-screw and change wheels give place to other devices, one of which involves the use of a separate master-screw for every different pitch, the other that of encircling cutting instruments or *dies*. The first are represented by the *chasing lathe*, the second by the *screwing lathes* and *automatics*. Though the principles of operation are thus stated in brief, the details in design are most extensive and varied.

In a chasing lathe the master-screw or *hob*, which may be either at the rear of the headstock or in front of the slide-rest, receives a hollow clasp-nut or a half-nut, or a star-nut containing several pitches, which, partaking of the traverse movement of the screw-thread, imparts the same horizontal movement to the cutting tool. The latter is sometimes carried in a hinged holder, sometimes in a common slide-rest. The attendant throws it into engagement at the beginning of a traverse, and out when completed, and also changes the hobs for threads of different sections. The screwed stays of locomotive fire-boxes are almost invariably cut on chasing lathes of this class.

In the screwing machines the thread is cut with dies, which encircle the rotating bar; or alternatively the dies rotate round a fixed pipe, and generally the angular *lead* or advance of the thread draws the dies along. These dies differ in no essentials from similar tools operated by a hand lever at the bench. There are many modifications of these lathes, because the work is so highly specialized that they are seldom used for anything except the work of cutting screws varying but little in dimensions. Such being the case they can hardly be classed as lathes, and are often termed screwing machines, because no provision exists for preliminary turning work, which is then done elsewhere, the task of turning and threading being divided between two lathes. In some cases this is an economical system, but in others not. It cannot be considered so when bolts, screws and allied forms are of small dimensions.

Hollow Mandrel Lathes.—It has been the growing practice since the last decade of the 19th century to produce short articles, required in large quantities, from a long bar. This involves making the lathe with a hollow mandrel; that is, the mandrel of the headstock has a hole drilled right through it, large enough to permit of the passage through it of the largest bar which the class of work requires. Thus, if the largest section of the finished pieces should require a bar of 1¼ in. diameter, the hole in the mandrel would be made 1⅜ in. Then the bar, inserted from the rear-end, is gripped by a chuck or *collet* at the front, the operations of turning, screwing and cutting off done, and the bar then thrust farther through to the exact length for the next set of identical operations to be performed, and so on. This mechanism is termed a *wire feed*, because the first lathes which were built of this type only operated on large wires; the heavy bar lathes have been subsequently developed from it. In the more advanced types of lathes this feeding through the hollow spindle does not require the intervention of the attendant, but is performed automatically.

The amount of preliminary work which has to be done upon a portion of a bar before it is ready for screwing varies. The simplest object is a stud, which is a parallel piece screwed up from each end. A bolt is a screw with a head of hexagonal, square or circular form, and the production of this involves turning the shank and shoulder and imparting convexity to the end, as well as screwing. But screw-threads have often to be cut on objects which are not primarily bolts, but which are spindles of various kinds used on mechanisms and machine tools, and in which reductions in the form

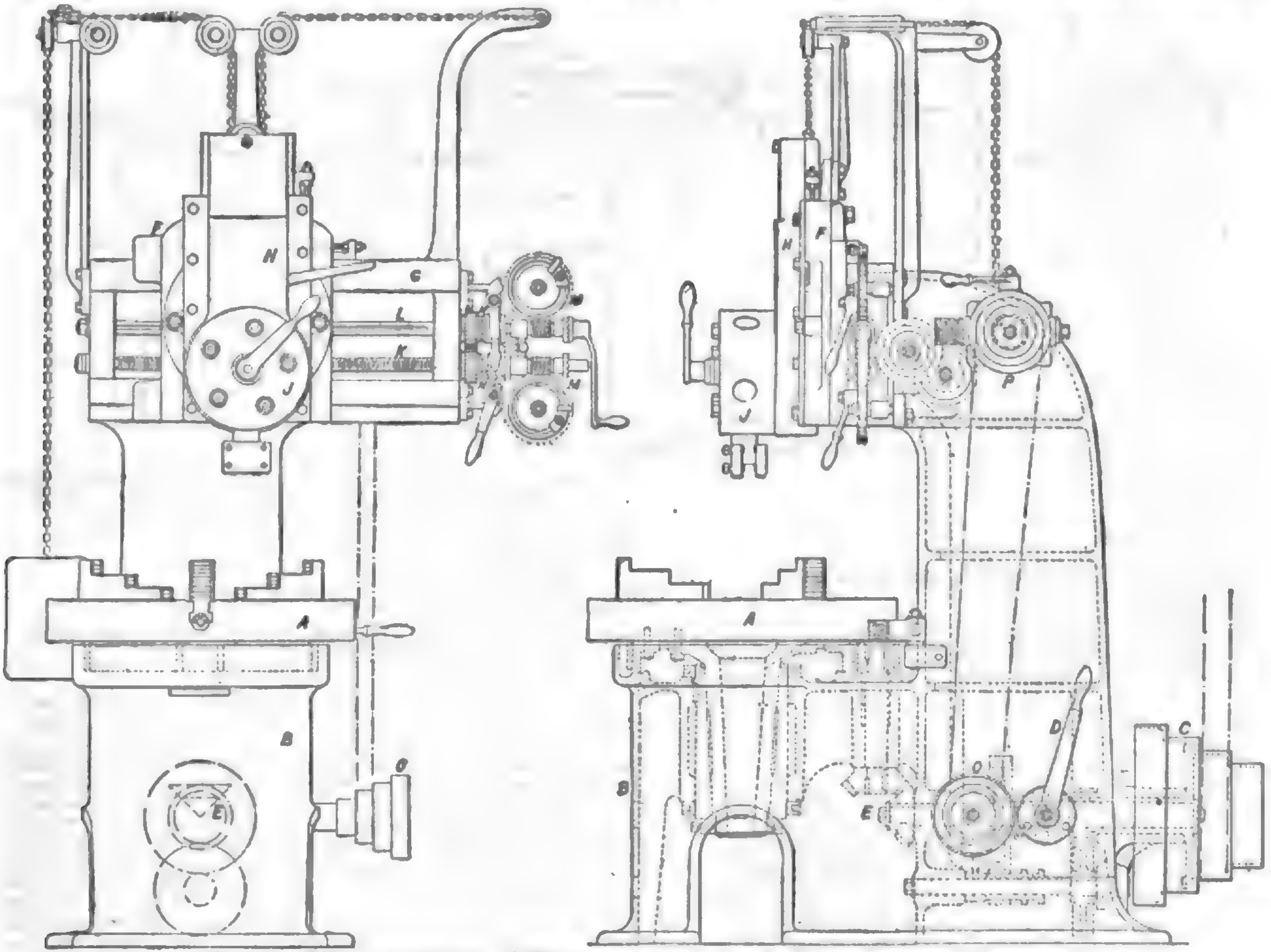


Fig. 30.—Boring and Turning Mill, vertical lathe. (Webster Bennett, Ltd., Coventry.)

- *A*, Table, running with stem in vertical bearing.
- *B*, Frame of machine.
- *C*, Driving cones.
- *D*, Handle giving the choice of two rates, through concealed sliding gears, shown dotted.
- *E*, Bevel-gears driving up to pinion gearing with ring of teeth on the table.
- *F*, Saddle moved on cross-rail *G*.
- *H*, Vertical slide, carrying turret *J*.
- *K*, Screw feeding *F* across.
- *L*, Splined shaft connecting to *H* for feeding the latter up or down.
- *M*, *M*, Worm-gears throwing out clutches *N*, *N* at predetermined points.
- *O*, Cone pulley belted up to *P*, for driving the feeds of saddle and down-slide.

of steps have to be made, and recesses, or flanges, or other features produced. Out of the demands for this more complicated work, as well as for plain bolts and studs, has arisen the great group of *turret* or *capstan lathes* (fig. 31) and the automatics or *automatic screw machines* which are a high development of the turret lathes.

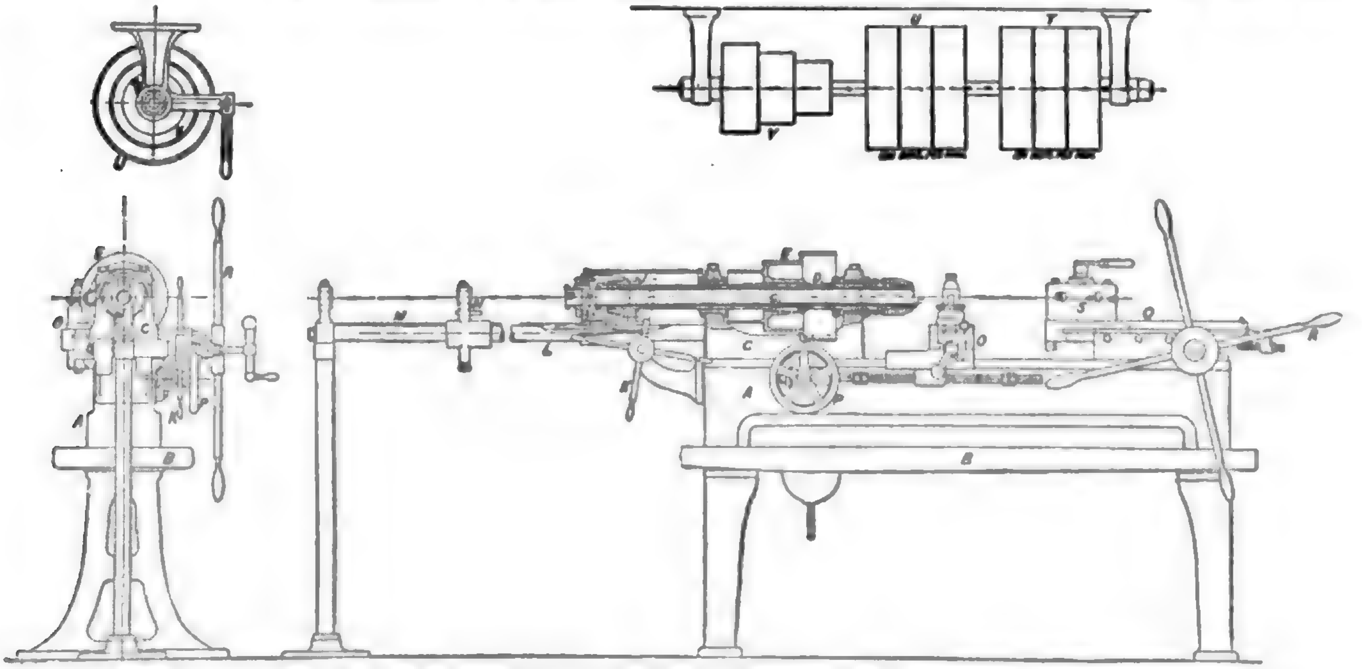


FIG. 31.—Turret Lathe. (Webster & Bennett, Ltd., Coventry.)

A, Bed.
B, Waste oil tray.
C, Headstock.
D, Hollow mandrel.
E, Cones keyed to *D*.
F, Split tapered close-in chuck, actuated by tube *G*.
H, Toggle dogs which push *G*.
J, Coned collar acting on *H*.
K, Handle to slide *J* through sleeve on bar *L*.
M, Rack slid on release of chuck, moving bearing *N* forward.
N. Bearing to feed the work through mandrel (constituting the *wire* or *bar feed*). A collar is clamped on the work, and is pushed by the bearing *N* at each time of feeding.
O, Cross-slide.
P, Hand-wheel operating screw to travel *O*.
Q, Turret-slide.
R, Cross-handle moving *Q* to and fro.
S, Turret or capstan.
T, *U*, Sets of fast and loose pulleys, for open and crossed belts.
V, Cone belted down to *E* on lathe.

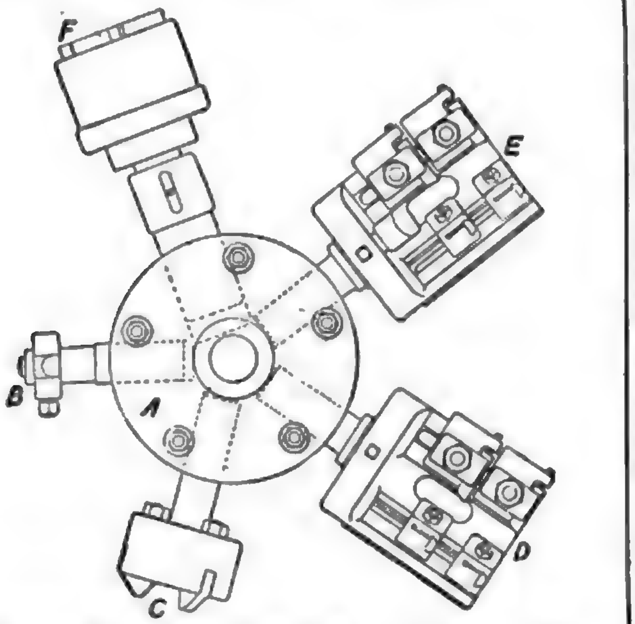


FIG. 32.—Plan of Set of Turret Tools. (A. Herbert, Ltd.)

A, Turret.
B, Tool for first operation or chucking.
C, Cutting tools for second operation, starting or pointing.
D, Box tool carrying two cutters for third operation, rough turning.
E, Similar tool for fourth operation, finish turning.
F, Screwing tools in head for final operation of screwing.

Turret Lathes.—The turret or capstan (fig. 32) is a device for gripping as many separate tools as there are distinct operations to be performed on a piece of work; the number ranges from four to as many as twenty in some highly elaborated machines, but five or six is the usual number of holes. These tools are brought round in due succession, each one doing its little share of work, until the cycle of operations required to produce the object is complete, the cycle including such operations as turning and screwing, roughing and finishing cuts, drilling and boring. Severance of the finished piece is generally done by a tool or tools held by a *cross-slide* between the headstock and turret, so termed because its movements take place at right angles with the axis of the machine. This also often performs the duty of "forming," by which is meant the shaping of the exterior portion of an object of irregular outline, by a tool the edge of which is an exact counterpart of the profile required. The exterior of a cycle hub is shaped thus, as also are numerous handles and other objects involving various curves and shoulders, &c. The tool is fed perpendicularly to the axis of the rotating work and completes outlines at once; if this were done in ordinary lathes much tedious manipulation of separate tools would be involved.

Automatics.—But the marvel of the modern automatics (fig. 33) lies in the mechanism by which the cycle of operations is rendered absolutely independent of attendance, beyond the first adjustments and the insertion of a fresh bar as often as the previous one becomes used up. The movements of the rotating turret and of the cross-slide, and the feeding of the bar through the hollow spindle, take place within a second, at the conclusion of the operation preceding. These movements are effected by a set of mechanism independent of that by which the headstock spindle is rotated, viz. by cams or cam drums on a horizontal cam shaft, or other equivalent device, differing much in arrangement, but not principle. Movements are hastened or retarded, or pauses of some moments may ensue, according to the cam arrangements devised, which of course have to be varied for pieces of different proportions and dimensions. But when the machines with their tools are once set up, they will run for days or weeks, repeating precisely the same cycle of operations; they are self-lubricating, and only require to be fed with fresh lengths of bar and to have their tools resharpened occasionally. Of these automatics alone there are something like a dozen distinct types, some with their turrets vertical, others horizontal. Not only so but the use of a single spindle is not always deemed sufficiently economical, and some of these designs now have two, three and four separate work spindles grouped in one head.

Specialized Lathes.—Outside of these main types of lathes there are a large number which do not admit of group classification. They are designed for special duties, and only a representative list can be given. Lathes for turning tapered work form a limited number, and they include the usual provisions for ordinary turning. In some designs change wheels are made use of for imparting a definite movement of cross traverse to the tool, which being compounded with the parallel sliding movements produces the taper. In others an upper bed carrying the heads and work swivels on a lower bed, which carries the slide rest. More often tapers are turned by a cross adjustment of the loose poppet, or by a taper attachment at the rear of the lathe, which coerces the movement of the top or tool-carrying slide of the rest. Or, as in short tapers, the slide-rest is set to the required angle on its carriage. Balls are sometimes turned by a spherical attachment to the slide-rest of an ordinary lathe. Copying lathes are those in which an object is reproduced from a pattern precisely like the objects required. The commonest example is that in which gun-stocks and the spokes of wheels are turned, but these are used for timber, and the engineer's copying lathe uses a form or cam and a milling cutter. The form milling machine is the copying machine for metal-work. The manufacture of boilers has given birth to two kinds of lathes, one for turning the boiler ends, the other the boiler flue flanges, the edges of which have to be caulked. Shaft pulleys have appropriated a special lathe containing provision for turning the convexity of the faces. Lathes are duplicated in two or three ways. Two, four, six or eight tools sometimes operate simultaneously on a piece of work. Two lathes are mounted on one bed. A tool will be boring a hole while another is turning the edges of the same wheel. One will be boring, another turning a wheel tire, and so on. The rolls for iron and steel mills have special lathes for trueing them up. The thin sheet metal-work produced by spinning has given rise to a special kind of spinning lathe where pressure, and not cutting, is the method adopted.

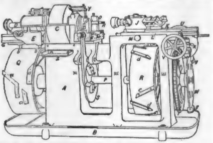


FIG. 33.—Automatic Lathe or Screw Machine. (A. Herbert, Ltd.)

A, Main body.
B, Waste oil tray.
C, Headstock.
D, Wire-feed tube.
E, Slide for closing chuck.
F, Shaft for ditto.
G, Feed-slide.
H, Piece of work.
J, Turret with box tools.
K, Turret slide.
L, Saddle for ditto, adjustable along bed.
M, Screw for locating adjustable slide.
N, Cut-off and forming cross-slide.
O, *O*, Back and front tool-holders on slide.
P, Cam shaft.
Q, Cam drum for operating chuck.
R, Cam drum for operating turret.
S, Cam disk for actuating cross-slide.
a, *a*, *a*, Cams for actuating chuck movements through pins *b*, *b*. The cam which returns *D* is adjustable but is not in view.
c, Feeding cam for turret.
d, *d*, Return cams for turret.
e, *e*, Cams on cam disk for operating the lever *f*, which actuates the cut-off and forming slide.
T, Worm-wheel which drives cam shaft by a worm on the same shaft as the feed-pulley *U*.
V, Handwheel on worm shaft for making first adjustments.
W, Change feed disk.
g, *g*, Change feed dogs adjustable round disk.
X, Change feed lever.
Y, Oil tube and spreader for lubricating tools and work.
Z, Tray for tools, &c.

Methods of Holding and Rotating Work. Chucks.—The term chuck signifies an appliance used in the lathe to hold and rotate work. As the dimensions and shapes of the latter vary extensively, so also do those of the chucks. Broadly, however, the latter correspond with the two principal classes of work done in the lathe, that *between centres*, and that held at one end only or *face work*. This of course is an extremely comprehensive classification, because chucks of the same name differ vastly when used in small and large lathes. The chucks, again, used in turret work, though they grip the work by one end only, differ entirely in design from the face chucks proper.

Chucking between Centres.—The simplest and by far the commonest method adopted is to drill countersunk centres at the ends of the work to be turned, in the centre or longitudinal axis (fig. 34, *A*), and support these on the point centres of headstock and poppet. The angle included by the centres is usually 60°, and the points may enter the work to depths ranging from as little as $\frac{1}{16}$ in. in very light pieces to $\frac{1}{2}$ in., $\frac{3}{4}$ in. or 1 in. in the heaviest. Obviously a piece centred thus cannot be rotated by the mere revolution of the lathe, but it has to be driven by some other agent making connexion between it and the mandrel. The wood turner uses a forked or prong centre to obtain the necessary leverage at the headstock end, but that would be useless in metal. A *driver* is therefore used, of which there are several forms (fig. 34), the essential element being a short stiff prong of metal set away from the centre, and rotating the work directly, or against a *carrier* which encircles and pinches the work. As this method of driving sets up an unbalanced force, the "Clement" or *double driver* (fig. 34, *D*), was invented, and is frequently made use of, though not nearly so much as the common single driver. In large and heavy work it is frequently the practice to drive in another way, by the dogs of the face-plate.

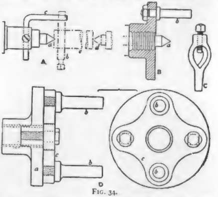


FIG. 34.

A, Centring and driving; *a*, point centre; *b*, carrier; *c*, driver fixed in slot in body of point centre; *d*, back centre; *e*, work.
B, Face-plate driver or catch-plate; *a*, centre; *b*, driver.
C, Common heart-shaped carrier.
D, Clement double driver; *a*, face-plate; *b*, *b*, drivers; *c*, loose plate carrying drivers.

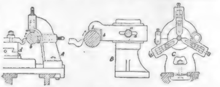


FIG. 35.

A, Travelling steady with adjustable studs *a*, *a*; *b*, work; *c*, tool; *d*, slide-rest.
B, Steady with horizontal and vertical adjustment through slotted bolt holes *a*, *a*; *b*, *b*, brass or steel facings.
C, Fixed steady with hinged top and three setting pieces.

Steadies.—Pieces of work which are rigid enough to withstand the stress of cutting do not require any support except the centres. But long and comparatively slender pieces have to be steadied at intermediate points (fig. 35). Of devices for this purpose there are many designs; some are *fixed* or bolted to the bed and are shifted when necessary to new positions, and others are bolted to the carriage of the slide-rest and move along with it—*travelling* *steadies*. In some the work is steadied in a vee, or a right angle, in others adjustable pins or arms are brought into contact with it. As the pressure of the cut would cause an upward as well as backward yielding of the work, these two movements are invariably provided against, no matter in what ways the details of the steadies are worked out. Before a steady can be used, a light cut has to be taken in the locality where the steady has to take its bearing, to render the work true in that place. The travelling steady follows immediately behind the tool, coming in contact therefore with finished work continually.

Mandrels.—Some kinds of work are carried between centres indirectly, upon mandrels or arbors (fig. 36). This is the method adopted when wheels, pulleys, bushes and similar articles are bored first and turned afterwards, being chucked by the bore hole, which fits on a mandrel. The latter is then driven between point centres and the bore fits the mandrel sufficiently tightly to resist the stress of turning. The large number of bores possible involves stocking a considerable number of mandrels of different diameters. As it is not usual to turn a mandrel as often as a piece of work requires chucking, economy is studied by the use of *stepped* mandrels, which comprise several diameters, say from three to a dozen. A better device is the *expanding* mandrel, of which there are several forms. The essential principle in all is the capacity for slight adjustments in diameter, amounting to from ⅛ in. to ¼ in., by the utilization of a long taper. A split, springy cylinder may be moved endwise over a tapered body, or separate single keys or blades may be similarly moved.

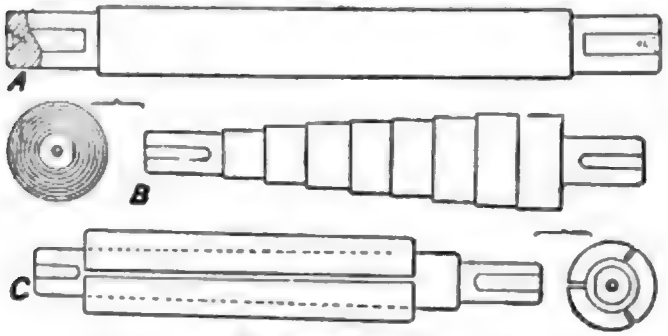


FIG. 36.—Mandrels.

A, Plain mandrel. *B*, Stepped mandrel. *C*, Expanding mandrel.

Face-Work.—That kind of work in which support is given at the headstock end only, the centre of the movable poppet not being required, is known as face-work. It includes pieces the length of which ranges from something less than the diameter to about three or four times the diameter, the essential condition being that the unsupported end shall be sufficiently steady to resist the stress of cutting. Work which has to be bored, even though long, cannot be steadied on the back centre, and if long is often supported on a *cone plate*. The typical appliance used for face-work is the common *face-plate* (fig. 37). It is a plain disk, screwed on the mandrel nose, and having slot holes in which bolts are inserted for the purpose of cramping pieces of work to its face. There are numerous forms of these clamps, and common bolts also are used. The face-plate may also serve to receive an intermediary, the *angle-plate*, against which work may be bolted when its shape is such as to render bolting directly to the plate inconvenient.

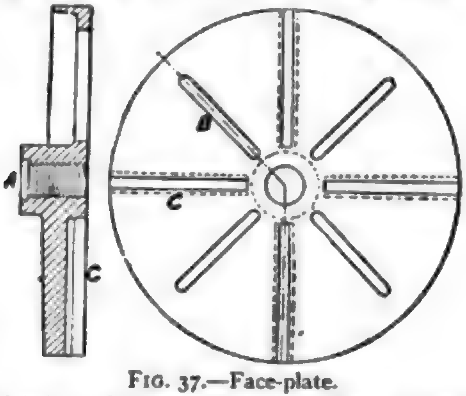


FIG. 37.—Face-plate.

A, Screwed hole to fit mandrel nose. *B*, Slots for common bolts. *C*, Tee-slots for tee-head bolts.

Jaw Chucks.—When a face-plate has fitted to it permanent *dogs* or *jaws* it is termed a dog or *jaw chuck* (fig. 38). In the commonest form the jaws are moved radially and independently, each by its own screw, to grip work either externally or internally. In some cases the dogs are loosely fitted to the holes in a plain face-plate. In all these types the radial setting is tentative, that is, the jaws being independent, there is no self-centring capacity, and thus much time is lost. A large group, therefore, are rendered self-centring by the turning of a ring which actuates a face scroll

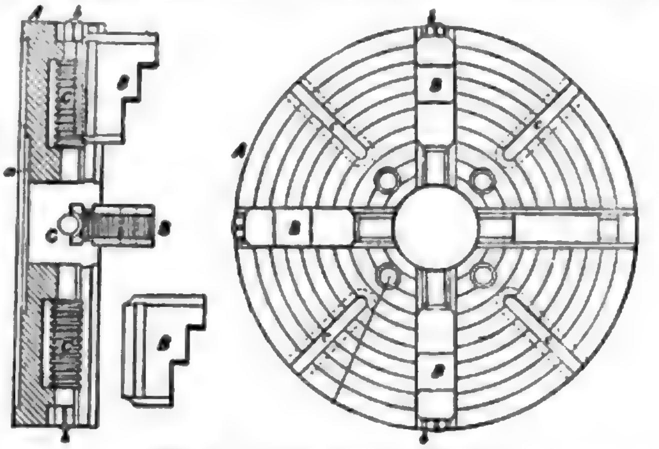


FIG. 38.—Independent Jaw Chuck.

A, Body.
a, Recess to receive face-plate.
B, Jaws or dogs.
C, Screws for operating jaws.
b, Square heads of screws for key.
c, Tee-grooves for bolts.

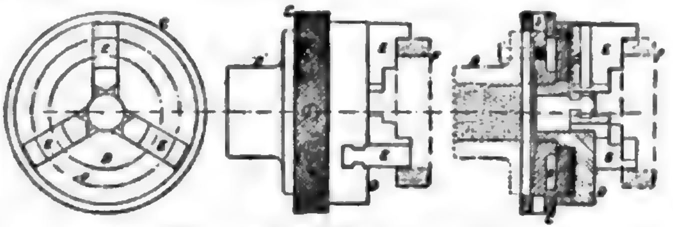


FIG. 39.—Scroll Chuck, ungeared.

A, Face-plate screwed to mandrel nose.
B, Back of chuck screwed to *A*.
C, Knurled chuck body with scroll *a* on face.
D, Chuck face.
E, Jaws in chuck face, having sectional scroll teeth engaging with scroll *a*, and moved inwards or outwards by the scroll when *C* is turned.
b, Tommy or lever hole in *C*.
F, Piece of work outlined.

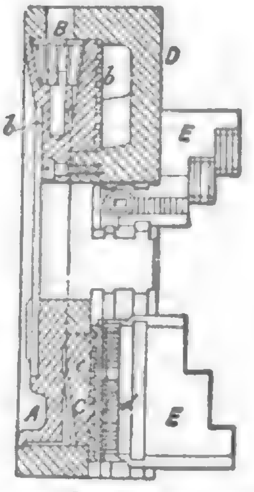


FIG. 40.—Combination Geared Scroll Chuck.

A, Back plate; *a*, recess for face-plate.
B, Pinions.
C, Circular rack with scroll *b* on face.
D, Chuck body.
E, Jaws fitting on intermediate pieces *c* that engage with the scroll *b*.
d, Screws for operating jaws independently.

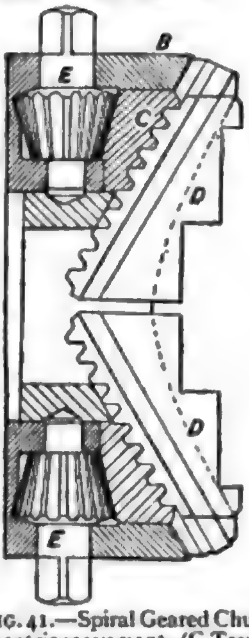


FIG. 41.—Spiral Geared Chuck, concentric movement. (C. Taylor, Birmingham.)

A, Back.
B, Body.
C, Spiral plate with teeth engaging in jaws *D*.
E, Bevel pinions gearing with teeth on back of *C*.

(fig. 39) or a circular rack with pinions (fig. 40), turned with a key which operates all the jaws simultaneously inwards or outwards. But as some classes of jobs have to be adjusted eccentrically, many chucks are of the *combination* type (fig. 40), capable of being used independently or concentrically, hence termed *universal* chucks. The change from one to the other simply means throwing the ring of teeth out of or into engagement with the pinions by means of cams or equivalent devices. Each type of chuck occurs in a large range of dimensions to suit lathes of all centres, besides which every lathe includes several chucks, large and small, in its equipment. The range of diameters which can be taken by any one chuck is limited, though the jaws are made with steps, in addition to the range afforded by the operating screws. The "Taylor" spiral chucks (fig. 41) differ essentially from the scroll types in having the actuating threads set spirally on the sloping interior of a cone. The result is that the outward pressure of each jaw is received behind the body, because the spiral rises up at the back. In the ordinary scroll chucks the pressure is taken only at the bottom of each jaw, and the tendency to tilt and pull the teeth out of shape is very noticeable. The spiral, moreover, enables a stronger form of tooth to be used, together with a finer pitch of threads, so that the wearing area can be increased.

The foregoing may be termed the standard chucks. But in addition there are large numbers for dealing with special classes of work. Brass finishers have several. Most of the hollow spindle lathes and automatics have *draw-in* or *push-out* chucks, in which the jaws are operated simultaneously by the conical bore of the encircling nose, so that their action is instantaneous and self-centring. They are either operated by hand, as in fig. 31, or automatically, as in fig. 33. There is also a large group used for drills and reamers—the *drill chucks* employed in lathes as well as in drilling machines.

II.—Reciprocating Machine Tools

This is the only convenient head under which to group three great classes of machine tools which possess the feature of reciprocation in common. It includes the planing, shaping and slotting machines. The feature of reciprocation is that the cutting tool is operative only in one direction; that is, it cuts during one stroke or movement and is idle during the return stroke. It is, therefore, in precisely the same condition as a hand tool such as a chisel, a carpenter's plane or a hand saw. We shall return again to this feature of an idle stroke and discuss the devices that exist to avoid it.

Planing Machines.—In the standard planer for general shop purposes (fig. 42) the piece of work to be operated on is attached to a horizontal table moving to and fro on a rigid bed, and passing underneath the fixed cutting tool. The tool is gripped in a box having certain necessary adjustments and movements, so that the tool can be carried or *fed* transversely across the work, or at right angles with the direction of its travel, to take successive cuts, and also downwards or in a vertical direction. The tool-box is carried on a cross-slide which has capacity for several feet of vertical adjustment on upright members to suit work of varying depths. These uprights or *housings* are bolted to the sides of the bed, and the whole framing is so rigidly designed that no perceptible tremor or yielding takes place under the heaviest duty imposed by the stress of cutting.

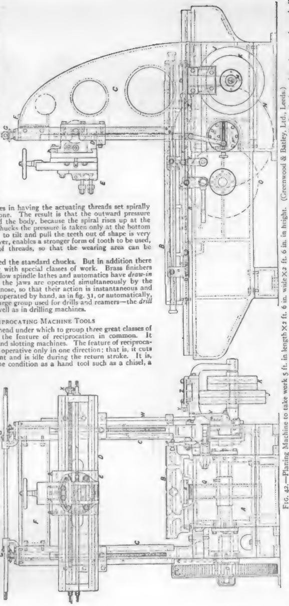


FIG. 42.—Planing Machine to take work 5 ft. in length × 2 ft. 6 in. wide × 2 ft. 6 in. in height. (Greenwood & Batley, Ltd., Leeds.)

A, Bed.
B, Table.
C, *C*, Housings.
D, Cross-rail.
E, Tool-box.
F, Stretcher.
G, *G*, Bevel-gears for elevating cross-slide by means of screws *H*, *H*.
J, Fast and loose pulleys for driving the table during the cutting stroke.
K, Pulleys for non-cutting stroke.
L, Pulley shaft.
M, Pinion on ditto, driving wheel *N*.
O, Shaft of *N* carrying pinion *P*, which drives *Q*, engaging with the rack *R* on the underside of the table *B*.
S, Traverse screw actuating linear movement of tool-box, *E*.
T, Splined rod for actuating down-feed of tool-box.
U, Slotted feed disk rotated by shaft *O*.
V. Lever adjustable across disk.
W, Toothed rack reciprocated vertically by disk and lever, and operating feed gear-wheels on shafts *S* and *T*.
X, Ratchet feed.
a, *a*, Dogs adjustable in slot at the edge of the table *B*.
Y, *Y*, Levers actuated by dogs, and operating belt-shifting forks *Z*.

Moreover, after the required adjustments have been made and the machine started, the travel and the return of the work-table and the feeding of the tool across the surface are performed by self-acting mechanism actuated by the reciprocations of the table itself, the table being driven from the belt pulleys.

To such a design there are objections, which, though their importance has often been exaggerated, are yet real. First, the cross-rail and housings make a rigid enclosure over the table, which sometimes prevents the admission of a piece that is too large to pass under the cross-rail or between the housings. Out of this

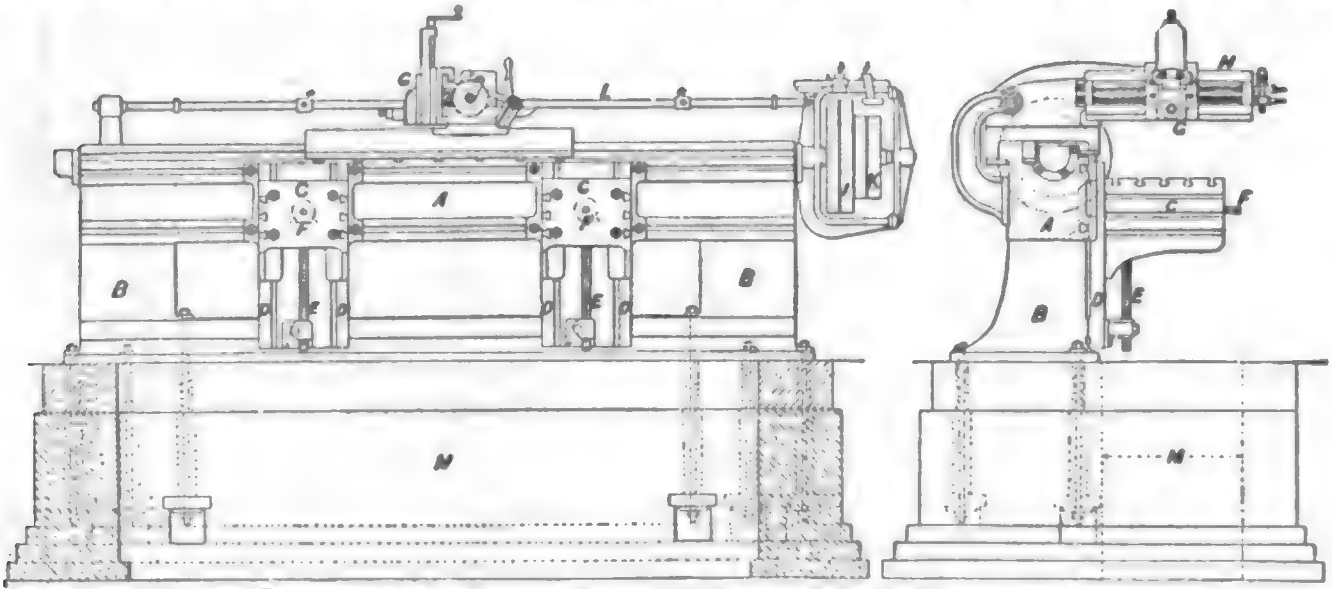


FIG. 43.—20-in. Side Planing Machine. (G. Richards & Co., Ltd., Manchester.)

A, Bed.
B, *B*, Feet.
C, *C*, Work tables adjustable vertically on the faces *D*, *D*, by means of screws *E*, *E*, from handles *F*, *F*, through bevel gears.
G, Tool-box on travelling arm *H*, travelled by fast and loose pulleys *J* for cutting, and by pulleys *K* for quick return.
L, Feed-rod with adjustable dogs *a*, *a*, for effecting reversals through the belt forks *b*, *b*.
M, Brickwork pit to receive deep objects.

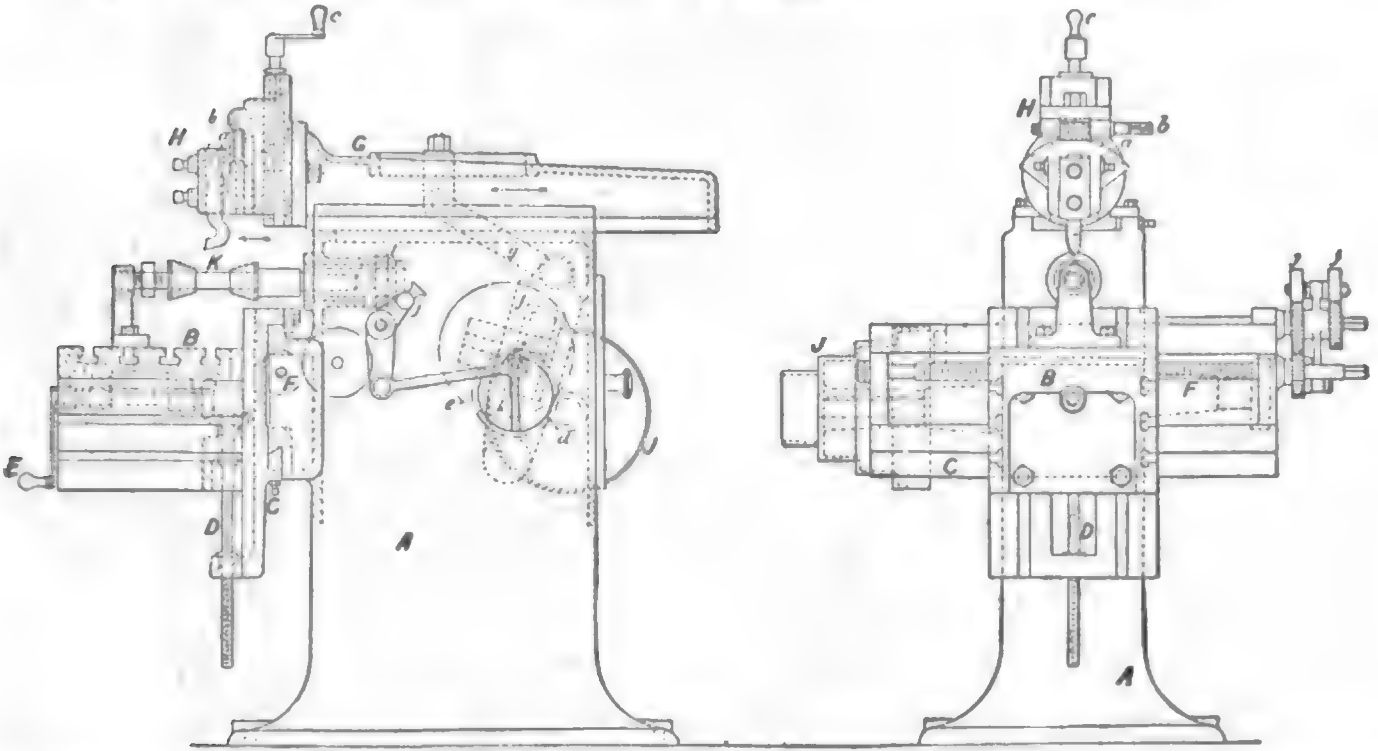


FIG. 44.—8-in. Shaping Machine. (Cunliffe & Croom, Ltd., Manchester.)

A, Base.
B, Work-table, having vertical movement on carriage *C*, which has horizontal movement along the face of *A*.
D, Screw for effecting vertical movement, by handle *E*, and bevel gears.
F, Screw for operating longitudinal movement with feed by hand or power.
G, Tool ram.
H, Tool-box.
a, Worm-gear for setting tool-holder at an angle.
b, Crank handle spindle for operating ditto.
c, Handle for actuating down feed of tool.
J, Driving cone pulley actuating pinion *d*, disk wheel *e*, with slotted disk, and adjustable nut moving in the slot of the crank *f*, which actuates the lever *g*, connected to the tool ram *G*, the motion constituting the Whitworth quick return; *g* is pivoted to a block which is adjustable along a slot in *G*, and the clamping of this block in the slot regulates the position of the ram *G*, to suit the position of the work on the table.
h, Feed disk driven by small gears from cone pulley.
j, Pawl driven from disk through levers at various rates, and controlling the amount of rotation of the feed screw *F*.
K, Conical mandrel for circular shaping, driven by worm and wheel *l*.

objection has arisen a new design, the *side planer* (fig. 43), in which the tool-box is carried by an arm movable along a fixed bed or base, and overhanging the work, which is fastened to the side of the base, or on angle brackets, or in a deep pit alongside. Here the important difference is that the work is not traversed under the tool as in the ordinary planer, but the tool moves over the work. But an evil results, due to the overhang of the tool arm, which being a cantilever supported at one end only is not so rigid when cutting as the cross-rail of the ordinary machine, supported at both ends on housings. The same idea is embodied in machines built in other respects on the reciprocating table model. Sometimes one housing is omitted, and the tool arm is carried on the other, being therefore unsupported at one end. Sometimes a housing is made to be removable at pleasure, to be temporarily taken away only when a piece of work of unusual dimensions has to be fixed on the table.

Another objection to the common planer is this. It seems unmechanical in this machine to reciprocate a heavy table and piece of work which often weighs several tons, and let the tool and its holder of a few hundredweights only remain stationary. The mere reversal of the table absorbs much greater horse-power than the actual work of cutting. Hence a strong case is often stated for the abandonment of the common practice. But, on the other hand, the centre of gravity of the moving table and work lies low down, while when the cross-rail and housings with the cutting tool are travelled and reversed, their centre of gravity is high, and great precautions have to be taken to ensure steadiness of movement. Several planers are made thus, but they are nearly all of extremely massive type—the *pit planers*. The device is seldom applied to those of small and medium dimensions.

But there is a great group of planers in which the work is always fixed, the tools travelling. These are the *wall planers, vertical planers* or *wall creepers*, used chiefly by marine engine builders. They are necessary, because many of the castings and forgings are too massive to be put on the tables of the largest standard machines. They are therefore laid on the base-plate of the wall planer, and the tool-box travels up and down a tall pillar bolted to the wall or standing independently, and so makes vertical cutting strokes. In some designs horizontal strokes are provided for, or either vertical or horizontal as required. Here, as in the side planer, there is no limitation whatever to the length of the work, since it may extend to any distance beyond the base-plate.

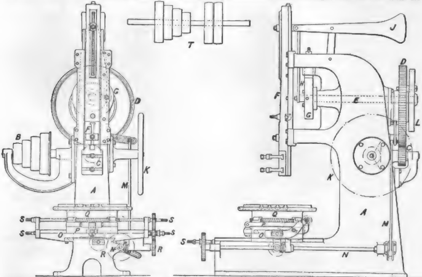


FIG. 45.—12-in. Stroke Slotting Machine. (Greenwood & Batley, Ltd., Leeds.)

A, Main framing.
B, Driving cone.
C, *D*, Gears driven by cones.
E, Shaft of *L*.
F, Tool ram driven from shaft *E* through disk *G* and rod *H*, with quick return mechanism *D*.
J, Counter-balance lever to ram.
K, Flywheel.
L, Driving-disk.
M, *N*, Feed levers and shaft operated from disk, actuating linear movements of slides *O*, *P*, and circular movement of table *Q*, through gears *R*.
S, Hand-feed motions to table.
T, Countershaft.

Shaping Machines.—The shaping machine (fig. 44) does for comparatively small pieces that which the planer does for long ones. It came later in time than the planer, being one of James Nasmyth's inventions, and beyond the fact that it has a reciprocating non-cutting return stroke it bears no resemblance to the older machine. Its design is briefly as follows: The piece of work to be shaped is attached to the top, or one of the vertical side faces, of a right-angled bracket or brackets. These are carried upon the face of a main standard and are adjustable thereon in horizontal and vertical directions. In small machines the ram or reciprocating arm (see fig. 44, *G*) slides in fixed guides on the top of the pillar, and the necessary side traverse is imparted to the work table *B*. To the top of the main standard, in one design, a carriage is fitted with horizontal traverse to cover the whole breadth, within the capacity of the machine, of any work to be operated on. In the largest machines two standards support a long bed, on which the carriage, with its ram, traverses past the work. These machines are frequently made double-headed, that is carriages, rams and work tables are duplicated, and the operator can set one piece of work while the other is being shaped. In all cases the movement of the reciprocating arm, to the outer end of which the tool is attached, takes place in a direction transversely to the direction of movement of the carriage, and the tool receives no support beyond that which it receives from the arm which overhangs the work. Hence the shaper labours under the same disadvantages as the side planer—it cannot operate over a great breadth. A shaper with a 24-in. stroke is one of large capacity, 16 in. being an average limit. Although the non-cutting stroke exists, as in the planer, the objection due to the mass of a reciprocating table does not exist, so that the problem does not assume the same magnitude as in the planer. The weak point in the shaper is the overhang of the arm, which renders it liable to spring, and renders heavy cutting difficult. Recently a novel design has been introduced to avoid this, the *draw-cut shaper*, in which the cutting is done on the inward or return stroke, instead of on the outward one.

Slotting Machines.—In the slotting machine (fig. 45) the cutting takes place vertically and there is a lost return stroke. All the necessary movements save the simple reciprocating stroke are imparted to the compound table on which the work is carried. These include two linear movements at right angles with each other and a circular motion capable of making a complete circle. Frequently a tilting adjustment is included to permit of slotting at an angle. The slotting machine has the disadvantage of an arm unsupported beyond the guides in which it moves. But the compound movements of the table permit of the production of shapes which cannot be done on planers and shapers, as circular parts and circular arcs, in combination with straight portions. Narrow key grooves in the bores of wheels are also readily cut, the wheels lying on the horizontal table, which would only be possible on planer and shaper by the use of awkward angle brackets, and of specially projecting tools.

Quick return in planers is accomplished by having two distinct sets of gearing—a slow set for cutting and a quick train for return, each operated from the same group of driving pulleys. The return travel is thus accomplished usually three, often four, times more quickly than the forward rate; sometimes even higher rates are arranged for. In the shaper and slotter such acceleration is not practicable, a rate of two to one being about the limit, and this is obtained not by gears, but by the slotted crank, the *Whitworth return*, on shapers and slotters, or by elliptical toothed wheels on slotters. The small machines are generally unprovided with this acceleration.

The double-cutting device seems at first sight the best solution, and it is adopted on a number of machines, though still in a great minority. The pioneer device of this kind, the rotating tool-box of Whitworth, simply turns the tool round through an angle of 180° at the termination of each stroke, the movement being self-acting. In some later designs, instead of the box being rotated to reverse the tool. two tools are used set back to back, and the one that is not cutting is *relieved* for the time being, that is tilted to clear the work. Neither of these tools will plane up to a shoulder as will the ordinary ones.

Allied Machines.—The reciprocation of the tool or the work, generally the former, is adopted in several machines besides the standard types named. The plate-edge planer is used by platers and boiler makers. It is a side planer, the plates being bolted to a bed, and the tool traversing and cutting on one or both strokes. Provision is often included for planing edges at right angles. The key-seaters are a special type, designed mainly to remove the work of cutting key grooves in the bores of wheels and pulleys from the slotting machine. The work is fixed on a table and the keyway cutting tool is drawn downwards through the bore, with several resulting practical advantages. Many planing machines are portable so that they may be fixed upon very massive work. Several gear-wheel cutting machines embody the reciprocating tool.

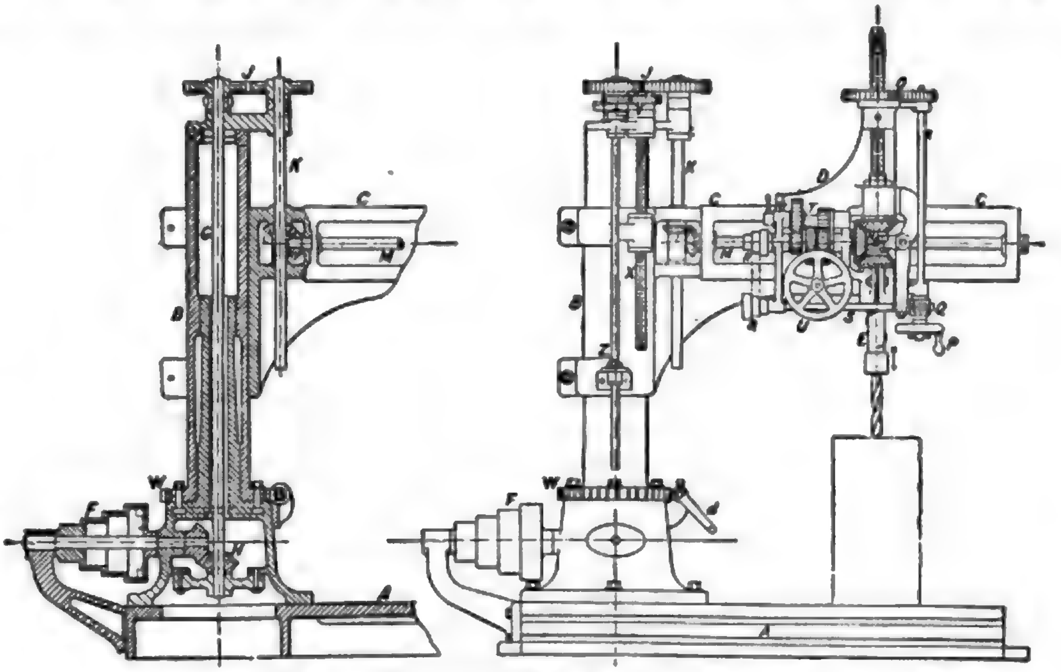


Fig. 46.—Pillar Radial Drilling Machine, 5 ft. radius.

A, Base-plate.
B, Pillar.
C, Radial arm.
D, Spindle carriage.
E, Drill spindle.
F, Main driving cones driving vertical shaft *G* through mitre-gears *H*.
J, Spur-wheels, driving from *C* to vertical shaft *K*.
L, Mitre-wheels, driving from *K* to horizontal shaft *M*, having its bearings in the radial arm.
N, Nest of mitre-wheels driving the wheel spindle *E* from *M*.
O, Feed-gears to drill spindle, actuated by hand-wheel *P* or worm-gears *Q*.
R, *R*, Feed cones driving from shaft *M* to worm-shaft *S*, for self-acting feed of drill.
T, Change-speed gears.
U, Hand-wheel for racking carriage *D* along radial arm *C*.
V, Clutch and lever for reversing direction of rotation of spindle.
W, Worm-gear for turning pillar *B*.
d, Handle for turning worm.
X, Screw for adjusting the height of the radial arm.
Y, Gears for actuating ditto from shaft *C*.
Z, Rod with handle for operating elevating gear.

III.—Drilling and Boring Machines

The strict distinction between the operations of drilling and boring is that the first initiates a hole, while the second enlarges one already existing. But the terms are used with some latitude. A combined drilling and boring machine is one which has provision for both functions. But when holes are of large dimensions the drilling machine is useless because the proportions and gears are unsuitable. A 6-in. drill is unusually large, but holes are bored up to 30 ft. or more in diameter.

Types of Machines.—The distinction between machines with vertical and horizontal spindles is not vital, but of convenience only. The principal controlling element in design is the mass of the work, which often determines whether it or the machine shall be adjusted relatively to each other. Also the dimensions of a hole determine the speed of the tools, and this controls the design of the driving and feeding mechanism. Another important difference is that between drilling or boring one or more holes simultaneously. With few exceptions the tool rotates and the work is stationary. The notable exceptions are the vertical boring lathes already mentioned. Obviously the demands made upon drilling machines are nearly as varied as those on lathes. There is little in common between the machines which are serviceable for the odd jobs done in the general shop and those which are required for the repetitive work of the shops which handle specialities. Provision often has to be made for drilling simultaneously several holes at certain centres or holes at various angles or to definite depths, while the mass of the spindles of the heavier machines renders counter-balancing essential.

Bench Machines are the simplest and smallest of the group. They are operated either by hand or by power. In the power machines generally, except in the smallest, the drill is also fed downwards by power, by means of toothed gears. The upper part of the drilling spindle being threaded is turned by an encircling spur-wheel, operated very slowly by a pinion and hand-wheel by the right hand of the attendant, the movement being made independent of the rotation of the spindle. A rack sleeve encircling the spindle is also common. In the power machines gears are also used, but a belt on small cone pulleys drives from the main cone shaft at variable speeds. From three to four drilling and feeding speeds are provided for by the respective cone pulleys. Work is held on or bolted to a circular table, which may have provision for vertical adjustment to suit pieces of work of different depths, and which can usually be swung aside out of the way to permit of deep pieces of work being introduced, resting on the floor or on blocking.

Wall Machines.—One group of these machines resembles the bench machines in general design, but they are made to bolt to a wall instead of on a bench. Their value lies in the facilities which they afford for drilling large pieces of work lying on the floor or on blocking, which could not go on the tables of the bench machines. Sometimes a compound work-table is fastened to the floor beneath; and several machines also are ranged in line, by means of which long plates, angles, boilers or castings may be brought under the simultaneous action of the group of machines. Another type is the radial arm machine, with or without a table beneath. In each case an advantage gained is that a supporting pillar or standard is not required, its place being taken by the wall.

Self-contained Pillar Machines include a large number having the above-named feature in common. In the older and less valuable types the framework is rigid, and the driving and feeding are by belt cones. But the machines being mostly of larger capacities than those just noted, back-gears similar to those of lathes are generally introduced. The spindles also are usually counterbalanced. The machine framing is bolted to a bed-plate. A circular work-table may or may not be included. When it is, provision is made for elevating the table by gears, and also for swinging it aside when deep work has to be put on the base-plate.

Radial Arm Machines.—In these (fig. 46) the drilling mechanism is carried on a radial arm which is pivoted to the pillar with the object of moving the drill over the work, when the latter is too massive to permit of convenient adjustment under the drill. The driving takes place through shafts at right angles, from a horizontal shaft carrying the cones and back-geared to a vertical one, thence to a horizontal one along the radial arm, whence the vertical drilling spindle is driven. The latter has its bearings in a carriage which can be traversed along the arm for adjustment of radius. The spindle is counterbalanced. Hand as well as power adjustments are included. In the work-tables of radial and rigid machines there is a great diversity, so that work can be set on top, or at the sides, or at an angle, or on compound tables, so covering all the requirements of practice.

Sensitive Machines have developed greatly and have superseded many of the older, slower designs. The occasion for their use lies in the drilling of small holes, ranging up to about an inch in diameter. They are belt-driven, without back-gears, and usually without bevel-gears to change the direction of motion. The feed is by lever moving a rack sleeve. A slender pillar with a foot supports the entire mechanism, and the work-table, with a range of vertical adjustment.

Multiple Spindle Machines.—Many of the sensitive machines are fitted with two, three or more spindles operated in unison with a belt common to all. In other machines the multiple spindles are capable of adjustment for centres, as in the machines used by boiler makers and platers. In others the spindles are adjustable in circles of varying radii, as in those employed for drilling the bolt holes in pipe flanges. In many of these the spindles are horizontal. Some very special multiple-spindle machines have the spindles at different angles, horizontal and vertical, or at angles.

Universal Machines are a particular form of the pillar type in which the spindle is horizontal, moving with its carriage on a pillar capable of traversing horizontally along a bed; the carriage has vertical adjustment on its pillar and so commands the whole of the face of a large piece of work bolted to a low bed-plate adjacent to the machine. The term "universal" signifies that the machine combines provision for drilling, boring, tapping screws and inserting screw studs; facing and in some cases milling. The power required for boring is obtained by double and treble gears. These machines are used largely in marine engine works, where very massive castings and forgings must be operated on with their faces set vertically.

Boring Machines.—Many machines are classified as suitable for drilling and boring. That simply means that provision is made on a drilling machine for boring holes of moderate size, say up to 8 or 10 in., by double and treble back-gears. But the real boring machine is of a different type. In the horizontal machines a splined bar actuated by suitable gears carries a boring head which holds the cutters, which head is both rotated with, and traversed or fed along the bar. The work to be bored is fixed on a table which has provision for vertical adjustment to suit work of different dimensions. The boring-bar is supported at both ends. In the case of the largest work the boring-bar is preferably set with its axis vertically, and the framing of the machine is arch-like. The bar is carried in a bearing at the crown of the arch and driven and fed there by suitable gears, while the other end of the bar rotates in the table which forms the base of the machine. Some boring machines for small engine cylinders and pump barrels have no bar proper, but a long boring spindle carrying cutters at the further end is supported along its entire length in a long stiff boss projecting from the headstock of the machine—the *snout* machine. The work is bolted on a carriage which slides along a bed similar to a lathe bed. Many of these machines have two bars for boring two cylinders simultaneously.

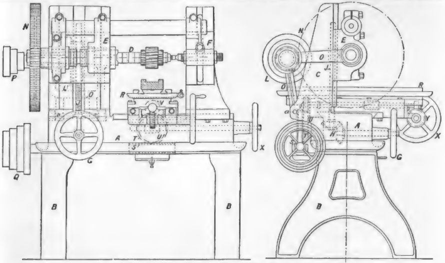


FIG. 47.—Lincoln Milling Machine. (John Holroyd & Co., Ltd., Milnrow.)

A, Bed.
B, *B*, Legs.
C, Upright.
D, Spindle or arbor.
E, Headstock, carrying bearings for spindle *D*.
F, Tailstock, carrying point centre for tail end of spindle.
G, Hand-wheel for effecting adjustment in height of headstock, through bevel-gears *H* and screw *J*.
K, Cross-bar connecting head- and tail-stocks, and ensuring equal vertical adjustment of the spindle bearings from the screw *J*.
L, Speed cones for driving spindle, through pinion *M* and wheel *N*.
O, Frame, carrying the bearings for the cone pulley *L*, and pivoted to the bed at *o*, and to the headstock *E*. This device keeps the gears *M* and *N* in engagement in all variations in the height of the spindle *D*.
P, *Q*, Cones for driving the table *R* through worm-gears *S*, *T*, and spurs *U*, *V*, to the table screw.
W, Stop for automatic knock-off to feed.
X, Hand-wheel for turning the same screw through worm-gears *Y*, *Z*.

IV.—MILLING MACHINES

In milling machines rotary saw-like cutters are employed. To a certain extent these and some gear-cutting machines overlap because they have points in common. Many gear-wheel teeth are produced by rotary cutters on milling machines. In many machines designed for gear cutting only, rotary cutters alone are used. For this reason the two classes of machines are conveniently and naturally grouped together, notwithstanding that a large and increasing group of gear-cutting machines operate with reciprocating tools.

The French engineer, Jacques de Vaucanson (1709–1782), is credited with having made the first milling cutter. The first very crude milling machine was made in 1818 at a gun factory in Connecticut. To-day the practice of milling ranks as of equal economic value with that of any other department of the machine shop, and the varieties of milling machines made are as highly differentiated as are those of any other group. An apparent incongruity which is rather striking is the relative disproportion between the mass of these machines and the small dimensions of the cutters. The failures of many of the early machines were largely due to a lack of appreciation of the intensity of the stresses involved in milling. A single-edged cutting tool has generally a very narrow edge in operation. Milling cutters are as a rule very wide by comparison, and several teeth in deep cuts are often in simultaneous operation. The result is that the machine spindle and the arbor or tool mandrel are subjected to severe stress, the cutter tends to spring away from the surface being cut, and if the framings are of light proportions they vibrate, and inaccuracy and chatter result. Even with the very stiff machines now made it is not possible to produce such accurate results on wide surfaces as with the planer using a narrow-edged tool. Because of this great resistance and stress, cutters of over about an inch in width are always made with the teeth arranged spirally, and wide cutters which are intended for roughing down to compete with the planer always have either inserted cutters or staggered teeth. Hence the rotary cutter type of machine has not been able to displace the planing machine in wide work when great accuracy is essential. Its place lies in other spheres, in some of which its position is unassailable. Nearly all pieces of small and medium dimensions are machined as well by milling as by single-edged tools. All pieces which have more than one face to be operated on are done better in the milling machine than elsewhere. All pieces which have profiled outlines involving combinations of curves and plane faces can generally only be produced economically by milling. Nearly all work that involves equal divisions, or pitchings, as in the manufacture of the cutters themselves, or spiral cutting, or the teeth of gear-wheels when produced by rotary cutters, must be done in milling machines. Beyond these a large quantity of work lies on the border-line, where the choice between milling and planing, shaping, slotting, &c., is a matter for individual judgment and experience. It is a matter for some surprise that round the little milling cutter so many designs of machines have been built, varying from each other in the position of the tool spindles, in their number, and in the means adopted for actuating them and the tables which carry the work.

A very early type of milling machine, which remains extremely popular, was the Lincoln. It was designed, as were all the early machines, for the small arms factories in the United States. The necessity for all the similar parts of pistols and rifles being interchangeable, has had the paramount influence in the development of the milling machine. In the Lincoln machine as now made (fig. 47) the work is attached to a table, or to a vice on the table, which has horizontal and cross traverse movements on a bed, but no capacity for vertical adjustment. The cutter is held and rotated on an arbor driven from a headstock pulley, and supported on a tail-stock centre at the other end, with capacity for a good range of vertical adjustment. This is necessary both to admit pieces of work of different depths or thicknesses between the table and the cutter, and to regulate the depth of cutting (vertical feed). Around this general design numerous machines small and large, with many variations in detail, are built. But the essential feature is the vertical movement of the spindle and cutter, the support of the arbor (cutter spindle) at both ends, and the rigidity afforded by the bed which supports head- and tail-stock and table.

The pillar and knee machines form another group which divides favour about equally with the Lincoln, the design being nearly of an opposite character. The vertical movements for setting and feed are imparted to the work, which in this case is carried on a bracket or knee that slides on the face of the pillar which supports the headstock. Travelling and transverse movements are imparted to the table slides. The cutter arbor may or may not be supported away from the headstock by an arched overhanging arm. None of these machines is of large dimensions. They are made in two leading designs—the plain and the universal. The first embodies rectangular relations only, the second is a marvellous instrument both in its range of movements and fine degree of precision. The first machine of this kind was exhibited at Paris in 1867. The design permits the cutting of spiral grooves, the angle of which is embodied in the adjustment of a swivelling table and of a headstock thereon (universal or spiral head). The latter embodies change-gears like a screw-cutting lathe and worm-gear for turning the head, in combination with an index or dividing plate having several circles of holes, which by the insertion of an index peg permit of the work spindle being locked during a cut. The combinations possible with the division plate and worm-gear number hundreds. The head also has angular adjustments in the vertical direction, so that tapered work can be done as well as parallel. The result is that there is nothing in the range of spiral or parallel milling, or tapered work or spur or bevel-gear cutting, or cutter making, that cannot be done on this type of machine, and the accuracy of the results of equal divisions of pitch and angle of spiral do not depend on the human element, but are embodied in the mechanism.

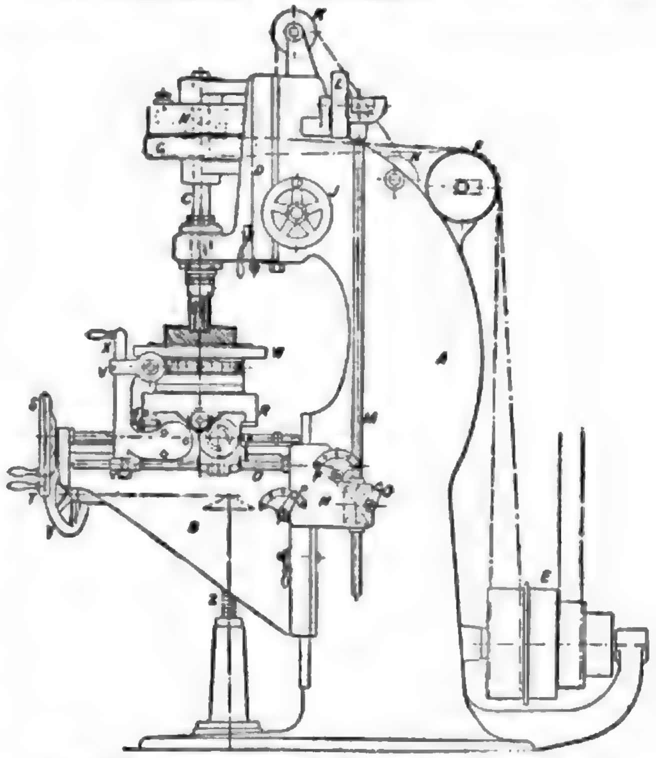


FIG. 48.—Vertical Spindle Milling Machine. (James Archdale & Co., Ltd.)

A, Main framing.
B, Knee.
C, Spindle, having its vertical position capable of adjustment by the sliding of *D* on *A*.
E, Driving cone, belt driving over guide pulleys *F* to spindle pulley *G*.
H, Enclosed gears for driving spindle by back gear.
J, Hand-wheel for adjusting spindle vertically.
K, *K*, Pulleys over which spindle is counterbalanced.
L, Feed pulley, driven from counter shaft.
M, Vertical feed shaft, driven from *L* through mitre-gears.
N, Change gear box.
O, Horizontal feed shaft, operating longitudinal and transverse feed of table through spiral and spur-gears.
P, *P*, Handles for operating changes in feed speeds, nine in number.
Q, Handle for reversing direction of motion of table *R*.
S, Hand-wheel for longitudinal movement of table.
T, Hand-wheel for effecting cross adjustments.
V, Spiral gears indicated for effecting self-acting rotation of circular table *W*.
X, Hand-wheel for rotation of table.
Y, Hand-wheel for vertical movements of knee *B* on screw *Z*.

Machines with vertical spindles (fig. 48) form another great group, the general construction of which resembles that either of the common drilling machine or of the slotting machine. In many cases the horizontal position is preferable for tooling, in others the vertical, but often the matter is indifferent. For general purposes, the heavier class of work excepted, the vertical is more convenient. But apart from the fitting of a special brace to the lower end of the spindle which carries the cutter, the spindle is unsupported there and is thus liable to spring. But a brace can only be used with a milling cutter that operates by its edges, while one advantage of the vertical spindle machine is that it permits of the use of end or face cutters. One of the greatest advantages incidental to the vertical position of the spindle is that it permits of profile milling being done. One of the most tedious operations in the machine shop is the production of outlines which are not those of the regular geometric figures, as rectangles and circles, or combinations of the same. There is only one way in which irregular forms can be produced cheaply and interchangeably, and that is by controlling the movements of the tool with an object of similar shape termed a "form" or "former," as in the well-known copying lathes, in the cam grinding machine, and in the forming adjuncts fitted to vertical spindle milling machines, so converting those into profiling machines. The principle and its application are alike simple. An object (the form) is made in hardened steel, having the same outlines as the object to be milled, and the slide which carries the cutter spindle has a hardened former pin or roller, which is pulled hard against the edges of the form by a suspended weight, so causing the tool to move and cut in the same path and in the same plane around the edges of the work. Here the milling machine holds a paramount place. No matter how many curves and straight portions may be combined in a piece, the machine reproduces them all faultlessly, and a hundred or a thousand others all precisely alike without any tentative corrections.

Plano-millers, also termed slabbing machines, form a group that grows in value and in mass and capacity. They are a comparatively late development, becoming the chief rivals to the planing machines, for all the early milling was of a very light character. In general outlines the plano-millers closely resemble the planing machines, having bed, table, housings and cross-rail. The latter in the plano-miller carries the bearings for the cutter spindle or spindles under which the work travels and reciprocates. These spindles are vertical, but in some machines horizontal ones are fitted also, as in planers, so that three faces at right or other angles can be operated on simultaneously. The slabbing operations of the plano-millers do not indicate the full or even the principal utilities of these machines. To understand these it must be remembered that the cross-sections of very many parts which have to be tooled do not lie in single planes merely, but in combinations of plane surfaces, horizontal, vertical or angular. In working these on the planing machine separate settings of tools are required, and often successive settings. But milling cutters are built up in "gangs" to deal with such cases, and in this way the entire width of profile is milled at once. Horizontal faces, and vertical and angular edges and grooves, are tooled simultaneously, with much economy in time, and the cutter profile will be accurately reproduced on numbers of separate pieces. Allied to the plano-millers are the rotary planers. They derive their name from the design of the cutters. An iron disk is pierced with holes for the insertion of a large number of separate cutters, which by the rotation of the disk produce plane surfaces. These are milling cutters, though the tools are single-edged ones, hence termed "inserted tooth mills." These are used on other machines besides the rotary planers, but the latter are massive machines built on the planer model, with but one housing or upright to carry the carriage of the cutter spindle. These machines, varied considerably in design, do good service on a class of work in which a very high degree of accuracy is not essential, as column flanges, ends of girders, feet of castings, and such like.

V.—Gear-cutting Machines

The practice of cutting the teeth of gear-wheels has grown but slowly. In the gears used by engineers, those of large dimensions are numerous, and the cost of cutting these is often prohibitive, though it is unnecessary in numbers of mechanisms for which cast wheels are as suitable as the more accurately cut ones. The smallest gears for machines of precision have long been produced by cutting, but of late years the practice has been extending to include those of medium and large dimensions, a movement which has been largely favoured by the growth of electric driving, the high speeds of which make great demands on reduction and transmission gears. Several new types of gear-cutting machines have been designed, and specialization is still growing, until the older machines, which would, after a fashion, cut all forms of gears, are being ousted from modern establishments.

The teeth of gear-wheels are produced either by rotary milling cutters or by single-edged tools (fig. 49). The advantage of the first is that the cutter used has the same sectional form as the inter-tooth space, so that the act of tooth cutting imparts the shapes without assistance from external mechanism. But this holds good only in regard to spur-wheel teeth, that is, those in which the teeth lie parallel with the axis of the wheel. The teeth of bevel-wheels, though often produced by rotary cutters, can never be formed absolutely correctly, simply because a cutter of unalterable section is employed to form the shapes which are constantly changing in dimensions along the length of the teeth (the bevel-wheel being a frustum of a cone). Hence, though fair working teeth are obtained in this way, they result from the practice of varying the relative angles of the cutters and wheel and removing the material in several successive operations or traverses, often followed by a little correction with the file. Although this practice is still commonly followed in bevel-wheels of small dimensions, and was at one time the only method available, the practice has been changing in favour of shaping the teeth by a process of planing with a single-edged reciprocating tool. As, however, such a tool embodies no formative section as do the milling cutters, either it or the wheel blank, or both, have to be coerced and controlled by mechanism outside the tool itself. Around this method a number of very ingenious machines have been designed, which may be broadly classed under two great groups—the form and the generating types.

In the form machines a pattern tooth or form-tooth is prepared in hardened steel, usually three times as large as the actual teeth to be cut, and the movement of the mechanism which carries the wheel blank is coerced by this form, so that the tool, reciprocated by its bar, produces the same shape on the reduced dimensions of the wheel teeth. The generating machines use no pattern tooth, but the principles of the tooth formation are embodied in the mechanism itself. These are very interesting designs, because they not only shape the teeth without a pattern tooth, but their movements are automatically controlled. A large number of these have been brought out in recent years, their growth being due to the demand for accurate gears for motor cars, for electric driving, and for general high-class engineers' work. These are so specialized that they can only cut the one class of gear for which they are designed—the bevel-wheels, and these in only a moderate range of dimensions on a single machine of a given size. The principal bevel-gear cutting machines using forms or formers, are the Greenwood & Batley, Le Progrès Industriel, the Bouhey (cuts helical teeth), the Oerlikon, which includes two types, the single and double cutting tools, the Gleason and the Rice. Generating machines include the Bilgram (the oldest), the Robey-Smith, the Monneret, the Warren, the Beale and the Dubosc.

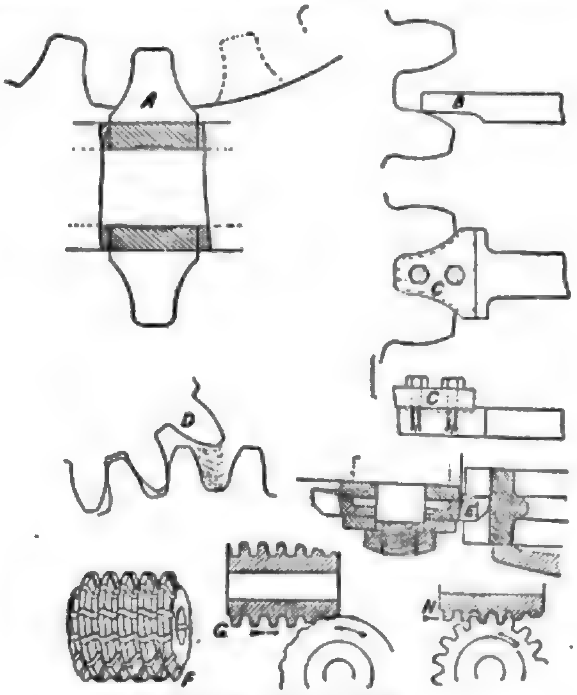


Fig. 49.—Gear Cutting.

A, Rotary milling cutter producing tooth space.
B, Planer tool operating on tooth flank.
C, Planer form-tool finishing tooth space.
D, Action of "Fellows" cutter, planing teeth.
E, Shape of "Fellows" cutter.
F, Hobbing cutter.
G, Tapered hob beginning worm-wheel.
H, Ditto finishing.

As the difficulties of cutting bevel-wheels with rotary cutters, consequent on change of section of the teeth, do not occur in spur-gears, there are no examples of form machines for spur-wheel cutting, and only one generating planing type of machine, the Fellows, which produces involute teeth by a hardened steel-cutting pinion, which shapes wheels having any number of teeth of the same pitch, the cutter and blank being partly rotated between each cut as they roll when in engagement.

The worm-gears appropriate a different group of machines, the demands on which have become more exacting since the growth of electric driving has brought these gears into a position of greater importance than they ever occupied before. With this growth the demand for nothing less than perfect gears has developed. A perfect gear is one in which the teeth of the worm-wheel are envelopes of the worm or screw, and this form can only be produced in practice in one way—by using a cutter that is practically a serrated worm (a hob), which cuts its way into the wheel just as an actual worm might be supposed to mould the teeth of a wheel made of a plastic substance. To accomplish this the relative movements of the hob and the wheel blank are arranged to be precisely those of the working worm and wheel. Very few such machines are made. A practical compromise is effected by causing the hob both to drive and cut the blank in an ordinary machine. When worms are not produced by these methods the envelope cannot be obtained, but each tooth space is cut by an involute milling cutter set at the angle of thread in a universal machine, or else in one of the general gear-cutting machines used for spur, bevel and worm gears, and only capable of yielding really accurate results in the case of spur-wheels.

The previous remarks relate only to the sectional forms of the teeth. But their pitch or distance from centre to centre requires dividing mechanism. This includes a main dividing or worm-wheel, a worm in conjunction with change gears, and a division plate for setting and locking the mechanism. The plate may have four divisions only to receive the locking lever or it may be drilled with a large number of holes in circles for an index peg. The first is adopted in the regular gear-cutters, the second on the universal milling machines which are used also for gear-cutting. In the largest number of machines this pitching has to be done by an attendant as often as one tooth is completed. But in a good number of recent machines the pitching is effected by the movements of the machine itself without human intervention. With spur-wheels the cutting proceeds until the wheel is complete, when the machine is often made to ring a bell to call attention to the fact. But in bevel-wheels only one side of the teeth all the way round can be done; the attendant must then effect the necessary settings for the other side, after which the pitchings are automatic.

As a general rule only one tooth is being operated on at one time. But economy is studied in spur-gears by setting several similar wheels in line on a mandrel and cutting through a single tooth of the series at one traverse of the tool. In toothed racks the same device is adopted. Again, there are cases in which cutters are made to operate simultaneously on two, three or more adjacent teeth.

Recently a generating machine of novel design has been manufactured, the spur-wheel hobbing machine. In appearance the hob resembles that employed for cutting worm-gears, but it also generates the teeth of spur and spiral gears. The hob is a worm cut to form teeth, backed off and hardened. The section of the worm thread is that of a rack. Though it will cut worm-wheels, spiral-wheels or spur-wheels equally correctly, the method of presentation varies. When cutting worm-wheels it is fed inwards perpendicularly to the blank; when cutting spirals it is set at a suitable angle and fed across the face of the blank. The angle of the worm thread in the hob being about 2½°, it has to be set by that amount out of parallel with the plane of the gear to be cut. It is then fed down the face of the wheel blank, which is rotated so as to synchronize with the rotation of the worm. This is effected through change gears, which are altered for wheels having different numbers of teeth. The advantage is that of the hob over single cutters; one hob serves for all wheels of the same pitch, and each wheel is cut absolutely correct. While using a set of single cutters many wheels must have their teeth only approximately correct.

VI.—GRINDING MACHINES

The practice of finishing metallic surfaces by grinding, though very old, is nevertheless with regard to its rivalry with the work of the ordinary machine tools a development of the last part of the 19th century. From being a non-precision method, grinding has become the most perfect device for producing accurate results measured precisely within thousandths of an inch. It would be rather difficult to mention any class of machine-shop work which is not now done by the grinding wheel. The most recent developments are grinding out engine cylinders and grinding the lips of twist drills by automatic movements, the drills rotating constantly.

There are five very broad divisions under which grinding machines may be classified, but the individual, well-defined groups or types might number a hundred. The main divisions are: (1) Machines for dealing with plane surfaces; (2) machines for plain cylindrical work, external and internal; (3) the universals, which embody movements rendering them capable of angular setting; (4) the tool grinders; and (5) the specialized machines. Most of these might be again classed under two heads, the non-precision and the precision types. The difference between these two classes is that the first does not embody provision for measuring the amount of material removed, while the second does. This distinction is a most important one.

The underlying resemblances and the differences in the main designs of the groups of machines just now noted will be better understood if the essential conditions of grinding as a corrective process are grasped. The cardinal point is that accurate results are produced by wheels that are themselves being abraded constantly. That is not the case in steel cutting tools, or at least in but an infinitesimal degree. A steel tool will retain its edge for several hours (often for days) without the need for regrinding, but the particles of abrasive in an emery or other grinding wheel are being incessantly torn out and removed. A wheel in traversing along a shaft say of 3 ft. in length is smaller in diameter at the termination than at the beginning of the traverse, and therefore the shaft must be theoretically larger at one end than the other. Shafts, nevertheless, are ground parallel. The explanation is, and it lies at the basis of emery grinding, that the feed or amount removed at a single traverse is extremely minute, say a thousandth or half a thousandth of an inch. The minuteness of the feed receives compensation in the repetition and rapidity of the traverse. The wear of the wheel is reduced to a minimum and true work is produced.

From this fact of the wear of grinding wheels two important results follow. One is that a traverse or lateral movement must always take place between the wheel and the piece of work being ground. This is necessary in order to prevent a mutual grooving action between the wheel and work. The other is that it is essential to provide a large range in quality of wheels, graded according to coarseness and fineness, of hardness and softness of emery to suit all the different metals and alloys. Actually about sixty grades are manufactured, but about a dozen will generally cover average shop practice. With such a choice of wheels the softest brass as well as the hardest tempered steel or case-hardened glass-like surfaces that could not possibly be cut in lathe or planer, can be ground with extreme accuracy.

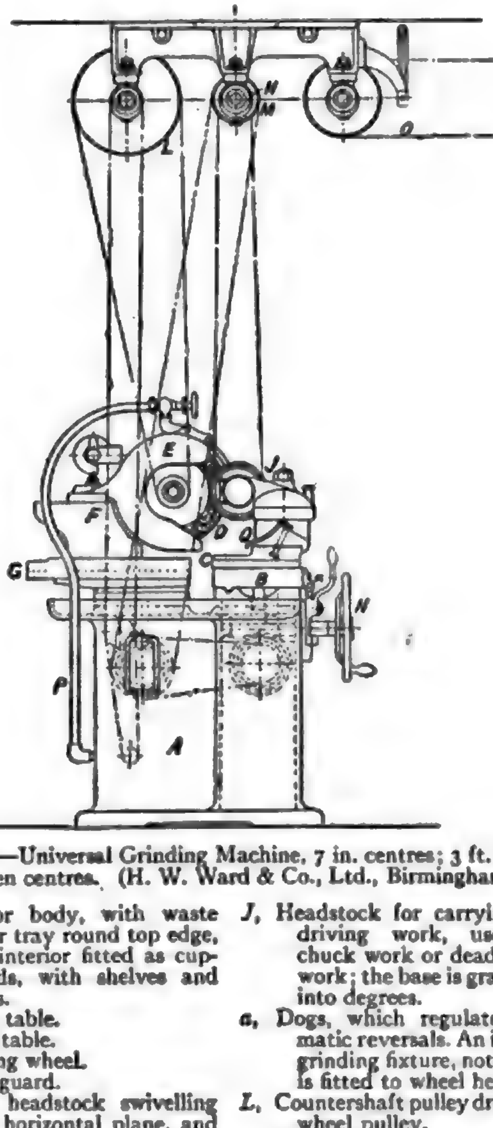


FIG. 50.—Universal Grinding Machine, 7 in. centres; 3 ft. 6 in. between centres. (H. W. Ward & Co., Ltd., Birmingham.)

A, Base or body, with waste water tray round top edge, and interior fitted as cupboards, with shelves and doors.
B, Sliding table.
C, Swivel table.
D, Grinding wheel.
E, Wheel guard.
F, Wheel headstock swivelling in a horizontal plane, and having the base graduated into degrees for angular setting.
G, Slide carrying headstock.
H, Hand-wheel for traversing table.
J, Headstock for carrying and driving work, used for chuck work or dead centre work; the base is graduated into degrees.
a, Dogs, which regulate automatic reversals. An internal grinding fixture, not shown, is fitted to wheel head.
L, Countershaft pulley driving to wheel pulley.
M, Pulley driving to cones.
N, Pulley driving to work headstock pulley.
O, Belt from line shaft.
P, Water pipe from pump.
Q, Water guards above table.

Plane surfacing machines in many cases resemble in general outlines the well-known planing machine and the vertical boring mill. The wheels traverse across the work, and they are fed vertically to precise fractional dimensions. They fill a large place in finishing plane surfaces, broad and narrow alike, and have become rivals to the planing and milling machines doing a similar class of work. For hardened surfaces they have no rival.

Cylindrical grinders include many subdivisions to embrace external and internal surfaces, either parallel or tapered, small or large. In their highest development they fulfil what are termed "universal" functions (fig. 50), that is, they are capable of grinding both external and internal cylinders, plane faces, tapers, both of low and high angle, and the teeth of various kinds of tools and cutters. These machines occur in two broad types. In one the axis of the revolving wheel is traversed past the work, which revolves but is not traversed. In the other the reverse occurs, the work traversing and the axis of the wheel with its bearings remaining stationary. Equally satisfactory results are obtained by each.

In all external cylindrical grinding, when the work can be rotated, the piece being ground rotates in an opposite direction to the rotation of the wheel (fig. 51, *A*). In all small pieces ground internally the same procedure is adopted (fig. 51, *B*). Incidentally, mention should be made of the fineness of the fitting required and attained in the construction of the spindles which carry the wheels for internal grinding. The perfection of fitting and of the means of adjustment for eliminating the effects of wear in the ordinary spindles for external and internal grinding is remarkable. The spindles for internal work have to revolve at rates ranging from about 6000 to 30,000 times in a minute, yet run so truly that the holes ground do not depart from accuracy by more than say $\frac{1}{5000}$ to $\frac{1}{10000}$ of an inch. Yet so long as the work can be revolved no special complication of mechanism is required to ensure good results. The revolution of the wheel and the work is mutually helpful. The real difficulties arise when the work, on account of its mass or awkwardness of shape, cannot be revolved. The principle embodied in machines designed to deal satisfactorily with such cases, though much diversified in detail, is the application of the planet device to the grinding wheels. That is, the wheel spindle rotating at a high speed, 6000 or 7000 revolutions per minute, is simultaneously carried round in a circular path, so that its axis makes about 25 or 30 revolutions per minute (fig. 51, *C* and *D*). The diameter of the path is capable of adjustment with minute precision within wide limits to suit bores of different diameters. The periphery of the grinding wheel which lies farthest from its axis of revolution sweeps round in a path the diameter of which equals that of the bore to be ground. These machines are now used largely for grinding out the cylinders of gas and petrol engines, valve seatings, the bushed holes of coupling rods, and similar classes of work. Many of them have their spindles set horizontally, others vertically.

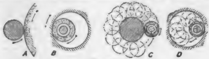


FIG. 51.

A, External cylindrical grinding. *B*, Internal ditto. *C*, External grinding when the work is fixed. *D*, Internal ditto.

Allied to these are a relatively small but important group of machines used for grinding the slot links of the slide-valve gear of locomotive and other engines. The slot is mounted on a pivoted bar adjusted to the same radius as the slot to be ground, and the slot is moved relatively to the wheel, so producing the required curves.

In another direction much development has taken place in the practice of grinding. The increasing use of the milling cutter has been the occasion for the growth and high specialization of the cutter grinding machines. It is essential to the efficiency of such cutters that regrinding shall be done without drawing the temper, and this can only be effected by the use of an abrasive. In the early days of their use the temper had to be drawn to permit of filing and rehardening effected with its inevitable distortion.

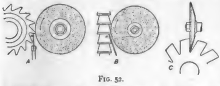


FIG. 52.

A, Grinding front edges of milling cutter. *B*, Grinding side edges of milling cutter; *a*, *a*, Tooth rests. *C*, Grinding face of formed mill.

Cutter grinding machines must possess universality of movements to deal with the numerous shapes in which milling cutters are made; hence they often resemble in general outlines the universal grinding machines. But as a rule they are built on lighter models, and with a smaller range of movements, because the dimensions of cutters are generally much smaller than those of the ordinary run of engineers' work which has to be ground. Frequently a single pillar or standard suffices to carry the mechanism. In an ordinary universal tool grinder all the teeth of any form of cutter can be ground precisely alike (fig. 52) excepting those having irregular profiled outlines, for which a special machine, or an extra attachment to an ordinary machine, is necessary. But little of this is done, because in such cases, and in many others, the faces of the teeth are ground instead of the edge. This idea, due to the firm of Brown & Sharpe, may seem a trifle, but nevertheless to it the credit is largely due for the economies of cutter grinding. The principle is that in the "formed cutter," as it is termed, the profiles of the teeth are not struck from the axis of revolution, but from another centre (fig. 20); grinding the tooth faces, therefore, has no effect on the shapes of the profiles, but only lessens the tooth thicknesses. Designed originally for the cutters for the teeth of gear-wheels, it has long been applied to profiles which involve combinations of curves. The pitching of the teeth is effected by a strip of metal, or tooth rest *a* (fig. 52), on which each successive tooth rests and is coerced during the grinding. If teeth are of special form the traverse movement of a spiral tooth along the rest ensures the required movement.

Besides the cutter grinders used for milling cutters, reamers and screwing taps, there are two other groups of tool grinders, one for twist drills only and the other for the single-edged tools used in lathe, planer, shaper and other machines. Both these in their best forms are of recent development. The machines used for grinding twist drills embody numerous designs. Hand grinding is practically abandoned, the reason being that a very minute departure from symmetry on the two cutting lips of the drill results inevitably in the production of inaccurate holes. It is essential that the two lips be alike in regard to length, angle and clearance, and these are embodied in the mechanism of the grinding machines. But formerly in all these the drill holder had to be moved by hand around its pivot, and one lip ground at a time There are now some very beautiful machines of German manufacture in which the necessary movements are all automatic, derived from the continuous rotation of a belt pulley The drill rotates constantly, and small amounts are ground off each lip in turn until the grinding is finished. The other group for grinding single-edged tools is a very small one. The correct angles for grinding are embodied in the setting of the machine, with the great advantage that any number of similar tools can be ground all alike without skilled attendance.

Lying outside these broad types of machines there is a large and growing number designed for special service. The knife-grinding group for sharpening the planer knives used in wood-working machinery is a large one. Another is that for gulleting or deepening the teeth of circular saws as they wear. Another is designed for grinding the cups and cones for the ball races of cycle wheels, and another for grinding the hardened steel balls employed in ball bearings.

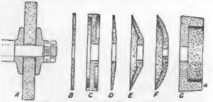


FIG. 53.—Typical Grinding Wheels.

- *A*, Common disk held on spindle with washers and nuts.
- *B*, Thin disk.
- *C*, Flanged disk for grinding to shoulders.
- *D*, Bevelled disk for cutter grinding.
- *E*, *F*, Cupped and dished wheels for cutter grinding.
- *G*, Cup wheel for grinding on face *a*; diameter remains constant.

Emery grinding is dependent for much of its success on a plentiful supply of water. Dry grinding, which was the original practice, is hardly employed now. The early difficulties of wet grinding were due to the want of a cementing material which would not soften under the action of water. Now wheels will run constantly without damage by water, and they are so porous that water will filter through them. Improvements in the manufacture of wheels, and the increased use of water, have concurred to render possible heavier and more rapid grinding without risk of distortion due to heating effects. In the best modern machines the provisions for water supply are a study in themselves, including a centrifugal pump, a tank, jointed piping, spraying tube, guards to protect the bearings and slides from damage, and trays to receive the waste water and conduct it back to the tank.

There are two points of view from which the modern practice of grinding is now regarded—one as a corrective, the other as a formative process. The first is the older and is still by far the most important. The second is a later ideal towards which design and practice have been extending. As yet grinding cannot compete with the work of the single-edged tools and milling cutters when large quantities of material have to be removed. Just as some leading firms have been designing stiffer machines having fuller lubrication with a view to increase the duty of grinding wheels, the advent of the high-speed steels has given a new lease of life to the single-edged cutting tools. The rivalry now lies not with the tools of carbon temper steel, but with high-speed varieties. But as a corrective process grinding never occupied so important a position as it does to-day, and its utility continues to extend.

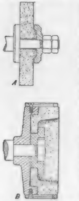


FIG. 54.—Safety Devices.
A, Grinding wheel, with coned washer to retain broken pieces in case of fracture.
B, Cup wheel with encircling ring, moved backwards as the wheel face wears.

The commoner forms in which grinding wheels are made are shown in fig. 53. These are varied largely in dimensions, from tiny cylindrical rollers a fraction of an inch in diameter for hole grinding, to big wheels of 3 ft. or more in diameter. Safety mountings, two examples of which are shown in fig. 54, embody means of retaining the broken pieces of a wheel in case it bursts.

Sand-blast.—The well-known erosive action of sand when driven against rocks and stones by the wind is utilized industrially in the sand-blast apparatus, the invention of B. C. Tilghman. The sand is propelled by a current of steam or air, and being delivered through a nozzle is directed against the surface of the work, cutting it away by the action of the enormous number of grains striking the face, each removing a very minute quantity of material. The action is very gentle, and may be modified by varying the class of sand and its velocity. Other materials, such as emery, chilled iron globules, &c., are employed for certain classes of work. In some instances the powder is used dry, in others it is mixed with water, being then in the condition of fluid mud. The plant includes an air-compressing engine, an air reservoir and the blast nozzle through which the air passes and propels the sand in the form of a jet. The pressures range from 8 lb up to about 60 lb per sq. in., depending on the class of work which is done.

The peculiar advantage of the sandblast lies in its adaptability to the working of irregular surfaces, which could not be touched by any other class of grinding. The blast penetrates hollows and recesses, and acts over an entire surface. There are many classes of operation done with the sand-blast, including cleaning, frosting, ornamentation, engraving and sharpening. In engineers' works a large amount of cleaning is effected upon castings, forgings, sheets and other products, either preparatory to machining or to painting, enamelling, tinning, galvanizing or plating. Cycle frames are cleaned with the sand-blast after brazing. The teeth of files are sharpened by directing a stream of sand and water against their backs, with the result that the burr thrown up by the chisel when cutting is obliterated, and a strong form of tooth is produced. Worn files may also be sharpened up to equal new ones by sand-blasting them. Frosting glass is another useful application of the sand-blast, and by attaching suitable patterns or designs to the surface the sand may be caused to work ornamental figurings. It is a peculiar circumstance that the sand has little effect upon soft and yielding substances in comparison with the abrasion it produces on hard surfaces, so that the pattern will remain undamaged, while the glass or other object beneath is frosted where the sand reaches it, through the openings. Not only can designs be worked on glass, or cut in stone, but perforations may be made in glass, &c., by the continued action of the sand, without any risk of fracture occurring. Much sand-blasting is performed inside closed chambers, having panes through which the workman watches the progress of the operation. But when the blast must be used in the open, protection is necessary and is afforded to the operator by a special helmet, which keeps out the flying dust and gives a supply of pure air through a tube in a similar fashion to the diver's helmet.

VII.—SAWING MACHINES

Metal-sawing machines are employed extensively in engineering works for cutting off bars, shafts, rails, girders and risers on steel castings, and for getting out curved pieces which would be difficult and expensive to slot. There are three classes of these saws, circular, band and reciprocating. The first named are used for straight-forward work, operating at right or other angles, the second for straight cuts and also for curves which cannot be treated with circular saws, and the third for small pieces. The circular saws embody a stiff spindle, carrying the saw disk and driven by gearing. This spindle may be mounted in a sliding bearing to carry it past the work held on a fixed table, or the spindle may be stationary and the work be moved along past the saw. The method of feeding should be sensitive, so that it will "give" and prevent damage

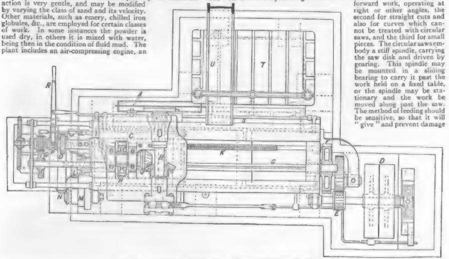


FIG. 55.—Cold-sawing Machine. (Isaac Hill & Son, Derby.)

A, Saw blade.
B, Spindle.
C, Sliding spindle carriage.
D, Driving pulleys.
E, First pinion, connecting through train of gears to wheel *F*, driving splined shaft *G*.
H, Wheel driven from sliding pinion on *G*.
J, Bevel-gears, communicating the motion to spindle *B*.
K, Screw for feeding carriage *C* along.
L, Three-step cone on shaft *G*, belted to *M*, connected by bevel-gears *N* and worm-gear *O*, to the screw *K*.
P, Clutch for throwing in *O* to drive *K*.
Q, Gears connecting shaft of *L* direct to *K*, also through clutch *P*.
R, Handle for operating clutch *P*, which thus gives slow feed when clutch is in mesh with *O*, and quick return when engaging with *P*.
S, Tappet rod, having dogs struck by carriage to stop feeding.
T, Work-table, with clamp to hold objects.
U, H-Girder being sawn off.

to the teeth, should undue stress come upon the saw. This is usually effected by the use of weights or springs, which allow a certain freedom or latitude to the driving gears. The work is held by screw clamps, V-blocks being required in the case of circular objects. A number of pieces, such as shafts, rails or girders, can be fastened down close together in a pile and cut through in one operation.

There is a very useful class of circular saw, the flush-side (fig. 55), that is valuable for cutting close up to a surface. The disk is bolted to a flange on the end of the spindle with countersunk bolts, so that the face is quite flat. Another class of saw used for dealing with girders and bars is carried in bearings upon a pivoted arm, which is pulled downwards by a weight to give the feed. The work is bolted to a table below the saw. Ample lubrication, by oil or soapy water, is essential in cutting wrought iron and steel; it is pumped on the blade, keeping it cool and washing away the cuttings.

Band-saw machines resemble in outline the familiar types employed for sawing wood, but they are necessarily stronger and stiffer, and the saws run at a much lower speed. The tables, moreover, differ in possessing compound slides for moving the work and in the provision of a series of slots on the top table, whereby the object to be sawn is secured with bolts and clamps. The tables are moved automatically or by hand. The rate of cutting must be varied according to the thickness of metal. Lubrication is effected by running the lower saw pulley in a bath of oil or soapy water, which is carried up, so keeping the blade cool and "easing" the cut.

The reciprocating class of saw has until recently been confined to small types for workshop use, termed hack saws, which have a small blade ranging from 12 to 18 in. long. This is strained between a couple of bearings in a frame which is reciprocated above the work clamped in a vice. An arrangement of weights feeds the saw downwards. The larger hack saws cut off bars and girders up to 12 in. across, and in some there is a provision introduced for giving intermittent rotation to the bar, thus presenting fresh faces to the saw. The hack saw is of great utility for comparatively light work, and, as the smallest blades are cheap enough to be thrown away when worn out, there is no trouble and expense connected with their sharpening, as in the circular and band saws. An adaptation of the reciprocating saw is that of the jig type, which has a small blade set vertically and passing up through a table on which the work is laid. It is handy for cutting out dies and various curved outlines, in the same manner that fret-sawing in wood is done.

VIII.—Shearing and Punching Machines

These have much in common as regards their mode of operation. They are actuated either by belt and spur gearing, by steam-engine, by electric motor, or hydraulically. The first named is only suitable where arrangements can be made for driving from a line shaft. In view of the great convenience of the other methods of driving, they are coming into greater use, especially for ship-yards and other works where shafting is undesirable or inconvenient.

For boiler makers' and platers' use the function of punching, and shearing are usually combined in one machine, the rams being placed at opposite ends and actuated from the same source of power. The last shaft in the train of gearing is set to bring its ends within the boxes containing the rams, and eccentrics on the shaft are moved within die blocks fitted to the rams, so that as the shaft revolves it causes the rams to move up and down and operate the shear blade and the punch attached to the bottom end. Another class of machines is worked by means of massive levers, pivoted in the framing, and actuated by cams on the driving shaft which cause the levers to rock and move the punches or shears up and down by the opposite ends. The punch slides are constructed to "dwell" for a short period at the top of the stroke at each revolution, thus giving the attendant time to place and adjust the plate accurately beneath the punch. The same effect is obtained in the eccentric types of machines mentioned above, by a disengaging motion, which is thrown in by touching a lever, thus stopping the punch until the operator is ready for its descent. The more complete machines have an angle shear situated centrally, with V-blades for severing angle iron. The largest forms of shears, for massive plates, usually have the blade reciprocated by crank or eccentrics on the driving shaft, coupled by connecting-rods to the slide.

Hydraulic punching and shearing machines are used largely on account of their convenience, since they dispense with all belts, engines or motors in the vicinity, and give a very powerful

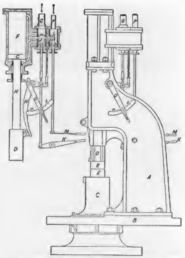


FIG. 57.—Steam Hammer, small Overhanging Type. (B. & S. Massey, Manchester).

A, Standard. *B*, Base-plate.
C, Anvil block (independent of standards).
D, Tup or hammer head.
E, *E*, Pallets, or forging blocks, attached to anvil and tup.
F, Steam cylinder.
G, Piston, solid with piston rod *H*.
J, Piston valve, regulating period of admission of steam, operated by hand by lever *K* or lever *N*.
L, Stop or throttle valve for controlling admission of steam to valve chest, operated by hand lever *M*.
N, Lever in contact with roller on tup *D*, which moves the valve *J* automatically as the tup rises and falls.
O, Lever for pre-adjusting the range of movement of *N* and *J*, according to its setting in the notches of the quadrant from *a* to *b*.
P, Steam supply pipe from boiler. *Q*, Exhaust steam pipe.

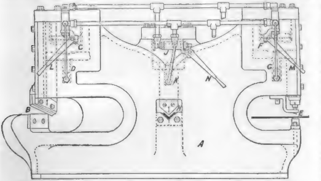


FIG. 56.—Hydraulic Punching and Shearing Machine. (Musgrave Brothers, Leeds.)

A, Frame.
B Shear blades, set angularly.
C. Ram for operating blade.
D, Small ram for returning ditto.
E, Punch.
F & *G*, Main and return rams for punch.
H, Angle shear.
J, *K*, Main and return rams for ditto.
L, *M*, *N*, Attendant's controlling handles.

stroke. The hydraulic cylinder is generally direct-connected to the slides, and the operator turns on the pressure water by a lever. The machine shown in fig. 56 is a very complete example of the hydraulic type, combining punching and shearing with angle-cutting.

Circular shears are used for the thinner plates and for sheet-metal work; they embody two circular blades placed with their axes parallel, and the sharp bevelled edges nearly in contact. The blades being rotated sever the plate as it is fed between them. Either straight or circular cuts may be made; true circles or disks are produced by mounting the plate on a fixed stud and rotating it through a complete revolution past the cutters.

IX.—Hammers and Presses

The growth in the use of hammers actuated by steam and compressed air, and of presses worked by water power, has been remarkable. The precursors of the power hammers were the helve and the Oliver; the first named was operated by gravity, being lifted by a circle of cams, while the second was lifted by a spring pole overhead and pulled down by the foot of the workman, acting on a lever—the hammer shaft. The first was used by the ironworkers and the second by the smiths, until displaced by the Nasmyth hammer and its extensive progeny. Even now the old helve and Oliver survive in some unprogressive shops.

Steam Hammers.—The original hammer as invented by James Nasmyth was single acting, operating simply by gravity, the function of the steam being to lift the hammer for each succeeding fall. The first improvement was made by Rigby, who took the waste steam exhausted from the lower side of the piston to the upper side and so imparted some slight pressure in the descent. It was a stage between the early and the present hammers. In these, high-pressure steam is admitted above the piston to impart a more powerful blow, compounded of velocity×mass, than is obtainable by gravity; hence they are termed double-acting hammers (fig. 57). The principal difficulties which have to be surmounted in their construction are those due to the severe concussion of the blows, which very sensibly shake the ground over an area of many yards. Framings are made very rigid, and in the larger hammers double, enclosing the hammer head between them. The foundations are by far the heaviest used in any machine tools. Deep piling is often resorted to, supporting crossing timber balks; or concrete is laid in mass on which the iron anvil block is bedded. This block weighs anywhere between 100 and 1000 tons. The piston and its rod and the hammer head are generally a solid steel forging, for the piston rod is a weak element and cottered or screwed fittings are not trustworthy. Piston valves are generally used in preference to ordinary D-valves, combining simplicity of fitting with good balance. The periods of steam admission are under the control of the attendant, so that the length of stroke and the force of the blow are instantly responsive to his manipulation of the operating lever. Many hammers can be set to run automatically for any given length of stroke.

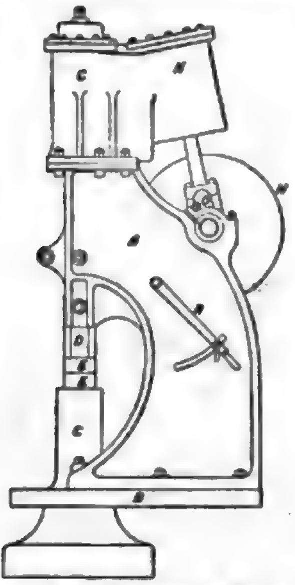


Fig. 58.—Pneumatic Forging Hammer.

(W. & J. Player, Birmingham.)

A,	Standards.
B,	Base-plate.
C,	Anvil block.
D,	Tup.
E, *E*,	Pallets.
G,	Hammer cylinder, the piston rod of which is attached to *D*.
H,	Air compressing cylinder.
N,	Belt pulleys which reciprocate by means of the crank *O*, the piston in *H*.
R,	Handle controlling the valve between *H* and *G*.

Pneumatic Hammers.—A successful type of hammer for the ordinary operations of the smithy is that which is actuated by compressed air. Though designs vary the principle is the same, namely, air compressed in a controlling cylinder (fig. 58), and brought into an operating or *hammer* cylinder above the piston. Cushioning, or release of the air below the piston, is under control, as is the pressure of the air above it.

Drop Hammers.—The requirements of forged work have, besides the power hammers operated by a positive down stroke, been the cause of the development of an equally large group which are gravity hammers only —the drop hammers. They are put into operation by a belt or belts, but the function of the belt is simply to lift the hammer to the height desired, at which point it is released and falls. The place of the drop hammer is in the lighter class of smith's work, as that of the steam hammer lies in the heavier, but there is much overlapping, since small steam hammers are rivals to the others in light forging. But, speaking generally, the largest volume of repetitive die forging or stamping of light articles is done under drop hammers. The small arms factories and the regular stamping shops scarcely use any other type. They may be roughly divided into three great groups; the belt, the board and the latest form—the Brett lifter. In each the hammer head or tup is lifted to any height within the range of lift, the height being controlled by the attendant at each blow. In most machines setting can be done at any constant height and the blows delivered automatically. Control is effected by hand or foot or both. Drop hammers generally have the advantage of working with greater rapidity than steam hammers.

The original drop hammers, which are believed to have originated with the locksmiths of Birmingham and district, consisted of a hammer head attached to a rope, one end of which ran up over a loose pulley suspended in the roof, and the other was pulled by a man or two men, so lifting the hammer, which was then allowed to drop. The principle is embodied in many belt hammers to-day, but the pulley is driven constantly by shafting, and when the attendant pulls at the free end of the belt the friction of the pulley draws the belt over and lifts the hammer until the attendant lets it go. The weight lifted is greater than in the old type, but the labour is nevertheless very severe, and the blows are not rapid enough for quick forging. A far better machine is the board hammer. In this (fig. 59) the place of the belt is taken by an ordinary strip of board which passes between two rollers at the top of the hammer, which rollers are belt driven. The rollers are fitted on eccentric

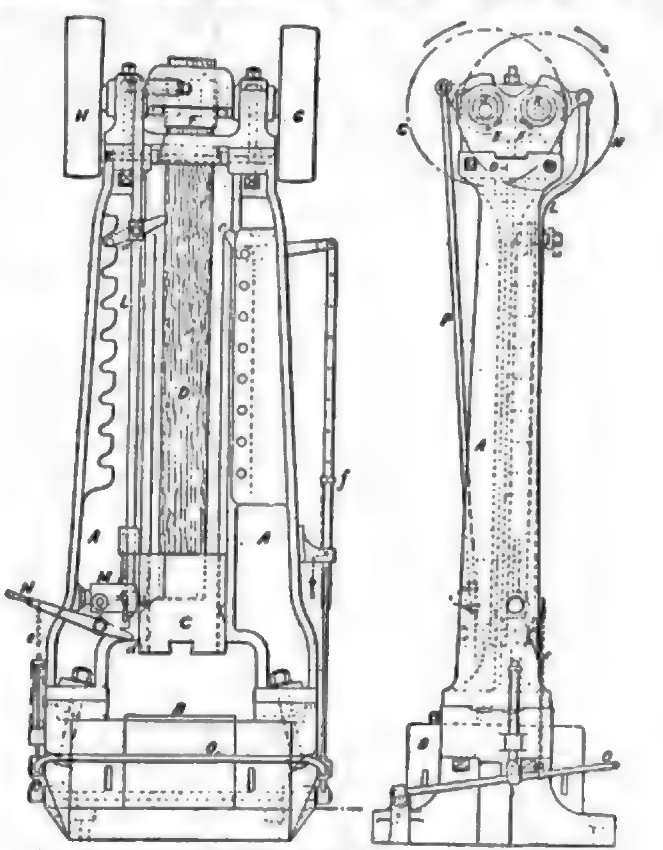


Fig. 59.—Drop Hammer—board type. (B. & S. Massey, Manchester.)

A, *A*,	Standards.
B,	Anvil, or baseblock.
C,	Tup.
D,	Board, fitting in slot in tup.
E, *F*,	Rollers gripping and lifting board.
G, *H*,	Pulleys actuating rollers through eccentrics *J*, *K*.
L,	Rod by which the amount of lift is regulated.
a,	Dog and lever adjustable on *L*, which strikes the edge *b* of the tup, releasing eccentrics and roller and allowing tup to fall.
c,	Catch on which tup rests previous to release, fitted into either one of the row of holes beneath, to suit various heights of drop.
M,	Mechanism struck by the edge *d* of the tup, which either keeps the roller *F* clear of the board *D*, allowing the tup to fall, or brings the rollers *E* and *F* into contact, and lifts the board and tup.
N,	Hand-lever for operating hammer.
O,	Foot-lever for ditto, connected by chain *e*.
f,	Spring for lifting levers.
P,	Rod with nuts *g*, to compensate for wear on the rollers by the adjustment of roller *E*.

pins, so that the movement of levers causes them to grip the board for the lift, or release it for the fall, these levers being under the control of the attendant. They can also be set to operate automically for any height of lift.

These types are all subject to much concussion and vibration, because the machines are self-contained; anvil, standards and heads being rigidly bolted together, the concussion of every blow is transmitted through the entire mechanism. The Brett hammers (fig. 60) are designed to lessen this, in some cases by making the anvil distinct from the superstructure, and in all by connecting the lifting ropes to the ends of long levers which act something like elastic springs, absorbing vibration. The driving mechanism is also original, comprising a cylinder with a wing piston, which is rotated by steam pressure through an arc of a circle only, sufficiently to operate the lifting levers. Another advantage is that the lifter cylinder need not be immediately over the hammer, but may be situated elsewhere. The hammer can be operated by hand directly for each stroke, or be set to work automatically.

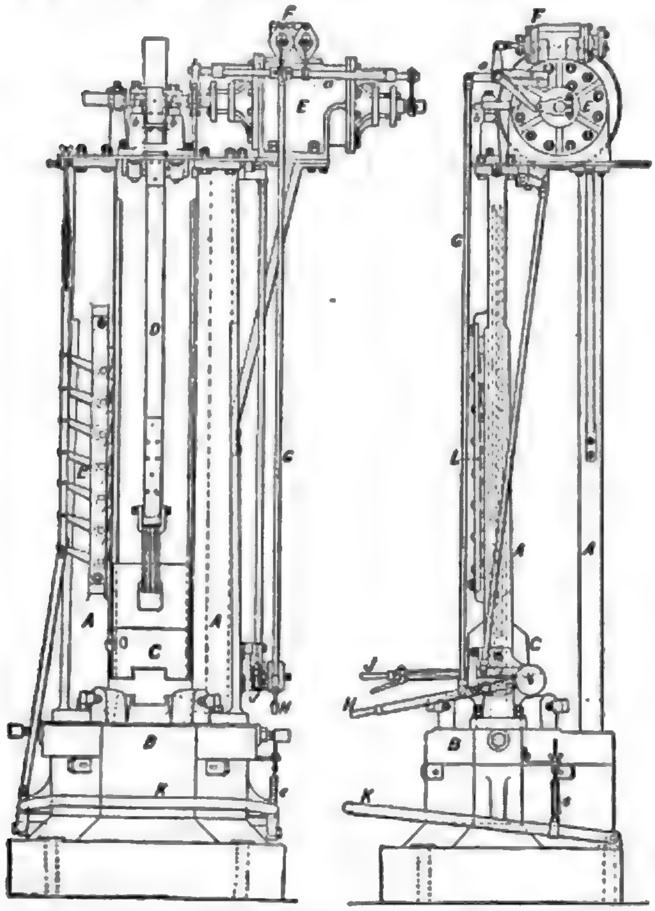


FIG. 60.—5 cwt. Belt Drop Hammer with Brett's Lifter. (Brett's Patent Lifter Co., Ltd., Coventry.)

A, *A*, Uprights.
B, Anvil.
C, Tup.
D, Belt.
E, Lifter cylinder.
F, Valve casing.
G, Rod operating valve by lever *H*.
a, Rock shaft.
b, Buffer blocks which arrest motion of lever *c*.
d, Lever for automatic regulation of valve.
J, Lever for regulating amount of opening of valve by hand.
K, Foot lever for holding tup in either of the stops *L*.
e, Spring for foot lever.

Spring Hammers are a rather smaller group than the others. In these a belt-driven pulley actuates the tup through the medium of elastic leaf springs. The length of stroke is adjustable across the face of a slotted disk on the driving shaft.

Forging Machines.—The Ryder forging machine is fitted with four or five pairs of swage tools, the lower halves being fixed and the upper ones driven by a rotating eccentric shaft. The operations imitate those on the anvil by hand forging, but from 800 to 1200 blows are delivered in a minute. The swages are arranged in succession, so that an operation is begun at one end and finished at the other, the attendant moving the bar rapidly through the successive swages or dies.

Forging Presses.—These are rivals to the hammers, especially for heavy forgings, from which hammers are being rapidly displaced (fig. 61). It is now well understood that a hammer will not effect the consolidation of a massive forging right to the centre as a press will. The force of the hammer blow is not transmitted to the centre as is that of a press, nor is the hammer so useful in work of large dimensions but of no great weight. In railway and wagon shops the presses are used far more frequently than the hammers. A great advantage of the press is that two and three rams can be brought into operation so that a forging may be pressed from above, from below and to one side, which is of great value in complicated forms and in welding, but is not practicable in the hammers. Hence the forging presses have become developed for work of average dimensions as well as for the most massive. Many are of horizontal type, termed bull-dozers.

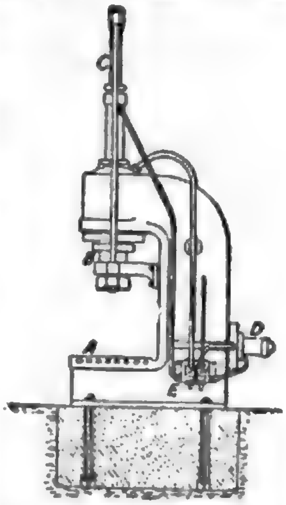
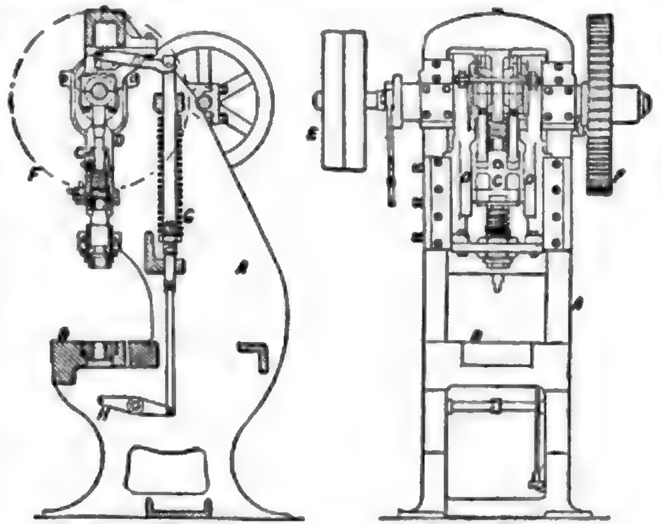


FIG. 61.—Hydraulic Forging Press. (Fielding & Platt, Ltd., Gloucester.)

A, Table.
B, Vertical ram.
C, Drawback ram for returning *B*.
D, Horizontal ram.
E, Controlling valves.

Power presses for working sheet-metal articles include those for cutting out the blanks, termed cutting-out or blanking presses, and those for cupping or drawing the flat blank into shape if desired (fig. 62). The lower dies are held upon a bed, and the upper in a sliding ram, moved up and down by a cam or crank-shaft. A clutch mechanism is fitted, by means of which this shaft is connected with or disconnected from the heavy driving-wheel at will to give a single stroke or a series of strokes to the ram. In the normal state the ram remains stationary at the top position. The lightest presses are driven direct by belt on the crank-shaft pulley, but in the heavier classes spur-gearing must be interposed between the pulley shaft and the final shaft. The operation of drawing requires an encircling die which presses on the blank as it lies on its die, the cupping of the blank being effected by the downward motion of the plunger.



Sectional Elevation. Front Elevation.

FIG. 62.—Power Press.

A, Main frame.
B, Bed for attaching dies.
C, Central slide.
D, Outer slide.
E, Belt pulleys on shaft, geared to wheel *F* thrown in by clutch to drive its shaft, which has two crank pins to reciprocate *D* and a cam disk actuating *C*.
G Extractor rocked downwards as slide rises to raise lever *H* and work an ejector rod, forcing finished article out of die.

This is why the machine shown in fig. 62 has an outer slide *D*, which is made to "dwell" with an even pressure, while the middle ram is moving down and drawing out the article. Blanking and cupping may be done as one continuous operation if the work is shallow.

Inclinable presses are employed for certain classes of work, the object being to let the stamped articles slide down the slope of the bed as rapidly as they are produced, instead of having to be removed by the operator. Much work can be placed on the dies by hand, but for producing large quantities of small articles automatic feeds are employed whenever possible. A good deal of work is produced from flat sheet, supplied in the form of a roll and fed through rollers by intermittent movements to the dies. Circular turn-tables are also used, operated by ratchet devices, which turn the tables round to bring a ring of pockets, carrying the pieces, successively under the dies; the attendant keeps the pockets supplied, but his hands do not come near the dies.

X.—PORTABLE TOOLS

The growth of portable machine tools is one of the remarkable movements of the present day. To some extent they have always been used, notably in the drilling and tapping operations of locomotive fire-boxes, but not until recently to any important extent in the ordinary fitting and erecting shops. The main reason lay in the difficulties due to transmission of power by ropes or shafts. The employment of compressed air, water, electricity and flexible shafts, by which long distances can be covered, has given new life to the portable system, which is destined to occupy a place of even greater importance than it does at present. The reason for the growing desirability of these tools is to be seen in the massive character of much engine and machine construction of the present time. Although firms that undertake the largest work can generally arrange to tool the individual parts on machines of massive sizes, that only meets a part of the difficulty. Very big work cannot be treated like that of small or even medium dimensions, done repetitively; that is, it is not practicable to drill and bore and ream and provide for the fitting of every piece by the aid of templets and jigs, while the work lies on the machine, but a great deal of adjustment and mutual fitting has to be accomplished in the course of erection. Therein lies the opportunity for the portable machine. If this is not used the alternatives are partial dismantling of the work and the transference of certain portions to machines or hand work. Another cause has been the substitution of machining for much hand work formerly done on massive constructions.

The principal operations for which portable tools are designed are the following: Drilling, screwing, cutting the seatings for keys, planing short portions of work, facings for the attachment of other pieces, as brackets and bearings, hammering operations, as in making welded joints, caulking the edges of boiler plates, chipping with hammer and chisel, riveting, ramming sand in foundry moulds, planing ships' decks, and some operations of lesser magnitude.

Portable tools are used in various ways. The first and most obvious is to attach them directly to the casting, forging or machine which is being built up. Thus a drilling machine will be clamped just where it is required to operate. Or if it has to be used on a large plane surface as a ship's deck, an electrical machine is suitable, in which magnetic attraction is set up between the foot of the machine and the deck sufficient to hold it down. A key-seating machine will be clamped on the shaft in which a keygroove has to be cut. A drilling machine may be fastened to a pipe with a chain embracing the pipe. Very many of the drills, and all the caulking and chipping hammers, are grasped in the hands and so thrust to their work. The tapping of screw holes is mostly done in this way, a common example being the holes for the stay bolts in the fire-boxes of steam boilers.

Another later method which has been introduced and practised in a few shops consists in installing a cast-iron floor-plate of large area, planed truly and provided with bolt holes and slots. On this a massive casting, forging or piece of work undergoing erection will be bolted. Then the portable tools—planers, drills, &c., as required—will be bolted to the table and brought into operation on the various sections of the work, several sometimes operating simultaneously. This method is to a certain extent coming into rivalry with the abnormal growth of machine tools, the development of which has been greatly accelerated by the massive dimensions of productions which only became possible by the substitution of steel made by the Bessemer and Siemens processes for iron.

The reciprocating motion necessary to effect hammering, chipping or caulking operations is produced by the action of a solid piston, sliding in a cylinder (fig. 63) and driven sharply against the end of the tool by the inrush of compressed air, being then returned for another stroke. The strokes range in number up to as many as 2000 per minute in some cases. For heavy riveting a "long-stroke" hammer is employed, having a longer barrel than the chipping hammer shown in fig. 63, in order to obtain a greater force of blow. The operator grasps the hammer by the handle, with his fingers or thumb on the controlling lever, and as long as this is held down the blows continue. The air-supply pipe is flexible, so that it does not impede the movements of the workman. The tools at the end of the cylinder are simply held in a socket, so that they can be changed rapidly.

Rotative motion can be produced either by electric or pneumatic motors, and both systems are in wide use. Pneumatic motors are very suitable when an air-compressing plant is already laid down for other tools, while if electricity is used in the works portable tools operated by this agent may be employed instead of the pneumatic ones. In the electric drills (fig. 64) a small motor is fitted within the body and connected by spur-gears to the spindle to effect suitable speed reduction. A switch provides for stopping and starting the motor; the current is brought through a flexible cable which, like pneumatic hose, is armoured with wire to protect it from damage. The smallest drills are simply gripped in the operator's hand and pushed up to the work; larger ones are supported by a pillar and arm, against which the thrust is taken, and the feed given by turning a screw at intervals.

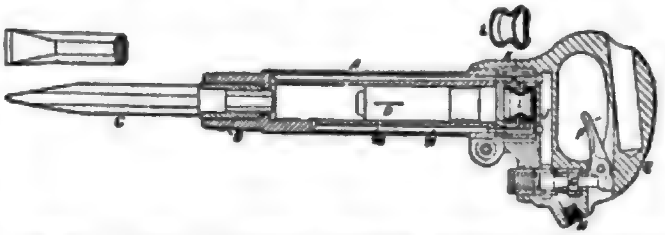


FIG. 63.—Tierney Pneumatic Chipping Hammer. (The Globe Pneumatic Engineering Co., Ltd.)

A, Cylinder.
B, Tool socket, carrying chisel *C*.
D, Piston, which strikes the back of *C*.
E, Handle, screwed and clamped to *A*.
F, Trigger or lever clasped by operator's hand and opening valve *G*, admitting compressed air through connexion *H*. up passage *J*, through valve-box *K*, past valve *L*, and so against end of *D*, moving it towards *C*. As soon as the groove in the piston *D* registers with the hole *M*, air is admitted from a small hole (not shown), passes round the groove through hole *M* and passage *N* to the rear of the valve. This acting on the back of the valve throws it forward, thus shutting off the supply to the rear of the piston and permitting a small quantity of air to flow to the forward end of the piston for driving it in a backward direction. As soon as the air pressure is relieved on the back of the valve by the uncovering of exhaust holes (not seen) by the piston *D*, the valve is returned to the original position, owing to the air constantly pressing on the small area of the valve.

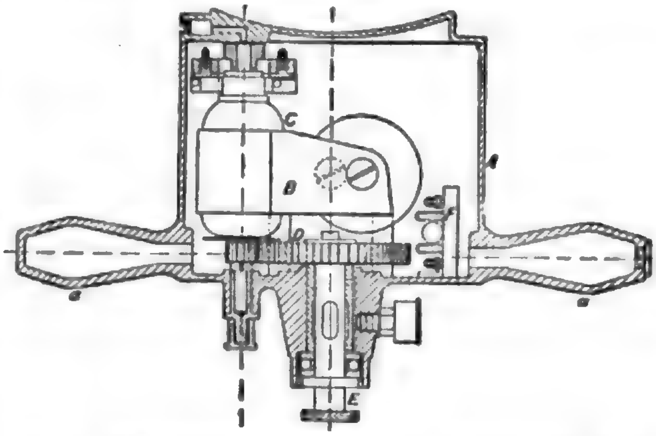


FIG. 64.—Electrically-driven Hand Drill. (Kramos Ltd., Bath.)

A, Body, cast in aluminium, with handles *a*, *a*.
B, Motor, with revolving armature *C*, connected by spur-gears *D*, to the drill spindle *E*, fitted with ball thrust bearings.
F, Switch, operated by attendant pushing in a plug; the current is brought by flexible wires through the right-hand handle *a*.

Pneumatic drills are usually worked by little motors having oscillating cylinders, by which the air and exhaust ports are covered and uncovered. They run at a high speed and are geared down to the spindle. In some cases two cylinders are used, but often four are fitted to give a powerful and equable turning moment. Grinding machines are also built with air motors directly coupled to the wheel spindle, the machines being moved about over the work by handles.

Another class of portable tools is driven, not by self-contained motors, but from an outside source of power, which is conveyed to the tools through flexible shafts built up of a series of spiral springs, or through flexible joints which form a connexion that permits the shaft to bend round corners and accommodate itself to any position in which the tool may be placed. The advantage of this is that the tool itself is much lightened, since there is no motor, and it can therefore be easily handled. Thus a drill simply contains the spindle, running in a frame which carries bevel-gears for transmitting the motion of the flexible shaft. Portable grinders also have nothing but the spindle, wheel and frame.

XI.—APPLIANCES

Appliances are vastly more numerous in a modern shop than in the older works, largely on account of the more repetitive character of the operations done and of the desire to eliminate human labour, with its greater cost and chances of inaccuracy in the finished product. On all machines there are numerous aids by which the fixing of the work is facilitated. Many of these consist of simple packing blocks, by which heights are adjusted. These reach their higher developments in wedge-shaped packings, some of which are operated by a screw, while others act directly by screws. In some cases the exact height can be ascertained by observing graduations on the packings. Circular work is held in V-blocks, which occur in numerous modified forms. Various kinds of straps, clamps and bolts are used for gripping work with sufficient security to enable it to withstand the stress of the heaviest cutting. The highest development of all is attained in the templets and jigs, which are now indispensable in all modern shops, and which increase in number and complexity as the product of the shop becomes more specialized. A templet is a piece of metal cut to a definite shape, which being laid upon the work becomes a guide for striking the same shape on the surface of the work with a pointed scriber, and by which the tooling of any number of similar pieces is done without the labour of lining out each separate piece. Obviously, in such a case the degree of accuracy of the tooling still depends on the machine hand, who may work exactly, or only approximately, to these lines. Hence a great advance is made in the jig, which may be defined generally as a templet that is clamped rigidly to the work, or a box in which the work to be tooled is held. No marking off is done, but the jig becomes the actual guide for the operation of the cutting tools. The operation most frequently performed in jigs is drilling. Then the holes in the jig receive and coerce the drills, so that the holes made cannot vary in the least degree from those already in the jig. As it will often happen that hundreds or thousands of similar pieces will have to be tooled in this manner, holes in jigs are generally bushed with hardened steel, which is capable of enduring very lengthy service, and which can be renewed when worn. This is a simple illustration, but many jigs are of an extremely elaborate character, for it is obvious that the cost of a jig, though it may run into many pounds, becomes a mere trifle when spread over some thousands of pieces of work.

XII.—Wood-working Machinery

There is a large range of various classes of tools for performing the operations on timber, from the rough log to the finished product. Division is effected by saws, planing and finishing to outlines by knives or cutters, boring by augers and smoothing by sandpaper.

The first operation is that of tree-felling, which is often effected by machine, consisting of a reciprocating blade, working horizontally in a frame and moved by a steam cylinder. The boiler is separate, so that the machine may be transported about and set to work over a considerable area, steam being conveyed to it by a flexible pipe. When the trees are brought into the saw-mills in the form of logs, *i.e.* with the branches lopped off, they are often cross-cut to reduce them to suitable lengths. This operation is effected either by a reciprocating saw, operated by a pulley and crank, or by an electric motor, or else with a circular saw, travelling on a carriage which moves the saw through the log laid in front of it. The next operation, that of division or breaking-down into smaller portions, is done by saws of various types, according to the class of work. The oldest form of machine is the frame-saw, which is still used very largely. It comprises a framing within which a saw-gate or saw-frame is reciprocated up and down by a crank; the frame holds a number of saws or webs of flat form, strained up tightly with wedges or cotters between the top and bottom of the frame, the distance between the saws being capable of variation to suit boards of all thicknesses. The log is fed longitudinally to the gang of saws upon carriages, which are of two types. In the roller-feed, which is suitable for comparatively even and straight logs, ribbed rollers in front and behind the saws obtain a bite on the top and bottom of the timber and feed it forward by their rotation. In the rack-feed the log is mounted bodily upon a long carriage that runs by rollers upon a set of rails, and the carriage is travelled along by pinions and racks, which give a positive feed regardless of the shape of the log. The carriage in the roller-feed machines is only represented by a couple of plain trolleys supporting the timber at back and front. The feed is obtained through a friction wheel of V-shape, with a smooth pawl, called the silent feed; the wheel is given a partial rotation at each down stroke of the saw-gate to turn the rollers or the pinions for carrying forward the log. The division of the timber may be either into deals or flitches, or planks or boards. In the last-named case as many as fifty saw-blades are sometimes held in a frame.

For the more valuable hardwoods a single blade reciprocating saw, operated horizontally, is used very largely, the machine being termed a board-cutter. The log is clamped to a travelling table, passing underneath the saw, which is strained in a frame sliding on a cross-rail that can be adjusted up or down on a couple of uprights like a planing machine. The saw is worked from a crank and connecting-rod. As only one board is sawn at a time the attendant is able to see the figuring of the timber and to avoid waste when bad places are encountered.

A machine much more rapid in operation is the horizontal band-saw, modelled on the lines of the above machine, but with a band-saw blade running over two pulleys, at a high speed, of about 7000 ft. per minute. The saws are very thin, so that a minimum of wood is wasted in the cut or "kerf," a very important consideration in dealing with costly woods. Vertical band-saws, having one pulley above the other so that the blade runs vertically, are very popular in America; they occupy less floor space than the horizontal types. It is necessary to present the log from the side, and it is therefore clamped by dogs upon a carriage running on rails, with provision for feeding the log laterally to the saw by sliding ways on the carriage.

The use of circular saws for breaking-down is confined chiefly to squaring up heavy balks, which need only a cut on each side, or for cutting thick slabs. The thickness of the saw entails considerable waste of wood, and a large amount of power is required for driving. The machines are termed rack-benches, and comprise a long divided table built up of thin plates and travelling past the fixed saw upon rollers, the movement being effected by a rack and pinion.

Re-sawing machines are those designed for further cutting-up deals, flitches, planks, &c., already broken out from the log, into boards and other scantlings. The deal and flitch frames are built on the model of the frame-saws first described, but with the differences that roller feed is always used, because the stuff is smooth and easily fed, and that the back of the timber is run against fences to keep it moving in a straight line. In the double equilibrium frames, which are much favoured, there are two sets of saws in separate frames connected by rods to opposite crank-shafts, so that as one frame is rising the other is going down; the forces are thus balanced and vibration is diminished, so that the machines can be speeded rather higher. Re-sawing is also done on circular and band saws of various types, fitted with fences for guiding the timber and controlling the thicknesses.

The cross-cut saws constitute another large group. They are employed for cutting-off various classes of stuff, after breaking-down or re-sawing, and are of circular saw type. The pendulum saw is a suspended form, comprising a circular saw at the bottom of a hanging arm, which can be pulled over by the attendant to draw the saw through a piece of wood laid on a bench beneath. Circular saws are also mounted in tables or benches and made to part off stuff moved laterally upon a sliding-table. When there is sufficient repetition work machines with two or more saws are used to cut one or more pieces to accurate length without the necessity for measurement.

The lighter classes of circular and band-saws, employed for sawing up comparatively small pieces of timber, embody numerous provisions for quickening output. The plain saw benches, with circular saws, are the simplest class, consisting merely of a framed table or bench carrying bearings for the saw spindle and a fence on the top to guide the wood. A mechanical feed is incorporated in the heavier machines to push the timber along. The rope-feed mechanism includes a drum driven at varying rates and giving motion to a rope, which is connected with a hook to the timber, to drag it along past the saw, roller supports on rails taking the weight at each end of the bench. Roller-feed saws propel the stuff by the contact of vertical fluted rollers placed opposite the fence. Other classes of saws for joinery work, &c., are constructed with rising and falling spindles, so that the saw may be made to project more or less from the table, this provision being necessary in grooving and tonguing with special types of saws. The same effect is obtained by making the table instead of the spindle rise and fall.

As it is necessary to use different saws for ripping (with the grain) and cross-cutting, some machines embody two saws so that work can be cut to shape on the same machine. These "dimension saws" have two spindles at the opposite ends of a pivoted arm that can be turned on a central pin to bring one or the other saw above as required. In cases where much angular and intricate sawing is done universal benches are employed, having in addition to the double saws a tilting motion to the table, which in conjunction with various special fittings enables the sawyer to produce a large range of pieces for any class of construction.

Band-saws, which have a thin narrow blade, are adapted especially for curved sawing and cutting-out work which the circular saw cannot manage. The usual design of machine (fig. 65) comprises a stiff standard supporting a lower pulley in fixed bearings, and an upper one in a sliding bearing, which by means of a weight or spring is caused to rise and maintain an even tension on the saw blade as it is driven by the lower pulley, and runs the upper one. India-rubber tires are placed around the pulley rims to prevent damage to the saw teeth. The table, placed between the pulleys, may be angled for cutting bevel work. It is necessary, in order to do true work, to guide the saw blade above and below the cut, and it is therefore run in guides consisting of flat strips, in combination with anti-friction rollers which take the backward thrust of the saw. Fret or jig saws are a small class with a vertical reciprocating blade, employed chiefly for cutting out interior portions which necessitate threading the saw first through a hole.

Planing machines, used for truing up the surfaces of wood after sawing, depend for their action upon rapidly revolving knives fastened to flat-sided cutter blocks. The simplest machines, the hand-planers, have a cutter cylinder revolving between two flat table slides adjustable for height to support the wood while it is pushed along over the knives by the hand. A fence guides it in a straight line. Exact thicknessing is done on another type of machine, the panel planer or thicknesser, in which the cutter cylinder revolves above the table and the stuff is fed through by rollers above and below. By altering the height of the table the thickness of wood can be varied. Double machines include a cutter cylinder above and below the timber, so that the upper and under sides are planed simultaneously. A combination of the hand-planer and the thicknesser is useful in cases where space or expenditure must be limited.

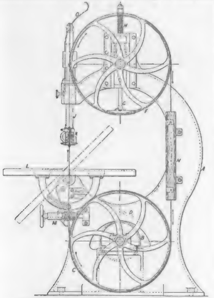


FIG. 65.—Band-sawing Machine with 30 in. pulleys. (Thomas White & Sons, Paisley.)

A, Cast-iron cored frame.
B, Fast and loose pulleys driving pulley *C*.
D, Belt shipper operated by handle *E*.
F, Upper saw pulley, with its shaft carried in swivel bearing.
G, Screw for raising or lowering *F* to suit saw.
H, Spring to maintain even tension on saw, by raising *E*.
J, Counterbalanced guide bar, having a Jackson guide *K* at bottom: *K* has wooden strips embracing the saw and a ball-bearing roller against which the back runs, while *J* is adjusted up or down to bring *K* as near to the work as convenient.
L, Table, with slit for saw; it may be canted for bevel sawing, by means of hand worm-gear *M*.
N, Protective casing to saw.
O, Guard to prevent saw flying over in case of breakage.

When large quantities of planed stuff are wanted, such as for flooring-boards, &c., other types of machines are employed. The four-cutter planers are the most rapid in output, and the timber is passed through them at a high rate, ranging up to 150 ft. per minute. There is first a revolving cutter cylinder, which roughs off the underside of the stuff, whence it passes (being propelled by rollers) to a fixed knife which imparts a very smooth face. A little farther on in the machine two vertical cutter blocks are encountered which carry cutters to plane or tongue or mould the edges, after which another cylinder above finishes the top face. Similar types of machines are made to produce mouldings, using four cutters shaped to suit the pattern required.

Moulding is also done on the vertical spindle shapers, which carry a cutter or cutters at the top of a spindle projecting through a flat table. The work is slid over the table and controlled by touching a collar below the cutter Any form may be given to the cutters to produce different profiles. Some special moulding machines use a cutter at the end of a spindle projecting downwards from an arm overhanging a table, an arrangement which enables recessing and carving to be performed.

Boring machines comprise rotating spindles and feeding mechanism to actuate augers. The single spindle machines are satisfactory enough for ordinary work, but when a number of differently sized holes have to be bored in a single piece of work, or in rapid succession, it is the practice to employ a machine with a number of spindles, so that a succession of augers of graduated diameters may be ready to use at will.

Mortising or cutting slots is done in vertical machines with a reciprocating spindle, operated either by hand or by crank disk and pulleys. The tool that cuts the mortise resembles a woodworker's chisel, but is of stouter form and has a suitable shank to fit in the spindle. The latter can be reversed to turn round and let the chisel face in the opposite direction for cutting at each end of a mortise. A boring spindle is often incorporated with the machine to make holes for the mortising chisel to start in (fig. 66). Another class of mortiser employs a square hollow chisel, inside of which an auger rotates and first bores a hole leaving to the chisel the duty of finishing out the corners. The chain mortiser is another type; it has an endless chain of flat links, sharpened to make cutting teeth, and is run around a bar and a roller at a high speed, so that when fed into the wood a recess or mortise is cut out.

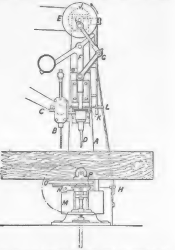


FIG. 66.—Mortising and Boring Machine with graduated stroke. (John McDowall & Sons, Johnstone.)

A, Frame.
B, Auger head, driven by belt *C*.
D, Mortising chisel reciprocated up and down by crank-disk *E*.
F, *G*, Levers connecting crank-pin to spindle of *D*.
H, Treadle connected to *F*; a gradually increasing stroke is imparted to the chisel by depressing *H*, which brings *F*, *G* into play and continually lengthens the stroke of *D*, cutting the mortise without shock.
J, Fast and loose pulleys driving *E*.
K, Cord actuated from shaft of *J*, which reverses the chisel when the handle *L* is moved and makes it cut in the reverse position.
M, Knee raised or lowered by hand-wheel and screw.
N, Cross-slide, adjusted by hand-wheel and screw.
O, Longitudinal slide, moved by rack and pinion and hand-wheel.
P, Timber vice.

Tenoning machines, designed to cut the reduced ends or tenons to fit in mortises, perform their work by the aid of cutter blocks, revolved on horizontal spindles above and below the timber, which is fed laterally upon a sliding carriage.

Dovetailing is effected by revolving cutters in machines having mechanism for pitching out the cuts, or if the work warrants it an entire row of dovetails is made at one traverse, by fitting a row of cutters and feeding simultaneously. Corner-locking, or cutting parallel tongues and grooves in the edges of boxes, &c., is a rather more rapid operation than dovetailing, and is done with suitable cutter blocks or disks of appropriate thickness and pitching apart.

The general joiner, as its name implies, will do a large variety of operations, and is used in shops and on estates where a complete plant of machines would be out of the question. It usually has a circular saw and sometimes a band-saw also, together with planing and moulding apparatus, a moulding spindle, boring spindle and tenoning apparatus.

The lathes used in woodworking comprise the plain hand types with a simple T-rest on which the turner rests the tools to deal with the work revolving between centres, and the copying or Blanchard lathes, in which a master form or copy is rotated and caused by the contact and coercion of a roller to move the cutter rest in a corresponding fashion, so that the work is cut away until it exactly matches the shape of the copy.

Sand-papering machines, which finish the surface of wood to a high degree, deal with both flat and curved faces. Flat boards, panels, &c., can be done by contact against revolving drums or disks covered with glass-paper, being fed along over them by hand or by rotating rollers. In one class of machine a revolving disk is placed at the end of a series of jointed arms, by which the disk can be moved about over the work resting on a table underneath.

XIII.—MEASUREMENT

An advance of the greatest importance made in mechanical engineering is that of measurement. Since the beginning of the 19th century steady movement has been going on in this direction until it seems impossible that much greater refinement can now be looked for. Probably the chief advances to be expected will lie in the general extension in workshop practice of the knowledge already acquired, rather than in the acquisition of higher degrees of refinement.

Methods of measurement adopted in woodworking have but little application in high-class engineers' work. They are adopted, however, to a considerable extent in the metal trades which are allied to engineering, as sheet metal working, girder work, &c. When a carpenter or joiner sets about constructing a door, window sash, roof or box he takes a two-foot rule, a flat lead pencil, and marks off the dimensions and lines by which he intends to work. If he has to work very carefully, then instead of using a pencil he cuts a line with the edge of a keen scriber or chisel-like tool, by which to saw, plane or chisel. If outlines are curved, the compasses are brought into requisition, and these cut a fine line or lines on the surface of the wood. But in any case the eye alone judges of the coincidence of the cutting with the lines marked. Whether the tool used be saw, chisel, gouge or plane, the woodworker estimates by sight alone whether or not the lines marked are worked by.

The broad difference between his method and that of the engineer's machinist lies in this, that while the first tests his work by the eye, the second judges of its accuracy or otherwise by the sense of touch. It may seem that there cannot be very much difference in these two methods, but there is. To the first, the sixty-fourth part of an inch is a fine dimension, to the second one-thousandth of an inch is rather coarse. Now the thickness of tissue paper is about one-thousandth of an inch, and no one could possibly work so closely as that by the eye alone. Engineers' steel rules usually have one inch which is divided into one hundred parts. Tolerably keen sight is required to distinguish those divisions, and few could work by them by ocular measurement alone, that is, by placing them in direct juxtaposition with the work. A thousandth part of an inch seems by comparison a fine dimension. But it is very coarse when considered in relation to modern methods of measurement. In what are called "limit gauges" the plugs and rings are made of slightly different dimensions. If a plug is made a thousandth of an inch less than its ring it will slip through it easily with very perceptible slop. The common rule is therefore scarcely seen in modern machine shop, while the common calipers fill but a secondary place, their function having been invaded by the gauges. A minute dimension cannot be tested by lines of division on a rule, neither can a dimension which should be fixed be tested with high precision with a movable caliper of ordinary type. Yet it must not be supposed that the adoption of the system of gauging instead of the older methods of rule measurement relieves men of responsibility. The instruments of precision require delicate handling. Rough forcing of gauges will not yield correct results. A clumsy workman is as much out of place in a modern machine shop as he would be in a watch factory. Without correctness of measurement mechanical constructions would be impossible, and the older device of mutual fitting of parts is of lessening value in face of the growth of the interchangeable system, of international standards, and of automatic machine tools which are run with no intervention save that of feeding stock.

The two broad divisions of measurement by sight and by contact are represented in a vast number of instruments. To the first-named belong the numerous rules in wood and metal and with English and metric divisions, and the scales which are used for setting out dimensions on drawings smaller than those of the real objects, but strictly proportional thereto. The second include all the gauges. These are either fixed or movable, an important subdivision. The first embrace two groups—one for daily workshop service, the other for testing and correcting the wear of these, hence termed "reference gauges." They are either made to exact standard sizes, or they embody "limits of tolerance," that is, allowances for certain classes of fits, and for the minute degrees of inaccuracy which are permissible in an interchangeable system of manufacture. The movable group includes a movable portion, either corresponding with one leg of a caliper or having an adjustable rod, with provision for precise measurement in the form of a vernier or of a screw thread divided micrometrically. These may be of general character for testing internal or external diameters, or for special functions as screw threads. Subtitles indicate some particular aspect or design of the gauges, as "plug and ring," "caliper," "horseshoe," "depth," "rod," "end measure," &c. So severe are the requirements demanded of instruments of measurement that the manufacture of the finer kinds remains a speciality in the hands of a very few firms. The cost and experience necessary are so great that prices rule high for the best instruments. As these, however, are not required for ordinary workshop use, two or three grades are manufactured, the limits of inaccuracy being usually stated and a guarantee given that these are not exceeded.

Measurement by Sight. Rules and Scales.—The rules are used for marking off distances and dimensions in conjunction with other instruments, as scribers, compasses, dividers, squares; and for testing and checking dimensions when marked, and work in course of reduction or erection, directly or from calipers. They are made in boxwood and in steel, the latter being either rigid or flexible, as when required to go round curves. Rules are fitted in combination with other instruments, as sliding calipers, squares, depth gauges, &c. The scales are of boxwood, of ivory, the value of which is discounted by its shrinkage, and of paper. They are of flat section with bevelled edges, and of oval and of triangular sections, each giving a thin edge to facilitate readings. They are fully divided, or open divided; in the first case each division is alike subdivided, in the second only the end ones are thus treated.

The Gauges. Fixed Gauges.—These now embrace several kinds, the typical forms being represented by the cylindrical or plug and ring gauges and by the caliper form or snap gauges. The principle in each is that a definite dimension being embodied in the gauge, the workman has not to refer to the rule, either directly or through the medium of a caliper. This distinction, though slight, is of immense importance in modern manufacturing. Broadly it corresponds with the difference between the older heterogeneous and the present interchangeable systems.

Plug and Ring Gauges.—The principal ones and the originals of all the rest, termed Whitworth gauges after the inventor, are the plug and ring gauges (fig. 67, *A* and *B*). The principle on which they depend is that if the two gauges are made to fit with perfect accuracy, without tightness on the one hand or slop on the other, then any work which is measured or turned and bored or ground by them will also fit with equal accuracy. Bored holes are tested by the plug gauge, and spindles are tested by the ring gauge, and such spindles and holes make a close fit if the work is done carefully. Of course, in practice, there is very much variation in the character of the work done, and the finest gauges are too fine for a large proportion of engineers' work. It is possible to make these gauges within $\frac{1}{25000}$ of an inch. But they are seldom required so fine as that for shop use; $\frac{1}{2500}$ is generally fine enough. For general shop work the gauges are made to within about $\frac{1}{1000}$ of an inch. Standard gauges in which the plug and ring are of the same diameter will only fit by the application of a thin film of oil and by keeping the plug in slight movement within the ring. Without these precautions the two would "seize" so hard that they could not be separated without force and injury.

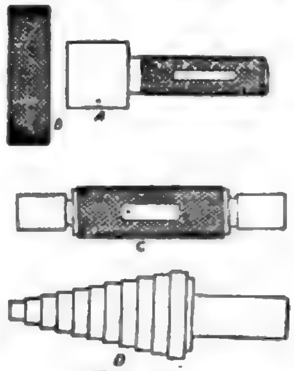


FIG. 67.

A, *B*, Plug and ring gauges.
C, Difference gauge.
D, Stepped reference gauge.

Plug and Ring v. Horseshoe Gauges.—The horseshoe, snap or caliper gauges (fig. 68) are often used in preference to the plug and ring types. They are preferred because the surfaces in contact are narrow. These occur in various designs, with and without handles, separately and in combination and in a much larger range of dimensions than the plug and ring. Ring gauges are not quite such delicate instruments as the fixed caliper gauges. But since they measure diameter only, and turned work is not always quite circular, the caliper gauges are not so convenient for measurement as the round gauges, which fit in the same manner as the parts have to fit to one another.

Fixed Gauges. Limit Gauges.—Some fits have to be what is termed in the shops "driving fits," that is, so tight that they have to be effected by driving with a hammer or a press, while others have to be "working fits," suitable, say, for the revolution of a loose pulley on its shaft or of an axle in its bearings. The "limit" or "difference gauges" (figs. 67 and 68) are designed for producing these working fits; that is, the plug and ring gauges differ in dimensions so that the work bored will drive tightly, or slide freely over the work turned. These are variously sub-classified. The system which is generally accepted is embodied in the gauges by the Newall Engineering Co. These embrace *force fits*, which require the application of a screw or hydraulic press, *driving fits*, that require less power, as that of a hammer; *push fits*, in which a spindle can be thrust into its hole by hand; and *running fits*, such as that of shafts in bearings. Fixed gauges are made for each of these, but as this involves a heavy outlay the Newall firm have adjustable limit gauges (fig. 68, *D*) for external dimensions, the standard plug being used for holes. The setting is done by screwed plugs or anvils adjusted by reference bars. In all these gauges the "go on" and "not go on" ends respectively are stamped on the gauge, or the equivalents of + and −.

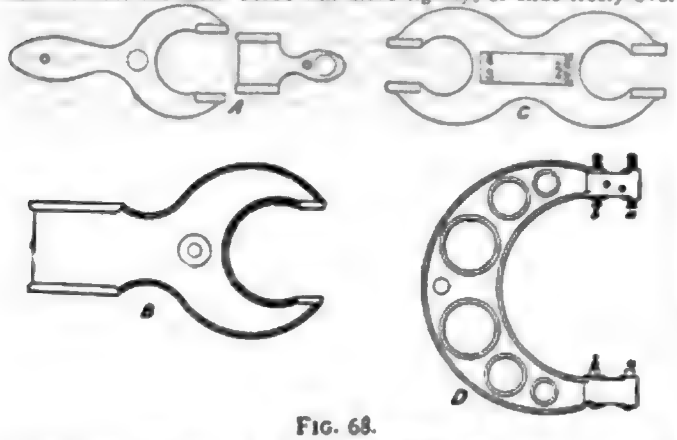


FIG. 68.

A, Separate caliper or snap gauges.
B, Combined internal and external gauges.
C, Difference gauge.
D, Newall adjustable limit gauge.
a, *b*, Plugs.

Fixed Reference Gauges. Reference Disks and End Measuring Rods.—Shop working gauges become in time so damaged by service that they fail to measure so accurately as when new. To correct these errors reference gauges are provided, by which the inaccuracy of the worn ones is brought to the test. These are never used in the shops for actual measurement of work, but are only kept for checking the truth of the working gauges. They include disk, stepped and end measurement gauges. The disk and the stepped are used for testing the ring gauges, the stepped kind comprising essentially a collection of disks in one piece (fig. 67, *D*). The end measure pieces test the external gauges. The end measure standard lengths made by the Pratt & Whitney Co. are so accurate that any sizes taken at random in any numbers from ¼ in. to 4 in., varying by sixteenths of an inch, will, when placed end to end, make up an exact length; this is a difficult test, since slight variations in the lengths of the components would add up materially when multiplied by the number of pieces. The ends are ground off with diamond dust or emery in a special machine under water, and are so true that one piece will support another by cohesive force, and this though the surfaces are less than ¼ in. square.

Movable Gauges.—This extensive group may be regarded as compounded of the common caliper and the Whitworth measuring machine. They are required when precise dimensions have to be ascertained in whole numbers and minute fractional parts. They combine the sense of touch by contact, as in the calipers, with the exact dimensions obtained by inspection of graduated scales, either the vernier or the micrometer screw. If gauges must not vary by more than $\frac{1}{10000}$ of an inch, which is the limit imposed by modern shop ideals, then instruments must be capable of measuring to finer dimensions than this. Hence, while the coarser classes of micrometers read directly to $\frac{1}{1000}$ part of an inch, the finest measure up to $\frac{1}{100000}$ of an inch, about 200 times as fine as the diameter of a human hair. They range in price correspondingly from about a sovereign to £100.

The Calipers.—Common calipers (fig. 69) are adjusted over or within work, and the dimensions are taken therefrom by a rule or a gauge. They usually have no provision for minute adjustment beyond the gentle tapping of one of the legs when setting. In some forms screw adjustment is provided, and in a few instances a vernier attachment on the side of the pivot opposite to the legs.

Vernier Calipers.—The vernier fitting, so named after its inventor, Pierre Vernier, in 1631, is fitted to numerous calipers and caliper rules. It is applied to calipers for engineers' use to read to $\frac{1}{1000}$ of an inch without requiring a magnifier. The beam of the caliper is divided into inches and tenths of the inch, and each tenth into fourths and the vernier into twenty-five parts, or the beam is divided into fiftieths of an inch (fig. 70) and the vernier has 20 divisions to 19 on the rule. The caliper jaws are adapted to take both external and internal dimensions. These "beam calipers" are also made for metric divisions. Minor variations in design by different manufacturers are numerous.

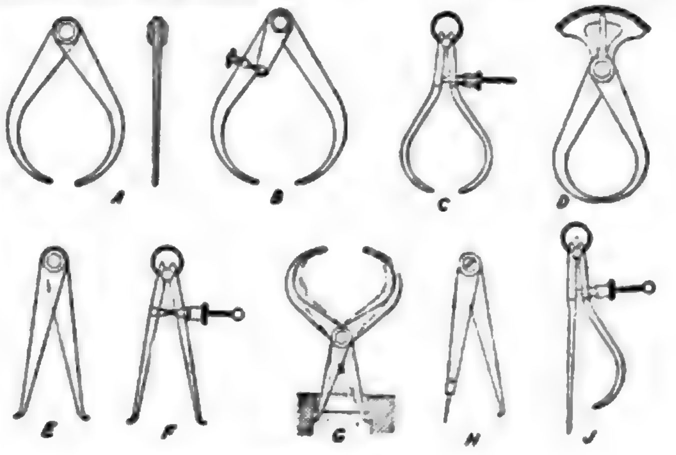


FIG. 69.—Calipers.

A, Ordinary external type, adjusted by tapping the legs.
B, Type adjusted by screw in auxiliary leg.
C, Screw calipers, opened by contraction of curved spring and closed by nut.
D, Self-registering caliper, with pointer moving over quadrant.
E, Common internal type.
F, Screw type with spring.
G, Combined internal and external for measuring chambered holes.
H, Compass caliper for finding centres.
J, Keyhole caliper for measuring from hole to outside of boss.

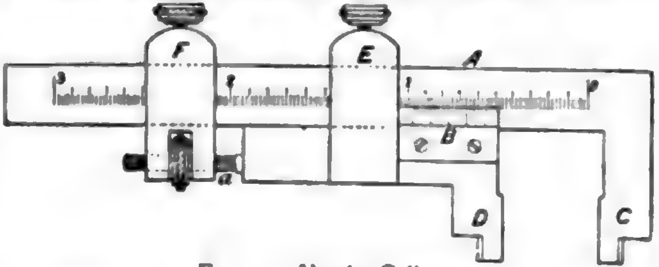


FIG. 70.—Vernier Caliper.

A, Beam; *B*, vernier; *C*, fixed jaw; *D*, movable jaw; *E*, clamping head; *F*, abutment head, with adjusting screw *a*, for fine adjustment of *D*.

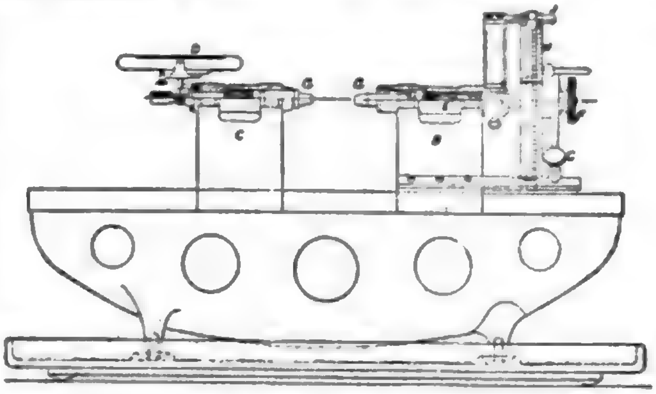


FIG. 71.—Measuring Machine. (The Newall Engineering Co.)

A, Hollow base or bed, mounted on three points.
B, Measuring or fast headstock.
C, Movable head, or tailstock.
D, Spirit-level to indicate alterations in length of piece being measured due to changes in temperature, termed the indicator or comparator.
E, Measuring screw.
F, Nut for rapid adjustment of ditto.
G, Knob of speed screw for slow movement of ditto.
H, Dividing and measuring wheel.
J, Vernier or reading bar.
a, *a*, Points between which contact is made.

Micrometer Calipers are the direct offspring of the Whitworth measuring machine. In the original form of this machine a screw of 20 threads to the inch, turned by a worm-wheel of 200 teeth and single-threaded worm, had a wheel on the axis of the worm with 250 divisions on its circumference, so that an adjustment of $\frac{1}{1000000}$ of an inch was possible. The costly measuring machines made to-day have a dividing wheel on the screw, but they combine modifications to ensure freedom from error, the fruits of prolonged experience. Good machines are made by the Whitworth, the Pratt & Whitney, the Newall (fig. 71), and the Brown & Sharpe firms. These are used for testing purposes. But there are immense numbers of small instruments, the micrometer calipers (fig. 72), made for general shop use, measuring directly to $\frac{1}{1000}$ of an inch, and in the hands of careful men easily to half and quarter thousandths; these cost from £1 to £1, 10s. only. In these the subdivision of the turns of the screw is effected by circular graduations. Usually the screw pitch is 40 to the inch, and the circular divisions number 25, so that a movement of one division indicates that the screw has been advanced $\frac{1}{25}$ of $\frac{1}{40}$ or $\frac{1}{1000}$ of an inch. Provision for correcting or taking up the effects of wear is included in these designs (*e.g.* at *a* in fig. 72), and varies with different manufacturers. A vernier is sometimes fitted in addition, in very high class instruments, to the circular divisions, so that readings of ten thousandths of an inch can be taken. Beam micrometer calipers (fig. 73) take several inches in length, the micrometer being reserved for fractional parts of the inch only.

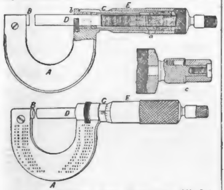


FIG. 72.—Micrometer Calipers. (Brown & Sharpe Mfg. Co.)

A, Frames.	*a*, Adjusting nuts for taking up wear.
B, Anvil or abutment.	*b*, Clamping nut.
C, Hub divided longitudinally.	*c*, Ratchet stop, which slips under undue pressure to ensure uniform measurement.
D, Spindle with micrometer screw.	
E, Thimble, divided circularly	

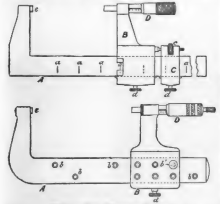


FIG. 73.—Beam Micrometer Calipers.

A, Beam.	*C*, Abutment block with screw *c* for fine adjustment.
B, Head, adjustable by equal inch divisions, by lines *a*, *a*, or holes *b*, *b*, and plug *b'* holes bushed.	*d*, Clamping screws.
	D, Micrometer.
	e, Anvil.

Depth Gauges.—It is often necessary to measure the depth of one portion of a piece of work below another part, or the height of one portion relatively to a lower one. To hold a rule perpendicularly and take a sight is not an accurate method, because the same objections apply to this as to rule measurement in general. There are many depth gauges made with rule divisions simply, and then these have the advantage of a shouldered face which rests upon the upper portion of the work and from which the rule measurement is taken (fig. 74). These generally have a clamping arrangement. But for very accurate work either the vernier or the micrometer fitting is applied, so that depths can be measured in thousandths of an inch, or sometimes in sixty-fourths, or in metric subdivisions.

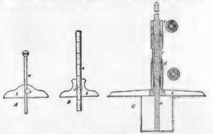


FIG. 74.—Depth Gauges.

A, Plain round rod *a*, sliding in head *b*, and pinched with screw *c*.
B, Rule *a*, graduated into inches or metric divisions, sliding on head *b*, in grooved head of clamping screw *c*.
C, Slocomb depth gauge, fitted with micrometer. *a*, Rod marked in half inches, sliding in head *b*; *c*, hub; *d*, thimble corresponding with similar divided parts in the micrometer calipers; *e*, clamping screw.

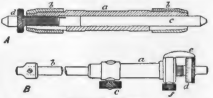


FIG. 75.—Rod Gauges.

A, Pratt & Whitney gauge. *a*, Tube split at ends; *b*, *b*, chucks clamping tube on plain rod *c*, and screwed end *d*. Rough adjustment is made on rod *c*, of which several are provided; fine adjustment is by screwed end *d*.
B, Sawyer gauge. *a*, Body; *b*, extension rods for rough adjustment, several being supplied and pinched with screw *c*; *d*, screwed end with graduated head; *e*, reading arm extending from body over graduations; *f*, clamping screw.

Rod Gauges.—When internal diameters have to be taken, too large for plug gauges or calipers to span, the usual custom is to set a rod of iron or steel across, file it till it fits the bore, and then measure its length with a rule. More accurate as well as adjustable are the rod gauges (fig. 75) to which the vernier or the micrometer are fitted. These occur in a few varied designs.

Screw Thread Gauges.—The taking of linear dimensions, though provided for so admirably by the systems of gauging just discussed, does not cover the important section of screw measurement. This is a department of the highest importance. In most English shops the only test to-day of the size of a screw or nut is the use of a standard screw or nut. That there is variation in these is evidenced by the necessity for fitting nuts to bolts when large numbers of these are being assembled, after they have been used in temporary erections or when nuts are brought from the stores to fit studs or bolts cut in the shop. This method may suffice in many classes of work, but it is utterly unsuited to an interchangeable system; and when there is a fair amount of the latter firms sometimes make thread gauges of their own, in general form like the plug and ring gauges, using a hard quality of steel for small sizes or a tough quality of cast iron for the larger. These, though not hardened, will endure for a long time if treated carefully. But though very useful and far better than none at all they lack two essentials. They are simply accommodation gauges, made to an existing tap or die, and do not therefore embody any precise absolute measurement, nor do they include any means for measuring variations from standard, nor are they hardened. To produce gauges to fulfil these requirements demands an original standard to work by, micrometric measurements, and the means of grinding after the hardening process. These requirements are fulfilled in the screw thread gauges and calipers of the Pratt & Whitney and the Brown & Sharpe companies. The essential feature of a screw gauge is that it measures the sides of the threads without risk of a possible false reading due to contact on the bottom or top of the V. This is fulfilled by flatting the top and making the bottom of the gauge keen. The Pratt & Whitney gauges are made as a plug and ring (fig. 76), the plug being solid and the ring capable of precise adjustment round it. There is a plain round end, ground and lapped exactly to the standard size of the bottom of the thread, a dimension which is obliterated in the threaded end because of the bottoms of the angles being made keen for clearance. There are three kinds of this class of gauge made; the first and most expensive is hardened and ground in the angle, while the second is hardened but not ground. The first is intended for use when a very perfect gauge is required, the second for ordinary shop usage. The third is made unhardened for purposes of reference simply, and it is not brought into contact with the work to be tested at all, but measurements are taken by calipers; in every detail it represents the standard threads. The Brown & Sharpe appliance is of quite a different character. It is a micrometer caliper having a fixed V and a movable point between which the screw to be measured is embraced. By the reading of the micrometer and the use of a constant the diameter of any thread in the middle of the thread can be estimated.

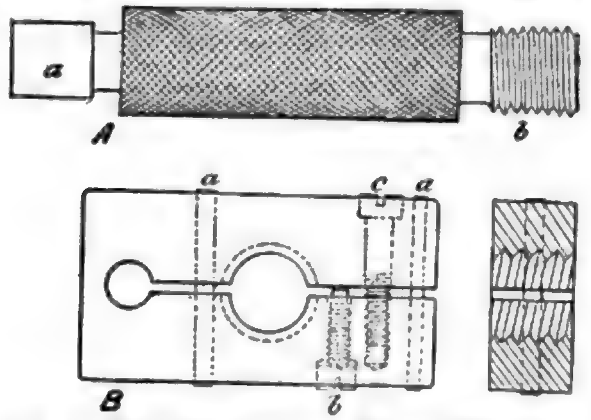


FIG. 76.—Screw Thread Gauges. (Pratt & Whitney Co.)

A, Plug gauge; *a*, size of tapping hole; *b*, thread.
B, Ring gauge; *a*, pins to prevent lateral movement; *b*, adjusting screw for opening gauge; *c*, screw for closing ditto.

Miscellaneous.—The foregoing do not exhaust the gauges. There are gauges for the sectional shapes of screw threads of all pitches, gauges for drilled holes that have to be screwed, gauges for the depth and thickness of the teeth of gear-wheels, gauges for the tapers of machine spindles, gauges for key-grooves, &c. There are also the woodworker's gauges—the marking and cutting, the panel, the mortise and the long-tooth.

Indicators are a small group of measuring instruments of a rather peculiar character. They magnify the most minute error by adaptations of long and short lever arms. The Bath, the Starrett and the Brown & Sharpe are familiar in high-class shops. Some simply magnify inaccuracy, but in one type an index reads to thousandths of an inch (fig. 77). They are used in some kinds of lathe chuck work, but their principal value is in fitting and erecting the finer mechanisms.

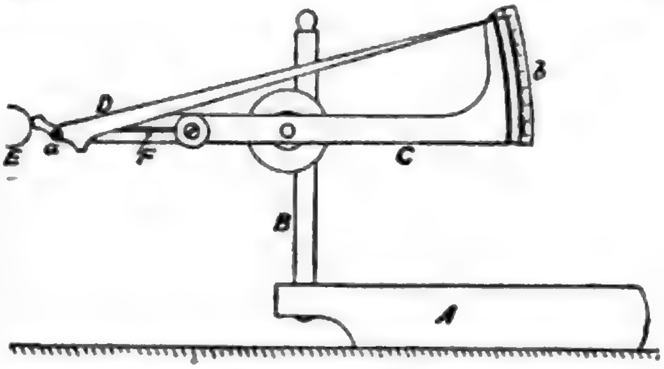


FIG. 77.—Indicator.

A, Base; *B*, stem; *C*, arm; *D*, pointer or feeler, pivoted at *a*, and magnifying movement of the work *E* upon the scale *b*; *F*, spring to return *D* to zero.

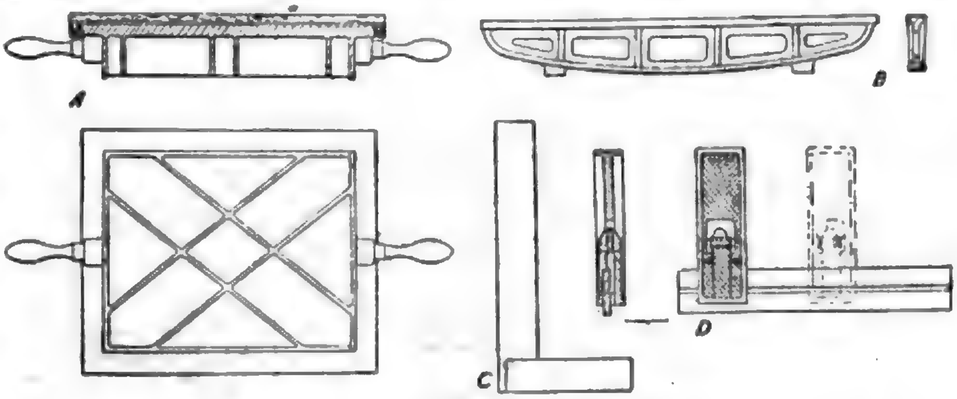


FIG. 78.

A, Surface plate; *a*, protecting cover for ditto when not in use.
B, Large ribbed straight-edge.
C, Common square.
D, Square with adjustable blade.

Surface Plates and Cognate Forms.—Allied to the gauges are the instruments for testing the truth of plane surfaces: the surface plates, straight-edges and winding strips. The origination of plane surfaces by scraping, until the mutual coincidence of three plates is secured, was due to Whitworth. These surface plates (fig. 78, *A*) fill an important place in workshop practice, since in the best work plane surfaces are tested on them and corrected by scraping. To a large extent the precision grinding machines have lessened the value of scraping, but it is still retained for machine slides and other work of a similar class. In the shops there are two classes of surface plates: those employed daily about the shops, the accuracy of which becomes impaired in time, and the standard plate or plates employed for test and correction. Straight-edges are derived from the surface plates, or may be originated like them. The largest are made of cast-iron, ribbed and curved on one edge, to prevent flexure, and provided with feet (fig. 78, B). But the smaller straight-edges are generally parallel, and a similar pair constitutes "winding strips," by which any twist or departure from a plane surface is detected. Squares, of which there are numerous designs (fig. 78, *C* and *D*), are straight-edges set at right angles. Bevels or bevel-squares (fig. 79), are straight-edges comprising a stock and a blade, which are adjustable for angle in relation to each other. Shop protractors often include a blade adjustable for angle, forming a bevel with graduations. Spirit-levels test the horizontal truth of surfaces. Many levels have two bubble tubes at right angles with each other, one of which tests the truth of vertical faces. Generally levels have flat feet, but some are made of V-section to fit over shafting. The common plumb-bob is in frequent use for locating the vertical position of centres not in the same horizontal plane. When a

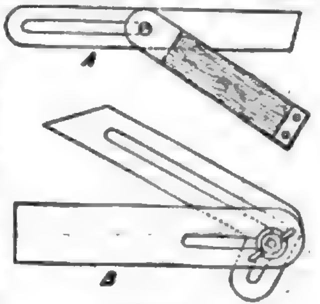


FIG. 79.

A, Common bevel.
B, Universal bevel for testing low angles.

plumb-bob is combined with a parallel straight-edge the term plumb-rule is applied. It tests the truth of vertical surface more accurately than a spirit-level. (J. G. H.)

TOOLE, JOHN LAWRENCE (1832–1906), English actor, son of an old employé of the East India Company who for many years acted as toast-master in the City of London, was born in London on the 12th of March 1832. He was educated at the City of London School, and started life in a wine merchant's office; but his natural propensity for comic acting was not to be denied, and after some practice as an amateur with the City Histrionic Club, he definitely took to the stage in 1852, appearing in Dublin as Simmons in *The Spitalfields Weaver*. He gained experience in the provinces, and in 1854 made his first professional appearance in London at the St James's theatre, acting Samuel Pepys in *The King's Rival* and Weazel in *My Friend the Major*. In 1857, having just had a great success as Paul Pry, he met Henry Irving in Edinburgh, and recommended him to go to London; and their friendship remained thenceforth of the closest kind. In 1858 Toole joined Webster at the Adelphi, and established his popularity as a comedian, among other parts creating Joe Spriggins in *Ici on parle français*. In 1868 he was engaged at the Gaiety, appearing among other pieces in *Thespis*, the first Gilbert and Sullivan collaboration. His fame was at its height in 1874, when he went on tour to the United States, but he failed to reproduce there the success he had in England. In 1879 he took the "Folly" theatre in London, which he renamed "Toole's" in 1882. He was constantly away in the provinces, but he produced here a number of plays: H. J. Byron's *Upper Crust* and *Auntie*; Pinero's *Hester's Mystery* and *Girls and Boys*; burlesques such as *Paw Claudian*, and, later, J. M. Barrie's *Walker, London*. But his appearances gradually became fewer, and after 1893 he was seen no more on the London stage, while his theatre was pulled down shortly afterwards for an extension of Charing Cross Hospital. He published his reminiscences in 1888. Toole married in 1854; and the death of his only son in 1879, and later of his wife and daughter, had distressing effects on his health; attacks of gout, from 1886 onwards, crippled him, and ultimately he retired to Brighton, where after a long illness he died on the 30th of July 1906. In his prime he was immensely popular, and also immensely funny in a way which depended a good deal on his tricks and delivery of words. He excelled in what may be called Dickens parts—combining humour and pathos. He was a good man of business, and left a considerable fortune, out of which he made a number of bequests to charity and to his friends. His genial and sympathetic nature was no less conspicuous off the stage than on it.

TOOMBS, ROBERT (1810–1885), American political leader, was born near Washington, Wilkes county, Georgia, on the 2nd of July 1810. He was educated at Franklin College (university of Georgia), at Union College, Schenectady, New York, from which he graduated in 1828, and at the law school of the university of Virginia. He was admitted to the bar in 1830, and served in the Georgia House of Representatives (1838, 1840–1841 and 1843–1844), in the Federal House of Representatives (1845–1853), and in the United States Senate (1853–1861). He opposed the annexation of Texas, the Mexican War, President Polk's Oregon policy, and the Walker Tariff of 1846. In common with Alexander H. Stephens and Howell Cobb, he supported the Compromise Measures of 1850, denounced the Nashville Convention, opposed the secessionists in Georgia, and helped to frame the famous Georgia platform (1850). His position and that of Southern Unionists during the decade 1850–1860 has often been misunderstood. They disapproved of secession, not because they considered it wrong in principle, but because they considered it inexpedient. On the dissolution of the Whig party Toombs went over to the Democrats. He favoured the Kansas-Nebraska Bill, the admission of Kansas under the Lecompton Constitution, and the English Bill (1858), and on the 24th of June 1856 introduced in the Senate the Toombs Bill, which proposed a constitutional convention in Kansas under conditions which were acknowledged by various anti-slavery leaders as fair, and which mark the greatest concessions made by the pro-slavery senators during the Kansas struggle. The bill did not provide for the submission of the constitution to popular vote, and the silence on this point of the territorial law under which the Lecompton Constitution of Kansas was framed in 1857 was the crux of the Lecompton struggle (see KANSAS). In the presidential campaign of 1860 he supported John C. Breckinridge, and on the 22nd of December, soon after the election of Lincoln, sent a telegram to Georgia which asserted that "secession by the 4th of March next should be thundered forth from the ballot-box by the united voice of Georgia." He delivered a farewell address in the Senate (Jan. 7, 1861), returned to Georgia, and with Governor Joseph E. Brown led the fight for secession against Stephens and Herschel V. Johnson (1812–1880). His influence was a most powerful factor in inducing the "old-line Whigs" to support immediate secession. After a short term as secretary of state in President Davis's cabinet, he entered the army (July 21, 1861), and served first as a brigadier-general in the Army of Northern Virginia and after 1863 as adjutant and inspector-general of General G. W. Smith's division of Georgia militia. He then spent two years in exile in Cuba, France and England, but returned to Georgia in 1867, and resumed the practice of law. Owing to his refusal to take the oath of allegiance, he was never restored to the full rights of citizenship. He died at his home in Washington, Georgia, on the 15th of December 1885.

See Pleasant A. Stovall, *Robert Toombs, Statesman, Speaker, Soldier, Sage* (New York, 1892).

TOOTHWORT, the popular name for a small British plant of curious form and growth, known botanically as *Lathraea squamaria*. It grows parasitically on roots, chiefly of hazel, in shady places such as hedge sides. It consists of a branched whitish underground stem closely covered with thick fleshy colourless leaves, which are bent over so as to hide the under surface; irregular cavities communicating with the exterior are formed in the thickness of the leaf. On the inner wall of these chambers are stalked hairs, which when stimulated by the touch of an insect send out delicate filaments by means of which the insect is killed and digested. The only portions that appear above ground are the short flower-bearing shoots, which bear a spike of two-lipped dull purple flowers. The scales which represent the leaves also secrete water, which escapes and softens the ground around the plant. *Lathraea* is closely allied to another British parasitic plant, broomrape (*Orobanche*).

TOOWOOMBA, a town of Aubigny county, Queensland, Australia, 76 m. by rail W. by N. of Ipswich, and 101 m. from Brisbane. It is situated on the summit of the Great Dividing Range, and is the centre of the rich pastoral and agricultural district of Darling Downs. The chief buildings are the town-hall, a large theatre, a school of arts and a library; the Christian Brothers College and several handsome churches. The industries are brewing, tanning, soap-boiling, flour-milling, malting, iron-founding, saw-milling and jam-making. Vineyards are cultivated by a German colony and large quantities of wine are made. The town received a municipal charter in 1860, and during the governorship of Lord Lamington (1896–1897) became the summer residence of the governor and his staff. Pop. (1901), 9137; within the five-mile radius, 14,087.

TOP (cf. Dan. *top*, Ger. *Topf*, also meaning pot), a toy consisting of a body of conical, circular or oval shape with a point or peg on which it turns or is made to whirl. The twisting or whirling motion is applied by whipping or lashing when it is a "whipping top" or "peg-top," or by the rapid unwinding of a string tightly wound round a head or handle. When the body is hollow this results in a whirring noise, whence the name "humming top." Other kinds of tops are made as supports for coloured disks which on revolving show a kaleidoscopic variation of patterns. The top is also used in certain games of chance, when it is generally known as a "teetotum." There are many references to it in ancient classical literature. The Greek terms for the toy are *βέμβιξ*, which was evidently the whipping or peg top (Arist. *Birds*, 1461), and *στρόβιλος*, a humming top, spun by a string (Plato, *Rep.* iv. 436 E.). In Homer (*Il.* xiv. 413) the word *στρόμβος* seems to point to the humming top. The Latin name for the top was *turbo*. This word and the Greek *ῥόμβος* are sometimes translated by "top" when they refer to the instrument used in the Dionysiac mysteries, which, when whirled in the air by a string, produced a booming noise. This was no doubt the equivalent of the "bull roarer" (*q.v.*). Strutt (*Games and Pastimes*, 491) says that the top was known in England as early as the 14th century. For the scientific properties of the top see GYROSCOPE and GYROSTAT.

[1] This word must be distinguished from that signifying the highest or uppermost part of anything. It appears to have meant originally a tuft or crest of hair, cf. Ger. *Zopf*, Du. *top*, Icel. *topps*, &c.; it is allied to Eng. "tap," a spike for a cask, and "tip," point. Some etymologists have identified the two words, the toy being so called from spinning on its top or tip, but the two German forms seem to prove conclusively that the words are different.

TOPAZ, a mineral usually found in connexion with granitic rocks and used, when fine, as a gem-stone. It is believed that the topaz of modern mineralogists was unknown to the ancients, and that the stone described under the name of *τοπάζιος*, in allusion to its occurrence on an island in the Red Sea known as *τοπάζιος νῆσος*, was the mineral which is now termed chrysolite or peridot (*q.v.*). The Hebrew *pitdah*, translated "topaz" in the Old Testament, may also have been the chrysolite.

Topaz crystallizes in the orthorhombic system, usually with a prismatic habit (figs. 1 and 2). Many of the crystals, like those from Saxony and Siberia, are rich in faces, and present with the prisms a complicated combination of pyramids and domes. The faces of the prism-zone are usually striated vertically. Doubly-terminated crystals are rare, and sometimes apparently hemimorphic. The mineral presents a perfect cleavage transverse to the long axis of the prism, and the cleavage-plane often has a pearly lustre. The chemical composition of the topaz has given rise to much discussion, but it is now generally regarded as an aluminium fluo-silicate having the formula $Al_2F_2SiO_4$. It was shown by Professor S. L. Penfield and Mr J. C. Minor that the fluorine may be partially replaced by hydroxyl. When strongly heated topaz suffers considerable loss of weight. Sir D. Brewster found in topaz numerous microscopic cavities containing fluids, some of which have received the names of brewsterlinite and cryptolinite. Possibly some of the liquid inclusions may be hydrocarbons.

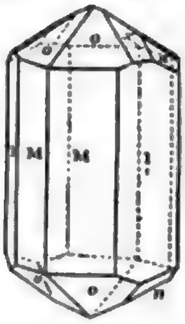


FIG. 1.

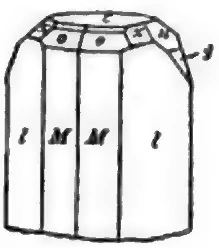


FIG. 2.

The topaz, when pure, may be colourless, and if cut as a brilliant has been mistaken for diamond. It has, too, the same specific gravity, about 3·5. It is, however, greatly inferior in hardness, the hardness of topaz being only 8; and it has lower refractivity and dispersive powers: moreover, being an orthorhombic mineral, it possesses double refraction. From phenacite and from rock-crystal, for which it may be mistaken, it is distinguished by being biaxial and by having a much higher specific gravity. The topaz becomes electric by heating, by friction or by pressure. Colourless limpid topazes are known in Brazil as *pingos d'agoa*, or "drops of water," whilst in England they pass in trade as "minas novas," from a locality in the state of Minas Geraes in Brazil.

Coloured topazes usually present various shades of yellow, blue or brown. The pleochroism is fairly marked, the colour of the sherry-yellow crystals from Brazil being generally resolved by the dichroscope into a brownish-yellow and a rose-pink. The colour in many cases is unstable, and the brown topazes of Siberia are specially liable to suffer bleaching by exposure to sunlight. In 1750 a Parisian jeweller named Dumelle discovered that the yellow Brazilian topaz becomes pink on exposure to a moderate heat, and this treatment has since been extensively applied, so that nearly all the pink topaz occurring in jewelry has been artificially heated. Such "burnt topaz" is often known as "Brazilian ruby," a name applied also to the natural red topaz, which, however, is excessively rare. "Brazilian sapphire" is the term sometimes given to blue topaz, but the colour is usually pale. The delicate green topaz has been incorrectly called aquamarine, which is a name applicable only to the sea-green beryl (*q.v.*). According to A. K. Coomáraswámy, yellow sapphire is often sold as topaz in Ceylon, where yellow topaz is unknown, whilst pink corundum is frequently called there "king topaz."

The topaz is cut on a leaden wheel, and polished with tripoli. It is generally step-cut, or table-cut, but its beauty is best developed when in the form of a brilliant. Cut topazes of large size are known, and it is said that the great "Braganza diamond" of Portugal is probably a topaz.

Topaz usually occurs in granitic and gneissose rocks, often in greisen, and is commonly associated with cassiterite, tourmaline and beryl. It seems to have been formed, in many cases, by pneumatolytic action. In the west of England it is found in Cornwall, notably at St Michael's Mount and at Cligga Head near St Agnes. It occurs also in Lundy Island. The finest British topaz is found in the Cairngorm group of mountains in the central Highlands, especially at Ben a Buird. Rolled pebbles occur in the bed of the Avon in Banffshire. Beautiful, though small, crystals occur in the drusy cavities of the granite of the Mourne Mountains in Ireland. The famous topaz-rock of the Schneckenstein, near Auerbach, in Saxony, yields pale yellow crystals, formerly cut for jewelry, and it is said that these do not become pink on heating. Fine topazes occur in Russia, at several localities in the Urals and in the Adun-chalon Mountains, near Nerchinsk, in Siberia. A very fine series from the Koksharov collection is in the British Museum. Beautiful crystals of topaz are found in Japan, especially at Takayama in the province of Mino, and at Tanokamiyama in Omi province. Ceylon and Burma occasionally yield topazes. Brazil is a famous locality, the well-known sherry-yellow crystals coming from Ouro Preto, formerly called Villa Rica, the capital of Minas Geraes, where they occur in a kaolinitic matrix, resulting from the alteration of a mica-schist, which is regarded by Professor O. A. Derby as a metamorphosed igneous rock. Topaz occurs in the tin-drifts of New South Wales, especially in the New England district; it has been discovered in the Coolgardie goldfield, West Australia; and it is found also in the tinfields of Tasmania and on Flinders Island in Bass's Strait. Fine topaz has been worked near Pike's Peak in Colorado, and in San Diego county, California. The mineral occurs in rhyolite at Nathrop in Chaffee county and Chalk Mountain in Summit county, Colorado, and in trachyte near Sevier Lake, Utah. The occurrence of topaz in these volcanic rocks is very notable, and contrasts with its common occurrence in granites. It is found in like manner in rhyolite at San Luis Potosi in Mexico; and beautiful little limpid crystals accompany stream-tin at Durango. Common topaz occurs in coarse crystals at many localities. A columnar variety from the tin-districts of Saxony and Bohemia, and from Mt Bischoff in Tasmania, is known as pycnite (πυκνός, dense); whilst a coarse opaque topaz from granite near Falun, in Sweden, has been termed pyrophysalite (πῦρ, fire; φυσᾶω, to blow), in allusion to its behaviour when heated.

"Oriental topaz" is the name sometimes given to yellow corundum, a mineral readily distinguished from true topaz by superior hardness and density. Yellow and smoke-tinted quartz, or cairngorm, is often known as "Scotch topaz" or "Spanish topaz," according to its locality; but these, on the contrary, are inferior in hardness and density. The chief differences between the three minerals may be seen in the following table, in which they are arranged in order of hardness, density and refractivity:—

	Scotch Topaz.	True Topaz.	Oriental Topaz.
Hardness	7	8	9
Specific gravity . .	2·6	3·5	4
Refractive indices .	1·54, 1·55	1·61, 1·62	1·76, 1·77
Crystallization . .	Hexagonal	Orthorhombic	Hexagonal
Chemical composition	SiO_2	$Al_2F_2SiO_4$	Al_2O_3

(F. W. R.*)

TOPEKA, a city and the county-seat of Shawnee county, Kansas, U.S.A., the capital of the state, situated on both sides of the Kansas river, in the east part of the state, about 60 m. W. of Kansas City. Pop. (1900), 33,608, of whom 3201 were foreign-born (including 702 Germans, 575 Swedes, 512 English, 407 Russians, 320 Irish, &c.) and 4807 were negroes; (1910, census), 43,684. It is served by the Atchison, Topeka & Santa Fé, the Chicago, Rock Island & Pacific, the Union Pacific and the Missouri Pacific railways. The city is regularly laid out on a fairly level prairie bench, considerably elevated above the river and about 890 ft. above sea-level. Among its prominent buildings are the United States government building, the Capitol (erected 1866–1903 at a cost of $3,200,589 and one of the best state buildings in the country), the county court house, the public library (1882), an auditorium (with a seating capacity of about 5000), the Y.M.C.A. building, a memorial building, housing historical relics of the state, and Grace Church Cathedral (Protestant Episcopal). The city is the see of a Protestant Episcopal bishop. In the Capitol are the library (about 6000 volumes) and natural history collections of the Kansas Academy of Science, and the library (30,000 books, 94,000 pamphlets and 28,500 manuscripts) and collections of the Kansas State Historical Society, which publishes *Kansas Historical Collections* (1875 sqq.) and *Biennial Reports* (1879 sqq.). The city is the seat of Washburn (formerly Lincoln) College (1865), which took its present name in 1868 in honour of Ichabod Washburn of Worcester, Massachusetts, who gave it $25,000; in 1909 it had 783 students (424 being women). Other educational establishments are the College of the Sisters of Bethany (Protestant Episcopal, 1861), for women, and the Topeka Industrial and Educational Institute (1895), for negroes. In Topeka are the state insane asylum, Christ's Hospital (1894), the Jane C. Stormont Hospital and Training School for nurses (1895), the Santa Fé Railway Hospital, the Bethesda Hospital (1906) and the St Francis Hospital (1909). Topeka is an important manufacturing city. Its factory product was valued in 1905 at $14,448,869. Natural gas is piped from southern Kansas for manufacturing and domestic use.

The first white settlement on the site of Topeka was made in 1852, but the city really originated in 1854, when its site was chosen by a party from Lawrence. It was from the first a free-state stronghold. More than one convention was held here in Territorial days, including that which framed the Topeka Constitution of 1855; and some of the meetings of the free-state legislature chosen under that document (see KANSAS) were also held here. Topeka was made the temporary state capital under the Wyandotte Constitution, and became the permanent capital in 1861. It was first chartered by the pro-slavery Territorial legislature in 1857, but did not organize its government until 1858 (see LAWRENCE). In 1881 it was chartered as a city of the first class. The first railway outlet, the Union Pacific, reached Eugene, now North Topeka, in 1865. The construction of the Atchison, Topeka & Santa Fé was begun here in 1868, and its construction shops, of extreme importance to the city, were built here in 1878. In 1880, just after the great negro immigration to Kansas, the coloured population was 31% of the total.

See F. W. Giles, *Thirty Years in Topeka* (Topeka, 1886).

TOPELIUS, ZAKRIS [ZACHARIAS] (1818–1898), Finnish author, was born at Kuddnäs, near Nykarleby, on the 14th of January 1818. He was the son of a doctor of the same name, who was distinguished as the earliest collector of Finnish folk-songs. Topelius became a student at Helsingfors in 1833, was made professor in 1863 and received in succession all the academic distinctions open to him. Quite early in his career he began to distinguish himself as a lyric poet, with the three successive volumes of his *Heather Blossoms* (1845–1854). The earliest of his historical romances was *The Duchess of Finland*, published in 1850. He was also editor-in-chief of the *Helsingfors Gazette* from 1841 to 1860. In 1878 Topelius was allowed to withdraw from his professional duties, but this did not sever his connexion with the university; it gave him, however, more leisure for his abundant and various literary enterprises. Of all the multifarious writings of Topelius, in prose and verse, that which has enjoyed the greatest popularity is his *Tales of a Barber-Surgeon*, episodes of historical fiction from the days of Gustavus II. Adolphus to those of Gustavus III., treated in the manner of Sir Walter Scott; the five volumes of this work appeared at intervals between 1853 and 1867. Topelius attempted the drama also, with most success in his tragedy of *Regina von Emmeritz* (1854). Topelius aimed, with eminent but perhaps pathetic success, at the cultivation of a strong passion of patriotism in Finland. He died on the 13th of March 1898 at Helsingfors. Topelius was an exceptionally happy writer for children, his best-known book being *Läsning för barn*. His abundant poetry is graceful and patriotic, but does not offer any features of great originality. (E. G.)

TOPETE, JUAN BAUPTISTA (1821–1885), Spanish naval commander and politician, was born in Mexico on the 24th of May 1821. His father and grandfather were also Spanish admirals. He entered the navy at the age of seventeen, cut out a Carlist vessel in 1839, became a midshipman at twenty-two, obtained the cross of naval merit for saving the life of a sailor in 1841 and became a lieutenant in 1845. He served on the West Indian station for three years, and was engaged in repressing the slave trade before he was promoted frigate captain in 1857. He was chief of staff to the fleet during the Morocco War, 1859, after which he got the crosses of San Fernando and San Hermenegildo. Having been appointed chief of the Carrara arsenal at Cadiz, he was elected deputy and joined the Union Liberal of O'Donnell and Serrano. He was sent out to the Pacific in command of the frigate "Blanca," and was present at the bombardment of Valparaiso and Callao, where he was badly wounded, and in other engagements of the war between Chile and Peru. On his return to Spain, Topete was made port captain at Cadiz, which enabled him to take the lead of the conspiracy in the fleet against the Bourbon monarchy. He sent the steamer "Buenaventura" to the Canary Isle for Serrano and the other exiles; and when Prim and Sagasta arrived from Gibraltar, the whole fleet under the influence of Topete took such an attitude that the people, garrison and authorities of Cadiz followed suit. Topete took part in all the acts of the revolutionary government, accepted the post of marine minister, was elected a member of the Cortes of 1869, supported the pretensions of Montpensier, opposed the election of Amadeus, sat in several cabinets of that king's reign, was prosecuted by the federal republic of 1873 and again took charge of the marine under Serrano in 1874. After the Restoration Topete for some years held aloof, but finally accepted the presidency of a naval board in 1877, and sat in the Senate as a life peer until his death on the 29th of October 1885 at Madrid.

TÖPFFER, RODOLPHE (1799–1846), the inventor of pedestrian journeys in Switzerland by schoolboys, was born at Geneva on the 31st of January 1799. His grandfather, a tailor, came about 1760 from Schweinfurt (Bavaria) to settle in Geneva, while his father, Adam, was an artist. Rodolphe's literary education was rather desultory, as he intended to be an artist, like his father. But in 1819 his weak eyesight put an end to that intention, so he studied in Paris, intending to devote himself to the profession of schoolmaster. After passing some time in a private school in Geneva (1822–1824), he founded (1824) one of his own, after his marriage. It was in 1823 that he made his first foot journey in the Alps with his pupils, though this became his regular practice only from 1832 onwards. These *Voyages en zigzag* were described annually (1832–1843) in a series of lithographed volumes, with sketches by the author—the first printed edition appeared at Paris in 1844, and a second series (*Nouveaux voyages en zigzag*) also at Paris in 1854. Both series have since passed through many editions. In 1832 he was named professor of belles-lettres at the university of Geneva, and held that chair till his death, on the 8th of June 1846. As early as 1830 he published an article in the *Bibliothèque universelle* of Geneva. It was followed by a number of tales, commencing with the *Bibliothèque de mon oncle* (1832), many of which were later collected (1841) into the well-known volume which bears the title of *Nouvelles genevoises*. He took some part (on the Conservative side) in local politics, and was (1841–1843) editor of the *Courrier de Genève*. Among his other works are an edition of Demosthenes (1824), and a volume of artistic studies. the *Réflexions et menus propos d'un peintre génevois* (1848).

Lives by A. Blondel and the abbé Relave (both published at Paris, 1886), and shorter notices in E. Rambert's *Écrivains nationaux* (Geneva, 1874); and E. Javelle's *Souvenirs d'un alpiniste* (Lausanne, 1886; Eng. trans., 1899, under the title of *Alpine Memories*), and several chapters in Ste Beuve's *Causeries du lundi*, *Derniers portraits littéraires* and *Portraits contemporains*. (W. A. B. C.)

TOPHET, or TOPHETH (תֹּפֶת), the name given in 2 Kings xxiii. 10; Jer. vii. 31, to a spot in the valley of Ben Hinnom near Jerusalem where the Hebrews in the time of Ahab and Manasseh offered children to Molech and other heathen gods. Josiah "defiled" it as part of his reforming activity, and it became a place for the bestowal and destruction of refuse, and a synonym for Gehenna (Isa. xxx. 33; Jer. vii. 32).

The uncertain etymology of the word is discussed in the *Ency. Bib.*, *s.v.* "Molech," § 3, "Topheth."

TOPIARY, a term in gardening or horticulture for the cutting and trimming of shrubs, such as cypress, box or yew, into regular and ornamental shapes. It is usually applied to the cutting of trees into urns, vases, birds and other fantastic shapes, which were common at the end of the 17th century and through the 18th, but it also embraces the more restrained art necessary for the laying out of a formal garden. Yew and holly trees cut into fantastic objects may still be seen in old-fashioned cottage or farmhouse gardens in England. The Lat. *topiarius* meant an ornamental or landscape gardener, and was formed from *topia* (Gr. τόπος, place), a term specially employed for a formal kind of landscape painting used as a mural decoration in Roman houses.

TOPLADY, AUGUSTUS MONTAGUE (1740–1778), Anglican divine, was born at Farnham, Surrey, and educated at Westminster and Trinity College, Dublin. Although originally a follower of Wesley, he in 1758 adopted extreme Calvinist opinions. He was ordained in 1762 and became vicar of Harpford with Fenn-Ottery, Devonshire, in 1766. In 1768 he exchanged to the living of Broadhembury, Devonshire. He is chiefly known as a writer of hymns and poems, including "Rock of Ages," and the collections entitled *Poems on Sacred Subjects* (Dublin, 1759) and *Psalms and Hymns for Public and Private Worship* (London, 1776). His best prose work is the *Historic Proof of the Doctrinal Calvinism of the Church of England* (London, 1774). Some comments by Wesley upon Toplady's presentation of Calvinism led to a controversy which was carried on with much bitterness on both sides. Toplady wrote a venomous *Letter to Mr Wesley* (1770), and Wesley repeated his comments in *The Consequence Proved* (1771), whereupon Toplady replied with increased acridity in *More Work for Mr Wesley* (1772). From 1775 to 1778, having obtained leave of non-residence at Broadhembury, he lived in London, and ministered at a Calvinist church in Orange Street.

TOPOGRAPHY (Gr. τόπος, place, γράφειν, to write), a description of a town, district or locality, giving details of its geographical and architectural features. The term is also applied in anatomy to the mapping out of the surface of the human body, either according to a division based on the organs or parts lying below certain regions, or on a superficial plotting out of the body by anatomical boundaries and landmarks.

TORAN, the name in Hindustani (Skr. *torana*, from *tor*, pass) of a sacred or honorific gateway in Buddhist architecture. Its typical form is a projecting cross-piece resting on two uprights or posts. It is made of wood or stone, and the cross-piece is generally of three bars placed one on the top of the other; both cross-piece and posts are usually sculptured.

TORBERNITE (or cupro-uranite), a mineral which is one of the "uranium micas"; a hydrous uranium and copper phosphate, $Cu(UO_2)_2(PO_4)_2+12H_2O$. Crystals are tetragonal and have the form of square plates, which are often very thin. There is a perfect micaceous cleavage parallel to the basal plane, and on this face the lustre is pearly. The bright grass-green colour is a characteristic feature of the mineral. The hardness is 2½ and the specific gravity 3·5. The radio-activity of the mineral is greater than that of some specimens of pitchblende. It was first observed in 1772 at Johanngeorgenstadt in Saxony, but the best examples are from Gunnislake near Calstock and Redruth in Cornwall. The name torbenite is after Torbern Bergman: *chalcolite* is a synonym. (L. J. S.)

TORCELLO, an island of Venetia, Italy, in the lagoons about 6 m. to the N.W. of Venice, belonging to the commune of Burano. It was a flourishing city in the early middle ages, but now has only a few houses and two interesting churches. The former cathedral of S. Maria was founded in the 7th century. The present building, a basilica with columns, dates from 864; the nave was restored in 1008, in which year the now ruined octagonal baptistery was built. It contains large mosaics of the 12th century, strongly under Byzantine influence; those on the west wall represent the Resurrection and Last Judgment. The seats for the priests are arranged round the semicircular apse, rising in steps with the bishop's throne in the centre—an arrangement unique in Italy. Close by is S. Fosca, a church of the 12th century, octagonal outside, with colonnades on five sides and a rectangular interior intended for a dome which was never executed, beyond which is a three-apsed choir. In the local museum are four Mycenaean vases, one found in the island and another on the adjacent island of Mazzorbo, proving direct intercourse with the Aegean Sea in prehistoric times.

See R. M. Dawkins, in *Journal of Hellenic Studies* (1904), xxiv. 125.

TORCH (O. Fr. *torche*, from Med. Lat. *tortia*, derived from *tortus*, twisted, *torquere*, to twist), a light or illuminant that can be carried in the hand, made of twisted tow, hemp or other inflammable substance. Torches or "links" were, till the general introduction of street lighting, necessary adjuncts for passengers on foot or in carriages in towns at night, and many of the older houses in London and elsewhere still retain the iron stands outside their doors, in which the torches might be placed.

TORCHÈRE, a candelabrum mounted upon a tall stand of wood or metal, usually with two or three lights. When it was first introduced in France towards the end of the 17th century the torchère mounted one candle only, and when the number was doubled or tripled the improvement was regarded almost as a revolution in the lighting of large rooms.

TORDENSKJOLD, PEDER (1691–1720), eminent Danish naval hero, the tenth child of alderman Jan Wessel of Bergen, in Norway, was born at Trondhjem on the 28th of October 1691. Wessel was a wild unruly lad who gave his pious parents much trouble. Finally he ran away from them by hiding in a ship bound for Copenhagen, where the king's chaplain Dr Peder Jespersen took pity on the friendless lad, gratified his love for the sea by sending him on a voyage to the West Indies, and finally procured him a vacant cadetship. After further voyages, this time to the East Indies, Wessel was, on the 7th of July 1711, appointed 2nd lieutenant in the royal marine and shortly afterwards became the captain of a little 4-gun sloop "Ormen" (The Serpent), in which he cruised about the Swedish coast and picked up much useful information about the enemy. In June 1712 he was promoted to a 20-gun frigate, against the advice of the Danish admiralty, which pronounced him to be too flighty and unstable for such a command. His discriminating patron was the Norwegian admiral Lövendal, who was the first to recognize the young man's ability as a naval officer. At this period Wessel was already renowned for two things: the audacity with which he attacked any Swedish vessels he came across regardless of odds, and his unique seamanship, which always enabled him to escape capture. The Great Northern War had now entered upon its later stage, when Sweden, beset on every side by foes, employed her fleet principally to transport troops and stores to her distressed German provinces. The audacity of Wessel impeded her at every point. He was continually snapping up transports, dashing into the fjords where her vessels lay concealed, and holding up her detached frigates. In July 1714 he encountered a frigate which had been equipped in England for the Swedes and was on its way to Gothenburg under the command of an English captain. Wessel instantly attacked her but in the English captain he met his match. The combat lasted all day, was interrupted by nightfall, and renewed again indecisively the following morning. Wessel's free and easy ways procured him many enemies in the Danish navy. He was accused of unnecessarily endangering his majesty's war-ships in the affairs with the frigate and he was brought before a court-martial. But the spirit with which he defended himself and the contempt he poured on his less courageous comrades took the fancy of King Frederick IV., who cancelled the proceedings and raised Wessel to the rank of captain. When in the course of 1715 the return of Charles XII. from Turkey to Stralsund put a new life into the jaded and dispirited Swedish forces, Wessel distinguished himself in numerous engagements off the Pomeranian coast and did the enemy infinite damage by cutting out their frigates and destroying their transports. On returning to Denmark in the beginning of 1716 he was ennobled under the title of "Tordenskjold" (Thundershield). When in the course of 1716 Charles XII. invaded Norway and sat down before the fortress of Fredrikshald, Tordenskjold compelled him to raise the siege and retire to Sweden by pouncing upon the Swedish transport fleet laden with ammunition and other military stores which rode at anchor in the narrow and dangerous strait of Dynekil, utterly destroying the Swedish fleet with little damage to himself. For this, his greatest exploit, he was promoted to the rank of commander, but at the same time incurred the enmity of his superior officer Admiral Gabel, whom he had omitted to take into his confidence on the occasion. Tordenskjold's first important command was the squadron with which he was entrusted in the beginning of 1717 for the purpose of destroying the Swedish Gothenburg squadron which interrupted the communications between Denmark and Norway. Owing to the disloyalty of certain of his officers who resented serving under the young adventurer, Tordenskjold failed to do all that was expected of him. His enemies were not slow to take advantage of his partial failure. The old charge of criminal recklessness was revived against him at a second court-martial before which he was summoned in 1718; but his old patron Admiral U. C. Gyldenlöve again intervened energetically in his behalf and the charge was quashed. In December 1718 Tordenskjold brought to Frederick IV. the welcome news of the death of Charles XII. and was made a rear-admiral for his pains. Tordenskjold's last feat of arms was his capture of the Swedish fortress of Marstrand, when he partially destroyed and partially captured the Gothenburg squadron which had so long eluded him. He was rewarded with the rank of vice-admiral. Tordenskjold did not long survive the termination of the war. On the 20th of November 1720 he was killed in a duel with a Livonian colonel, Jakob Axel Stael von Holstein. Although, Dynekil excepted, Tordenskjold's victories were of far less importance than Sehested's at Stralsund and Gyldenlöve's at Rügen, he is certainly, after Charles XII., the most heroic figure of the Great Northern War. His courage was fully equal to the courage of "The Lion of the North," but he lacked that absolute self-command which gives to the bravery of Charles XII. its peculiar, almost superhuman, character.

See Carstensen and Lütken, *Tordenskjold* (Copenhagen, 1887).

(R. N. B.)

TOREADOR, a Spanish word derived from *torear*, to engage in a bull-fight, *toro*, a bull, Latin *taurus*, for one of the principal performers in the national sport of bull-fighting (*q.v.*).

TORELL, OTTO MARTIN (1828–1900), Swedish geologist, was born in Varberg on the 5th of June 1828. He was educated at Lund for the medical profession, but became interested in zoological and geological studies, and being of independent means he devoted himself to science. He gave his attention first especially to the invertebrate fauna and the physical changes of pleistocene and recent times. He studied the glacial phenomena of Switzerland, Spitzbergen and Greenland, making two Arctic expeditions in company with A. E. Nordenskiöld. In 1866 he became professor of zoology and geology in the University at Lund, and in 1871 he was appointed chief of the Swedish Geological Survey. In the latter capacity he laboured until 1897. His published contributions, though of much interest and importance, were not large, but his influence in promoting a knowledge of geology in Sweden was of great service. His Arctic experiences enabled him to interpret the method of origin of the drift deposits in northern Europe, and to show that they were largely of glacial or fluvio-glacial origin. In the English drifts he recognized many boulders of Scandinavian origin. He died on the 11th of September 1900.

His publications include: *Bidrag till Spitzbergens molluskfauna* (1859); and memoirs to accompany several sheets of the Geological Survey map of Sweden.

Obituary with portrait, in *Geol. Mag* (May 1902), reproduced in abridged form from memoir by L. Holmström, in *Geologiska foreningen i Stockholm's forhandlingar*, xxiii.

TORENO, JOSÉ MARIA QUIEPO DE LLANO RUIZ DE SARAVIA, Count of (1786–1843), Spanish politician and historian, was born at Oviedo on the 25th of November 1786. His family was wealthy and belonged to the most ancient nobility of Asturias. His mother, Dominga Ruiz de Saravia, had property in the province of Cuenca. The son received a better education in classics, mathematics and modern languages than was usual at that time. The young viscount of Matarrosa, the title he bore in his father's lifetime, was introduced to the writings of Voltaire and Rousseau by the abbot of the Benedictine house of Monserrat in Madrid. He was present at Madrid when the city rose against Murat on the 2nd of May 1808, and took part in the struggle which was the beginning of the Peninsular War. From Madrid he escaped to Asturias, and on the 30th of May he embarked in a Jersey privateer at Gijon, with other delegates, in order to ask for the help of England against the French. The deputation was enthusiastically received in London. By the 30th of December he was back in Asturias, his father having died in the interval. During the Peninsular War he saw some service in the first occupation of Asturias by the French, but he was mainly occupied by his duties as a member of the Cortes. In 1809 he was at Seville, where one of his uncles was a member of the central Junta. In the following year he was a leader of the party which compelled the Regency to summon the Cortes—to which he was elected by Asturias early in 1811 though he wanted some months of the legal age of twenty-five. His election was opposed by some of his own relatives who did not share his advanced opinions, but it was ratified by the Cortes. Toreno was conspicuous among the well-meaning men who framed the constitution of 1812, which was made as if it was meant for some imaginary republic and not for Catholic and monarchical Spain. When Ferdinand VII. returned from prison in France in 1814 Toreno foresaw a reaction, and put himself out of reach of the king. He was the more an object of suspicion because his brother-in-law, Porlier, perished in a wild attempt to support the constitution by force. Toreno remained in exile till the outbreak of the revolution of 1820. Between that year and 1823 he was in Spain serving in the restored Cortes, and experience had abated his radical ardour. When the French intervened in 1823 Toreno had again to go into exile, and remained abroad till the king published the amnesty of the 15th of October 1832. He returned home in July 1833, but remained on his estates till the king's death on the 29th of September. As hereditary standard bearer of Asturias (Alferez Mayor) it fell to him to proclaim the young queen, Isabella II. In 1834 his now moderate opinions pointed him out to the queen regent, Maria Christina, as a useful man for office. In June 1834 he was minister of finance, and became prime minister on the 7th of June. His tenure of the premiership lasted only till the 14th of September of the same year, when the regent's attempt to retain a practically despotic government under a thin constitutional veil broke down. The greater part of the remainder of his life was spent in voluntary exile, and he died in Paris on the 16th of September 1843. As a politician he felt the need for a revision of the worn out despotism which ruled till 1808, but he was destitute of any real political capacity. Toreno is chiefly remembered as the author of the *History of the Rising, War* *and Revolution of Spain*, which he began between 1823 and 1832 and published in 1836–1838 in Paris. As a work of military criticism it is not of high value, and Toreno was prejudiced in favour of his colleagues of the Cortes, whose errors and excesses he shared in and excused. The book is, however, written in excellent Castilian, and was compiled with industry. It is worth consulting as an illustration of the time in which the author lived, as a patriotic Spanish view of the war, and for the prominence it gives to the political side of the Peninsular War, which he justly treated as a revolution.

A biography by Don Antonio de Cueto is prefixed to the reprint of the *Levantamiento guerra y revolución de España*, in vol. lxiv. of the *Biblioteca de autores españoles* of Rivadeneyra (Madrid 1846–1880).

TORENO, QUEIPO DE LLANO Y GAYOSO DE, COUNT (1840–1890), Spanish politician, son of the preceding, was born in Madrid in 1840. He was educated at the Madrid Institute and University, entered parliament in 1864 as a Moderado, and sat in all the Cortes of Queen Isabella's reign as a deputy for his ancestral province, Asturias. Loyal to the Bourbons all through the revolution, he nevertheless became a deputy in the Cortes of 1871–1873, and founded an Alphonsist paper, *El Tiempo*, in 1873. When the Restoration took place, its first cabinet made Count de Toreno mayor of the capital, and in 1875 minister of public works, in which capacity he improved the public libraries, museums, academies and archives, and caused many important works to be published, including the *Cartas de Indias*. In 1879 he became minister for foreign affairs, in 1880 president of the House of Deputies, in 1884 again governor of Madrid, and in 1885 again president of the House of Deputies. During the reign of Alphonso XII. and the first years of the regency of Queen Christina Count de Toreno was one of the most prominent Conservative leaders, and was often consulted by the Crown. He died on the 31st of January 1890. He was a patron of the turf, and established a race-course in Madrid, where the first races took place in the reign of Alphonso XII.

TORGAU, a town of Germany, in the Prussian province of Saxony, situated on the left bank of the Elbe, 30 m. N.E. of Leipzig and 26 m. S.E. of Wittenberg by rail. Pop. (1905), 12,299. Its most conspicuous building is the Schloss Hartenfels, on an island in the Elbe, which was built, or at least was finished, by the elector of Saxony, John Frederick the Magnanimous. This castle, which is now used as a barracks, is one of the largest Renaissance buildings in Germany. It was for some time the residence of the electors of Saxony and contains a chapel consecrated by Martin Luther. The town hall, a 16th-century building, houses a collection of Saxon antiquities. Torgau has two Evangelical churches and a Roman Catholic church. One of the former, the Stadt Kirche, contains paintings by Lucas Cranach and the tomb of Catherine von Bora, the wife of Luther. The chief industries of the town are the manufacture of gloves, carriages, agricultural machinery, beer and bricks; there is a trade in grain both on the Elbe and by rail. The fortifications, begun in 1807 by order of Napoleon, were dismantled in 1889–1891. In the vicinity is the royal stud farm of Graditz.

Torgau is said to have existed as the capital of a distinct principality in the time of the German king Henry I., but early in the 14th century it was in the possession of the margraves of Meissen and later of the electors of Saxony, who frequently resided here. The town came into prominence at the time of the Reformation. In 1526 John, elector of Saxony, Philip, landgrave of Hesse, and other Protestant princes formed a league against the Roman Catholics, and the Torgau articles, drawn up here by Luther and his friends in 1530, were the basis of the confession of Augsburg. Torgau is particularly celebrated as the scene of a battle fought on the 3rd of November 1760, when Frederick the Great defeated the Austrians (see SEVEN YEARS' WAR). In January 1814 Torgau was taken by the Germans after a siege of three months and it was formally ceded to Prussia in 1815.

See Grulich and Bürger, *Denkwürdigkeiten der altsächsischen Residenz Torgau aus der Zeit der Reformation* (Torgau, 1855); Knabe, *Geschichte der Stadt Torgau bis zur Reformation* (Torgau, 1880); and the publications of the *Altertumverein zu Torgau* (Torgau, 1884 sqq.).

TORNADO (Span., *tornada*, a turning about, cf. "turn"), a local whirlwind of extreme violence, usually formed within a thunderstorm. In appearance it consists of a funnel-shaped cloud, depending from the mass of storm-cloud above, and when fully developed tapering downwards to the earth. Besides its whirling motion, a tornado has an advancing movement of from 20 to 40 m. an hour—and along its own narrow path it carries destruction. Its duration is usually from half an hour to an hour. Tornadoes are most common in America, especially in the Mississippi Valley and the Southern states, in Europe and elsewhere they are comparatively rare. Owing to their association with thunderstorms they generally occur in warm weather. A tornado is the result of a condition of local instability in the atmosphere, originating high above the earth. A current of air is induced to ascend with a rapid spiral motion round a central core of low pressure. The moisture in the ascending air is condensed by cooling both as it ascends and as it expands into the low-pressure core. The cloud-funnel appears to grow downwards because the moisture in the air is condensed more rapidly than the air itself, following a spiral course, ascends.

TORO, a town of Spain, in the province of Zamora, on the right bank of the river Duero (Douro), and on the Zamora-Medina del Campo railway. Pop. (1900), 8379. Toro is an ancient fortified town, with picturesque narrow streets, among which are many medieval churches, convents and palaces, besides modern schools and public buildings. A fine bridge of twenty-two arches spans the river. The cathedral church is Romanesque; it dates from the 12th century but has been partially restored. The palace of the marquesses of Santa Cruz was the meeting place of the Cortes of 1371, 1442 and 1505, which made Toro and its code of laws celebrated. Toro is first mentioned in documents of the 10th century. It played an important part in the development of the kingdoms of Leon and Castile and in the reconquest of Spain from the Moors.

TORONTO, the capital of the province of Ontario, and the second largest city in the Dominion of Canada, situated on the northern shore of Lake Ontario, almost due north from the mouth of the Niagara river. It lies on a plateau gradually ascending from the lake shore to an altitude of 220 ft., and covers an area of nearly 20 sq. m. The river Don flows through the eastern part of the city, and the river Humber forms its western limit. The fine bay in front of the city, affording a safe and commodious harbour, is formed by an island stretching along the south of it. The city is well laid out for the most part, the streets crossing each other at right angles; Yonge Street, the chief artery, running north from the bay, was constructed as a military road in 1796, and extends under the same name for upwards of 30 m. to Lake Simcoe. It constitutes the dividing line of the city, the cross streets being called east or west according to the side of it they are on.

Toronto is the seat of government for the province, and contains the parliament buildings, the lieutenant-governor's residence, the courts of law and the educational departmental buildings. The parliament buildings are situated in Queen's Park, almost in the centre of the city, and are an imposing structure of red sandstone in the neo-Greek style built at great cost. They are shortly to be enlarged, as the needs of the province have outgrown them. A little distance to the west stand the university buildings, the central one being a splendid piece of architecture in the Norman style. Stretching in a semicircle round the broad campus are the library, the medical building, the biology building and museum, the school of practical science, the geology and chemistry buildings and the convocation hall, their architecture varying very greatly, beauty having been sacrificed to more practical considerations; the magnetic observatory is also in the grounds, but is overshadowed by some of the more recent erections. It is one of the meteorological stations established by the British government on the recommendation of the Royal Society in 1840 and is now maintained by the Dominion government. The university of Toronto, for the support of which the province is responsible, includes faculties of arts, science and medicine, in the teaching of which it is strictly secular. But near at hand and in full affiliation with the university are Victoria College (Methodist), Wycliffe College (Anglican), Knox College (Presbyterian) and St Michael's College (Roman Catholic), wherein courses in divinity are given and degrees conferred. Victoria College, likewise, provides a course in arts, but none in science. Trinity College (Anglican), though some distance away, is also affiliated with the university, and her students enjoy its full advantages. Besides the university, Toronto is remarkably rich in educational institutions. Upper Canada College, founded in 1829, in many respects resembles one of the English public schools. It has over 300 students. St Andrew's College, also for boys, is a more recent establishment, and has about the same number of pupils. There are three large collegiate institutes, having some 300 to 600 pupils each, and in addition a number of schools for girls, such as Havergal College and Westminster College. Osgoode Hall, a stately structure in the heart of the city, houses the higher courts of law and appeal, and also a flourishing law school. The city hall and court-house is one of the finest civic buildings in North America. It is in the Romanesque style, and accommodates all the civic offices, the board of education, the police and county courts, &c. Many of the churches are worthy examples of good architecture.

Toronto is essentially a residential city. The houses of the better class stand separate, not in long rows, and have about them ample lawns and abundant trees. It is consequently a widespread city, the length from east to west approximating ten miles. An electric railway system provides means of communication. There are many parks, ranging in size from Carlton Park of one acre to High Park (375 acres) and Island Park (389), the latter being across the harbour and constituting the favourite resort of the people during the summer. In Exhibition Park there is held annually an industrial and agricultural exhibition that has grown to great magnitude. It lasts a fortnight in late summer. It is a municipal enterprise and the profits belong to the city.

The population in 1907, as shown by the police census, exceeded 300,000. The government of the city is vested in a council consisting of the mayor and four controllers elected annually and eighteen aldermen (three from each of the six wards into which the city is divided). The council as a whole is the legislative body, while the board of control is the executive body, and as such is responsible for the supervision of all matters of finance, the appointment of officials, the carrying on of public works, and the general administration of the affairs of the city, except the departments of education and of police, the first being under the control of the board of education, elected annually by the citizens, and the latter under the board of police commissioners, consisting of the mayor, the county judge and the police magistrate.

Toronto is one of the chief manufacturing centres of the dominion; agricultural machinery, automobiles, bicycles, cotton goods, engines, furniture, foundry products, flour, smoked meats, tobacco, jewelry, &c., are flourishing industries, and the list is constantly extending. The situation of the city is favourable to commerce, and the largest vessels on the lakes can use its harbour. It is the outlet of a rich and extensive agricultural district, and throughout the season of navigation lines of steamers ply between Toronto and the other lake ports on both the Canadian and American sides, the route of some of them extending from Montreal to Port Arthur on Lake Superior. Railway communication is complete, three great trunk lines making the city a terminal point, viz. the Grand Trunk, the Canadian Pacific and the Canadian Northern.

As a financial centre Toronto has made remarkable advance. The transactions on the stock exchange rival those of Montreal. The Bank of Commerce has its headquarters here, as have also the Bank of Nova Scotia, the Bank of Toronto, the Standard Traders, Imperial, Sovereign, Dominion, Crown, United Empire, Sterling and other banks.

The name of the city is of Indian origin, meaning "a place of meeting," the site in the days before the coming of the white man being an established rendezvous among the neighbouring Indian tribes. It first appears in history in 1749 as a centre of trade when the French built a small fort and started a trading establishment called Fort Rouille. Before long, however, British traders came up from the south and entered into active rivalry with the French, and in 1793 the fort was burned by the latter to prevent its occupation by their foes. A year later Governor Simcoe transferred the seat of government of the new province of Upper Canada from the town of Newark at the mouth of the Niagara River to Toronto, giving the new capital the name of York, in honour of the second son of George III. Under its new name it made slow progress as the surrounding country was cleared and settled. The entrance to the harbour was guarded by two blockhouses; provision was made for barracks and garrison stores; buildings were erected for the legislature; and there the members of parliament, summoned by royal proclamation to "meet us in our provincial parliament in our town of York," assembled on the 1st of June 1797. Sixteen years later the population numbered only 456. The town was twice sacked in the war of 1812. General Dearborn captured it at the head of a force of upwards of 2000. On their advance to the outworks of the garrison the magazine of the fort exploded, whether by accident or design, killing many of the invaders. The halls of legislature and other buildings were burnt and the town pillaged. On the restoration of peace the work of creating a capital for Upper Canada had wellnigh to begin anew. The organization of Upper Canada College in 1830, with a staff of teachers nearly all graduates of Cambridge, gave a great impetus to the city and province. In 1834 the population of York numbered fully 10,000; and an act of the provincial legislature conferred on it a charter of incorporation, with a mayor, aldermen and councilmen. Under this charter it was constituted a city with the name of Toronto. Since that time the progress of the city has been rapid and substantial, the population doubling every twenty years. In 1885 the total assessment was $69,000,000; in 1895 $146,000,000 and in 1906 $167,411,000, the rate of taxation being 18½ mills.

TORPEDO. In 1805 Robert Fulton demonstrated a new method of destroying ships by exploding a large charge of gunpowder against the hull under water. No doubt then remained as to the effectiveness of this form of attack when successfully applied; it was the difficulty of getting the torpedo, as it was called, to the required position which for many years retarded its progress as a practical weapon of naval warfare. Attempts were first made to bring the explosive in contact with the vessel by allowing it to drift down to her by the action of tide or current, and afterwards to fix it against her from some form of diving boat, but successive failures led to its restriction for a considerable period to the submarine mine (*q.v.*) in which the explosive is stationary and takes effect only when the ship itself moves over or strikes the charge. Used in this way, it is an excellent deterrent to hostile warships forcing a harbour.

Spar or Outrigger Torpedo.—The limitations attached to the employment of submarine mines, except for coast defence, revived the idea of taking the torpedo to the ship instead of waiting for the latter to gain some exact point which she might very possibly avoid. This first took practical shape in the spar or outrigger torpedo. This consisted of a charge of explosive at the end of a long pole projecting from the bow of a boat, the pole being run out and immersed on arriving near the object. Directly the charge came in contact with the hull of the ship it was exploded by an electric battery in the boat. If the boat was not discovered and disabled while approaching, the chances were favourable to success and escape afterwards. Against a vigilant enemy it was doubtless a forlorn hope, but to brave men the venture offered considerable attractions.

Frequent use of this spar or outrigger torpedo was made during the American Civil War. A notable instance was the destruction of the Confederate ironclad "Albemarle" at the end of October 1864. On this mission Lieut. Cushing took a steam launch equipped with an outrigger torpedo up the Roanoke River, in which lay the "Albemarle." On arriving near the ship Cushing found her surrounded by logs, but pushing his boat over them, he immersed the spar and exploded his charge in contact with the "Albemarle" under a heavy fire. Ship and launch sank together, but the gallant officer jumped overboard, swam away and escaped. Submerged boats were also used for similar service, but usually went to the bottom with their crews. During the war between France and China in 1884 the "Yang Woo" was attacked and destroyed by an outrigger torpedo.

Locomotive Torpedoes.—Though the spar torpedo had scored some successes, it was mainly because the means of defence against it at that time were inefficient. The ship trusted solely to her heavy gun and rifle fire to repel the attack. The noise, smoke, and difficulty of hitting a small object at night with a piece that could probably be discharged but once before the boat arrived, while rifle bullets would not stop its advance, favoured the attack. When a number of small guns and electric lights were added to a ship's equipment, success with an outrigger torpedo became nearly, if not entirely, impossible. Attention was then turned in the direction of giving motion to the torpedo and steering it to the required point by electric wires worked from the shore or from another vessel; or, dispensing with any such connexion, of devising a torpedo which would travel under water in a given direction by means of self-contained motive power and machinery. Of the former type are the Lay, Sims-Edison and Brennan torpedoes. The first two—electrically steered by a wire which trails behind the torpedo—have insufficient speed to be of practical value, and are no longer used. The Brennan torpedo, carrying a charge of explosive, travels under water and is propelled by unwinding two drums or reels of fine steel wire within the torpedo. The rotation of these reels is communicated to the propellers, causing the torpedo to advance. The ends of the wires are connected to an engine on shore to give rapid unwinding and increased speed to the torpedo. It is steered by varying the speed of unwinding the two wires. This torpedo was adopted by the British war office for harbour defence and the protection of narrow channels.

Uncontrolled Torpedoes.—The objection of naval officers to have any form of torpedo connected by wire to their ship during an action, impeding her free movement, liable to get entangled in her propellers and perhaps exploding where not desired—disadvantages which led them to discard the Harvey towing torpedo many years ago—has hitherto prevented any navy from adopting a controlled torpedo for its sea-going fleet. The last quarter of the 19th century saw, however, great advances in the equipment of ships with locomotive torpedoes of the uncontrolled type. The Howell may be briefly described, as it has a special feature of some interest. Motive power is provided by causing a heavy steel fly-wheel inside the torpedo to revolve with great velocity. This is effected by a small special engine outside operating on the axle. When sufficiently spun up, the axle of the flywheel is connected with the propeller shafts and screws which drive the torpedo, so that on entering the water it is driven ahead and continues its course until the power stored up in the flywheel is exhausted. Now when a torpedo is discharged into the sea from a ship in motion, it has a tendency to deflect owing to the action of the passing water. The angle of deflexion will vary according to the speed of the ship, and is also affected by other causes, such as the position in the ship from which the torpedo is discharged, and its own angle with the line of keel. Hence arise inaccuracies of shooting; but these do not occur with this torpedo, for the motion of the flywheel, acting as a gyroscope—the principle of which applied to the Whitehead torpedo is described later—keeps this torpedo on a straight course. This advantage, combined with simplicity in construction, induced the American naval authorities at one time to contemplate equipping their fleet with this torpedo, for they had not, up to within a few years ago, adopted any locomotive torpedo. A great improvement in the torpedo devised by Mr Whitehead led them, however, definitely to prefer the latter and to discontinue the further development of the Howell system.

The Whitehead torpedo is a steel fish-shaped body which travels under water at a high rate of speed, being propelled by two screws driven by compressed air. It carries a large charge of explosive which is ignited on the torpedo striking any hard substance, such as the hull of a ship. The body is divided into three parts. The foremost portion or head contains the explosive—usually wet gun-cotton—with dry primer and mechanical igniting arrangement; the centre portion is the air chamber or reservoir, while the remaining part or tail carries the engines, rudders, and propellers besides the apparatus for controlling depth and direction. This portion also gives buoyancy to the torpedo.

When the torpedo is projected from a ship or boat into the water a lever is thrown back, admitting air into the engines causing the propellers to revolve and drive the torpedo ahead. It is desirable that a certain depth under water should be maintained. An explosion on the surface would be deprived of the greater part of its effect, for most of the gas generated would escape into the air. Immersed, the water above confines the liberated gas and compels it to exert all its energy against the bottom of the ship. It is also necessary to correct the tendency to rise that is due to the torpedo getting lighter as the air is used up, for compressed air has an appreciable weight. This is effected by an ingenious apparatus long maintained secret. The general principle is to utilize the pressures due to different depths of water to actuate horizontal rudders, so that the torpedo is automatically directed upwards or downwards as its tendency is to sink or rise.

The efficiency of such a torpedo compared with all previous types was clearly manifest when it was brought before the maritime states by the inventor, Whitehead, and it was almost universally adopted. The principal defect was want of speed—which at first did not exceed 10 knots an hour—but by the application of Brotherhood's 3-cylinder engine the speed was increased to 18 knots—a great advance. From that time continuous improvements have resulted in speeds of 30 knots and upwards for a short range being obtained. For some years a torpedo 14 ft. long and 14 in. in diameter was considered large enough, though it had a very limited effective range. For a longer range a larger weapon must be employed capable of carrying a greater supply of air. To obtain this, torpedoes of 18 in. diameter, involving increased length and weight, have for some time been constructed, and have taken the place of the smaller torpedo in the equipment of warships. This advance in dimensions has not only given a faster and steadier torpedo, but enabled such a heavy charge of gun-cotton to be carried that its explosion against any portion of a ship would inevitably either sink or disable her. The dimensions, shape, &c., of the 14- and 18-in. torpedoes are shown in fig. 1. A limited range was still imposed by the uncertainty of its course under water. The speed of the ship from which it was discharged, the angle with her keel at which it entered the water, and the varying velocity of impulse, tended to error of flight, such error being magnified the farther the path of the torpedo was prolonged. Hence 800 yds. was formerly considered the limit of distance within which the torpedo should be discharged at sea against an object from a ship in motion.

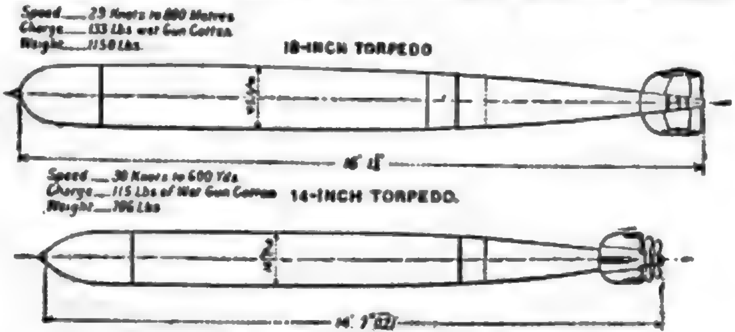

Speed—23 Knots to 800 Metres
Charge—133 Lbs wet Gun Cotton
Weight—1150 Lbs
18-INCH TORPEDO
Speed—30 Knots to 600 Yds
Charge—115 Lbs of Wet Gun Cotton
Weight—706 Lbs
14-INCH TORPEDO.
14' 7"

FIG. 1.—Diagrams of 14- and 18-in. Torpedoes.

In these circumstances, though improvements in the manufacture of steel and engines allowed of torpedoes of far longer range being made (the fastest torpedo up to 1898 having a speed of 29 knots for 800 yds.), it was of no advantage to make them, as they could not be depended upon to run in a straight line from a stationary point for more than 800 yds., while from a ship in motion good practice could only be ensured at a reduced range. It was obvious, therefore, that to increase the effective range of the torpedo, these errors of direction must be overcome by some automatic steering arrangement. Several inventors turned their attention to the subject, nearly all of whom proposed to utilize the principle of the gyroscope for the purpose. The first which gave any satisfactory results was an apparatus devised by Ludwig Obry—an engineer in Austria—and tried by the Italian government about 1896. These trials demonstrated the feasibility of accurately and automatically steering a torpedo in a direct line by this means. Messrs Whitehead & Co., of Fiume, then acquired the invention, and after exhaustive experiments produced the apparatus which is now fitted to every torpedo made. It is based on the principle that a body revolving on a free axis tends to preserve its plane of rotation. A gyroscope with plane of rotation parallel to the vertical axis of the torpedo will have an angular motion if the torpedo is diverted from its original course. This angular motion is employed to actuate the steering mechanism by operating an air motor connected with the rudders, and keeping the torpedo in the line of discharge. The apparatus consists of a flywheel caused to rotate by a spring, the barrel on which the latter is wound having a segmental wheel which gears into a toothed pinion spindle of the flywheel. Owing to the diameter of the segment being much greater than the pinion, a rapid rotatory motion is imparted. The spring is wound up by a key from outside the torpedo, and kept in tension until the projectile is discharged, when the spring is released by the air lever being thrown back, which admits air to the engine; the gyroscope is then freed and set in motion with its plane in the plane of the vertical axis of the torpedo as it was in the launching tube.

Assuming now that the course of the torpedo is diverted by any cause, its axis will move or perform a certain angular motion with regard to the plane of the flywheel, which will have the same result as if we consider the conditions reversed, *i.e.* as if the plane of rotation of the flywheel were altered and that of the axis of the torpedo remained the same. The axis of the flywheel performs a relative angular motion which it imparts to a crank actuating a servo-motor worked by compressed air, and connected with the rudders of the torpedo, moving them in the opposite direction to that in which the torpedo was diverted from its original course. Thus all inaccuracies of flight due to errors of adjustment, miscalculation of deflexion, or even damage to some part, are eliminated. As long as the gyroscope is in good order the torpedo is bound to run in the line it was pointing when the flywheel was started. It is placed in the after-body of the torpedo, as indicated in fig. 2.

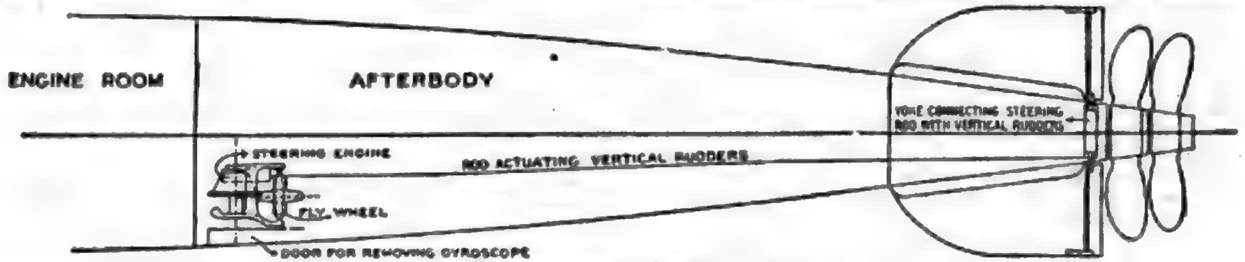

ENGINE ROOM
AFTERBODY
YOKE CONNECTING STEERING ROD WITH VERTICAL RUDDERS
STEERING ENGINE
ROD ACTUATING VERTICAL RUDDERS
FLY-WHEEL
DOOR FOR REMOVING GYROSCOPE

Fig. 2.—Arrangement of Gyroscope in Torpedo.

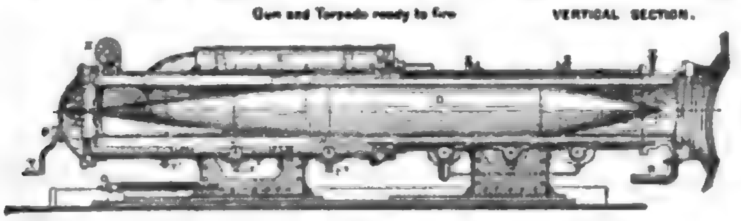
The efficiency of the Whitehead torpedo has thus been enormously increased, and more accurate practice can now be made at 2000 yds. than was formerly possible at 800 yds. This adds considerably to the chances of torpedo-boats attacking ships, even in day-time, at sea or at anchor, and will render further protection necessary against this weapon. Against a ship in motion there is still, however, the calculation as to her speed and the distance she will travel before the torpedo reaches her. Should this be miscalculated, an increased range for torpedoes will magnify the error. For instance, a 30-knot torpedo will travel 1000 yds. in a minute. If aimed at a ship on the beam assumed to be steaming 15 knots an hour, to reach her when 1000 yds. distant the torpedo must be discharged at a point 500 yds. ahead of her. But if the ship is actually steaming 12 knots, she will have travelled only 400 yds. in the minute, and the torpedo will be 100 yds. in advance of her. If discharged at a range of 500 yds., such a miscalculation causes an error of only 50 yds. or 150 ft. But if the object is 300 ft. long, and her centre was taken as the target, her bow would be just at the spot the torpedo would reach in thirty seconds. It would seem, therefore, that increased velocity of torpedo is necessary before the full advantages of the gyroscope can be realized. Now the range of the torpedo is entirely dependent upon the store of energy which can be carried; upon, therefore, the capacity of the air reservoir, the maximum pressure it can stand, and on the efficiency of the propelling engines. The speed over a given range is also dependent upon these factors; the maximum speed being limited by the strength of the engines and other parts. Improvements in steel manufacture have permitted the use of much higher pressures of air and the construction of air-chambers able to withstand the pressure of 2000 lb to the sq. in. with the same weight of air-chamber. This has enabled increased range without reduction in speed to be attained, or conversely, increased speed at shorter ranges. By improvement in the engines which are now of the Brotherhood 4-cylinder central crank type further gains have been effected.

Having reached the limit of pressure and endurance of air-chambers with present materials without undue increase of weight, the designer had to seek additional energy in another direction. Now the energy obtainable from a given weight of compressed air is dependent upon the volume of air available at the working pressure of the engines. At a constant pressure this volume of air is proportionate to its absolute temperature. If then the air be stored cold and highly heated before delivery to the engine the available energy from a given weight will be greatly increased. By this means we obtain the equivalent of a larger and heavier air-chamber without the increased weight such would involve.

As originally used a quantity of hydrocarbon fuel was placed in the air-vessel. Upon discharging the torpedo this fuel was automatically ignited and the contents of the air-chamber were heated. Unless, however, the combustion could be regulated there were serious risks of abnormal pressures, of overheating and weakening the air-vessel. Devices have been applied to overcome this liability, and other methods devised to obtain the same result.

By the use of heating and thereby increasing the volume of air in proportion to the rise of temperature the extra volume will allow of an increased speed for a given range or a greater range without increase of speed. The limit to the development of this system seems to be the temperature the materials will stand, but even at this early stage it has added several knots to the speed of this wonderful weapon.

Torpedo Carriages and Discharge.—As no gun which is inefficiently mounted can give good results, so the best torpedo is valueless without a good carriage or system of discharge. In the early days of the Whitehead, discredit came upon it because the importance of this was not sufficiently realized; and an erratic course under water was in nine cases out of ten due to a crude method of discharge. A delicate piece of mechanism was dropped into the water from a height of several feet, and naturally suffered internal derangement. Gun-ports were then used for the purpose, but now a special orifice is made, to which the torpedo carriage is fitted with a ball-and-socket joint—forming a water-tight aperture—so that this carriage or tube may be only 2 or 3 ft. above the water-line. The ball-and-socket joint enables it also to have a considerable angle of training. Originally the torpedo was pushed out by a rod acted upon by compressed air, in which case the carriage was a simple frame. The rod, pressing against the tail with some force, was apt to damage or disarrange the rudders, so the air-gun took the place of rod impulse. Here the torpedo fits closely in a tube or cylinder with an opening at the rear made air-tight when closed. At the desired moment compressed air is admitted to the rear part of the cylinder and blows the torpedo out. Gunpowder then superseded air for this operation; and now this has given place to a small charge of cordite, which does not leave any deposit on the inside of the cylinder. There is a double risk in the use of locomotive torpedoes from above water. (1) The charge may be exploded by hostile fire. Though mainly consisting of damp gun-cotton, which is not readily ignited, the dry primer and detonator may be struck, which would lead to a disastrous explosion. (2) The air-chamber is also a source of danger. As it contains air compressed to a high degree of tension, experiments have shown that if struck by a small shell it may burst with great violence; and as it offers a considerable mark, this is not an improbable event in an action. An instance of the danger of above-water torpedo tubes occurred in the Spanish-American War at the battle of Santiago. A shell entered the "Almirante Oquendo" and struck a 14-in. torpedo in the tube. The charge detonated, causing a fearful explosion and practically wrecking that part of the vessel. The development of moderate-sized quick-firing guns has increased this risk. Hence we find the use of above-water torpedo tubes now mainly confined to torpedo and other craft too small for submerged discharge.



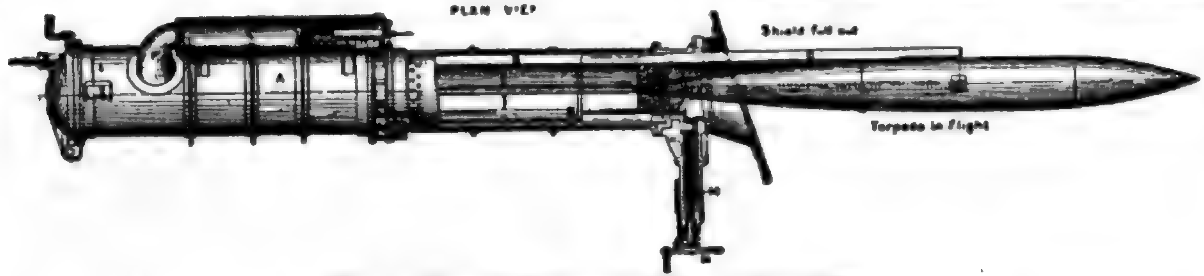


FIG. 3.—Broadside Submerged 18-in. Torpedo Tube.

Submerged Discharge.—The risk attached to having loaded torpedoes above the water-line—independently of the fact that to get the best result they should start in the element to which they belong—has given great impetus to the system of submerged discharge. From the earliest days of the weapon this has been employed to some extent. But it was principally in the direction of right-ahead fire, by having an orifice in the stem of the ship under water, to which a torpedo tube was connected. The tactical idea was thus to supplement attack with the ram, so that if the vessel endeavouring to ram saw that the object would evade this attack, she could project a torpedo ahead, which, travelling faster than the vessel, might as effectually accomplish the required service. The stem orifice had a water-tight cover, which was removed on the torpedo being placed in the tube and the inner door closed; then, sufficient impulse being imparted to eject the torpedo, and its machinery being set in motion at the same time, it darted forward towards the enemy. There is, however, some risk of the ship using a torpedo in this manner striking it before the missile has gathered the necessary impetus from its propellers to take it clear of the vessel. The system, moreover, has the disadvantage of weakening the ram, the construction of which should be of immense strength. There is the further liability of ramming with a torpedo in the bow tube, which would be as disastrous to friend as foe. This method of submerged discharge has therefore given place to ejecting the torpedo from the broadside. Considerable difficulty attached to getting the torpedo clear of the ship from this position without injury, especially when the vessel was proceeding at speed. The natural tendency of the passing water acting on the head of the torpedo as it emerged was to give a violent wrench and crush the rear end before that portion could clear the aperture. To prevent this the torpedo must be held rigid in the line of projection until the tail is clear of the ship. This is thus effected. Besides the tube with the aperture in side of the ship under water, fitted with sluice-valve, all broadside submerged discharge apparatus possess the following features: A shield is pushed out from the ship's side. In this shield there are grooves of some form. Guides on the torpedoes fit and run in these grooves. When discharged the torpedo is thus supported against the streams of passing water, and guided so that its axis continues in the line of projection until the tail is clear of the side, the shield being of such length that this occurs at the same time that the guides on the torpedo leave the grooves in the shield. An apparatus on this principle has been fitted to a number of ships of the British navy, and gives good results at high rates of speed. It has the defect that the shield must be run out previous to the torpedo being discharged, and brought back afterwards, thus involving three separate operations, each performed by compressed air.

In the broadside submerged discharge, designed, constructed and supplied to many foreign navies by Messrs Armstrong of the Elswick works, the three operations are combined in one. There is an outer tube as before, but it contains an inner tube carrying the torpedo. Fixed to this tube, and prolonging it, is the shield fitted with grooves. Both tubes have a door at the rear—made air-tight when closed—by which the torpedo is entered. A charge of cordite is used for ejection instead of compressed air, the gas from which entering the outer cylinder first forces the inner tube out, and then by means of a valve in the door of the inner tube passes in and blows out water and torpedo together, the shield supporting the latter until the tail is clear of the ship. By this time the cordite gas has expanded and cooled so as to relieve the pressure in rear; this causes the pressure of the water outside to push the shield and tube into the ship again, so that practically the whole operation is one motion.

Fig. 3 will further explain this apparatus. *A* is the outer tube; *B* the inner tube; *C* the shield; *D* torpedo; *E* explosion chamber for cordite charge placed at *K*; *F* pipe for gas to pass into outer tube; *G* and *Y* doors of inner and outer tube; *J* the valve which opens automatically when inner tube arrives at position shown in fig. 2; *T* and *P* appliance for running the tube in and out by hand when desired; *O* arrangement for bringing whole apparatus back for repair, &c.; *M* and *N* sluice-valve and handle; R, r^1, r^2, r^3, for draining tubes before torpedo is put in; *X* indicator showing position of inner tube.

Torpedoes have been discharged from this apparatus with successful result from a ship steaming at 17½ knots.

The advantage of cordite over compressed air for impulse is that it requires no attention: when a charge is placed in the explosion chamber, and a torpedo is in the tube, all is in readiness for firing when desired, without further attention in the torpedo-room. The cordite is fired by electricity from the conning-tower; the officer, therefore, having ascertained that all is ready below, has only to press a button when the object is in the required position. Automatic indications are given in the conning-tower when the sluice-valve is opened and when all is in readiness for firing.

This method of discharging torpedoes from the broadside under water eliminates the principal danger of the system, which required the shield to be put into position beforehand. It was then liable to be struck and distorted by passing wreckage without the fact being apparent to those in the ship. On the discharge of a torpedo its course might thus be arrested, or possibly the charge be prematurely exploded in dangerous proximity to its own ship. There was a risk of getting the shield out too soon, and thereby exposing it unduly to injury, or leaving the operation until too late. The tendency of naval equipment being towards complication, any readjustment which makes for simplicity cannot be otherwise than beneficial, and this feature is especially desirable in all matters connected with the use of torpedoes.

The compartment containing the broadside submerged apparatus usually extends across the ship, so as to contain a tube for each side.

Use in War.—This has been mainly confined to attacks upon squadrons and single ships by torpedo craft of various types. At the battle of Yalu, between the Chinese and Japanese fleets, torpedoes were discharged by the former, but none took effect. The Japanese trusted solely to gun-fire. After the defeat of the Chinese at sea, their remaining ships took refuge in the harbour of Wei-hai-Wei. Here they were blockaded by the Japanese fleet, which, having a number of torpedo-boats, made several determined attacks upon the ships inside. After one or two attempts, foiled by the obstructions placed by the Chinese to bar the passage, the Japanese boats succeeded in torpedoing several ships, and thus expedited the reduction of the place. In the war between Spain and the United States the inferiority of Admiral Cervera's squadron to that under Admiral Sampson might at the battle of Santiago have been to some extent counterbalanced by a skilful and vigorous use of torpedoes. If, instead of striving only to escape, a bold dash had been made for the American ships, the Spanish cruisers rapidly approaching end on to the foe, enveloped in the smoke of their own guns, should—some at least—have got within torpedo range without fatal injury. Closing each other at a speed of 10 knots only they would cover an interval of 6000 yds. in 9 minutes—a short time in which to disable a ship by gun-fire under such conditions. But Cervera elected to offer a passive resistance only, and while suffering destruction wrought no material injury upon his opponents. On the other hand, there have been several instances of large warships being sunk by locomotive torpedoes discharged from small craft. During the Chilean revolutionary war of 1891, a battleship, the "Blanco Encalada," of 3500 tons, was attacked in Caldera Bay by two torpedo vessels—the "Lynch" and "Condell"—of 750 tons. They entered the bay at dawn, the "Condell" leading. This vessel fired three torpedoes which missed the ironclad; then the "Lynch," after one ineffective shot, discharged a second torpedo, which struck the "Blanco" on the side nearly amidships. The latter had opened fire with little result, and sank soon afterwards. A similar incident occurred in 1894, when the Brazilian ironclad "Aquidaban" was sunk in Catherina Bay by the "Sampaio"—a torpedo vessel of 500 tons. She entered the bay at night, and first discharged her bow torpedo at the ironclad, which missed; she then fired a broadside torpedo, which struck and exploded against the bow of the "Aquidaban." It caused a great shock on board, throwing an officer on the bridge into the water. The vessel sank soon afterwards, and the "Sampaio" escaped uninjured.

In the war (1904–5) between Russia and Japan the Whitehead torpedo did not exercise an important influence upon the naval operations. It scored a success at the beginning of the struggle when a Japanese torpedo-flotilla made an attack upon the Russian fleet lying at anchor outside Port Arthur. For some unaccountable reason, though war was imminent, little or no precautions seemed to have been taken for effectually guarding the vessels. They had no nets in position nor boats patrolling outside them. Thus taken by surprise when the Japanese torpedo-boats suddenly appeared about midnight on the 8th of February 1904, several Russian ships were struck by torpedoes before they could offer any resistance. The most damaged were the "Retvisan" and "Tsarevitch" (battleships) and "Pallada" (cruiser), but all managed to get into Port Arthur and were eventually repaired. With three ships *hors de combat* the Russian fleet was considerably weakened at an early stage. The loss of the "Petropavlovsk" in April from a mine explosion was a further discouragement, especially as with this ship went down the gallant and energetic Admiral Makarov. In these circumstances the Russian fleet could not assume the offensive nor prevent the Japanese troops being sent by sea to invest Port Arthur. In June when the injured vessels were fit for service again the fleet put to sea but returned the same evening. The incident is noteworthy only because it led to an attack by the Japanese torpedo craft on the retiring squadron after sunset. As illustrating the uncertainty of hitting a moving object at sea with the Whitehead torpedo, already mentioned, no vessels were struck on this occasion and they reached the anchorage uninjured. In the battle of Tsushima the Japanese torpedo-boats attacked the Russian fleet after its disablement by gun-fire and gave the *coup de grâce* to some of the ships, which had little power of resistance owing to the destruction of their light armament. This war, therefore, did not increase to any extent our knowledge of the actual capability of this weapon.

Effect upon Naval Tactics: Blockade.—It has often been assumed that steam and the torpedo will in future render blockade impossible as it was carried out in the old wars; that, no longer dependent upon the wind to allow egress from the blockaded port, a vessel using steam can emerge when she chooses, while the fear of torpedo attack will deter a blockading squadron from keeping such watch as to foil the attempt. As regards the power conferred by steam, it will be no less advantageous to a blockading squadron, enabling it to maintain its position, whereas sailing ships were often driven by gales to leave their station and seek a port. This gave opportunities for the blockaded vessels to escape. As regards torpedo-boats, they would no doubt be a danger to a blockading squadron unprovided with a means of defence against these craft. Such defence consists in an adequate number of small vessels interposing an in-shore squadron between the port and the main body outside. Thus they perform the twofold service of watching the enemy's movements within and frustrating a torpedo attack. As an instance of blockade under modern conditions, we have that of Admiral Sampson upon Santiago—a guard more rigidly maintained than any in the old wars. So little was he deterred by the knowledge that Admiral Cervera had two torpedo vessels in his force, that he drew his squadron closer in at night when an attack might be expected, actually illuminating the entrance of the harbour with his electric searchlights, so that no craft could come out unperceived. No attempt was made to dislodge him from that position, and we may assume that blockade, if required in any scheme of naval strategy, will be carried out, whatever the weapons of warfare.

As regards the effect of torpedoes upon tactics at sea, and in general, as well as single ship, actions, they must operate against close range and employment of the ram. If it is recognized that a vessel within 1000 yds. is liable to a fatal blow, she will endeavour in ordinary circumstances to keep outside that distance and rely upon gun-fire. The exception would be where she is overmatched in that respect, and hence might endeavour to restore the balance by the use of torpedoes. In a fleet action the danger of missing a foe and hitting a friend would restrict the discharge of torpedoes; and this risk increases as formations disappear. But the torpedo must be conceded a tactical superiority over the ram for the following reasons: A vessel to use the latter must come within torpedo range, while her adversary may successfully apply torpedoes without placing herself in any danger of being rammed. The ram can only be used in one direction, and a small miscalculation may cause disaster. If a vessel has more than one position from which torpedoes can be discharged, she is not confined as regards attack to a single bearing or direction.

In action we may consider the speed of the torpedo as double that of the ship, and since against a moving object allowance must be made for the space traversed while ram or torpedo is travelling towards it, the faster weapon is less affected in its chance of successful impact by change of direction and speed of the object at the last moment. Lastly, with machinery disabled a ship is powerless to use the ram, but can avert a ram attack with her torpedoes. The movements of squadrons or single ships on entering an action are not likely to be influenced by any contemplated immediate use of torpedoes, for the gun must remain the primary weapon, at any rate at the first onset. Commanders would hardly risk being crushed by gun-fire before getting within torpedo range. Having faith in the efficiency of their ordnance and the gunnery skill of their crew, they would first manœuvre to bring these into play. Tactics for torpedo attack in such circumstances have not therefore been laid down, and it is only necessary to consider the positions which are advantageous for the use of this weapon, and, conversely, what should be avoided when a vessel, finding herself overmatched in gunnery, seeks to redress the balance with torpedoes.

Size of Target.—This, with a ship, varies in length as the torpedo approaches end on to the vessel, or at angle to the line of keel; the greatest being when the path of both forms a right angle. Hence the object is to place your ship where it presents the former condition to the enemy, while he affords the larger target. It must be remembered that, owing to the comparatively slow velocity of the torpedo, it must be aimed not directly at a ship in motion—like a shot from a gun—but at a point ahead which the ship will reach after the torpedo has traversed the intervening distance. Thus speed of object has to be estimated, and hence the importance of adding to the velocity of the torpedo and getting a broadside shot so as to reduce as much as possible errors of calculation. The great increase of the dimensions of warships, especially in length, which now has reached 500 ft., adds to the chances of a successful hit with torpedoes, and will doubtless tend to diminish a desire in future naval tactics to close inside torpedo range for the purpose of ramming.

Range.—Though the effective range of a torpedo discharged from a ship or torpedo vessel against a single object moving at high speed may be considered as approximately within 1000 yds. this limit of distance is considerably augmented where the target consists of several vessels at sea in close order, or is that afforded by a fleet at anchor. In the first case it may be worth while to discharge torpedoes from a distance of two or three thousand yards at the centre of the line for the chance of hitting one of the vessels composing it. As regards a mass of ships at anchor, unless protected by an impenetrable guard such as a breakwater or some invulnerable defence carried by the ships themselves, the increased range and accuracy of the torpedo imparted by recent developments would give it a chance of success if discharged against such a target at even greater distance.

Finally, by improvements in construction and methods of discharge the torpedo has recovered the place it was rapidly losing a few years ago. As armour receives increased resisting power to above-water projectiles, and gets on a level again with the gun, more attention will be given to under-water attack, against which no adequate protection has yet been devised. Thus we shall probably find the torpedo taking a very prominent place in any future war between the great maritime powers. (S. M E.-W.)

TORQUAY, a municipal borough, seaport and watering place, in the Torquay parliamentary division of Devonshire, England, on Tor Bay of the English Channel, 26 m. S. of Exeter, by the Great Western railway. Pop. (1901), 33,625. Owing to the beauty of its site and the equability of its climate, and to its being screened by lofty hills on the north, east and west, and open to the sea-breezes of the south, it has a high reputation as a winter residence. The temperature seldom rises as high as 70° F. in summer or falls below freezing-point in winter. To the north lies the populous suburb of St Mary Church. There are some remains of Tor or Torre Abbey, founded for Praemonstratensians by William, Lord Brewer, in 1196. They stand north of the modern mansion, but, with the exception of a beautiful pointed arch portal, are of small importance. On the south of the gateway is a 13th-century building, known as the Spanish barn. On Chapel Hill are the remains of a chapel of the 12th century, dedicated to St Michael, and supposed to have formerly belonged to the abbey. St Saviour's parish church of Tor-Mohun, or Tormoham, an ancient stone structure, was restored in 1874. The old church at St Mary Church, north of Torquay, was rebuilt in Early Decorated style; and in 1871 a tower was erected as a memorial to Dr Phillpotts, bishop of Exeter, who with his wife is buried in the churchyard. St John's Church, by G. E. Street, is a fine example of modern Gothic. Among the principal buildings and institutions are the town-hall, museum of the natural history society, theatre and opera-house (1880), market, schools of art and science, the Torbay infirmary and dispensary, the Western hospital for consumption, Crypt House institution for invalid ladies and the Mildmay home for incurable consumptives. The control of the harbour, piers, pleasure grounds, &c., was acquired from the lord of the manor by the local board in 1886. The harbour has a depth of over 20 ft. at low water. The principal imports are coal, timber and slates, and the principal export stone of the Transition limestone or Devonshire marble. In the town are a number of marble-polishing works. Terra-cotta ware of fine quality is also manufactured from a deposit of clay at Watcombe and at Hele. The town is governed by a mayor, 9 aldermen and 27 councillors. Area, 3588 acres.

There was a village at Torre even before the foundation of the abbey, and in the neighbourhood of Torre evidence has been found of Roman occupation. The manor was granted by William the Conqueror to Richard de Bruvere or de Brewere, and was subsequently known as Tor Brewer. After the defeat of the Spanish Armada, Don Pedro's galley was brought into Torbay; and William, prince of Orange, landed at Torbay on the 5th of November 1688. Until the middle of the 19th century it was an insignificant fishing village. It was incorporated in 1892.

TORQUE, or TORC (Lat. *torquis*, *torques*, a twisted collar, *torquere*, to twist), the term given by archaeologists to the twisted collars or armlets of gold or other metal worn particularly by the ancient Gauls and other allied Celtic races. The typical torque is a circlet with twisted rope-like strands, the ends not joined together; the torque was usually worn with the opening in the front as seen in a figure of a Gaul in a sculptured sarcophagus in the Capitoline Museum at Rome. In mechanics, the term "torque" is used of the turning-moment of a system-force, as in a series dynamo.

TORQUEMADA, JUAN DE (1388–1468), or rather JOHANNES DE TURRECREMATA, Spanish ecclesiastic, was born at Valladolid, in 1388, and was educated in that city. At an early age he joined the Dominican order, and soon distinguished himself for learning and devotion. In 1415 he accompanied the general of his order to the Council of Constance, whence he proceeded to Paris for study, and took his doctor's degree in 1423. After teaching for some time in Paris he became prior of the Dominican house first in Valladolid and then in Toledo. In 1431 Pope Eugenius IV. called him to Rome and made him "magister sancti palatii." At the Council of Basel he was one of the ablest supporters of the view of the Roman curia, and he was rewarded with a cardinal's hat in 1439. He died at Rome on the 26th of September 1468.

His principal works are *In Gratiani Decretum commentarii* (4 vols., Venice, 1578); *Expositio brevis et utilis super toto psalterio* (Mainz, 1474); *Quaestiones spirituales super evangelia totius anni* (Brixen, 1498); *Summa ecclesiastica* (Salamanca, 1550). The last-named work has the following topics: (1) De universa ecclesia; (2) De Ecclesia romana et pontificis primatu; (3) De universalibus conciliis; (4) De schismaticis et haereticis. His *De conceptione deiparae Mariae, libri viii.* (Rome, 1547), was edited with preface and notes by E. B. Pusey (London, 1869 seq.).

TORQUEMADA, THOMAS (1420–1498), inquisitor-general of Spain, son of Don Pedro Ferdinando, lord of Torquemada, a small town in Old Castile, was born in 1420 at Valladolid during the reign of John II. Being nephew to the well-known cardinal of the same name, he early displayed an attraction for the Dominican order; and, as soon as allowed, he joined the Friars Preachers in their convent at Valladolid. His biographers state that he showed himself from the beginning very earnest in austere life and humility; and he became a recognized example of the virtues of a Dominican. Valladolid was then the capital, and in due course eminent dignities were offered to him, but he gave signs of a determination to lead the simple life of a Friar Preacher. In the convent, his modesty was so great that he refused to accept the doctor's degree in theology, which is the highest prized honour in the order. His superiors, however, obliged him to take the priorship of the convent of Santa Cruz in Segovia, where he ruled for twenty-two years. The royal family, especially the queen and the infanta Isabella, often stayed at Segovia, and Torquemada became confessor to the infanta, who was then very young. He trained her to look on her future sovereignty as an engagement to make religion respected. Esprit Flechier, bishop of Nimes, in this *Histoire du cardinal Jimenes* (Paris, 1693), says that Torquemada made her promise that when she became queen she would make it her principal business to chastise and destroy heretics. He then began to teach her the political advantages of religion and to prepare the way for that tremendous engine in the hands of the state, the Inquisition.

Isabella succeeded to the throne (1474) on the death of Henry IV. Torquemada had always been strong in his advice that she should marry Ferdinand of Aragon and thus consolidate the kingdoms of Spain. Hitherto he had rarely appeared at court; but now the queen entrusted him not only with the care of her conscience, but also with the benefices in the royal patronage. He also helped her in quieting Ferdinand, who was chafing under the privileges of the Castilian grandees, and succeeded so well that the king also took him as confessor. Refusing the rich see of Seville and many other preferments he accepted that of councillor of state. For a long time he had pondered over the confusion in which Spain was, which he attributed to the intimate relations allowed between Christians and infidels for the sake of commerce. He saw Jews, Saracens, heretics and apostates roaming through Spain unmolested; and in this lax toleration of religious differences he thought he saw the main obstacle to the political union of the Spains, which was the necessity of the hour. He represented to Ferdinand and Isabella that it was essential to their safety to reorganize the Inquisition, which had since the 13th century (1236) been established in Spain. The bishops, who were *ex officio* inquisitors in their own dioceses, had not succeeded in putting a stop to the evils, nor had the friars, by whom they had been practically superseded. By the middle of the 15th century there was hardly an active inquisitor left in the kingdom. In 1473 Torquemada and Gonzalez de Mendoza, archbishop of Toledo, approached the sovereigns. Isabella had been for many years prepared, and she and Ferdinand, now that the proposal for this new tribunal came before them, saw in it a means of overcoming the independence of the nobility and clergy by which the royal power had been obstructed. With the royal sanction a petition was addressed to Sixtus IV. for the establishment of this new form of Inquisition; and as the result of a long intrigue, in 1479 a papal bull authorized the appointment by the Spanish sovereigns of two inquisitors at Seville, under whom the Dominican inquisitions already established elsewhere might serve. In the persecuting activity that ensued the Dominicans, "the Dogs of the Lord" (*Domini canes*), took the lead. Commissaries of the Holy Office were sent into different provinces, and ministers of the faith were established in the various cities to take cognisance of the crimes of heresy, apostasy, sorcery, sodomy and polygamy, these three last being considered to be implicit heresy. The royal Inquisition thus started was subversive of the regular tribunals of the bishops, who much resented the innovation, which, however, had the power of the state at its back.

In 1481, three years after the Sixtine commission, a tribunal was inaugurated at Seville, where freedom of speech and licence of manner were rife. The inquisitors at once began to detect errors. In order not to confound the innocent with the guilty, Torquemada published a declaration offering grace and pardon to all who presented themselves before the tribunal and avowed their fault. Some fled the country, but many (Mariana says 17,000) offered themselves for reconciliation. The first seat of the Holy Office was in the convent of San Pablo, where the friars, however, resented the orders, on the pretext that they were not delegates of the inquisitor-general. Soon the gloomy fortress of Triana, on the opposite bank of the Guadalquivir, was prepared as the palace of the Holy Office; and the terror-stricken Sevillianos read with dismay over the portals the motto of the Inquisition: "Exsurge, Domine, Judica causam tuam, Capite nobis vulpes." Other tribunals, like that of Seville and under *La Suprema*, were speedily established in Cordova, Jaen and Toledo. The sovereigns saw that wealth was beginning to flow in to the new tribunals by means of fines and confiscations; and they obliged Torquemada to take as assessors five persons who would represent them in all matters affecting the royal prerogatives. These assessors were allowed a definite vote in temporal matters but not in spiritual, and the final decision was reserved to Torquemada himself, who in 1483 was appointed the sole inquisitor-general over all the Spanish possessions. In the next year he ceded to Diego Deza, a Dominican, his office of confessor to the sovereigns, and gave himself up to the congenial work of reducing heretics. A general assembly of his inquisitors was convoked at Seville for the 29th of November 1484; and there he promulgated a code of twenty-eight articles for the guidance of the ministers of the faith. Among these rules are the following, which will give some idea of the procedure. Heretics were allowed thirty days to declare themselves. Those who availed themselves of this grace were only fined, and their goods escaped confiscation. Absolution *in foro externo* was forbidden to be given secretly to those who made voluntary confession; they had to submit to the ignominy of the public *auto-de-fé*. The result of this harsh law was that numerous applications were made to Rome for secret absolution; and thus much money escaped the Inquisition in Spain. Those who were reconciled were deprived of all honourable employment, and were forbidden to use gold, silver, jewelry, silk or fine wool. Against this law, too, many petitions went to Rome for rehabilitation, until in 1498 the Spanish pope Alexander VI. granted leave to Torquemada to rehabilitate the condemned, and withdrew practically all concessions hitherto made and paid for at Rome. Fines were imposed by way of penance on those confessing willingly. If a heretic in the Inquisition asked for absolution, he could receive it, but subject to a life imprisonment; but if his repentance were but feigned he could be at once condemned and handed over to the civil power for execution. Should the accused, after the testimony against him had been made public, continue to deny the charge, he was to be condemned as impenitent. When serious proof existed against one who denied his crime, he could be submitted to the question by torture; and if under torture he avowed his fault and confirmed his guilt by subsequent confession he was punished as one convicted, but should he retract he was again to be submitted to the tortures or condemned to extraordinary punishment. This second questioning was afterwards forbidden; but the prohibition was got over by merely suspending and then renewing the sessions for questioning. It was forbidden to communicate to the accused the entire copy of the declaration of the witnesses. The dead even were not free from the Holy Office; but processes could be instituted against them and their remains subjected to punishment. But along with these cruel and unjust measures there must be put down to Torquemada's credit some advanced ideas as to prison life. The cells of the Inquisition were, as a rule, large, airy, clean and with good windows admitting the sun. They were, in those respects, far superior to the civil prisons of that day. The use of irons was in Torquemada's time not allowed in the Holy Office; the use of torture was in accordance with the practice of the other royal tribunals; and when these gave it up the Holy Office did so also.

Such were some of the methods that Torquemada introduced into the Spanish Inquisition, which was to have so baneful an effect upon the whole country. During the eighteen years that he was inquisitor-general it is said that he burnt 10,220 persons, condemned 6860 others to be burnt in effigy, and reconciled 97,321, thus making an average of some 6000 convictions a year. These figures are given by Llorente, who was secretary of the Holy Office from 1790 to 1792 and had access to the archives; but modern research reduces the list of those burnt by Torquemada to 2000, in itself an awful holocaust to the principle of intolerance. The constant stream of petitions to Rome opened the eyes of the pope to the effects of Torquemada's severity. On three separate occasions he had to send Fray Alfonso Badaja to defend his acts before the Holy See. The sovereigns, too, saw the stream of money, which they had hoped for, diverted to the coffers of the Holy Office, and in 1493 they made complaint to the pope; but Torquemada was powerful enough to secure most of the money for the expenses of the Inquisition. But in 1496, when the sovereigns again complained that the inquisitors were, without royal knowledge or consent, disposing of the property of the condemned and thus depriving the public revenues of considerable sums, Alexander VI. appointed Jimenes to examine into the case and make the Holy Office disgorge the plunder.

For many years Torquemada had been persuading the sovereigns to make an attempt once for all to rid the country of the hated Moors. Mariana holds that the founding of the Inquisition, by giving a new impetus to the idea of a united kingdom, made the country more capable of carrying to a satisfactory ending the traditional wars against the Moors. The taking of Zahala in 1481 by the enemy gave occasion to reprisals. Troops were summoned to Seville and the war began by the siege of Alhama, a town eight leagues from Granada, the Moorish capital. Torquemada went with the sovereigns to Cordova, to Madrid or wherever the states-general were held, to urge on the war; and he obtained from the Holy See the same spiritual favours that had been enjoyed by the Crusaders. But he did not forget his favourite work of ferreting out heretics; and his ministers of the faith made great progress over all the kingdom, especially at Toledo, where merciless severity was shown to the Jews who had lapsed from Christianity. The Inquisition, although as a body the clergy did not mislike it, sometimes met with furious opposition from the nobles and common people. At Valentia and Lerida there were serious conflicts. At Saragossa Peter Arbué, a canon and an ardent inquisitor, was slain in 1485 whilst praying in a church; and the threats against the hated Torquemada made him go in fear of his life, and he never went abroad without an escort of forty familiars of the Holy Office on horseback and two hundred more on foot. In 1487 he went with Ferdinand to Malaga and thence to Valladolid, where in the October of 1488 he held another general congregation of the Inquisition and promulgated new laws based on the experience already gained. He then hurried back to Andalusia where he joined the sovereigns, who were now besieging Granada, which he entered with the conquering army in January 1492 and built there a convent of his order.

The Moors being vanquished, now came the turn of the Jews. In 1490 had happened the case of El Santo niño de la Guardia—a child supposed to have been killed by the Jews. His existence had never been proved; and in the district of Guardia no child was reported as missing. The whole story was most probably the creation of imaginations stimulated by torture and despair, unless it was a deliberate fiction set forth for the purpose of provoking hostility against the Jews. For a long time Torquemada had tried to get the royal consent to a general expulsion; but the sovereigns hesitated, and, as the victims were the backbone of the commerce of the country, proposed a ransom of 300,000 ducats instead. The indignant friar would hear of no compromise: "Judas," he cried, "sold Christ for 30 pence; and your highnesses wish to sell Him again for 300,000 ducats." Unable to bear up against the Dominican's fiery denunciations, the sovereigns, three months after the fall of Granada, issued a decree ordering every Jew either to embrace Christianity or to leave the country, four months being given to make up their minds; and those who refused to become Christians to order had leave to sell their property and carry off their effects. But this was not enough for the inquisitor-general, who in the following month (April) issued orders to forbid Christians, under severe penalties, having any communication with the Jews or, after the period of grace, to supply them even with the necessaries of life. The former prohibition made it impossible for the unfortunate people to sell their goods which hence fell to the Inquisition. The numbers of Jewish families driven out of the country by Torquemada is variously stated from Mariana's 1,700,000 to the more probable 800,000 of later historians. The loss to Spain was enormous, and from this act of the Dominican the commercial decay of Spain dates.

Age was now creeping on Torquemada, who, however, never would allow his misdirected zeal to rest. At another general assembly, his fourth, he gave new and more stringent rules, which are found in the *Compilación de las instrucciones del officio de la Santa Inquisición*. He took up his residence in Avila, where he had built a convent; and here he resumed the common life of a friar, leaving his cell in October 1497 to visit, at Salamanca, the dying infante, Don Juan, and to comfort the sovereigns in their parental distress. They often used to visit him at Avila, where in 1498, still in office as inquisitor-general, he held his last general assembly to complete his life's work. Soon afterwards he died, on the 16th of September 1498, "full of years and merit" says his biographer. He was buried in the chapel of the convent of St Thomas in Avila.

The name of Torquemada stands for all that is intolerant and narrow, despotic and cruel. He was no real statesman or minister of the Gospel, but a blind fanatic, who failed to see that faith, which is the gift of God, cannot be imposed on any conscience by force. (E. Tn.)

TORRE ANNUNZIATA, a seaport of Campania, Italy, in the province of Naples, on the east of the Bay of Naples, and at the south foot of Mt Vesuvius, 14 m. S.E. of Naples by rail. Pop. (1901), 25,070 (town); 28,084 (commune). It is on the main line to Battipaglia, at the point of junction of a branch line from Cancello round the east of Vesuvius, and of the branch to Castellammare di Stabia and Gragnano. It has a royal arms factory established by Charles IV., and other ironworks, considerable manufacture of macaroni, paper, breeding of silkworms, and some fishing and shipping. The harbour is protected by moles. Remains attributed to the Roman post-station of Oplontis were discovered in making the railway between Torre del Greco and Torre Annunziata, a little west of the latter, in 1842.

TORRE DEL GRECO, a seaport of Campania, Italy, in the province of Naples, 7½ m. S.E. of that city by rail. Pop. (1901), 35,328. It lies at the south-west foot of Vesuvius, on the shore of the Bay of Naples. It is built chiefly of lava, and stands on the lava stream of 1631, which destroyed two-thirds of the older town. Great damage was done by the eruptions of 1737 and 1794; the earthquake of 1857 and the eruption of the 8th of December 1861 were even more destructive. After each disaster the people returned, the advantage of the rich volcanic land overcoming apprehensions of danger. In the outskirts are many beautiful villas and gardens. The town has shipbuilding yards and lava quarries. The inhabitants take part in the coral and sponge fishing off the African and Sicilian coasts, and coral is worked in the town. There is also fishing for tunny, sardines and oysters; hemp is woven, and the neighbourhood is famed for its fruit and wine. In June the great popular festival "Dei Quattro Altari" is annually celebrated here in commemoration of the abolition of the feudal dominion in 1700. Remains of ancient villas and baths have been found here.

TORRENS, ROBERT (1780–1864), English soldier and economist, was born in Ireland in 1780. He entered the Marines in 1797, became a captain in 1806, and major in 1811 for bravery in Anhalt during the Walcheren expedition. He fought in the Peninsula, becoming lieutenant-colonel in 1835 and retiring as colonel in 1837. After abortive attempts to enter parliament in 1818 and 1826, he was returned in 1831 as member for Ashburton. He was a prolific writer, principally on financial and commercial policy. Almost the whole of the programme which was carried out in legislation by Sir Robert Peel had been laid down in his economic writings. He was an early and earnest advocate of the repeal of the corn laws, but was not in favour of a general system of absolute free trade, maintaining that it is expedient to impose retaliatory duties to countervail similar duties imposed by foreign countries, and a lowering of import duties on the productions of countries retaining their hostile tariffs would occasion a decline in prices, profits and wages.

His principal writings of a general character were: *The Economist* [*i.e.* Physiocrat] *refuted* (1808); *Essay on the Production of Wealth* (1821); *Essay on the External Corn-trade* (eulogized by Ricardo) (1827); *The Budget, a Series of Letters on Financial, Commercial and Colonial Policy* (1841–1843); *The Principles and Practical Operations of Sir Robert Peel's Act of 1844 Explained and Defended* (1847).

TORRENS, SIR ROBERT RICHARD (1814–1884), British colonial statesman, was born at Cork, Ireland, in 1814, and educated at Trinity College, Dublin. He went to South Australia in 1840, and was appointed collector of customs. He was an official member of the first legislative council and in 1852 was treasurer and registrar-general. When responsible government was established he was elected as a representative for Adelaide and became a member of the first ministry. In 1857 he introduced his famous Real Property Act, the principle of which consists of conveyance by registration and certificate instead of deeds. The system was rapidly adopted in the other colonies and elsewhere, and was expounded by the author during a visit to the United Kingdom in 1862–1864. After leaving South Australia, Sir R. R. Torrens represented Cambridge in the House of Commons from 1868 to 1874; in 1872 he was knighted. He was the author of works on the effect of the gold discoveries on the currency, and other subjects. He died on the 31st of August 1884.

TORRENS, WILLIAM TORRENS M'CULLAGH (1813–1894), English politician and social reformer, son of James M'Cullagh (whose wife's maiden name, Torrens, he assumed in 1863), was born near Dublin on the 13th of October 1813. He was called to the bar, and in 1835 became assistant commissioner on the special commission on Irish poor-relief, which resulted in the extension of the workhouse system in Ireland in 1838. In the 'forties he joined the Anti-Corn Law League, and in 1846 published his *Industrial History of Free Nations*. In 1847 he was elected to parliament for Dundalk, and sat till 1852. In 1857 he was elected as a Liberal for Yarmouth and from 1865 to 1885 he represented Finsbury. Torrens was a well known man in political life, and devoted himself mainly to social questions in parliament. It was an amendment of his to the Education Bill of 1870 which established the London School Board, and his Artisans' Dwellings Bill in 1868 facilitated the clearing away of slums by local authorities. He published several books, and his *Twenty Years in Parliament* (1893) and *History of Cabinets* (1894) contain useful material. He died in London on the 26th of April 1894.

TORRES NAHARRO, BARTOLOMÉ DE (1480–1530), Spanish dramatist, was born towards the end of the 15th century at Torres, near Badajoz. After some years of soldiering and of captivity in Algiers, Torres Naharro took orders, settled in Rome about 1511, and there devoted himself chiefly to writing plays. Though he alludes to the future pope, Clement VII. as his protector, he left Rome to enter the household of Fabrizio Colonna at Naples where his works were printed under the title of *Propaladia* (1517). He is conjectured to have returned to his native place, and to have died there shortly after 1529. His *Diálogo del nacimiento* is written in unavowed, though obvious, imitation of Encina, but in his subsequent plays he shows a much larger conception of dramatic possibilities. He classifies his pieces as *comedias á noticia* and *comedias á fantasia*; the former, of which the *Soldatesca* and *Tinellaria* are examples, present in dramatic form incidents within his personal experience; the latter, which include such plays as *Serafina*, *Himenea*, *Calamita* and *Aquilana*, present imaginary episodes with adroitness and persuasiveness. Torres Naharro is much less dexterous in stagecraft than many inferior successors, his humour is rude and boisterous and his diction is unequal; but to a varied knowledge of human nature he adds knowledge of dramatic effect, and his rapid dialogue, his fearless realism and vivacious fancy prepared the way for the romantic drama in Spain.

TORRES NOVAS, a town of Portugal, in the district of Santarem, 19 m. N.N.E. of Santarem on the Lisbon-Entroncamento railway. Pop. (1900), 10,746. It manufactures cottons, linens, jute, paper, leather and spirits. It was probably founded by Greeks, and was held by the Romans, Goths and Moors, from whom it was conquered in 1148 by Alphonso I. of Portugal.

TORRES VEDRAS, a town of Portugal, in the district of Lisbon, 43 m. N. by W. of Lisbon, on the Lisbon-Figueira da Foz railway. Pop. (1900), 6900. Torres Vedras is built on the left bank of the river Sizandro; it has a Moorish citadel and hot sulphur baths. Roman inscriptions and other remains have been found here, but the Latin name of the town, *Turres Veteres*, is probably medieval. Here were the noted fortifications known as the "lines of Torres Vedras," constructed by Wellington in 1810 (see PENINSULAR WAR). Here also in 1846 the troops of General Saldanha defeated those of the count de Bomfin and seized the castle and town (see PORTUGAL: *History*).

TORRES Y VILLAROEL, DIEGO DE (1696–1759?), Spanish miscellaneous writer, was born in 1696 at Salamanca, where his father was bookseller to the university. In his teens Torres escaped to Portugal where he enlisted under a false name; he next moved to Madrid, living from hand to mouth as a hawker; in 1717 he was ordained subdeacon, resumed his studies at Salamanca, and in 1726 became professor of mathematics at the university. A friend of his having stabbed a priest, Torres was suspected of complicity, and once more fled to Portugal, where he remained till his innocence was proved. He then returned to his chair, which he resigned in 1751 to act as steward to two noblemen; he was certainly alive in 1758, but the date of his death is not known. Torres had so slight a smattering of mathematics that his appointment as professor was thought scandalous even in his own scandalous age; yet he quickly acquired a store of knowledge which he displayed with serene assurance. His almanacs, his verses, his farces, his devotional and pseudo-scientific writings show that he possessed the alert adaptiveness of the born adventurer; but all that remains of his fourteen volumes (1745–1752) is his autobiography, an amusing record of cynical effrontery and successful imposture.

TORREVIEJA, a seaport of south-eastern Spain, in the province of Alicante, 3 m. S.W. of Cape Cervera, and at the terminus of a railway to Albatera on the Alicante-Murcia line. Pop. (1900), 7706. The district is famous for its salt beds, which are owned and worked by the state, the Laguna Grande alone yielding more than 100,000 tons a year. The other industries are chiefly fishing, shipbuilding and the manufacture of ropes and sails. The roadstead affords safe anchorage. There is an active trade in fruit and agricultural products.

TORREY, JOHN (1796–1873), American botanist, was born at New York on the 15th of August 1796. When he was 15 or 16 years of age his father received a prison appointment at Greenwich, and there he made the acquaintance of Amos Eaton (1776–1842), a pioneer of natural history studies in America. He thus learned the elements of botany, as well as something of mineralogy and chemistry. In 1815 he began the study of medicine, qualifying in 1818. In the following year he issued his *Catalogue of Plants growing spontaneously within Thirty Miles of the City of New York*, and in 1824 he issued the first and only volume of his *Flora of the Northern and Middle States*. In the same year he obtained the chair of chemistry and geology at West Point military academy, and three years later the professorship of chemistry and botany in the College of Physicians and Surgeons, New York. In 1836 he was appointed botanist to the state of New York and produced his *Flora* of that state in 1843; while from 1838 to 1843 he carried on the publication of the earlier portions of *Flora of North America*, with the assistance of his pupil, Asa Gray. From 1853 he was chief assayer to the United States assay office, but he continued to take an interest in botanical teaching until his death at New York on the 10th of March 1873. He made over his valuable herbarium and botanical library to Columbia College in 1860, and he was the first president of the Torrey Botanical Club in 1873. His name is commemorated in the small coniferous genus *Torreya*, found in North America and in China and Japan. *T. taxifolia*, a native of Florida, is known as the Torrey tree or savin, and also as the stinking cedar.

TORREY, REUBEN ARCHER (1856–), American evangelist, was born in Hoboken, New Jersey, on the 28th of January 1856. He graduated at Yale University in 1875 and at the Yale Divinity School in 1878. He became a Congregational minister in 1878, studied theology at Leipzig and Erlangen in 1882–1883, joined D. L. Moody in his evangelistic work in Chicago in 1889, and became pastor of the Chicago Avenue Church in 1894 and afterwards superintendent of the Moody Bible Institute of Chicago. In 1902–1903 he preached in nearly every part of the English-speaking world, and with Charles McCallon Alexander (b. 1867) conducted revival services in Great Britain in 1903–1905; Torrey conducted a similar campaign in American and Canadian cities in 1906–1907.

TORRICELLI, EVANGELISTA (1608–1647), Italian physicist and mathematician, was born at Faenza on the 15th of October 1608. Left fatherless at an early age, he was educated under the care of his uncle, a Camaldolese monk, who in 1627 sent him to Rome to study science under the Benedictine Benedetto Castelli (1577–1644), professor of mathematics at the Collegio di Sapienza. The perusal of Galileo's *Dialoghi delle nuove scienze* (1638) inspired him with many developments of the mechanical principles there set forth, which he embodied in a treatise *De motu* (printed amongst his *Opera geometrica*, 1644). Its communication by Castelli to Galileo in 1641, with a proposal that Torricelli should reside with him, led to Torricelli repairing to Florence, where he met Galileo, and acted as his amanuensis during the three remaining months of his life. After Galileo's death Torricelli was nominated grand-ducal mathematician and professor of mathematics in the Florentine academy. The discovery of the principle of the barometer (*q.v.*) which has perpetuated his fame ("Torricellian tube" "Torricellian vacuum") was made in 1643.

The publication amongst Torricelli's *Opera geometrica* (Florence, 1644) of a tract on the properties of the cycloid involved him in a controversy with G. P. de Roberval, who accused him of plagiarizing his earlier solution of the problem of its quadrature. There seems, however, no room for doubt that Torricelli's was arrived at independently. The matter was still in debate when he was seized with pleurisy, and died at Florence on the 25th of October 1647. He was buried in San Lorenzo, and a commemorative statue of him erected at Faenza in 1864.

Among the new truths detected by him was the valuable mechanical principle that if any number of bodies be so connected that, by their motion, their centre of gravity can neither ascend nor descend, then those bodies are in equilibrium. He also discovered the remarkable fact that the parabolas described (in a vacuum) by indefinitely numerous projectiles discharged from the same point with equal velocities, but in all directions have a paraboloid of revolution for their envelope. His theorem that a fluid issues from a small orifice with the same velocity (friction and atmospheric resistance being neglected) which it would have acquired in falling through the depth from its surface is of fundamental importance in hydraulics. He greatly improved both the telescope and microscope. Several large object lenses, engraven with his name, are preserved at Florence. He used and developed B. Cavalieri's method of indivisibles.

A selection from Torricelli's manuscripts was published by Tommaso Bonaventura in 1715, with the title *Lezioni accademiche* (Florence). They include an address of acknowledgment on his admission to the Accademia della Crusca. His essay on the inundations of the Val di Chiana was printed in *Raccolta d'autori che trattano del moto dell' acque*, iv. 115 (Florence, 1768), and amongst *Opuscoli idraulici*, iii. 347 (Bologna, 1822). For his life see Fabroni, *Vitae Italorum*, i. 345; Ghinassi, *Lettere fin qui inedite di Evangelista Torricelli* (Faenza, 1864); Tiraboschi, *Storia della lett. it.* viii. 302 (ed. 1824); Montucla, *Hist. des math.*, vol. ii.; Marie, *Hist. des sciences*, iv. 133.

TORRIDONIAN, in geology, a series of pre-Cambrian arenaceous sediments extensively developed in the north-west highlands of Scotland and particularly in the neighbourhood of upper Loch Torridon, a circumstance which suggested the name Torridon Sandstone, first applied to these rocks by J. Nicol. The rocks are mainly red and chocolate sandstones, arkoses, flagstones and shales with coarse conglomerates locally at the base. Some of the materials of these rocks were derived from the underlying Lewisian gneiss, upon the uneven surface of which they rest; but the bulk of the material was obtained from rocks that are nowhere now exposed. Upon this ancient denuded land surface the Torridonian strata rest horizontally or with gentle inclination. Their outcrop extends in a belt of variable breadth from Cape Wrath to the Point of Sleet in Skye, running in a N.N.E.-S.S.W. direction through Ross-shire and Sutherlandshire. They form the isolated mountain peaks of Canisp, Quinag and Suilven in the neighbourhood of Loch Assynt, of Slioch near Loch Maree and other hills. They attain their maximum development in the Applecross, Gairloch and Torridon districts, form the greater part of Scalpay, and occur also in Rum, Raasay, Soay and the Crowlin Islands. The Torridonian rocks have been subdivided into three groups: an upper Aultbea group, 3000–5000 ft.; a middle or Applecross group, 6000–8000 ft.; and a lower or Diabeg group, 500 ft. in Gairloch but reaching a thickness of 7200 ft. in Skye.

See "The Geological Structure of the North-West Highlands of Scotland," *Mem. Geol. Survey* (Glasgow, 1907). (J. A. H.)

TORRIGIANO, PIETRO (1472–1522), Florentine sculptor, was, according to Vasari, one of the group of talented youths who studied art under the patronage of Lorenzo the Magnificent in Florence. Benvenuto Cellini, reporting a conversation with Torrigiano, relates that he and Michelangelo, while both young, were copying the frescoes in the Carmine chapel, when some slighting remark made by Michelangelo so enraged Torrigiano that he struck him on the nose, and thus caused that disfigurement which is so conspicuous in all the portraits of Michelangelo. Soon after this Torrigiano visited Rome, and helped Pinturicchio in modelling the elaborate stucco decorations in the Apartamenti Borgia for Alexander VI. After some time spent as a hired soldier in the service of different states, Torrigiano was invited to England to execute the magnificent tomb for Henry VII. and his queen, which still exists in the lady chapel of Westminster Abbey. This appears to have been begun before the death of Henry VII. in 1509, but was not finished till 1517. The two effigies are well modelled, and have lifelike but not too realistic portraits. After this Torrigiano received the commission for the altar, retable and baldacchino which stood at the west, outside the screen of Henry VII.'s tomb. The altar had marble pilasters at the angles, two of which still exist, and below the *mensa* was a life-sized figure of the dead Christ in painted terra-cotta. The retable consisted of a large relief of the Resurrection. The baldacchino was of marble, with enrichments of gilt bronze; part of its frieze still exists, as do also a large number of fragments of the terra-cotta angels which surmounted the baldacchino and parts of the large figure of Christ. The whole of this work was destroyed by the Puritans in the 17th century.[1] Henry VIII. also commissioned Torrigiano to make him a magnificent tomb, somewhat similar to that of Henry VII., but one-fourth larger, to be placed in a chapel at Windsor; it was, however, never completed, and its rich bronze was melted by the Commonwealth, together with that of Wolsey's tomb. The indentures for these various works still exist, and are printed by Neale, *Westminster Abbey*, i. 54–59 (London, 1818). These interesting documents are written in English, and in them the Florentine is called "Peter Torrysany." For Henry VII.'s tomb he contracted to receive £1500, for the altar and its fittings £1000, and £2000 for Henry VIII.'s tomb. Other works attributed from internal evidence to Torrigiano are the tomb of Margaret of Richmond, mother of Henry VII., in the south aisle of his chapel, and a terra-cotta effigy in the chapel of the Rolls.

While these royal works were going on Torrigiano visited Florence in order to get skilled assistants. He tried to induce Benvenuto Cellini to come to England to help him, but Cellini refused partly from his dislike to the brutal and swaggering manners of Torrigiano, and also because he did not wish to live among "such beasts as the English." The latter part of Torrigiano's life was spent in Spain, especially at Seville, where, besides the painted figure of St Hieronymus in the museum, some terra-cotta sculpture by him still exists. His violent temper got him into difficulties with the authorities, and he ended his life in 1522 in the prisons of the Inquisition.

See Wilhelm Bode, *Die italienische Plastik* (Berlin, 1902).

TORRINGTON, ARTHUR HERBERT, EARL OF (1647–1716), British admiral, was the son of a judge, Sir Edward Herbert (*c.* 1591–1657). He entered the navy in 1663, and served in the Dutch wars of the reign of Charles II., as well as against the Barbary pirates. From 1680 to 1683 he commanded in the Mediterranean. His career had been honourable, and he had been wounded in action. The known Royalist sentiments of his family combined with his reputation as a naval officer to point him out to the favour of the king, and James II. appointed him rear-admiral of England and master of the robes. The king no doubt counted on his support of the repeal of the Test Acts, as the admiral was member for Dover. Herbert refused, and was dismissed from his places. He now entered into communication with the agents of the prince of Orange, and promised to use his influence with the fleet to forward a revolution. After the acquittal of the seven bishops in 1688 he carried the invitation to William of Orange. The Revolution brought him ample amends for his losses. He was named first lord, and took the command of the fleet at home. In 1689 he was at sea attempting to prevent the French admiral Château-Renault (*q.v.*) from landing the troops sent by the king of France to the aid of King James in Ireland. Though he fought an action with the French in Bantry Bay on the 10th of May he failed to baffle Château-Renault, who had a stronger force. Being discontented with the amount of force provided at sea, he resigned his place at the admiralty, but retained his command at sea. In May 1689 he was created earl of Torrington. In 1690 he was in the Channel with a fleet of English and Dutch vessels, which did not rise above 56 in all, and found himself in front of the much more powerful French fleet. In his report to the council of regency he indicated his intention of retiring to the Thames, and losing sight of the enemy, saying that they would not do any harm to the coast while they knew his fleet to be "in being." The council, which knew that the Jacobites were preparing for a rising, and only waited for the support of a body of French troops, ordered him not to lose sight of the enemy, but rather than do that to give battle "upon any advantage of the wind." On the 10th of July Torrington, after consulting with his Dutch colleagues, made a half-hearted attack on the French off Beachy Head in which his own ship was kept out of fire, and severe loss fell on his allies. Then he retired to the Thames. The French pursuit was fortunately feeble (see TOURVILLE, COMTE DE) and the loss of the allies was comparatively slight. The indignation of the country was at first great, and Torrington was brought to a court martial in December. He was acquitted, but never again employed. Although twice married, he was childless when he died on the 14th of April 1716, his earldom becoming extinct. The unfavourable account of his moral character given by Dartmouth to Pepys is confirmed by Bishop Burnet, who had seen much of him during his exile in Holland. An attempt has been made in recent years to rehabilitate the character of Torrington, and his phrase "a fleet in being" has been widely used (see *Naval Warfare*, by Vice-Admiral P. H. Colomb).

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[1] An old drawing still exists showing this elaborate work; it is engraved in the *Hierurgia anglicana*, p. 267 (London, 1848). Many hundreds of fragments of this terra-cotta sculpture were found a few years ago hidden under the floor of the triforium in the abbey; they are unfortunately too much broken and imperfect to be fitted together.

See Charnock's *Biog. Nav.*, i. 258. The best account of the battle of Beachy Head is to be found in "The Account given by Sir John Ashby Vice-Admiral and Rear-Admiral Rooke, to the Lords Commissioners" (1691).

TORRINGTON, GEORGE BYNG, VISCOUNT (1663-1733), English admiral, was born at Wrotham, Kent. His father, John Byng, was compelled by pecuniary losses to sell his property and his son entered the navy as a king's letter boy (see NAVY) in 1678. He served in a ship stationed at Tangier, and for a time left the navy to enter one of the regiments of the garrison, but in 1683 he returned to the navy as lieutenant, and went to the East Indies in the following year. During the year 1688, he had an active share in bringing the fleet over to the prince of Orange, and by the success of the revolution his fortune was made. In 1702 he was appointed to the command of the "Nassau," and was at the taking and burning of the French fleet at Vigo, and the next year he was made rear-admiral of the red. In 1704 he served in the Mediterranean under Sir Cloudesley Shovel, and reduced Gibraltar. He was in the battle of Malaga, and for his gallantry received the honour of knighthood. In 1708 as admiral of the blue he commanded the squadron which baffled the attempt of the Old Pretender to land in Scotland. In 1718 he commanded the fleet which defeated the Spaniards off Cape Passaro and compelled them to withdraw from their invasion of Sicily. This commission he executed so well that the king made him a handsome present and sent him full powers to negotiate with the princes and states of Italy. Byng procured for the emperor's troops free access into the fortresses which still held out in Sicily, sailed afterwards to Malta, and brought out the Sicilian galleys and a ship belonging to the Turkey Company. By his advice and assistance the Germans retook the city of Messina in 1719, and destroyed the ships which lay in the basin—an achievement which completed the ruin of the naval power of Spain. To his conduct it was entirely owing that Sicily was subdued and the king of Spain forced to accept the terms prescribed him by the quadruple alliance. On his return to England in 1721 he was made rear-admiral of Great Britain, a member of the privy council, Baron Byng of Southill, in the county of Bedford and Viscount Torrington in Devonshire. He was also made one of the Knights Companions of the Bath upon the revival of that order in 1725. In 1727 George II. on his accession made him first lord of the admiralty, and his administration was distinguished by the establishment of the Royal Naval College at Portsmouth. He died on the 17th of January 1733, and was buried at Southill, in Bedfordshire. Two of his eleven sons, Pattee (1699-1747) and George (1701-1750), became respectively the 2nd and 3rd viscounts. The title is still held by the descendants of the latter.

See *Memoirs relating to Lord Torrington*, Camden Soc., new series 46, and *A True Account of the Expedition of the British Fleet to Sicily 1718-1720*, published anonymously, but known to be by Thomas Corbett of the admiralty in 1739. Forbin's *Memoirs* contain the French side of the expedition to Scotland in 1708.

TORRINGTON, a borough of Litchfield county, Connecticut, U.S.A., in the township of Torrington, on the Naugatuck river, about 25 m. W. of Hartford. Pop. (1900), 8360, of whom 2565 were foreign-born; (1910) 15,483; of the township, including the borough (1900) 12,453; (1910) 16,840. It is served by the New York, New Haven & Hartford railway and by an electric line connecting with Winsted. It has a public library (1865) with 15,000 volumes in 1909. There is a state armoury in the borough. Torrington is a prosperous manufacturing centre. In 1905 the value of the factory product was $9,674,124. The township of Torrington, originally a part of the township of Windsor, was first settled in 1734, and was separately incorporated in 1740. The site was covered by pine trees, which were much used for ship-building, and for this reason it was known as Mast Swamp. In 1751 a mill was erected, but there were few, if any, residences until 1800. In 1806 the settlement was known as New Orleans village. In 1813 members of the Wolcott family of Litchfield, impressed with the water-power, bought land and built a woollen mill, and the village that soon developed was called Wolcottville. Its growth was slow until 1864. In 1881 its name was changed to Torrington, and in 1887 the borough was incorporated.

See S. Orcutt's *History of Torrington* (Albany, 1878), and an article, "The Growth of Torrington," in the *Connecticut Magazine*, vol. ix., No. 1.

TORRINGTON (GREAT TORRINGTON), a market town and municipal borough in the South Molton parliamentary division of Devonshire, England, on the Torridge, 225 m. W. by S. of London by the London & South-Western railway. Pop. (1901), 3241. It stands on a hill overlooking the richly wooded valley of the Torridge, here crossed by three bridges. Glove manufactures on a large scale, with flour and butter making and leather dressing, are the staple industries. The town is governed by a mayor, 4 aldermen and 12 councillors. Area, 3592 acres.

Torrington (*Torilone*) was the site of very early settlement, and possessed a market in Saxon times. The manor was held by Brictric in the reign of Edward the Confessor, and in 1086 formed part of the Domesday fief of Odo Fitz Gamelin, which later constituted an honour with Torrington as its caput. In 1221 it appears as a mesne borough under William de Toritone, a descendant of Odo and the supposed founder of the castle, which in 1228 was ordered to be razed to the ground, but is said to have been rebuilt in 1340 by Richard de Merton. The borough had a fair in 1221, and returned two members to parliament from 1295 until exempted from representation at its own request in 1368. The government was vested in bailiffs and a commonalty, and no charter of incorporation was granted till that of Queen Mary in 1554, which instituted a governing body of a mayor, 7 aldermen and 18 chief burgesses, with authority to hold a court of record every three weeks on Monday; law-days and view of frankpledge at Michaelmas and Easter; a weekly market on Saturday, and fairs at the feasts of St Michael and St George. This charter was confirmed by Elizabeth in 1568 and by James I. in 1617. A charter from James II. in 1686 changed the style of the corporation to a mayor, 8 aldermen and 12 chief burgesses. In the 16th century Torrington was an important centre of the clothing trade, and in 1605 the town is described as very prosperous, with three fairs, and a great market "furnished from far on every quarter, being the most convenient place for occasions of king or county in those parts." The Saturday market is still maintained, but the fairs have been altered to the third Saturday in March and the first Thursday in May. In 1643 Colonel Digby took up his position at Torrington and put to flight a contingent of parliamentary troops; but in 1646 the town was besieged by Sir Thomas Fairfax and finally forced to surrender. The borough records were destroyed by fire in 1724.

See *Victoria County History: Devonshire*; F. T. Colby, *History of Great Torrington* (1878)

TORSTENSSON, LENNART, Count (1603–1651), Swedish soldier, son of Torsten Lennartsson, commandant of Elfsborg, was born at Forstena in Vestergötland. At the age of fifteen he became one of the pages of the young Gustavus Adolphus and served during the Prussian campaigns of 1628–29. In 1629 he was set over the Swedish artillery, which under his guidance materially contributed to the victories of Breitenfeld (1631) and Lech (1632). The same year he was taken prisoner at Alte Veste and shut up for nearly a year at Ingolstadt. Under Banér he rendered distinguished service at the battle of Wittstock (1636) and during the energetic defence of Pomerania in 1637–38, as well as at the battle of Chemnitz (1638) and in the raid into Bohemia in 1639. Illness compelled him to return to Sweden in 1641, when he was made a senator. The sudden death of Banér in May 1641 recalled Torstensson to Germany as generalissimo of the Swedish forces and governor-general of Pomerania. He was at the same time promoted to the rank of field marshal. The period of his command (1641–1645) forms one of the most brilliant chapters in the military history of Sweden. In 1642 he marched through Brandenburg and Silesia into Moravia, taking all the principal fortresses on his way. On returning through Saxony he well nigh annihilated the imperialist army at the second battle of Breitenfeld (Oct. 23, 1642). In 1643 he invaded Moravia for the second time, but was suddenly recalled to invade Denmark, when his rapid and unexpected intervention paralysed the Danish defence on the land side, though Torstensson's own position in Jutland was for a time precarious owing to the skilful handling of the Danish fleet by Christian IV. In 1644 he led his army for the third time into the heart of Germany and routed the imperialists at Jüterbog (Nov. 23). At the beginning of November 1645 he broke into Bohemia, and the brilliant victory of Jankow (Feb. 24, 1645) laid open before him the road to Vienna. Yet, though one end of the Danube bridge actually fell into his hands, his exhausted army was unable to penetrate any farther and, in December the same year, Torstensson, crippled by gout, was forced to resign his command and return to Sweden. In 1647 he was created a count. From 1648 to 1651 he ruled all the western provinces of Sweden, as governor-general. On his death at Stockholm (April 7, 1651) he was buried solemnly in the Riddarholmskyrka, the Pantheon of Sweden. Torstensson was remarkable for the extraordinary and incalculable rapidity of his movements, though very frequently he had to lead the army in a litter, as his bodily infirmities would not permit him to mount his horse. He was also the most scientific artillery officer and the best and most successful engineer in the Swedish army.

His son, Senator Count Anders Torstensson (1641–1686), was from 1674 to 1681 governor-general of Esthonia. The family became extinct on the sword-side in 1727.

See J. W. de Peyster, *History of the Life of L. Torstensson* (Poughkeepsie, 1855); J. Feil, *Torstensson before Vienna* (trans. by de Peyster, New York, 1885); Gustavus III., *Eulogy of Torstensson* (trans. by de Peyster, New York, 1872). (R. N. B.)

TORT (Fr. for wrong, from Lat. *tortus*, twisted, participle of *torquere*), the technical term, in the law of England, of these dominions and possessions of the British Empire where the common law has been received or practically adopted in civil affairs, and of the United States, for a civil wrong, *i.e.* the breach of a duty imposed by law, by which breach some person becomes entitled to sue for damages. A tort must, on the one hand, be an act which violates a general duty. The rule which it breaks must be one made by the law, not, as in the case of a mere breach of contract, a rule which the law protects because the parties have made it for themselves. On the other hand, a tort is essentially the source of a private right of action. An offence which is punishable, but for which no one can bring a civil action, is not a tort. It is quite possible for one and the same act to be a tort and a breach of contract, or a tort and a crime; it is even possible in one class of cases for the plaintiff to have the option—for purposes of procedural advantage—of treating a real tort as a fictitious contract; but there is no necessary or general connexion. Again, it is not the case that pecuniary damages are always or necessarily the only remedy for a tort; but the right to bring an action in common law jurisdiction, as distinct from equity, matrimonial or admiralty jurisdiction, with the consequent right to damages, is invariably present where a tort has been committed.

This technical use of the French word *tort* (which at one time was near becoming a synonym of *wrong* in literary English) is not very ancient, and anything like systematic treatment of the subject as a whole is very modern. Since about the middle of the 19th century there has been a current assumption that all civil causes of action must be founded on either contract or tort; but there is no historical foundation for this doctrine, though modified forms of the action of trespass—actions *in consimili casu*, or "on the case" in the accustomed English phrase—did in practice largely supplant other more archaic forms of action by reason of their greater convenience. The old forms were designed as penal remedies for manifest breach of the peace or corruption of justice; and traces of the penal element remained in them long after the substance of the procedure had become private and merely civil. The transition belongs to the general history of English law.

In England the general scope of the law of torts has never been formulated by authority, the law having in fact been developed by a series of disconnected experiments with the various forms of action which seemed from time to time to promise the widest and most useful remedies. But there is no doubt that the duties enforced by the English law of torts are broadly those which the Roman institutional writers summed up in the precept *Alterum non laedere.* Every member of a civilized commonwealth is entitled to require of others a certain amount of respect for his person, reputation and property, and a certain amount of care and caution when they go about undertakings attended with risk to their neighbours. Under the modern law, it is submitted, the question arising when one man wilfully or recklessly harms another is not whether some technical form of action can be found in which he is liable, but whether he can justify or excuse himself. This view, at any rate, is countenanced by a judgment of the Supreme Court of the United States delivered in 1904. If it be right, the controverted question whether conspiracy is or is not a substantive cause of action seems to lose most of its importance. Instead of the doubtful proposition of law that some injuries become unlawful only when inflicted by concerted action, we shall have the plain proposition of fact that some kinds of injury cannot, as a rule, be inflicted by one person with such effect as to produce any damage worth suing for.

The precise amount of responsibility can be determined only by full consideration in each class of cases. It is important to observe, however, that a law of responsibility confined to a man's own personal acts and defaults would be of next to no practical use under the conditions of modern society. What makes the law of torts really effective, especially with regard to redress for harm suffered by negligence, is the universal rule of law that every one is answerable for the acts and defaults of his servants (that is, all persons acting under his direction and taking their orders from him or some one representing him) in the course of their employment. The person actually in fault is not the less answerable, but the remedy against him is very commonly not worth pursuing. But for this rule corporations could not be liable for any negligence of their servants, however disastrous to innocent persons, except so far as it might happen to constitute a breach of some express undertaking. We have spoken of the rule as universal, but, in the case of one servant of the same employer being injured by the default of another, an unfortunate aberration of the courts, which started about two generations ago from small beginnings, was pushed to extreme results, and led to great hardship. A partial remedy was applied in 1880 by the Employers' Liability Act; and in 1897 a much bolder step was taken by the Workmen's Compensation Act (superseded by a more comprehensive act in 1906). But, as the common law and the two acts (which proceed on entirely different principles) cover different fields, with a good deal of overlapping, and the acts are full of complicated provisos and exceptions, and contain very special provisions as to procedure, the improvement in substantial justice has been bought, so far, at the price of great confusion in the form of the law, and considerable difficulty in ascertaining what it is in any but the most obvious cases. The Workmen's Compensation Act includes cases of pure accident, where there is no fault at all, or none that can be proved, and therefore goes beyond the reasons of liability with which the law of torts has to do. In fact, it establishes a kind of compulsory insurance, which can be justified only on wider grounds of policy. A novel and extraordinary exception to the rule of responsibility for agents was made in the case of trade combinations by the Trade Disputes Act 1906. This has no interest for law as a science.

There are kinds of cases, on the other hand, in which the law, without aid from legislation, has imposed on occupiers and other persons in analogous positions a duty stricter than that of being answerable for themselves and their servants. Duties of this kind have been called "duties of insuring safety." Generally they extend to having the building, structure, or works in such order, having regard to the nature of the case, as not to create any danger to persons lawfully frequenting, using, or passing by them, which the exercise of reasonable care and skill could have avoided; but in some cases of "extra-hazardous" risk, even proof of all possible diligence—according to English authority, which is not unanimously accepted in America—will not suffice. There has lately been a notable tendency to extend these principles to the duties incurred towards the public by local authorities who undertake public works. Positive duties created by statute are on a similar footing, so far as the breach of them is capable of giving rise to any private right of action.

The classification of actionable wrongs is perplexing, not because it is difficult to find a scheme of division, but because it is easier to find many than to adhere to any one of them. We may start either from the character of the defendant's act or omission, with regard to his knowledge, intention and otherwise; or from the character of the harm suffered by the plaintiff. Whichever of these we take as the primary line of distinction, the results can seldom be worked out without calling in the other. Taking first the defendant's position, the widest governing principle is that, apart from various recognized grounds of immunity, a man is answerable for the "natural and probable" consequences of his acts; *i.e.* such consequences as a reasonable man in his place should have foreseen as probable. Still more is he answerable for what he did actually foresee and intend. Knowledge of particular facts may be necessary to make particular kinds of conduct wrongful. Such is the rule in the case of fraud and other allied wrongs, including what is rather unhappily called "slander of title," and what is now known as "unfair competition" in the matter of trade names and descriptions, short of actual piracy of trade-marks. But where an absolute right to security for a man's person, reputation or goods is interfered with, neither knowledge nor specific intention need be proved. In these cases we trespass altogether at our peril. It is in general the habit of the law to judge acts by their apparent tendency, and not by the actor's feelings or desires. I cannot excuse myself by good motives for infringing another man's rights, whatever other grounds of excuse may be available; and it is now settled conversely, though after much doubt, that an act not otherwise unlawful is not, as a rule, made unlawful by being done from an evil motive. This rule was known some time ago to apply to the exercise of rights of property, and such speculative doubt as remained was removed by the decision of the House of Lords in the leading case of *Allen* v. *Flood* (1898, A.C. 1). We now know that it applies to the exercise of all common rights. The exceptions are very few, and must be explained by exceptional reasons. Indeed, only two are known to the present writer—malicious prosecution, and the misuse of a "privileged occasion" which would justify the communication of defamatory matter if made in good faith. In each case the wrong lies in the deliberate perversion of a right or privilege allowed for the public good, though the precise extent of the analogy is not certain at present.[1] It must be remembered, however, that the presence or absence of personal ill will, and the behaviour of the parties generally, may have an important effect, when liability is proved or admitted, in mitigating or aggravating the amount of damages awarded by juries and allowed by the court to be reasonable. It may likewise be noted, by way of caution, that some problems of criminal law, with which we are not here concerned, require more subtle consideration. However, it is hardly ever safe to assume that the bounds of civil and criminal liability will be found coextensive. Perhaps we may go so far as to say that a man is neither civilly nor criminally liable for a mere omission (not being disobedience to a lawful command which he was bound to obey), unless he has in some way assumed a special duty of doing the act omitted.

We have already had to mention the existence of grounds of immunity for acts that would otherwise be wrongful. Such grounds there must be if the law is to be enforced and justice administered at all, and if the business of life is to be carried on with any freedom. Roughly speaking, we find in these cases one of the following conditions: Either the defendant was executing a lawful authority; or he was justified by extraordinary necessity; or he was doing something permitted by legislation for reasons of superior utility, though it may produce damage to others, and either with or without special provisions for compensating damage; or he was exercising a common right in matters open to free use and competition; or the plaintiff had, by consent or otherwise, disabled himself from having any grievance. Pure accident will hardly seem to any one who is not a lawyer to be a special ground of exemption, the question being rather how it could ever be supposed to be a ground of liability. But it was supposed so by many lawyers down to recent times; the reason lying in a history of archaic ideas too long to be traced here. Exercise of common rights is the category where most difficulty arises. Here, in fact, the point at which a man's freedom is limited by his neighbour's has to be fixed by a sense of policy not capable of formal demonstration.

As Justice Holmes of the Supreme Court of the United States has said, we allow unlimited trade competition (so long as it is without fraud) though we know that many traders must suffer, and some may be ruined by it, because we hold that free competition is worth more to society than its costs. A state with different economic foundations might have a different law on this, as on many other points. This freedom extends not only to the exercise of one's calling, but to choosing with whom and under what conditions one will exercise it. Also the law will not inquire with what motives a common right is exercised; and this applies to the ordinary rights of an owner in the use of his property as well as to the right of every man to carry on his business.[1] Owners and occupiers of immovable property are bound, indeed, to respect one another's convenience within certain limits. The maxim or precept *Sic utere tuo ut alienum non laedas* does not mean that I must not use my land in any way which can possibly diminish the profit or amenity of my neighbour's. That would be false. It is a warning that both his rights and mine extend beyond being free from actual unlawful entry, and that if either of us takes too literally the more popular but even less accurate maxim, "Every man may do as he will with his own," he will find that there is such a head of the law as nuisance.

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[1] It was formerly supposed that an action by a party to a contract against a third person for procuring the other party to break his contract was within the same class, *i.e.* that malice must be proved. But since *Allen* v. *Flood*, and the later decision of the House of Lords in *Quinn* v. *Leathem* (1901, A.C. 495), this view seems untenable. The ground of action is the intentional violation of an existing legal right; which, however, since 1906, may be practised with impunity in the United Kingdom "in contemplation or furtherance of a trade dispute": Trade Disputes Act, § 3.

From the point of view of the plaintiff, as regards the kind of damage suffered by him, actionable wrongs may be divided into four groups. We have some of a strictly personal kind; some which affect ownership and rights analogous to ownership; some which extend to the safety, convenience and profit of life generally—in short, to a man's estate in the widest sense; and some which may, according to circumstances, result in damage to person, property or estate, any or all of them. Personal wrongs touching a man's body or honour are assault, false imprisonment, seduction or "enticing away" of members of his family. Wrongs to property are trespass to land or goods, "conversion" of goods (*i.e.* wrongful assumption of dominion over them), disturbance of easements and other individual rights in property not amounting to exclusive possession. Trespass is essentially a wrong to possession; but with the aid of actions "on the case" the ground has been practically covered. Then there are infringements of incorporeal rights which, though not the subject of trespass proper, are exclusive rights of enjoyment and have many incidents of ownership. Actions, in some cases expressly given by statute, lie for the piracy of copyright, patents and trade marks. Wrongs to a man's estate in the larger sense above noted are defamation (not a strictly personal wrong, because according to English common law the temporal damage, not the insult, is, rightly or wrongly, made the ground of action); deceit, so-called "slander of title" and fraudulent trade competition, which are really varieties of deceit; malicious prosecution; and nuisance, which, though most important as affecting the enjoyment of property, is not considered in that relation only. Finally, we have the results of negligence and omission to perform special duties regarding the safety of one's neighbours or customers, or of the public, which may affect person, property, or estate generally.

The law of wrongs is made to do a great deal of work which, in a system less dependent on historical conditions, we should expect to find done by the law of property. We can claim or reclaim our movable goods only by complaining of a wrong done to our possession or our right to possess. There is no direct assertion of ownership like the Roman *vindicatio*. The law of negligence, with the refined discussions of the test and measure of liability which it has introduced, is wholly modern; and the same may be said of the present working law of nuisance, though the term is of respectable antiquity. Most recent of all is the rubric of "unfair competition," which is fast acquiring great importance.

It will be observed that the English law of torts answers approximately in its purpose and contents to the Roman law of obligations *ex delicto* and *quasi ex delicto*. When we have allowed for the peculiar treatment of rights of property in the common law, and remembered that, according to one plausible theory, the Roman law of possession itself is closely connected in its origin with the law of delicts, we shall find the correspondence at least as close as might be expected a priori. Nor is the correspondence to be explained by borrowing, for this branch of the common law seems to owe less to the classical Roman or medieval canon law than any other. Some few misunderstood Roman maxims have done considerable harm in detail, but the principles have been worked out in all but complete independence.

A list of modern books and monographs will be found at the end of the article on "Torts" by the present writer in the *Encyclopaedia of the Laws of England* (2nd ed.). Among recent editions of works on the law of torts and new publications the following may be mentioned here: Addison, by W. E. Gordon and W. H. Griffith (8th ed., 1906); Clerk and Lindsell, by Wyatt Paine (4th ed., 1906); Pollock (8th ed., 1908); Salmond, *The Law of Torts* (2nd ed., 1910). In America: Burdick, *The Law of Torts* (1905); Street, *The Foundations of Legal Liability* (1906), 3 vols. of which vol. i. is on Tort. (F. Po.)

TORTOISE. Of the three names generally used for this order of reptiles, viz. tortoise, turtle and terrapin, the first is derived from the Old French word *tortis*, *i.e.* twisted, and was probably applied first to the common European species on account of its curiously bent forelegs. Turtle is believed to be a corruption of the same word, but the origin of the name terrapin is unknown: since the time of the navigators of the 16th century it has been in general use for fresh-water species of the tropics, and especially for those of the New World. The name tortoise is now generally applied to the terrestrial members of this group of animals, and that of turtle to those which live in the sea or pass a great part of their existence in fresh water. They constitute one of the orders of reptiles, the Chelonia: toothless reptiles, with well developed limbs, with a dorsal and a ventral shell composed of numerous bony plates, large firmly fixed quadrates, a longitudinal anal opening and an unpaired copulatory organ.

The whole shell consists of the dorsal, more or less convex carapace and the ventral plastron, both portions being joined laterally by the so-called bridge. The carapace is (with the exception of *Sphargis*) formed by dermal ossifications which are arranged in regular series, viz. a median row (1 nuchal, mostly 8 neurals and 1–3 supracaudal or pygal plates), a right and left row of costal plates which surround and partly replace the ribs, and a considerable number (about 11 pairs) of marginal plates. The plastron consists of usually 9, rarely 11, dermal bones, viz. paired epi-, hyo-, hypo- and xiphi-plastral plates and the unpaired endo-plastral; the latter is homologous with the interclavicle, the epi-plastra with the clavicles, the rest with so-called abdominal ribs of other reptiles.

In most Chelonians the bony shell is covered with a hard epidermal coat, which is divided into large shields, commonly called "tortoiseshell." These horny shields or scutes do not correspond in numbers and extent with the underlying bones, although there is a general, vague resemblance in their arrangement; for instance, there is a neural, a paired costal and a paired marginal series. The terminology may be learned from the accompanying illustrations (figs. 1 and 2).

The integuments of the head, neck, tail and limbs are either soft and smooth or scaly or tubercular, frequently with small osseous nuclei.

All the bones of the skull are suturally united. The dentary portion of the mandible consists of one piece only, both halves being completely fused together. The pectoral arch remains separate in the median line; it consists of the coracoids, which slope backwards, and the scapulae, which stand upright and often abut against the inside of the first pair of costal plates. Near the glenoid cavity for the humerus arises from the scapula a long process which is directed transversely towards its fellow; it represents the acromial process of other vertebrates, although so much enlarged, and is neither the precoracoid, nor the clavicle, as stated by the thoughtless. The tail is still best developed in the Chelydridae, shortest in the Trionychoidea. Since it contains the large copulatory organ, it is less reduced in the males. No Chelonians possess the slightest traces of teeth, but their jaws are provided with horny sheaths, with hard and sharp edges, forming a beak.

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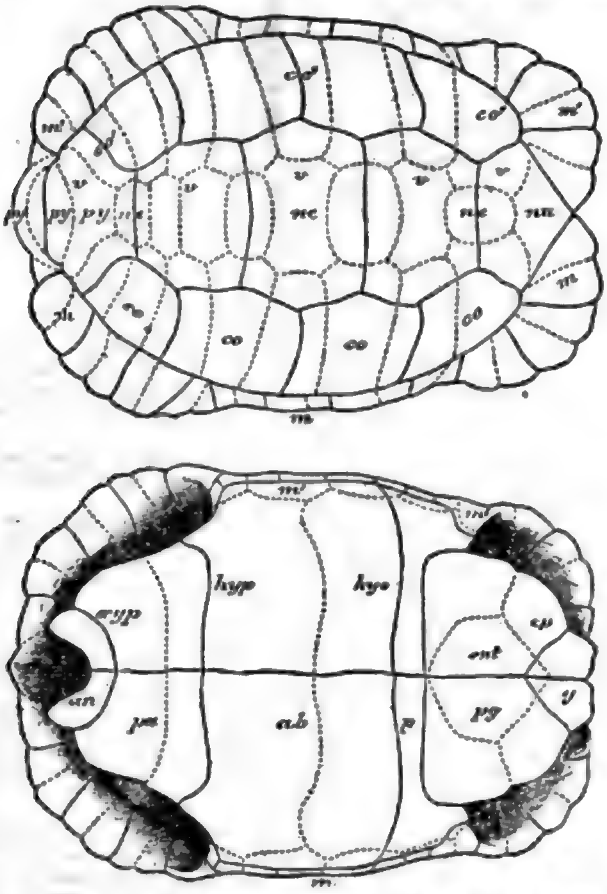
[1] The rule that a man's motives for exercising his common rights are not examinable involves the consequence that advising or procuring another, who is a free agent, to do an act of this kind can, a fortiori, not be an actionable wrong at the suit of a third person who is damnified by the act, and that whatever the adviser's motives may be. This appears to be included in the decision of the House of Lords in *Allen* v. *Flood*. That decision, though not binding in any American court, is approved and followed in most American jurisdictions. It is otherwise where a system of coercion is exercised on a man's workmen or customers in order to injure him in his business. The extension of immunity to such conduct would destroy the value of the common right which the law protects: *Quinn* v. *Leathem*. The coercion need not be physical, and the wrong as a whole may be made up of acts none of which taken alone would be a cause of action. In this point there is nothing novel, for it is so in almost every case of nuisance. Conspiracy is naturally a frequent element in such cases, but it does not appear to be necessary; if it were, millionaires and corporations might exceed the bounds of lawful competition with impunity whenever they were strong enough. The reasons given in *Quinn* v. *Leathem* are many and various, but the decision is quite consistent with *Allen* v. *Flood*. However, the Trade Disputes Act will probably have its intended effect of reducing the law on this head to relative insignificance in England.

The number of Chelonians known at present may be estimated at about 200, the fresh-water species being far the most numerous, and are abundant in well-watered districts of the tropical and sub-tropical zones. Their number and variety decrease beyond the tropics, and in the north they disappear entirely about the 50th parallel in the western and about the 56th in the eastern hemisphere, whilst in the southern hemisphere the terrestrial forms seem to advance to 36° S. only. The marine turtles, which are spread over the whole of the equatorial and sub-tropical seas, sometimes stray beyond those limits. As in other orders of reptiles, the most specialized and the largest forms are restricted to the tropics (with the exception of *Macroclemmys*); but, unlike lizards or snakes, Chelonians are unable to exist in sterile districts or at great altitudes.



FIGS. 1, 2.—Shell of *Testudo pardalis*, to show the divisions of the integument, which are marked by entire lines, and of the osseous carapace, these being marked by dotted lines. Fig. 1, Upper or dorsal aspect. Fig. 2, Lower or ventral aspect.

Epidermal shields:—	
co,	Costals.
v,	Vertebrals.
m,	Marginals.
g.	Gulars.
pg,	Postgulars or humerals.
p,	Pectorals.
ab,	Abdominals.
pa,	Preanals or femorals.
an,	Anals.

Bones of the Carapace:—	
*co*¹,	Costals.
ne,	Neurals.
nu,	Nuchal.
py,	Pygals.
*m*¹,	Marginals.
ent,	Entoplastron
ep,	Epiplastron.
hyo,	Hyoplastron.
hyp,	Hypoplastron.
xyp,	Xiphiplastron.

They show a great divergence in their mode of life—some living constantly on land, others having partly terrestrial partly aquatic habits, others again rarely leaving the water or the sea. The first-mentioned, the land tortoises proper, have short club-shaped feet with blunt claws, and a very convex, heavy, completely ossified shell. In the fresh-water forms the joints of the limb bones are much more mobile, the digits distinct, armed with sharp claws, and united by a membrane or web; their shell is less convex, and is flattened, and more or less extensive areas may remain unossified, or transparent windows are formed with age, for instance in *Batagur*. As a rule, the degree of development of the interdigital web and of convexity of the shell indicates the prevalence of aquatic or terrestrial habits of a species of terrapin. Finally, the marine turtles have paddle-shaped limbs resembling those of Cetaceans.

Land tortoises are sufficiently protected by their carapace, and therefore have no need of any special modification of structure by means of which their appearance would be assimilated to the surroundings and thus give them additional security from their enemies. These, however, are few in number. On the other hand, among the carnivorous terrapins and fresh-water turtles instances of protective resemblance are not scarce, and may even attain to a high degree of specialization, as in *Chelys*, the matamata. The colours of land tortoises are generally plain, or in yellow and brown patterns, whilst those of many terrapins are singularly varied, bright and beautiful, especially in the very young, but all this beauty is lost in the adult of many species.

Chelonians are diurnal animals; only a few are active during the night, habitually or on special occasions, as, for instance, during oviposition. Land tortoises are slow in all their movements, but all kinds living in water can execute rapid motions, either to seize their prey or to escape from danger. All Chelonians are stationary, residing throughout the year in the same locality, with the exception of the marine turtles, which periodically migrate to their breeding-stations. Species inhabiting temperate regions hibernate.

Land tortoises, a few terrapins, and some of the marine turtles are herbivorous, the others carnivorous, their prey consisting chiefly of fish, frogs, molluscs, and other small aquatic animals; some, *e.g. Clemmys insculpta* and *Cistudo carolina*, have a mixed vegetable and animal diet.

All Chelonians are oviparous, and the eggs are generally covered with a hard shell, mostly elliptical, rarely quite round, as in the case of the marine turtles. The various modifications, and also the not uncommon individual variations, in the composition of the carapace plates and the number and disposition of the shields, are very significant. They show an unmistakable tendency towards reduction in numbers, a concentration and simplification of the shell and its covering shields. We can to a certain extent reconstruct a generalized ancestral tortoise and thereby narrow the wide gap which separates the Chelonia from every other reptilian order. The early Chelonians possessed most likely more than five longitudinal dorsal rows of plates. The presence of several small supramarginal shields in *Macroclemmys* may be an indication that the total number of longitudinal rows was originally at least seven. The number of transverse rows, both of plates and shields, was also greater. We can account for at least twelve median plates and as many pairs of marginals, but for only eight median and eight pairs of costal shields (individual variations observed in *Thalassochelys*). It stands to reason that originally each trunk metamere had its full complement of plates and shields; consequently that about twelve trunk metameres partook in the formation of the shell, which, with subsequent shortening and broadening of the trunk, has undergone considerable concentration and reduction, a process which has reduced the costal plates to seven pairs in the American species of *Trionyx*, has completely abolished the neural plates of some Chelydidae, and has brought down the costal shields to four pairs in the majority of recent Chelonians. In several species of *Testudo* the little nuchal shield is suppressed, thereby reducing the unpaired median shields to five. The complete absence of shields in the *Trionychidae* and in *Carettochelys* is also due to a secondary process, which, however, has proceeded in a different way.

Classification of Chelonia.

H. Stannius in 1854 clearly separated the Trionychoidea from the rest. E. D. Cope, in 1870, distinguished between Pleurodira and Cryptodira according to whether the neck, δέρη or δειρή, is bent sidewards, or hidden by being withdrawn in an S-shaped curve in a vertical plane; he also separated *Sphargis* as Athecae from all the other Chelonians, for which L. Dollo, in 1886, proposed the term Thecophora. These terms are most unfortunate, misleading. Athecae (from θήκη, shell) has reference to the absence of a horny shell-covering in the leathery turtle; but since the same character applies to Trionychoidea and to *Carettochelys*, nobody can guess that the term *Athecae* in Dollo's sense refers to the fact that the shell of the leathery turtle is not homologous with the typical shell or θήκη of the other Chelonians. The grouping of the latter into families recognizable by chiefly internal, skeletal characters has been effected by G. A. Boulenger. For practical purposes the following "key" is preferable to those taxonomic characters which are mentioned in the descriptions of the different families. The relationships between them may be indicated as follows:—

	Athecae		Sphargidae
			Pelomedusidae
Chelonia		Pleurodira .	Chelydidae
			Carettochelydidae
	Thecophora		
			Chelydridae—Dermatemydidae-Cinosternida
		Cryptodira	Platysternidae
			Testudinidae
			Chelonidae
		Trionychoidea	

Key to the Families of Chelonia.

Shell covered with horny shields.	
Digits distinct, with five or four claws.	
Pectoral shields separated from the marginals by inframarginals.	
Tail long and crested. Plastron small and cruciform	Chelydridae
Tail long, covered with rings of shields. Plastron large	Platysternidae
Tail short	Dermatemydidae Cinosternidae
Pectoral shields in contact with the marginals.	
Plastral shields 11 or 12, without an intergular.	
Neck retractile in an S-shaped vertical curve	Testudinidae
Plastral shields 13, an intergular being present.	
Neck bending sideways under the shell	Chelydidae Pelomedusidae
Limbs paddle-shaped, with one or two claws	Chelonidae
Shell without horny shields, covered with soft leathery skin.	
Digits distinct, broadly webbed, but with only three claws	Trionychoidea
Limbs paddle-shaped.	
Shell composed of regular series of bony plates. Two claws	Carettochelydidae
Shell composed of very many small plates arranged like mosaic. No claws . .	Sphargidae.

Sub-order I. Athecae.—The shell consists of a mosaic of numerous small polygonal osseous plates and is covered with leathery skin without any horny shields. The limbs are transformed into paddles, without claws. Marine. Sole representative *Sphargis* or *Dermatochelys coriacea*, the leathery turtle or luth; it is the largest of living Chelonians, surpassing 6 ft. in length, has a wide distribution over all the intertropical seas, but is very rare everywhere; a few stragglers have appeared as far north as the coasts of Long Island, and those of Great Britain, Holland and France. It is a curious fact that only adults and young, but none of intermediate size, happen to be known. This creature shows many important features. The vertebrae and ribs are not fused with, but remain free from, the carapace, and this is fundamentally different from and not homologous with that of other Chelonians. O. P. Hay has suggested that the mosaic polygonal components of the shell of *Sphargis* are, so to speak, an earlier generation of osteodermal plates than the fewer and larger plates of the Thecophora, which in them fuse with the neural arches and the ribs. *Sphargis* has, however, the later category in the plastron and in its first neural or nuchal plate. If this suggestion is correct, this turtle has either lost or perhaps never had developed the horny shields. The many mosaic plates comprise larger plates which form an unpaired median, two pairs of other dorsal, a lateral and three pairs of ventral series or ridges; thirteen, or when the inner ventral pair fuses, twelve pairs in all.

The skull, excellently studied by J. F van Bemmelen, much resembles that of *Chelone*, but so-called epipterygoids are absent; further, the pterygoids, instead of sending lateral arms to the jugals and maxillaries, are widely separated from these bones by the palatines, and these do not at all ventrally roof over the choanae. The position of *Sphargis* in the system is still a moot question. G. A. Boulenger looks upon it as the sole remnant of a primitive group in opposition to all the other recent Chelonia; G. Baur considered it the most specialized descendant of the Chelonidae, a view which has been supported by W. Dames, E. C. Case, and to a certain extent by J. F. van Bemmelen. For literature, &c., see L. Dollo, *Bull. S. R. Bruxelles* (Février 4, 1901).

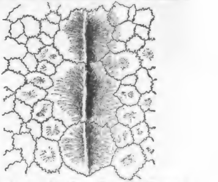


Fig. 3.—A portion of the Osseous Plates of the Carapace of *Sphargis coriacea*, showing three large keeled plates of one of the longitudinal ridges of the carapace, with a number of the small irregular plates on either side of them.

Sub-order II. Thecophora.—The bony shell is composed of several longitudinal series of plates (on the dorsal side a median or neural, a paired lateral or costal series, and marginal plates). With few exceptions this shell is covered with large horny scutes or shields.

Super-family 1. Cryptodira.—The neck, if retractile, bends in an S-shaped curve in a vertical plane. The pelvis is not fused with the shell, and this is covered with large horny shields, except in *Carettochelys*.

Family 1. Chelydridae.—The plastron is rather narrow, and cross-shaped; the bridge is very narrow and is covered by a pair of shields, the displaced abdominals, which are separated from the marginals by a few inframarginals. The limbs, neck and head are so stout that they cannot completely be withdrawn into the shell. The tail is very long. Only two genera with three species, confined to America. *Chelydra serpentina*, the "snapping turtle," ranging from the Canadian lakes through the United States east of the Rockies; closely allied is *C. rossignoni* of Central America and Ecuador. *Macroclemmys temmincki*, the "alligator turtle," is the largest known fresh-water Chelonian, its shell growing to a length of 3 ft. It is characterized by the three series of strong prominent keels along the back; it inhabits the whole basin of the Mississippi and Missouri rivers.

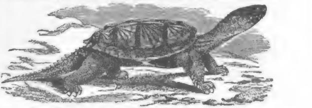


Fig. 4.—The Snapping Turtle (*Chelydra serpentina*).

Family 2. Dermatemydidae.—The pectoral shields are widely separated from the marginals by inframarginals, the gulars are small or absent, and the tail is extremely short. Only a few species, in Central America. The plastron is composed of nine plates. The nuchal plate has a pair of rib-like processes like those of the Chelydridae. One or more of the posterior costal plates meet in the middle line. The shell of these aquatic, broadly web-fingered tortoises, is very flat and the covering shields are thin. They feed upon leaves, grass and especially fruit. *Staurotypus, e.g. salvini* with 23. *Dermatemys, e.g. mawi*, with 25 marginal shields.

Family 3. Cinosternidae.—Closely allied to the two previous families from which *Cinosternum*, the only genus, differs chiefly by the absence of the endo-plastral plate. Inframarginals are present. The nuchal plate has a pair of rib-like processes. The neural plates are interrupted by the meeting of several pairs of the costal plates. Twenty-three marginal shields. In some species the skin of the legs and neck is so baggy that these parts slip in, the skin rolling off, when such a turtle withdraws into its shell. In some the plastron is hinged and the creature can shut itself up tightly, *e.g. C. leucostoma* of Mexico; in others the plastron leaves gaps, or it is narrow and without hinges, *e.g. C. odoratum*, the mud turtle or stinkpot terrapin of the eastern half of North America. About a dozen species, mostly Central American.

Family 4. Platysternidae.—*Platysternum megacephalum*, the only species, from Burma to southern China. The total length of these thick-headed, very long-tailed turtles is about 1 ft., only 5 in. belonging to the shell. The plastron is large, oblong, not cruciform, composed of nine plates. The nuchal is devoid of rib-like processes. A unique arrangement is that the jugals are completely shut off from the orbits owing to the meeting of the post-frontals with the maxillaries.

Family 5. Testudinidae.—The shell is always covered with well-developed shields; those which cover the plastral bridge are in direct contact with the marginals. The plastron is composed of nine bones. The digits have four or five claws. The neck is completely retractile.

This family contains the majority of tortoises, divided into as many as 20 genera. These, starting with *Emys* as the least specialized, can be arranged in two main diverging lines, one culminating in the thoroughly aquatic *Batagur*, the other in the exclusively terrestrial forms. *Emys*, with the plastron movably united to the carapace; with well-webbed limbs, amphibious. *E. orbicularis* or *europaea* was, towards the end of the Pleistocene period, distributed over a great part of middle Europe, remains occurring in the peat of England, Belgium, Denmark and Sweden; it is now withdrawing eastwards, being restricted in Germany to isolated localities east of Berlin, but it reoccurs in Poland and Russia, whence it extends into western Asia; it is common in south Europe. The other species, *E. blandingi*, lives in Canada and the north-eastern states of the Union. *Clemmys* with the plastron immovably united to the carapace; temperate holarctic region, *e.g. C. caspica, C. leprosa* in Spain and Morocco; *C. insculpta*, in north-east America. *Malacoclemmys* with a few species in North America, *e.g. M. terrapin*, the much prized "diamond-back." *Chrysemys* with many American species, *e.g. Ch. picta*, the "painted terrapin" and *C. concinna*, most of them very handsomely coloured and marked when still young. *Batagur* and *Kachuga* in the Indian sub-region.

Cistudo carolina, the box tortoise of North America, with the plastron divided into an anterior and a posterior movable lobe, so that the creature can shut itself up completely. Although essentially by its internal structure a water tortoise, it has become absolutely terrestrial in habits, and herewith agree the high-backed instead of depressed shell, the short webless fingers and its general coloration. It has a mixed diet. The eyes of the males are red, those of the females are brown. From Long Island to Mexico. *Cinixys, e.g. belliana* of tropical Africa, has the posterior portion of the carapace movably hinged. *Pyxis arachnoides* of Madagascar has the front-lobe of the plastron hinged.

Testudo, the main genus, with about 40 species, is cosmopolitan in tropical and sub-tropical countries, with the exception of the whole of the Australian and Malay countries; most of the species are African. *T. graeca*, in Mediterranean countries and islands. *T. marginata* in Greece with the posterior margin of the carapace much flanged or serrated, and *T. ibera* or *mauritanica* from Morocco to Persia; both differ from *T. graeca* by an unpaired supracaudal, marginal shield, and by the possession of a strong, conical, horny tubercle on the hinder surface of the thigh. With age the posterior portion of the plastron develops a transverse ligamentous hinge. *T. polyphemus*, the "gopher" of southern United States, lives in pairs in self-dug burrows. *T. tabulata* is one of the few South American terrestrial tortoises.

Of great interest are the so-called gigantic land tortoises. In former epochs truly gigantic species of the genus *Testudo* had a wide and probably more continuous distribution. There was *T. atlas*, of the Pliocene of the Sivalik hills with a skull nearly 8 in. long, but the shell probably measured not more than 6 ft. in length, the restored specimen in the Natural History Museum at South Kensington being exaggerated. *T. perpigniana* of Pliocene France was also large. Large land tortoises, with a length of shell of more than 2 ft., became restricted to two widely separated regions of the world, viz. the Galapagos Islands (called thus after the Spanish *galapago, i.e.* tortoise), and islands in the western Indian Ocean viz. the Mascarenes (Bourbon, Mauritius and Rodriguez) and Aldabra. When they became extinct in Madagascar is not known, but *T. grandidieri* was a very large kind, of apparently very recent date. At the time of their discovery those smaller islands were uninhabited by man or any predaceous mammal. It was on these peaceful islands that land tortoises lived in great numbers; with plenty of food there was nothing for them to do but to feed, to propagate, to grow and to vary. Most of the islands were or are inhabited by one or more typical, local forms. As they provided, like the equally ill-fated dodo and solitaire, a welcome provision of excellent meat, ships carried them about, to be slaughtered as occasion required, and soon almost exterminated them; some were occasionally liberated on other islands, for instance, on the Seychelles and on the Chagos, or they were left as presents, in Ceylon, Java or on Rotuma near the Fijis. Thus it has come to pass that the few survivors have been very much scattered. The small genuine stock at Aldabra is now under government protection, in a way. A large male of *T. gigantea* or *elephantina* or *hololissa* or *ponderosa*, was brought to London and weighed 870 lb; another specimen had in 1908 been living at St Helena for more than one hundred years. A specimen of *T. daudini*, native of the South Island of Aldabra, was known for many years on Egmont Island, one of the Chagos group, then it was taken to Mauritius and then to England, where of course it soon died; its shell measures 55 in. in a straight line, and it weighed 560 lb. The type specimen of *T. sumeirei*, supposed to have come originally from the Seychelles, was in 1908 still kept in the barrack grounds at Port Louis, Mauritius, and had been known as a large tortoise for about 150 years. *T. vosmaeri* was a very thin-shelled species in Rodriguez. Of the Galapagos species *T. ephippium* still survives on Duncan Island; *T. abingdoni* lived on Abingdon Island; of *T. elephantopus* or *vicina*, G. Baur still collected 21 specimens in 1893 on Albemarle Island. One monster of this kind is said to have measured 56 in. over the curve of the carapace, with a skull a little more than 7 in. in length. All the Galapagos species are remarkable for their comparatively small head and the very long neck, which is much larger and more slender than that of the eastern species.

Family 6. Chelonidae. Marine turtles, with only two recent genera, with three widely distributed species. The limbs are paddle-shaped, with only one or two claws, and the shell is covered with horny shields. The neck is short and incompletely retractile. The parietals, post-frontals, squamosals, quadrato-jugals, and jugals are much expanded and form an additional or false roof over the temporal region of the skull.

The Chelonidae are a highly specialized offshoot of the Cryptodira, adapted to marine life. Fundamentally they agree most with the Testudinidae, and there is nothing primitive about them except that they still possess complete series of inframarginal shields.

Chelone, with only 4 pairs of costal shields, with 5 neurals and a broad nuchal. *C. mydas* s. *viridis*, the "green or edible turtle," has, when adult, a nearly smooth shell. It attains a length of nearly 4 ft., and may then weigh more than three hundredweight. Their food consists of algae, and of *Zostera marina*. Their capture forms a regular pursuit wherever they occur in any numbers. Comparatively few are caught in the open sea, others in staked nets, but the majority are intercepted at well-known periods and localities where they go ashore to deposit their eggs. These are round, with a parchment-like shell and buried in the sand, above the high-tide mark, as many as 100 to 250 being laid by one female. They are eagerly searched for and eaten. The famous turtle-soup is made not only of the meat and the fat, but also from the thick and gelatinous layer of subcutaneous tissue which lines the inside of the shell. Only the females are eaten; the males, recognizable by the longer tail, are rejected at the London market. This species inhabits the Atlantic, Indian and Pacific Oceans.

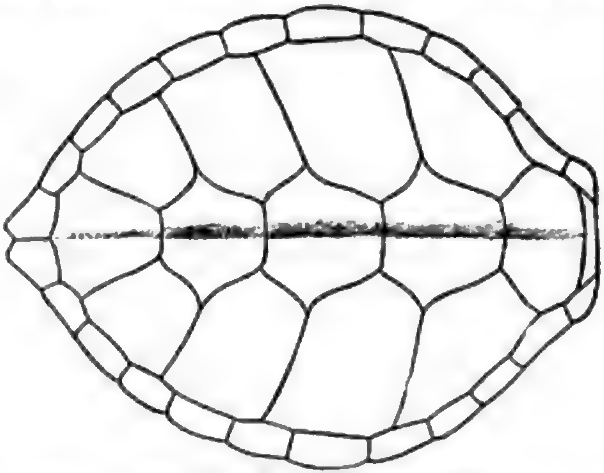


FIG. 5.—Green Turtle (*Chelone mydas*).

C. imbricata, the "hawksbill turtle." The shields are thick, strongly overlapping each other from before backwards, but in old specimens the shields lose their keel, flatten and become juxtaposed. The horny cover of the upper jaw forms a hooked beak. This species lives upon fish and molluscs and is not eaten; but is much persecuted for the horny shields which yield the "tortoise-shell," so far as this is not a fraudulent imitation. When heated in oil, or boiled, the shields (which singly are not thick enough to be manufactured into larger articles) can be welded together under pressure and be given any desired shape. The "hawksbill" ranges over all the tropical and sub-tropical seas and scarcely reaches 3 ft. in length, but such a shell yields up to 8 lb of tortoiseshell.

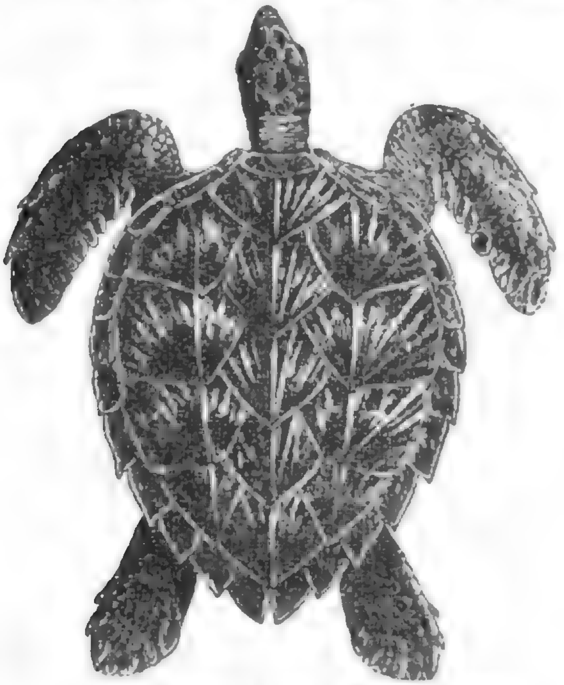


Fig. 6.—Hawksbill Turtle (*Chelone imbricata*).

Thalassochelys caretta, the "loggerhead," has normally five pairs of costal shields, but whilst the number of shields in the genus *Chelone* is very constant, that of the loggerhead varies individually to an astonishing extent. The greatest number of neurals observed, and counting the nuchal as the first, is 8, and 8 pairs of costal; in all 24; the lowest numbers are 6 neurals with 5 pairs of costals; odd costals are frequent. The most interesting facts are that some of the supernumerary shields are much smaller than the others, sometimes mere vestiges in all stages of gradual suppression, and that the abnormalities are much more common in babies and small specimens than in adults. The importance of these orthogenetic variations has been discussed by H. Gadow in A. Willey's *Zoolog. Results*, pt. iii. p. 207–222, pls. 24, 25 (Cambridge 1899).

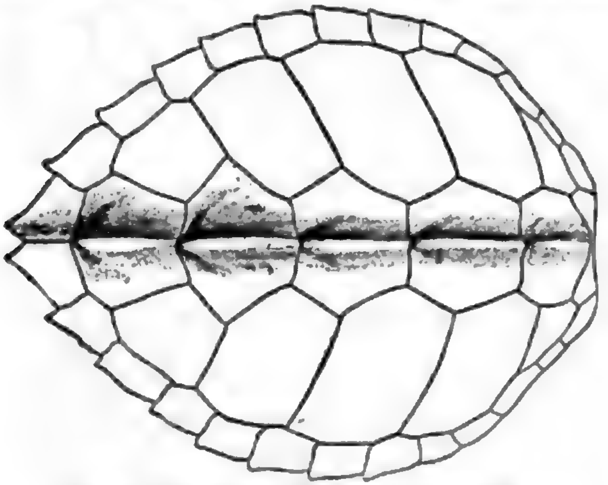


Fig. 7.—Loggerhead (*Thalassochelys caretta*).

The "loggerhead" is carnivorous, feeding on fish, molluscs and crustaceans, and is not esteemed as food. A great part of the turtle-oil which finds its way into the market is obtained from it; its tortoiseshell is of an inferior quality. Besides all the intertropical seas it inhabits the Mediterranean, and is an accidental visitor of the western coasts of Europe. The old specimen captured on the Dutch coast in 1894 contained the enormous number of 1150 eggs.

Super-family 2. Pleurodira.—The long neck bends laterally and is tucked away between the anterior portion of the carapace and the plastron. The dorsal and ventral ends of the pelvis are anchylosed to the shell. Fresh-water tortoises of South America, Australia, Africa and Madagascar.

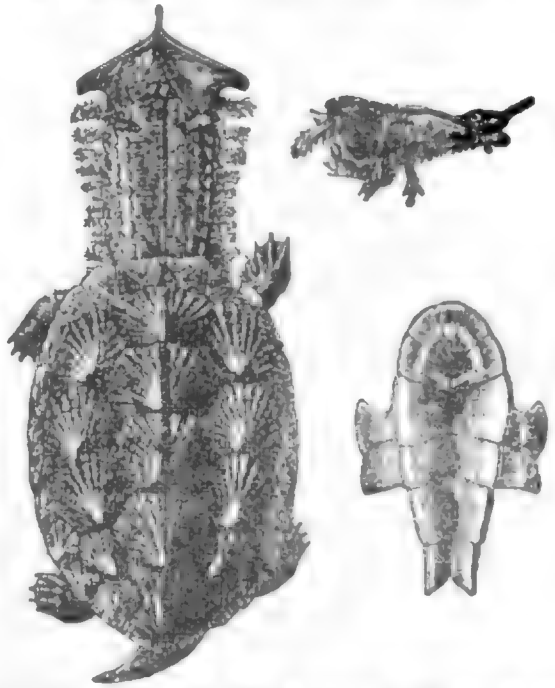


Fig. 8.—The Matamata (*Chelys fimbriata*) with side view of head, and separate view of plastron.

Family 1. Pelomedusidae.—Neck completely retractile. Carapace covered with horny shields, of which the nuchal is wanting. Plastron composed of 11 plates. With 24 marginal and 13 plastral shields, inclusive of a conspicuous intergular. *Sternothaerus* in Africa and Madagascar. *Pelomedusa galeata* in Madagascar and from the Cape to the Sinaitic peninsula. *Podocnemis* is common in tropical South America, *e.g.* *P. expansa* of Brazilian rivers, noteworthy for

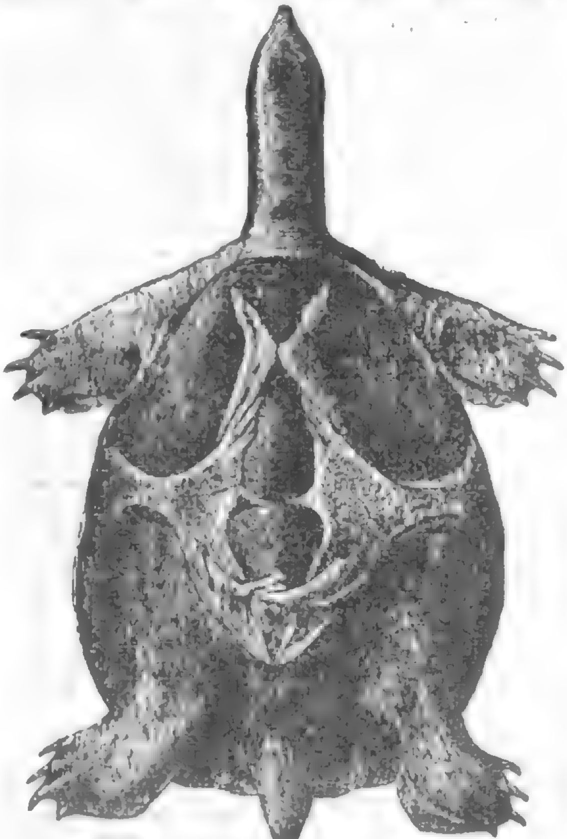


Fig. 9.—Lower view of *Trionyx euphratica*.

the millions of eggs which are, or were, annually collected for the sake of their oil. Bates (*The Naturalist on the River Amazon*) gives a most interesting account of these turtles, which are entirely frugivorous.

Family 2. Chelydidae.—The neck, when bent, remains partly exposed. Shell covered with shields. Plastron composed of 9 plates but covered with 13 shields. This family, still represented by nearly 30 species, with 8 genera, is found in South America and in Australia. *Chelys fimbriata*, the "matamata" in the rivers of Guiana and North Brazil; total length about 3 ft.; with animal diet. *Hydromedusa*, *e.g. tectifera*, with very long neck, in Brazil, much resembling *Chelodina*, *e.g. longicollis* of the Australian region.

Family 3. Carettochelydidae.—*Carettochelys insculpta*, the only species, in the Fly river of New Guinea; still imperfectly known. This peculiar turtle seems to stand in the same relation to the Chelydidae and to the Trionychidae as do the Chelonidae to the Testudinidae by the transformation of the limbs into paddles with only two claws, and the complete reduction of the horny shields upon the shell, which is covered with soft skin. The plastron is composed of 9 plates; the 6 neural plates are all separated from one another by the costals. The premaxilla is single, as elsewhere only in *Chelys* and in the Trionychidae. The neck is short and non-retractile. Length of shell about 18 in.

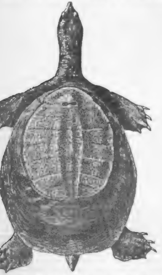


FIG. 10.—Upper view of the Turtle of the Euphrates (*Trionyx euphratica*).

Super-family 3. Trionychoidea.—The shell is very flat and much smaller than the body, and covered with soft leathery skin, but traces of horny structures are still represented, especially in the young of some species, by numerous scattered little spikes on the back of the shell and even on the soft parts of the back. The limbs are short, broadly webbed and only the three inner digits are provided with claws. Head and neck are retractile, bending in a sigmoid curve in a vertical plane. The jaws are concealed by soft lip-like flaps and the nose forms a short soft proboscis. The temporal region is not covered in by any arches; the quadrate is trumpet-shaped as in the Chelydidae, but the jugular arch is complete. The pelvis is not anchylosed to the shell. The carapace is much reduced in size, the ribs extending beyond the costal plates, and there are no marginals; except in the African *Cyclanorbis* the neural plates form a continuous series. All the nine elements of the plastron are deficient and but very loosely connected with each other. Most of these reductions in the skeletal and tegumentary armature are the result of life in muddy waters, in the bottom of which these creatures bury themselves with only the head exposed. They feed upon aquatic animals; those which are partial to hard-shelled molluscs soon wear down the sharp horny edges of the jaws, and thick horny crushing pads are developed in their stead. They only crawl upon land in order to lay their round brittle eggs. Trionyxes inhabit the rivers of Asia, Africa and North America. *Trionyx ferox*, the "soft-shelled turtle," in the whole of the Mississippi basin and in the chain of the great northern lakes. *T. triunguis* in Africa, the largest species, with a length of shell of 3 ft. *T. hurum* and *T. gangeticus* are the commonest Indian species. The young are ornamented with two or three pairs of large, round, ocellated spots on the back. (H. F. G.)

TORTOISESHELL. The tortoiseshell of commerce consists of the epidermic plates covering the bony carapace of the hawksbill turtle, *Chelonia imbricata*, the smallest of the sea turtles. The plates of the back or carapace, technically called the head, are 13 in number, 5 occupying the centre, flanked by 4 on each side. These overlap each other to the extent of one-third of their whole size, and hence they attain a large size, reaching in the largest to 8 in. by 13 in., and weighing as much as 9 oz. The carapace has also 24 marginal pieces, called hoofs or claws, forming a serrated edge round it; but these, with the plates of the plastron, or belly, are of inferior value. The plates of tortoiseshell consist of horny matter, but they are harder, more brittle, and less fibrous than ordinary horn. Their value depends on the rich mottled colours they display—a warm translucent yellow, dashed and spotted with rich brown tints—and on the high polish they take and retain. The finest tortoiseshell is obtained from the Eastern Archipelago, particularly from the east coast of Celebes to New Guinea; but the creature is found and tortoiseshell obtained from all tropical coasts, large supplies coming from the West Indian Islands and Brazil.

Tortoiseshell is worked precisely as horn; but, owing to the high value of the material, care is taken to prevent any waste in its working. The plates, as separated by heat from the bony skeleton, are keeled, curved, and irregular in form. They are first flattened by heat and pressure, and superficial inequalities are rasped away. Being harder and more brittle than horn, tortoiseshell requires careful treatment in moulding it into any form, and as high heat tends to darken and obscure the material it is treated at as low a heat as practicable. For many purposes it is necessary to increase the thickness or to add to the superficial size of tortoiseshell, and this is readily done by careful cleaning and rasping of the surfaces to be united, softening the plates in boiling water or sometimes by dry heat, and then pressing them tightly together by means of heated pincers or a vice. The heat softens and liquefies a superficial film of the horny material, and that with the pressure effects a perfect union of the surfaces brought together. Heat and pressure are also employed to mould the substance into boxes and the numerous artificial forms into which it is made up.

Tortoiseshell has been a prized ornamental material from very early times. It was one of the highly esteemed treasures of the Far East brought to ancient Rome by way of Egypt, and it was eagerly sought by wealthy Romans as a veneer for their rich furniture. In modern times it is most characteristically used in the elaborate inlaying of cabinet-work known as buhl furniture, and in combination with silver for toilet articles. It is also employed as a veneer for small boxes and frames. It is cut into combs, moulded into snuff-boxes and other small boxes, formed into knife-handles, and worked up into many other similar minor articles. The plates from certain other tortoises, known commercially as turtle-shell, possess a certain industrial value, but they are either opaque or soft and leathery, and cannot be mistaken for tortoiseshell. A close imitation of tortoiseshell can be made by staining translucent horn or by varieties of celluloid.

TORTOLÌ, a town and episcopal see of Sardinia, on the east coast, 140 m. N.N.E. of Cagliari by rail (55 m. direct). Pop. (1901), 2105. It lies 60 ft. above sea-level to the south-west of a large lagoon, which renders it unhealthy. The harbour is 2½ m. to the east, and serves for the export of the wine and agricultural produce of the Ogliastra. A little to the south of Tortoli was the station of Sulci on the Roman coast road, known to us only from the itineraries.

TORTONA (anc. *Dertona*), a town and episcopal see of Piedmont, Italy, in the province of Alessandria, from which it is 14 m. E. by rail, on the right bank of the Scrivia, at the northern foot of the Apennines, 304 ft. above sea-level. Pop. (1901), 11,308 (town); 17,419 (commune). Tortona is on the main line from Milan to Genoa; from it a main line runs to Alessandria, a branch to Castelnuovo Scrivia, and a steam tramway to Sale. Its fortifications were destroyed by the French after Marengo (1799); the ramparts are now turned into shady promenades. The cathedral, erected by Philip II., contains a remarkably fine Roman sarcophagus of the Christian period. Silk-weaving, tanning and hat-making are the chief industries; and there is some trade in wine and grain.

Dertona, which may have become a Roman colony as early as the 2nd century B.C. and certainly did so under Augustus, is spoken of by Strabo as one of the most important towns of Liguria. It stood at the point of divergence of the Via Postumia (see LIGURIA) and the Via Aemilia, while a branch road ran hence to Pollentia. A number of ancient inscriptions and other objects have been found here. In the middle ages Tortona was zealously attached to the Guelphs, on which account it was twice laid waste by Frederick Barbarossa, in 1155 and 1163. (T. As.)

TORTOSA, a fortified city of north-east Spain, in the province of Tarragona; 40 m. by rail W.S.W. of the city of Tarragona, on the river Ebro 22 m. above its mouth. Pop. (1900), 24,452. Tortosa is for the most part an old walled town on the left bank of the river, with narrow, crooked and ill-paved streets, in which the houses are lofty and massively built of granite. But some parts of the old town have been rebuilt, and there is a modern suburb on the opposite side of the Ebro. The slope on which old Tortosa stands is crowned with an ancient castle, which has been restored and converted into barracks and a hospital. All the fortifications are obsolete. The cathedral occupies the site of a Moorish mosque built in 914. The present structure, which dates from 1347, has its Gothic character disguised by a classical façade with Ionic pillars and much tasteless modernization. The stalls in the choir, carved by Cristobal de Salamanca in 1588–1593, and the sculpture of the pulpits, as well as the iron-work of the choir-railing and some of the precious marbles with which the chapels are adorned, deserve notice. The other public buildings include an episcopal palace, a town-hall and numerous churches. There are manufactures of paper, hats, leather, ropes, porcelain, majolica, soap, spirits, and ornaments made of palm leaves and grasses. There is an important fishery in the river, and the harbour is accessible to vessels of 100 tons burden. Corn, wine, oil, wool, silk, fruits and liquorice (a speciality of the district) are exported. The city is connected with Barcelona and Valencia by the coast railway, and with Saragossa by the Ebro valley line; it is also the terminus of a railway to San Carlos de la Rápita on the Mediterranean. Near Tortosa are rich quarries of marble and alabaster.

Tortosa, the *Dertosa* of Strabo and the *Colonia Julia Augusta Dertosa* of numerous coins, was a city of the Ilercaones in Hispania Tarraconensis. Under the Moors it was of great importance as the key of the Ebro valley. It was taken by Louis the Pious in 811 (after an unsuccessful siege two years before), but was soon recaptured. Having become a haunt of pirates, and exceedingly injurious to Italian commerce, it was made the object of a crusade proclaimed by Pope Eugenius III. in 1148, and was captured by Ramon Berenguer IV., count of Barcelona, assisted by Templars, Pisans and Genoese. An attempt to recapture the city in 1149 was defeated by the heroism of the women, who were thenceforth empowered by the count to wear the red sash of the Order of La Hacha (The Axe), to import their clothes free of duty, and to precede their bridegrooms at weddings. Tortosa fell into the hands of the duke of Orleans in 1708; during the Peninsular War it surrendered in 1811 to the French under Suchet, who held it till 1814.

TORTURE (from Lat. *torquere*, to twist), the general name for innumerable modes of inflicting pain which have been from time to time devised by the perverted ingenuity of man, and especially for those employed in a legal aspect by the civilized nations of antiquity and of modern Europe. From this point of view torture was always inflicted for one of two purposes: (1) As a means of eliciting evidence from a witness or from an accused person either before or after condemnation; (2) as a part of the punishment. The second was the earlier use, its function as a means of evidence arising when rules were gradually formulated by the experience of legal experts.

Torture as a part of the punishment may be regarded as including every kind of bodily or mental pain beyond what is necessary for the safe custody of the offender (with or without enforced labour) or the destruction of his life—in the language of Bentham, an "afflictive" as opposed to a "simple" punishment. Thus the unnecessary sufferings endured in English prisons before the reforms of John Howard, the *peine forte et dure*, and the drawing and quartering in executions for treason, fall without any straining of terms under the category of torture.

The whole subject is now one of only historical interest as far as Europe is concerned. It was, however, up to a comparatively recent date an integral part of the law of most countries (to which England, Aragon and Sweden[1] formed honourable exceptions)—as much a commonplace of law as trial by jury in England.[2] The prevailing view, no doubt, was that truth was best obtained by confession, the *regina probationum*. Where confession was not voluntary, it must be extorted. Speaking generally, torture may be said to have succeeded the ordeal and trial by battle. Where these are found in full vigour, as in the capitularies of Charlemagne, there is no provision for torture. It was no doubt accepted reluctantly as being a *quasi judicium Dei*, but tolerated in the absence of any better means of eliciting truth, especially in cases of great gravity, on the illogical assumption that extraordinary offences must be met by extraordinary remedies. Popular feeling too, says Verri, preferred, as causes of evil, human beings who could be forced to confess, rather than natural causes which must be accepted with resignation. Confession, as *probatio probatissima* and *vox vera*, was the best of all evidence, and all the machinery of law was moved to obtain it. The trials for witchcraft remain on record as a refutation of the theory.

The opinions of the best lay authorities have been almost unanimously against the use of torture, even in a system where it was as completely established as it was in Roman law. "Tormenta," says Cicero,[3] in words which it is almost impossible to translate satisfactorily, "gubernat dolor, regit quaesitor, flectit libido, corrumpit spes, infirmat metus, ut in tot rerum angustiis nihil veritati loci relinquatur." Seneca says bitterly, "it forces even the innocent to lie." St Augustine[4] recognizes the fallacy of torture. "If," says he, "the accused be innocent, he will undergo for an uncertain crime a certain punishment, and that not for having committed a crime, but because it is unknown whether he committed it." At the same time he regards it as excused by its necessity. The words of Ulpian, in the *Digest* of Justinian,[5] are no less impressive: "The torture (*quaestio*) is not to be regarded as wholly deserving or wholly undeserving of confidence; indeed, it is untrustworthy, perilous and deceptive. For most men, by patience or the severity of the torture, come so to despise the torture that the truth cannot be elicited from them; others are so impatient that they will lie in any direction rather than suffer the torture; so it happens that they depose to contradictions and accuse not only themselves but others." Montaigne's[6] view of torture as a part of the punishment is a most just one: "All that exceeds a simple death appears to me absolute cruelty; neither can our justice expect that he whom the fear of being executed by being beheaded or hanged will not restrain should be any more awed by the imagination of a languishing fire, burning pincers, or the wheel." He continues with the curious phrase: "He whom the judge has tortured (*gehenné*) that he may not die innocent, dies innocent and tortured." Montesquieu[7] speaks of torture in a most guarded manner, condemning it, but without giving reasons, and eulogizing England for doing without it. The system was condemned by Bayle and Voltaire with less reserve. Among the Germans, Sonnenfels (1766), and, among the Italians, Beccaria,[1] Verri[2] and Manzoni[3] will be found to contain most that can be said on the subject. The influence of Beccaria in rendering the use of torture obsolete was undoubtedly greater than that of any other legal reformer. The great point that he makes is the unfair incidence of torture, as minds and bodies differ in strength. Moreover, it is, says he, to confound all relations to expect that a man should be both accuser and accused, and that pain should be the test of truth, as though truth resided in the muscles and fibres of a wretch under torture. The result of the torture is simply a matter of calculation. Given the force of the muscles and the sensibility of the nerves of an innocent person, it is required to find the degree of pain necessary to make him confess himself guilty of a given crime. Bentham's[4] objection to torture is that the effect is exactly the reverse of the intention. "Upon the face of it, and probably enough in the intention of the framers, the object of this institution was the protection of innocence; the protection of guilt and the aggravation of the pressure upon innocence was the real fruit of it." The apologists of torture are chiefly among jurists. But theoretical objections to it are often urged by the authors of books of practice, as by Damhouder, von Rosbach, von Boden, Voet, and others named below under the head of *The Netherlands*. It is worthy of note as illustrative of the feeling of the time that even Bacon[5] compares experiment in nature to torture in civil matters as the best means of eliciting truth. Muyart de Vouglans[6] derives the origin of torture from the law of God. Other apologists are Simancas, bishop of Badajoz,[7] Engel,[8] Pedro de Castro,[9] and in England Sir R. Wiseman.[10]

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[1] But even in these countries, whatever the law was, torture certainly existed in fact.

[2] Primitive systems varied. There is no trace of it in Babylonian or Mosaic law, but Egyptian and Assyrian provided for it; and the story of Regulus seems to show that it was in use at Carthage.

[3] *Pro Sulla*, c. 28.

[4] *De civ. Dei*, bk. xix. c. 6.

[5] *Dig.* xlviii. 18, 23.

[6] Essay lxv. (Cotton's trans.)

[7] *Esprit des lois*, bk. vi. c. 17.

Greece.—The opinion of Aristotle was in favour of torture as a mode of proof. "It is," he says, "a kind of evidence, and appears to carry with it absolute credibility because a kind of constraint is applied." It is classed as one of the "artless persuasions" (ἄτεχνοι πίστεις).[11] "It was the surest means of obtaining evidence," says Demosthenes.[12] At Athens slaves, and probably at times resident aliens, were tortured,[13] in the former case generally with the master's consent, but torture was seldom applied to free citizens,[14] such application being forbidden by a psephism passed in the archonship of Scamandrius. After the mutilation of the Hermae in 415 B.C. a proposition was made, but not carried, that it should be applied to two senators named by an informer. In this particular case Andocides gave up all his slaves to be tortured.[15] Torture was sometimes inflicted in open court. The rack was used as a punishment even for free citizens. Antiphon was put to death by this means.[16] The torture of Nicias by the Syracusans is alluded to by Thucydides[17] as an event likely to happen, and it was only in order to avoid the possibility of inconvenient disclosures that he was put to death without torture. Isocrates and Lysias refer to torture under the generic name of *στρέβλωσις*, but it was generally called *βάσανοι*, in the plural, like *tormenta*. As might be expected, torture was frequently inflicted by the Greek despots, and both Zeno and Anaxarchus are said to have been put to it by such irresponsible authorities. At Sparta the despot Nabis was accustomed, as we learn from Polybius,[18] to put persons to death by an instrument of torture in the form of his wife Apega, a mode of torture no doubt resembling the *Jungfernkuss* once used in Germany. At Argos, as Diodorus informs us (xv. 57), certain conspirators were put to the torture in 371 B.C.[19]

Rome.—The Roman system was the basis of all subsequent European systems which recognized torture as a part of their procedure, and the rules attained a refinement beyond anything approached at Athens. The law of torture was said by Cicero to rest originally on custom (*mores majorum*), but there is no allusion to it in the Twelve Tables. There are frequent allusions to it in the classical writers,[20] both of the republic and the empire. The law, as it existed under the later empire, is contained mainly in the titles *De quaestionibus*[21] of the *Digest* and the *Code*[22]—the former consisting largely of opinions from the *Sententiae receptae* of Paulus,[23] the latter being for the most part merely a repetition of constitutions contained in the Theodosian Code.[24] Both substantive law and procedure were dealt with by these texts of Roman law, the latter, however, not as fully as in medieval codes, a large discretion being left to the judges. Torture was used both in civil and criminal trials, but in the former only upon slaves and freedmen or infamous persons (after *Nov.* xc. 1, 1, upon *ignoti* and *obscuri* if they showed signs of corruption)—such as gladiators—and in the absence of *alia manifesta indicia*,[25] as in cases affecting the inheritance (*res hereditariae*). Its place in the case of free citizens was taken by the reference to the oath of the party. During the republic torture appears to have been confined to slaves in all cases, but with the empire a free man became liable to it if accused of a crime, though in most cases not as a witness. On an accusation of treason every one, whatever his rank, was liable to torture, for in treason the condition of all was equal.[26] The same was the case of those accused of sorcery (*magi*), who were regarded as *humani generis inimici*.[27] A wife might be tortured (but only after her slaves had been put to the torture) if accused of poisoning her husband. In accusations of crimes other than treason or sorcery, certain persons were protected by the dignity of their position or their tender age. The main exemptions were contained in a constitution of Diocletian and Maximian, and included soldiers, nobles of a particular rank, *i.e. eminentissimi* and *perfectissimi*, and their descendants to the third generation, and *decuriones* and their children to a limited extent (*tormenta moderato*)—that is to say, they were subject to the torture of the *plumbatae* in certain cases, such as fraud on the revenue and extortion. In addition to these, priests (but not clergy of a lower rank), children under fourteen and pregnant women were exempt. A free man could be tortured only where he had been inconsistent in his depositions, or where there was a suspicion that he was lying.[28] The rules as to the torture of slaves were numerous and precise. It was a maxim of Roman law that torture of slaves was the most efficacious means of obtaining truth.[29] They could be tortured either as accused or as witnesses for their masters in all cases, but against their masters only in accusations of treason, adultery, frauds on the revenue, coining, and similar offences (which were regarded as a species of treason), attempts by a husband or wife on the life of the other, and in cases where a master had bought a slave for the special reason that he should not give evidence against him. The privilege from accusations by the slave extended to the master's father, mother, wife, or tutor, and also to a former master. On the same principle a freedman could not be tortured against his patron. The privilege did not apply where the slave was joint property, and one of his masters had been murdered by the other, or where he was the property of a corporation, for in such a case he could be tortured in a charge against a member of the corporation. Slaves belonging to the inheritance could be tortured in actions concerning the inheritance. The adult slaves of a deceased person could be tortured where the deceased had been murdered. In a charge of adultery against a wife, her husband's, her own and her father's slaves could be put to the torture. A slave manumitted for the express purpose of escaping torture was regarded as still liable to it. Before putting a slave to torture without the consent of his master, security must be given to the master for his value and the oath of calumny must be taken.[30] The master of a slave tortured on a false accusation could recover double his value from the accuser. The undergoing of torture had at one time a serious effect upon the after-life of the slave, for in the time of Gaius a slave who had been tortured could on manumission obtain no higher civil rights than those of a *dediticius*.[31] The rules of procedure were conceived in a spirit of as much fairness as such rules could be. Some of the most important were these: The amount of torture was at the discretion of the judge, but it was to be so applied as not to injure life or limb. If so applied the judge was *infamis*. The examination was not to begin by torture; other proofs must be exhausted first. The evidence[1] must have advanced so far that nothing but the confession of the slave was wanting to complete it. Those of weakest frame and tenderest age were to be tortured first. Except in treason, the unsupported testimony of a single witness was not a sufficient ground for torture. The voice and manner of the accused were to be carefully observed. A spontaneous confession, or the evidence of a personal enemy, was to be received with caution. Repetition of the torture could only be ordered in case of inconsistent depositions or denial in the face of strong evidence. There was no rule limiting the number of repetitions. Leading questions were not to be asked. A judge was not liable to an action for anything done during the course of the examination. An appeal from an order to torture was competent to the accused, except in the case of slaves, when an appeal could be made only by the master.[2] The appellant was not to be tortured pending the appeal, but was to remain in prison.[3] The *quaesitor* asked the questions, the *tortores* applied the instruments. The principal forms of torture in use were the *equuleus*, or rack (mentioned as far back as Cicero),[4] the *plumbatae*, or leaden balls, the *ungulae*, or barbed hooks, the *lamina*, or hot plate, the *mala mansio*,[5] and the *fidiculae*, or cord compressing the arm. Other allusions in the *Digest* and *Code*, in addition to those already cited, may be shortly noticed. The testimony of a gladiator or infamous person (such as an accomplice) was not valid without torture.[6] This was no doubt the origin of the medieval maxims (which were, however, by no means universally recognized)—*Vilitas personae est justa causa torquendi testem*, and *Tortura purgatur infamia*. Torture could not be inflicted during the forty days of Lent.[7] Robbers and pirates might be tortured even on Easter day, the divine pardon being hoped for where the safety of society was thus assured.[8] Capital punishment was not to be suffered until after conviction or confession under torture.[9] Withdrawal from prosecution (*abolitio*) was not to be allowed as a rule after the accused had undergone the torture.[10] In charges of treason the accuser was liable to torture if he did not prove his case.[11] The infliction of torture, not judicial, but at the same time countenanced by law, was at one time allowed to creditors. They were allowed to keep their debtors in private prisons, and most cruelly ill-use them, in order to extort payment.[12] Under the empire private prisons were forbidden.[13] In the time of Juvenal the Roman ladies actually hired the public torturers to torture their domestic slaves.[14] As a part of the punishment torture was in frequent use. Crucifixion, mutilation, exposure to wild beasts in the arena and other cruel modes of destroying life were common, especially in the time of the persecution of the Christians under Nero.[15] Crucifixion as a punishment was abolished by Constantine in 315, in veneration of the memory of Him who was crucified for mankind. On the other hand, where the interests of the Church were concerned the tendency was in favour of greater severity. Thus, by the Theodosian Code, a heretic was to be flogged with lead (*contusus plumbo*) before banishment,[16] and Justinian made liable to torture and exile any one insulting a bishop or priest in a church, or saying litany, if a layman.[17]

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[1] *Dei Delitti e delle pene*, c. xvi.

[2] *Osservazioni sulla tortura.*

[3] *Storia della Colonna infame.*

[4] *Works*, vii. 525.

[5] *Nov. Org.*, bk. i. aph. 98. In the *Advancement of Learning*, bk. iv. ch. 4, Bacon collects many instances of constancy under torture.

[6] *Instituts du droit criminel* (Paris, 1757).

[7] *De catholicis institutionibus liber, ad praecavendas et extirpandas haereses admodum necessarius* (Rome, 1575).

[8] *De tortura ex foris christianis non proscribenda* (Leipzig, 1733).

[9] *Defensa de la tortura* (Madrid, 1778).

[10] *Law of Laws*, p. 122 (London, 1686).

[11] *Rhet.* i. 15, 26.

[12] *In Onetum*, i. 874.

[13] Usually by the diaetetae in the Hephaestaeum, Isocrates, *Trapez.* 361.

[14] The opinion of Cicero (*De partitionibus oratoriis*, § 34), that it was so applied at Athens and Rhodes, seems, as far as regards Athens, not to be justified by existing evidence.

[15] The demand for, or the giving up of, a slave for torture was called *πρόκλησις εἰς βάσανον.*

[16] In the *Ranae* of Aristophanes, v. 617, there is a list of kinds of torture, and the wheel is alluded to in *Lysistrata*, v. 846.

[17] vii. 86.

[18] xiii. 7.

[19] For the whole subject, see *Dict. Ant.*, *s.v. Tormenta.*

[20] An instance is Pliny's letter to Trajan (*Epist.* x. 97), where he mentions having put to the torture two Christian deaconesses (*ministrae*). The words are *confitentes iterum ac tertio interrogavi.* This supports Tertullian's objection to the torture of Christians, *torquemur confitentes* (*Apol.* c. 2).

[21] *Quaestio* included the whole process of which torture was a part. In the words of Cujacius, *Quaestio est interrogatio quae fit per tormenta, vel de reis, vel de testibus qui facto intervenisse dicuntur.*

[22] *Dig.* xlviii. 18; *Cod.* ix. 41.

[23] v. 14, 15, 16.

[24] ix. 35.

[25] *Cod.* ix. 8, 3.

[26] Ibid. ix. 8, 4.

[27] Ibid. ix. 18, 7.

[28] Ibid. iv. 20, 13.

[29] Ibid. i. 3, 8.

[30] Ibid. ii. 59, 1, 1. The demand of another man's slave for torture was *postulare.*

[31] Gaius i. 13.

The *Leges barbarorum* are interesting as forming the link of connexion between the Roman and the medieval systems. Through them the Roman doctrines were transmitted into the Roman law countries. The barbarian codes were based chiefly on the Theodosian Code. As compared with Roman law there seems to be a leaning towards humanity, *e.g.* the provision for redemption of a slave after confession by s. 40 of the *Lex salica*. After the edict of Gundobald in 501 the combat rather than the torture became the expression of the *judicium Dei*.

The Church.—As far as it could the Church adopted the Roman law. The Church generally secured the almost entire immunity of its clergy, at any rate of the higher ranks, from torture by civil tribunals;[18] but in general, where laymen were concerned all persons were equal. In many instances councils of the Church pronounced against torture, *e.g.* in a synod at Rome in 384.[19] Torture even of heretics seems to have been originally left to the ordinary tribunals. Thus a bull of Innocent IV., in 1282, directed the torture of heretics by the civil power, as being robbers and murderers of souls, and thieves of the sacraments of God.[20] The Church also enjoined torture for usury.[21] A characteristic division of torture, accepted by the Church, but not generally acknowledged by lay authorities, was into spiritual and corporal, the latter being simply the imposition of the oath of purgation, the only form originally in use in the ecclesiastical courts. The canon law contains little on the subject of torture, and that little of a comparatively humane nature. It laid down that it was no sin in the faithful to inflict torture,[22] but a priest might not do so with his own hands,[23] and charity was to be used in all punishments.[24] No confession was to be extracted by torture[25] and it was not to be ordered *indiciis non praecedentibus*.[26] The principal ecclesiastical tribunal by which torture was inflicted in more recent times was the Inquisition. The code of instructions issued by Torquemada in Spain in 1484 provided that an accused person might be put to the torture if *semiplena probatio* existed against the accused—that is, so much evidence as to raise a grave and not merely a light presumption of guilt, often used for the evidence of one eye or ear witness of a fact. If the accused confessed during torture, and afterwards confirmed the confession, he was punished as convicted; if he retracted, he was tortured again, or subjected to extraordinary punishment. One or two inquisitors, or a commissioner of the Holy Office, were bound to be present at every examination. Owing to the occurrence of certain cases of abuse of torture, a decree of Philip II. was issued, in 1558, forbidding the administration of torture without an order from the council. But this decree does not appear to have been fully observed. By the edict of the inquisitor-general Valdés, in 1561, torture was to be left to the prudence and equity of the judges. They must consider motives and circumstances before decreeing torture, and must declare whether it is to be employed *in caput proprium*, *i.e.* to extort a confession, or *in caput alienum*, *i.e.* to incriminate an accomplice. Torture was not to be decreed until the termination of the process and after defence heard, and the decree was subject to appeal, but only in doubtful cases, to the Council of the Supreme. It was also only in doubtful cases that the inquisitors were bound to consult the council; where the law was clear (and of this they were the judges) there need be no consultation, and no appeal was allowed. On ratification twenty-four hours afterwards of a confession made under torture, the accused might be reconciled, if the inquisitors believed him to be sincerely repentant. If convicted of bad faith he might be relaxed, *i.e.* delivered to the secular power to be burned. The inquisitors had a discretion to allow the accused to make the canonical purgation by oath instead of undergoing corporal torture, but the rule which allows this to be done at the same time discountenances it as fallacious. It is remarkable that the rules do not allow much greater efficacy to torture. They speak of it almost in the terms of Roman law as dangerous and uncertain, and depending for its effects on physical strength.[27] Torture had ceased to be inflicted before the suppression of the Inquisition, and in 1816 a papal bull decreed that torture should cease, that proceedings should be public, and that the accuser should be confronted with the accused. The rules in themselves were not so cruel as the construction put upon them by the inquisitors. For instance, by Torquemada's instructions torture could not be repeated unless in case of retractation. This led to the subtlety of calling a renewed torture a continuation, and not a repetition. The rules of Torquemada and of Valdés are those of the greatest historical importance, the latter forming the code of the Holy Office until its suppression, not only in Spain, but in other countries where the Inquisition was established. But several other manuals of procedure existed before the final perfection of the system by Valdés. The earliest is perhaps the instructions for inquisitors (*Directorium inquisitorum*) compiled a century earlier than Torquemada by Nicholas Eymerico, grand inquisitor of Aragon about 1368.[1] Rules of practice were also framed two centuries later by Simancas, whose position as an apologist has been already stated. The textbook of procedure of the Italian Inquisition was the *Sacro arsenale*.[2] In 1545 and 1550 instructions for the guidance of inquisitors were issued by Charles V. The liability of a judge for exceeding the law was not always recognized by the Inquisition to the same extent as by the lay tribunals. Llorente gives an instance of a warrant by an inquisitor to a licentiate ordering the torture of an accused person, and protesting that, in case of death or fracture of limbs, the fact is not to be imputed to the licentiate.[3]

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[1] The evidence on which the accused might be tortured was expressed in Roman law by the terms *argumentum* and *indicium* (used technically as early as Cicero, *Verres*, i. 10 and 17). The latter term, as will be seen, afterwards became one of the most important in the law of torture, but the analysis of *indicium* is later than Roman law. *Indicium* was not quite the same thing as *semiplena probatio*, though the terms appear to be occasionally used as synonyms. *Indicium* was rather the foundation or cause of *probatio*, whether *plena* or *semiplena*. An *indicium* or a concurrence of *indicia* might, according to circumstances, constitute a *plena* or *semiplena probatio*. The phrase *legitima indicia* was sometimes used. In Sir T. Smith's work, c. 24 (see below), *index* means a prisoner acting as an approver under torture. *Tormentum*, *tortura* and *quaestio* appear to be equivalent terms. The medieval jurists derived the first of these from *torquere mentem*, an etymology as false as *testamentum* from *testatio mentis* (*Inst.* ii. 10 pr.).

[2] *Dig.* xlix. i. 15.

[3] *Cod.* vii. 62, 12.

[4] *Milo*, lvii.

[5] Of doubtful meaning, but perhaps like the "Little Ease" of the Tower of London.

[6] *Dig.* xxii. 5, 21, 2.

[7] *Cod.* iii. 12, 6.

[8] Ibid. iii. 12, 10.

[9] Ibid. ix. 47, 16.

[10] Ibid. ix. 42, 3.

[11] Ibid. ix. 8, 3.

[12] See, for instance, Livy vi. 36.

[13] *Cod.* i. 4, 23; ix. 5.

[14] Ibid. vi. 480.

[15] As an example of such punishments, cf. the well-known lines of Juvenal (*Sat.* i. 155):—

"Taeda lucebis in illa,
Qua stantes ardent qui fixo gutture fumant."

For other poetical allusions, see vi. 480, xiv. 21; Lucr. iii. 1030; Propert. iv. 7, 35.

[16] xvi. 53.

[17] *Nov.* cxxiii. 31. On the subject of torture in Roman law reference may be made to Wasserscheben, *Historia quaestionum per tormenta apud Romanos* (Berlin, 1836); H. Wallon, *Histoire de l'esclavage dans l'antiquité* (Paris, 1879); Mommsen, *Römisches Strafrecht*, iii. 5 (Leipzig, 1899); Greenidge, *Legal Procedure of Cicero's Time*, p. 479 (Oxford, 1901).

[18] See Escobar, *Theol. Mor.* tract. vi. c. 2. They were to be tortured only by the clergy, where possible, and only on *indicia* of special gravity.

[19] Lea, *Superstition and Force*, p. 419 (3rd ed., Philadelphia, 1878).

[20] *Leges et constitutiones contra haereticos*, § 26.

[21] Lecky, *Rationalism in Europe*, ii. 34.

[22] *Decretum*, pt. ii. 23, 4, 45.

[23] Ibid. pt. i. 86, 25.

[24] Ibid. pt. ii. 12, 2, 11.

[25] Ibid. pt. ii. 15, 6, 1.

[26] *Decretals*, v. 41, 6.

[27] The rules will be found in H. C. Lea, *Hist. of the Inquisition of Spain* (1906). See also *Hist. of the Inquisition of the Middle Ages* (New York, 1888) by the same writer; R. Schmidt, *Die Herkunft des Inquisitionsprocesses* (Berlin, 1902).

Thus far of the law. In practice all the ingenuity of cruelty was exercised to find new modes of torment.[4] These cruelties led at times to remonstrance from the civil power. One example is the edict of Philip II. just mentioned. Another and an earlier one is an *ordonnance* of Philip the Fair, in 1302, bidding the Inquisition confine itself within the limits of the law.[5] At Venice the senate decreed that three senators should be present as inquisitors.

As the practice of torture became more systematized, it grew to be the subject of casuistical inquiry by churchmen to an extent far exceeding the scanty discussion of the question in the text of the canon law. It will be sufficient here to cite as an example the treatment of it by Liguori, who incorporates the opinions of many of the Spanish casuists. On the whole, his views appear to be more humane than the prevailing practice. The object of torture he defines very neatly as being to turn *semiplena* into *plena probatio*. For this proper *indicia* are necessary. He then proceeds to decide certain questions which had arisen, the most interesting of which deal with the nature of the sin of which the accused and the judge are guilty in particular instances. A judge sins gravely if he does not attempt all milder means of discovering truth before resorting to torture. He sins in a criminal cause, or in one of notable infamy, if he binds the accused by oath to tell the truth before there is proof against him. It is the same if without oath he uses threats, terror or exhibition of torments to confound the witness.[6] If any one, to avoid grave torments, charges himself with a capital crime, he does not sin mortally.[7] It was a doubtful question whether he sinned gravely in such a case. Escobar at an earlier date supported the morally dangerous view that an inquisitor may follow a probable opinion in ordering torture, relinquishing a more probable.[8]

England.—It is the boast of the common law of England that it never recognized torture as legal. One, perhaps the chief, reason for this position taken by the law is the difference of the nature of the procedure in criminal cases from that in general use in European countries. To use words more familiar in foreign jurisprudence, the English system is *accusatorial* as distinguished from *inquisitorial*. In the former the accuser has to prove guilt, in the latter the accused has to prove innocence. The common law of England has always shown itself averse from the inquisitorial system, and so (at least in theory) to the torture which may be regarded as an outcome of the system whose one end was to obtain a confession from the accused. The tendency of the small amount of statute law bearing on the subject is in the same direction. It was provided by Magna Carta, § 29, " that no free man . . . should be destroyed in any way unless by legal judgment of his equals or by the law of the land." On this Sir E. Coke comments, " No man destroyed, &c., that is, forejudged of life or limb, disinherited, or put to torture or death."[9] The act of 27 Hen. VIII. c. 4 enacted that, owing to the frequent escape of pirates in trials by the civil law, " the nature whereof is that before any judgment of death can be given against the offenders they must plainly confess their offence (which they will never do without torture or pains)," such persons should be tried by jury before commissioners under the Great Seal. Finally, the Bill of Rights provided that cruel and unusual punishments ought not to be inflicted. The opinions of the judges have been invariably against torture in theory, however much some of them may have been led to countenance it in practice. The strongest authority is the resolution of the judges in Felton's case (1628), " that he ought not by the law to be tortured by the rack, for no such punishment is known or allowed by our law."[10] In accordance with this are the opinions of Sir John Fortescue,[11] Sir Thomas Smith[12] and Sir E. Coke. The latter says, " As there is no law to warrant tortures in this land, nor can they be justified by any prescription, being so lately brought in."[13] In spite of all this, torture in criminal proceedings was inflicted in England with more or less frequency for some centuries, both as a means of obtaining evidence and as a part of the punishment. But it should be remarked that torture of the former kind was invariably ordered by the Crown or council, or by some tribunal of extraordinary authority, such as the Star Chamber, not professing to be bound by the rules of the common law. In only two instances was a warrant to torture issued to a common law judge.[14]

A licence to torture is found as early as the Pipe Roll of 34 Hen. II.[15] The Templars were tortured in 1310 by royal warrant addressed to the mayor and sheriffs of London.[16] In this case it is recorded that torture was unknown in England, and that no torturer was to be found in the realm.[17] A commission was issued concerning the tortures at Newgate in 1334.[18] The rack in the Tower is said to have been introduced by the duke of Exeter in the reign of Henry VI., and to have been thence called "the duke of Exeter's daughter."[19] In this reign torture seems to have taken its place as a part of what may be called extraordinary criminal procedure, claimed, and it may be said tacitly recognized, as exercisable by virtue of the prerogative, and continued in use down to 1640.[20] The infliction of torture gradually became more common under the Tudor monarchs. Under Henry VIII. it appears to have been in frequent use. Only two cases are recorded under Edward VI., and eight under Mary.[21] The reign of Elizabeth was its culminating point. In the words of Hallam, " the rack seldom stood idle in the Tower for all the latter part of Elizabeth's reign."[22] The varieties of torture used at this period are fully described by Dr Lingard,[23] and consisted of the rack, the scavenger's daughter,[24] the iron gauntlets or bilboes, and the cell called " Little Ease." The registers of the council during the Tudor and early Stuart reigns are full of entries as to the use of torture, both for state and for ordinary offences.[25] Among notable prisoners put to the torture were Anne Askew, the Jesuit Campion, Guy Fawkes[26] and Peacham (who was examined by Bacon " before torture, in torture and after torture ").[27] The prevalence of torture in Elizabeth's reign led to the well-known defence attributed to Lord Burghley, " A declaration of the favourable dealing of Her Majesty's commissioners appointed for the examination of certain traitors, and of tortures unjustly reported to be done upon them for matter of religion," 1583.[28] The use of torture in England being always of an extraordinary and extra-judicial nature, it is comparatively certain that it could hardly have been applied with that observation of forms which existed in countries where it was regulated by law. There were no rules and no responsibility beyond the will of the Crown or council. This irresponsibility is urged by Selden [1] as a strong objection to the use of torture. The main differences between the infliction of torture in England and on the continent of Europe seem to be that English lawyers made no distinction of those liable to it, never allowed torture of witnesses, and elaborated no subtle rules as to *plena* and *semiplena probatio*.

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[1] An edition was published at Rome in 1558, and a compendium at Lisbon in 1762, and by Marchena at Montpellier in 1821.

[2] It was by Father Masini, and went through numerous editions (complete or compendia) from 1558 to 1730. Among other manuals of practice were those of Carenas Caesar (1655), Morellet (1762).

[3] Llorente c. xiv.

[4] Among others were the gradual pouring of water drop by drop on a particular spot of the body, the *tormento de toca*, or pouring of water into a gauze bag in the throat, which gradually forced the gauze into the stomach, and the *péndola*, or swinging pendulum, so graphically described in one of Edgar Poe's tales.

[5] *Ordonnances des rois*, i. 346.

[6] *Theol. mor.* bk. ix. § 202.

[7] Ibid. § 274.

[8] Ibid. v. 3 and 7.

[9] 2 *Inst.* 48 b.

[10] 3 *State Trials*, 371.

[11] *De laudibus legum Angliae*, c. 22.

[12] *Commonwealth of England*, bk. ii. c. 27 (1583; ed. by L. Alston, 1906). It is curious that Sir T. Smith, with all his hatred of torture, was directed by a warrant under the queen's seal alone (not through the council) to torture the duke of Norfolk's servants in 1571. In a letter to Lord Burghley he pleaded for exemption from so hateful a task.

[13] 3 *Inst.* 35. Nevertheless, in the trials of Lord Essex and Southampton, Coke is found extolling the queen's mercy for not racking or torturing the accused (1 *State Trials*, 1338). (See further authorities in Pollock and Maitland, *Hist. of English Law*, ii. 656.)

[14] Jardine, *Reading on the Use of Torture in the Criminal Law of England* (1837), p. 52.

[15] L. O. Pike, *Hist. of Crime in England*, i. 427.

[16] Rymer, *Foedera*, iii. 228, 232.

[17] Walter of Hemingford, p. 256.

[18] Pike i. 481.

[19] 3 *Inst.* 34.

[20] This is the date of the latest warrant in Jardine's work, but it was used on three Portuguese at Plymouth during the Commonwealth (Thurloe iii. 298).

[21] It is to be noticed, as Jardine observes, that all these are cases of an ordinary nature, and afford no ground for the assertions made by Strutt and Bishop Burnet that torture was used to heretics as heretics.

[22] *Const. Hist.* i. 201.

[23] *Hist. of England*, vol. viii. app. note v.

[24] These two were exactly opposite in principle. The rack stretched the limbs of the sufferer; the scavenger's daughter compressed him into a ball.

[25] Fifty-five of these will be found in the appendix to Mr Jardine's work. An ordinary robber of plate was threatened with torture in 1567.—Froude, *Hist. of England*, viii. 386.

[26] It is not certain whether he was racked, but probably he was, in accordance with the king's letter: " If he will not otherwise confess the gentlest tortures are to be first used to him, and so on, step by step, to the most severe, and so God speed the good work."

[27] Dalrymple, *Memoirs and Letters of James I.* p. 85; Macaulay's essay on the works of Bacon.

[28] Lord Somers's *Tracts*, i. 189.

So far of what may be called torture proper, to which the common law professed itself a stranger. There were, however, cases fully recognized by the common law which differed from torture only in name. The *peine forte et dure* was a notable example of this. If a prisoner stood mute of malice instead of pleading, he was condemned to the *peine*, that is, to be stretched upon his back and to have iron laid upon him as much as he could bear, and more, and so to continue, fed upon bad bread and stagnant water through alternate days until he pleaded or died.[2] It was abolished by 12 Geo. III. c. 20. 7 and 8 Geo. IV. c. 28 enacted that a plea of "not guilty" should be entered for a prisoner so standing mute. A case of *peine* occurred as lately as 1726. At times tying the thumbs with whip-cord was used instead of the *peine*. This was said to be a common practice at the Old Bailey up to the 18th century.[3] In trials for witchcraft the legal proceedings often partook of the nature of torture, as in the throwing of the reputed witch into a pond to see whether she would sink or swim, in drawing her blood,[4] and in thrusting pins into the body to try to find the insensible spot. Confessions, too, appear to have been often extorted by actual torture, and torture of an unusual nature, as the devil was supposed to protect his votaries from the effects of ordinary torture.

Torture as a part of the punishment existed in fact, if not in name, down to a very recent period. Mutilation as a punishment appears in some of the pre-Conquest codes, such as those of Alfred, Æthelstan and Canute, in the laws attributed to William the Conqueror and in the assize of Northampton (1176). Bracton, who does not notice torture as a means of obtaining evidence, divides corporal punishment into that inflicted with and without torture.[5] Later instances are the punishment of burning to death inflicted on heretics under the Six Articles (31 Hen. VIII. c. 14) and other acts, and on women for petit treason (abolished by 30 Geo. III. c. 48), the mutilation inflicted for violence in a royal palace by 33 Hen. VIII. c. 12, the punishment for high treason, which existed nominally until 1870, the pillory (abolished by 7 Will. IV. and 1 Vict. c. 23), the stocks, branks and cucking-stool, and the burning in the hand for felony (abolished by 19 Geo. III. c. 74). Corporal punishment now exists only in the case of juvenile offenders and of robbery with violence. It was abolished in the army by the Army Act 1881.[6] Cruelty in punishment did not entirely cease in prisons even after the Bill of Rights. See such cases as *R.* v. *Huggins*, 17 *State Trials*, 298; *Castell* v. *Bambridge*, 2 *Strange's Rep*. 856.

Scotland.—Torture was long a recognized part of Scottish criminal procedure, and was acknowledged as such by many acts and warrants of the Scottish parliament and warrants of the Crown and the privy council. Numerous instances occur in the *Register of the Privy Council*.[7] Two acts in 1649 dealt with torture; one took the form of a warrant to examine witnesses against William Barton by any form of probation,[8] the other of a warrant to a committee to inquire as to the use of torture against persons suspected of witchcraft.[9] The judges in 1689 were empowered by the estates to torture Chiesly of Dalrye, charged with the murder of the lord president Lockhart, in order to discover accomplices. In the same year the use of torture without evidence or in ordinary cases was declared illegal in the Claim of Right. The careful wording of this will be noticed: it does not object to torture altogether, but reserves it for cases where a basis of evidence had already been laid, and for crimes of great gravity, thus admitting the dangerous principle, founded on Roman law, that the importance of the crime is a reason for departing from the ordinary rules of justice. However great the crime, it is no more certain than in the case of a crime of less gravity that the person accused was the person who committed it. A warrant issued in the same year to put to the torture certain persons accused of conspiring against the government, and also certain dragoons suspected of corresponding with Lord Dundee. In 1690 an act passed reciting the torture of William Carstares, a minister, in 1683, and re-establishing his competency as a witness.[10] The last warrant appears to be one in 1690 for torturing a man accused of rape and murder. In 1708 torture in Scotland was finally abolished by 7 Anne c. 21, s 5. Many details of the tortures inflicted will be found in Pitcairn's *Criminal Trials*, the introduction to J. Maclaurins' *R. Criminal Cases* and J. H. Burton's *Narratives from Criminal Trials*. Among other varieties—the nature of some of them can only be guessed—were the rack, the pilniewinkis, the boot,[11] the caschie-laws, the lang irnis, the narrow-bore, the pynebankis, and worst of all, the waking, or artificial prevention of sleep.[12] The ingenuity of torture was exercised in a special degree on charges of witchcraft, notably in the reign of James VI., an expert both in witchcraft and in torture. The act of 1649 already cited shows that the principle survived him. Under the government of the dukes of Lauderdale and York torture as a practice in charges of religious and political offences reached its height. "The privy council was accustomed to extort confessions by torture; that grim divan of bishops, lawyers and peers sucking in the groans of each undaunted enthusiast, in hope that some imperfect avowal might lead to the sacrifice of other victims, or at least warrant the execution of the present." [13] With such examples before them in the law, it is scarcely to be wondered at that persons in positions of authority, especially the nobility, sometimes exceeded the law and inflicted torture at their own will and for their own purposes. There are several instances in the *Register of the Privy Council* of suits against such persons, *e.g.* against the earl of Orkney, in 1605, for putting a son of Sir Patrick Bellenden in the boots.

Ireland seems to have enjoyed comparative immunity from torture. It was not recognized by the common or statute law, and the cases of its infliction do not appear to be numerous. In 1566 the president and council of Munster, or any three of them, were empowered to inflict torture, "in cases necessary, upon vehement presumption of any great offence in any party committed against the Queen's Majesty." [14] In 1583 Hurley, an Irish priest, was tortured in Dublin by "toasting his feet against the fire with hot boots." [15] In 1627 the lord deputy doubted whether he had authority to put a priest named O'Cullenan to the rack. An answer was returned by Lord Killultagh to the effect that "you ought to rack him if you saw cause and hang him if you found reason." [16] The latest case of *peine forte et dure* seems to have been in 1740.

British Colonies and Dependencies.—The infliction of torture in any British colony or dependency has usually been regarded as contrary to law, and ordered only by arbitrary authority. It is true that in the trial of Sir Thomas Picton in 1806, for subjecting, while governor of Trinidad, a woman named Luisa Calderon to the torture of the picquet,[17] one of the grounds of defence was that such torture was authorized by the Spanish law of the island, but the accused was convicted in spite of this defence, and the final decision of the court of king's bench, in 1812, decreeing a respite of the defendant's recognizances till further order, was perhaps not so much an affirmation of the legality in the particular instance as the practical expression of a wish to spare an eminent public servant.[18] As to India, the second charge against Warren Hastings was extortion from the begums of Oude by means of the torture of their servants.[19] In the present Indian Penal Code and Evidence Acts there are provisions intended, as Sir James Stephen says,[20] to prevent the practice of torture by the police for the purpose of extracting confessions from persons in their custody.[21] In Ceylon torture, which had been allowed under the Dutch government, was expressly abolished by royal proclamation in 1799.

In the Channel Islands confessions of persons accused of witchcraft in the 17th century were frequently obtained by torture.[22]

United States.—One instance of the *peine forte et dure* is known. It was inflicted in 1692 on Giles Cory of Salem, who refused to plead when arraigned for witchcraft.[23] The constitution of the United States provides, in the words of the Bill of Rights, that cruel and unusual punishments are not to be inflicted.[24] This is repeated in the constitutions of most states. The infliction of cruel and unusual punishment by the master or officer of an American vessel on the high seas, or within the maritime jurisdiction of the United States, is punishable with fine or imprisonment, or both.[25] There have been a good many decisions on the question of cruel and unusual punishments; *e.g.* *Wilkerson* v. *Utah*, 99 U.S. Rep. 130;

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[1] *Table Talk*, "Trial."

[2] Stephen, *Hist. of the Criminal Law*, i. 297.

[3] Stephen i. 300; Kelyng, *Reports*, p. 27.

[4] The superstition was that any one drawing a witch's blood was free from her power. This is alluded to in *Henry VI*. pt. i. act i. sc. 5; "Blood will I draw on thee; thou art a witch."

[5] 104*b*.

[6] 44 Vict. c. 9, s 7.

[7] *E.g.* i. 525, iv. 680, vi. 156.

[8] c. 333.

[9] c. 370.

[10] The thumbscrew with which Carstares had been tortured was afterwards presented to him as a remembrance by the privy council.

[11] Persons subjected to more than usual torture from the boot were said to be "extremely booted."

[12] This seems to have been used in one case in England. Lecky, *Rationalism in Europe*, i. 122.

[13] Hallam, *Const. Hist.* iii. 436. See Burnet, *Hist. of Own Time*, i. 583; and SCOTLAND.

[14] Froude, *Hist. of England*, viii. 386.

[15] Ibid xi. 263.

[16] Jardine, p. 54.

[17] In the picquet the sufferer was supported only on the great toe (which rested on a sharp stake), and by a rope attached to one arm.

[18] 30 *State Trials*, 449, besides many pamphlets of the period.

[19] See the *Report of the Proceedings*, vol. i.

[20] Stephen, *Indian Evidence Act*, p. 126.

[21] Sections 327–331 of code; ss. 25–27 of act.

[22] J. L. Pitts, *Witchcraft in the Channel Islands*, p. 9 (Guernsey, 1886).

[23] Bouvier, *Law Dict.*, *s.v.* "Peine forte et dure."

[24] Amendments, art. viii. (1789).

[25] *Revised Stat.* 5347.

Territory of New Mexico v. *Ketchum*, 65 Pacific Rep. 169 (death penalty for train robbery held not unconstitutional).

Continental European States.—These fall into four main groups, the Latin, Teutonic, Scandinavian and Slav states respectively. The principles of Roman law were generally adopted in the first and second groups.

Latin States.—In France torture does not seem to have existed as a recognized practice before the 13th century. From that period until the 17th century it was regulated by a series of royal *ordonnances* at first of local obligation, afterwards applying to the whole kingdom. Torture was used only by the royal courts, its place in the seigneurial courts being supplied by the judicial combat. The earliest *ordonnance* on the subject was that of Louis IX. in 1254 for the reformation of the law in Languedoc. It enacted that persons of good fame, though poor, were not to be put to the question on the evidence of one witness.[1] Numerous other provisions were made between 1254 and 1670, when an *ordonnance* was passed under Louis XIV., which regulated the infliction of torture for more than a century. Two kinds were recognized, the *question préparatoire* and the *question préalable.* The first was used where strong evidence of a capital crime—strong, but of itself insufficient for conviction—was produced against the accused. The second was used to obtain a confession of accomplices after conviction. There was also a mitigated form called the presentment, in which the accused was simply bound upon the rack *in terrorem* and there interrogated. No person was exempt on the ground of dignity, but exemption was allowed to youths, old men, sick persons and others. Counsel for the accused were usually not allowed. The *question préparatoire* was abolished by royal decree in 1780, but in 1788 the parliaments refused to register a decree abolishing the *préalable.* But torture of all kinds was abolished by an *ordonnance* in 1789. The Declaration of Right in 1791 (art. viii.) affirmed that the law ought not to establish any punishments other than such as are strictly and evidently necessary. In modern law the *code pénal* enacts that all criminals shall be punished as guilty of assassination who for the execution of their crimes employ torture.[2] The code also makes it punishable to subject a person under arrest to torture.[3] The theory of *semiplena probatio* was worked out with more refinement than in other systems. In some parts of France not only were half-proofs admitted, but quarters and eighths of proofs.[4] Among the numerous cases of historical interest were those of the Templars in 1307, Villon about 1457, Dolet in 1546, the marquise de Brinvilliers in 1676 and Jean Calas in 1762.[5]

The law as it existed in Italy is contained in a long line of authorities chiefly supplied by the school of Bologna, beginning with the *glossatores* and coming down through the *post-glossatores*, until the system attained its perfection in the vast work of Farinaccius, written early in the 17th century, where every possible question that could arise is treated with a revolting completeness. One of the earliest jurists to treat it was Cino da Pistoia, the friend of Dante.[6] He treats it at no great length. With him the theory of *indicia* exists only in embryo, as they cannot be determined by law but must be at the discretion of the judge. Differing from Bartolus, he affirms that torture cannot be repeated without fresh *indicia.* The writings of jurists were supplemented by a large body of legislative enactments in most of the Italian states, extending from the constitutions of the emperor Frederick II. down to the 18th century. It is not until Bartolus (1314–1357) that the law begins to assume a definite and complete form. In his commentary on book xlviii. of the *Digest* he follows Roman law closely, but introduces some further refinements: *e.g.* though leading questions may not be asked in the main inquiry they are admissible as subsidiary. There is a beginning of classification of *indicia.* A very full discussion of the law is contained in the work on practice of Hippolytus de Marsiliis,[7] a jurist of Bologna, notorious, on his own admission, as the inventor of the torture of keeping without sleep. He defines the question as *inquisitio veritatis per tormenta et cordis dolorem*, thus recognizing the mental as well as the physical elements in torture. It was to be used only in capital cases and atrocious crimes. The works of Farinaccius and of Julius Clarus nearly a century later were of great authority from the high official positions filled by the writers. Farinaccius was procurator-general to Pope Paul V., and his discussion of torture is one of the most complete of any.[8] It occupies 251 closely printed folio pages with double columns. The length at which the subject is treated is one of the best proofs of the science to which it had been reduced. The chief feature of the work is the minute and skilful analysis of *indicia, fama, praesumptio*, and other technical terms. Many definitions of *indicium* are suggested, the best perhaps being *conjectura ex probabilibus et non necessariis orta, a quibus potest abesse veritas sed non verisimilitudo.* For every infliction of torture a distinct *indicium* is required. A single witness or an accomplice constitutes an *indicium.* But this rule does not apply where it is inflicted for discovering accomplices or for discovering a crime other than that for which it was originally inflicted. Torture may be ordered in all criminal cases, except small offences, and in certain civil cases, such as denial of a *depositum*, bankruptcy, usury, treasure trove, and fiscal cases. It may be inflicted on all persons, unless specially exempted (clergy, minors, &c.), and even those exempted may be tortured by command of the sovereign. There are three kinds of torture, *levis, gravis* and *gravissima*, the first and second corresponding to the ordinary torture of French writers, the last to the extraordinary. The extraordinary or *gravissima* was as much as could possibly be borne without destroying life. The judge could not begin with torture; it was only a *subsidium.* If inflicted without due course of law, it was void as a proof. The judge was liable to penalties if he tortured without proper *indicia*, if a privileged person, or if to the extent that death or permanent illness was the result. An immense variety of tortures is mentioned, and the list tended to grow, for, as Farinaccius says, judges continually invented new modes of torture to please themselves. Numerous casuistical questions are treated at length, such as, what kinds of reports or how much hearsay evidence constituted fame? Were there three or five grades in torture? Julius Clarus of Alessandria was a member of the council of Philip II. To a great extent he follows Farinaccius. He puts the questions for the consideration of the judge with great clearness. They are—whether (1) a crime has been committed, (2) the charge is one in which torture is admissible, (3) the fact can be proved otherwise, (4) the crime was secret or open, (5) the object of the torture is to elicit confession of crime or discovery of accomplices. The clergy can be tortured only in charges of treason, poisoning and violation of tombs. On the great question whether there are three or five grades, he decides in favour of five, viz. threats, taking to the place of torment, stripping and binding, lifting on the rack, racking.[9] Other Italian writers of less eminence have been referred to for the purposes of this article. The burden of their writings is practically the same, but they have not attained the systematic perfection of Farinaccius. Citations from many of them are made by Manzoni (see below). Among others are Guido de Suzara, Paris de Puteo, Aegidius Bossius of Milan, Casonus of Venice, Decianus, Follerius and Tranquillus Ambrosianus, whose works cover the period from the 13th to the end of the 17th century. The law depended mainly on the writings of the jurists as interpreters of custom. At the same time in all or nearly all the Italian states and colonies[10] the customary law was limited, supplemented, or amended by legislation. That a check by legislative authority was necessary appears from the glimpses afforded by the writings of the jurists that the letter of the law was by no means always followed. The earliest legislation after the Roman law seems to be the constitutions of the emperor Frederick II. for Sicily promulgated in 1231. Torture was abolished in Tuscany in 1786, largely owing to the influence of Beccaria, whose work first appeared in 1764, and other states followed, but the *puntale* or piquet seems to have existed in practice at Naples up to 1859.

Several instances of the torture of eminent persons occur in Italian history, such as Savonarola, Machiavelli, Giordano Bruno, Campanella. Galileo appears to have only been threatened with the *esame rigoroso.* The historical case of the greatest literary interest is that of the persons accused of bringing the plague into Milan in 1630 by smearing the walls of houses with poison. An analysis of the case was undertaken by Verri[11] and Manzoni,[12] and puts in a clear light some of the abuses to which the system led in times of popular panic. Convincing arguments are urged by Manzoni, after an exhaustive review of the authorities, to prove the groundlessness of the charge on which two innocent persons underwent the torture of the *canape*, or hempen cord (the effect of which was partial or complete dislocation of the wrist), and afterwards suffered death by breaking on the wheel. The main arguments, shortly stated, are these, all based upon the evidence as recorded, and the law as laid down by jurists. (1) The unsupported evidence of an accomplice was treated as an *indicium* in a case not one of those exceptional ones in which such an *indicium* was sufficient. The evidence of two witnesses or a confession by the accused was necessary to establish a remote *indicium*, such as lying. (2) Hearsay evidence was received when primary evidence was obtainable. (3) The confession made under torture was not ratified afterwards. (4) It was made in consequence of a promise of impunity. (5) It was of an impossible crime.

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[1] *Ordonnances des rois*, i. 72.

[2] s. 303.

[3] s. 344.

[4] See Pollock and Maitland, ii. 658, note.

[5] On the French system generally see Imbertus, *Institutiones forenses gallicae* (Utrecht, 1649); N. Weiss, *La Chambre ardente, 1540–1550* (Paris, 1889). A large number of authorities deal mainly with the *ordonnance* of 1670; Muyart de Vouglans, *Inst. crim.* (Paris, 1767), and Jousse, *Traité de la justice crim.* (Paris, 1771), are examples. F. Siegneux de Correvon, *Essai sur l'usage, l'abus, et les inconvéniens de la torture* (Geneva, 1768), is one of the opponents of the system.

[6] Cinus Pistorensis, *Super codice, de tormentis* (Venice, 1493).

[7] *Practica criminalis quae Averolda nuncupatur* (Venice, 1532)

[8] *Praxis et theorica criminalis*, bk. ii. tit. v. quaest. 36–51 (Frankfort, 1622).

[9] *Practica criminalis finalis* (Lyons, 1637).

[10] It is obvious from the allusion at the end of *Othello* that Shakespeare regarded torture as possible in Cyprus when it was a Venetian colony.

[11] *Osservazioni sulla tortura.*

[12] *Storia della Colonna infame.* Neither writer alludes to Beccaria.

In Spain, as in Italy, the law depended partly on the writings of jurists, partly on legislation. Roman law was carried through the Visigothic Code and the *Fuero juzgo*[1] (which repeats it almost word for word) down to the *Siete partidas*.[2] This treatise, compiled by Alphonso the Wise about 1243, but not promulgated till 1256, amended the previously existing law in the direction of greater precision. Torment is defined as a manner of punishment which lovers of justice use, to scrutinize by it the truth of crimes committed secretly and not provable in any other manner. Repetition was allowed in case of grave crimes. There were the usual provisions for the infliction of torture only by a judge having jurisdiction, and for the liability of the judge for exceeding legal limits. Subsequent codes did little more than amend the *Partidas* in matters of procedure. Torture is not named in the *Ordenanzas reales* of Ferdinand and Isabella (1485). The *Nueva recopilacion* of Philip II. enacted that torture was to be applied by the *alcaldes* on due sentence of the court—even on *hidalgos* in grave crimes—without regard to alleged privilege or custom. In the *Novisima recopilacion* of 1775 the only provisions on the subject are that the *alcaldes* are not to condemn to torment without preceding sentence according to law, and that *hidalgos* are not to be tormented or suffer infamous punishment. In Aragon, while it was an independent state, torture was not in use to the same extent as in other parts of Spain. It was abolished in the 13th century by the General Privilege of 1283 except in the case of vagabonds charged with coining. A statute of 1335 made it unlawful to put any freeman to the torture.[3] On the other hand, the Aragonese nobility had a power, similar to the *peine forte et dure*, of putting a criminal to death by cold, hunger and thirst.[4] The jurists dealing with the subject are not as numerous as in Italy, no doubt because Italian opinions were received as law in all countries whose systems were based on Roman law.[5] Some of the Italian jurists too, like Clarus, were at that same time Spanish officials. The earliest Spanish secular jurist appears to be Suarez de Paz.[6] According to him the most usual tortures in Spain were the water and cord, the pulley or *strappado*, the hot brick, and the *tablillas*, or thumbscrew and boot combined. Three was the greatest number of times that any torture could be applied. It might be decreed either on demand of the accuser or at will of the judge. The Roman rule of beginning with the weakest was amplified into a series of regulations that a son was to be put to the question before a father, a woman before a man, &c. The fullest statement of Spanish law is to be found in the work of Antonio Gomez, a professor at Salamanca.[7] With him no exceptions apply in charges of *laesa majestas divina* or *humana*. A judge is liable to different punishment according as he orders torture *dolose* or *culpabiliter*. Differing from Hippolytus de Marsiliis, Gomez holds that the dying accusation of a murdered man is not an *indicium*. A confession on insufficient *indicia* is void. His division of torture into *tortura actualis* and *terror propinquus* is the same as that of the French jurists into torture and presentment. The conclusions of the ecclesiastical writers of Spain, such as Eymerico and Simancas, were accepted wholly or partially by the secular writers, such as Alvarez de Velasco,[8] and the Peruvian, Juan de Hevia Bolaños,[9] who points out differences in the ecclesiastical and secular systems, *e.g.* the former brought up the accused for ratification in three days, the latter in twenty-four hours. A good deal of the Spanish law will be found in the proceedings against Sir Thomas Picton (see above). Torture in Spain seems to have been inflicted on Jews to an extraordinary extent, as it was also in Portugal, where the latest legislation as to torture seems to be of the year 1678. In 1790 it had become obsolete,[10] and in a work on criminal procedure four years later it is only referred to for the purpose of stating that when it did exist it was *realis* or *verbalis*.[11]

Teutonic States.—Germany (including Austria) is distinguished by the possession of the most extensive literature and legislation on the subject. The principal writers are Langer, von Rosbach and von Boden. In addition may be cited the curious *Layenspiegel* of Ulrich Tengler (1544), and the works of Remus, Casonus and Carpzow.[12] Legislation was partly for the empire, partly for its component states. Imperial legislation dealt with the matter in the Golden Bull (1356), the Ordinance of Bamberg (1507), the Carolina (1532)[13] and the *Constitutio criminalis theresiana* (1768).[14] The Carolina followed the usual lines, the main difference being that the infliction must be in the presence of two *scabini* and a notary, who was to make a detailed record of the proceedings. The code of Maria Theresa defines torture as "a subsidiary means of eliciting truth." It could be applied only in cases where condemnation would have involved capital or severe corporal punishment. The illustrated edition was suppressed by Prince Kaunitz a few days after its appearance. Torture was formally abolished in the empire in 1776. In Prussia it was practically abolished by Frederick the Great in 1740, formally in 1805. Even before its abolition it was in use only to discover accomplices after conviction.[15] In some other states it existed longer, in Baden as late as 1831. It was carried to excess in Germany, as in the Netherlands and Scotland in charges of witchcraft.

The Netherlands.—The principal legislative enactment was the code of criminal procedure promulgated by Philip II. in 1570 and generally known as the *Ordonnance sur le style*.[16] One of its main objects was to assimilate the varieties of local custom, as the *Nueva recopilacion* had done in Spain three years earlier. The French *ordonnance* of 1670 is probably largely based on it. In spite of the attempt of the ordinance to introduce uniformity, certain cities of Brabant, it is said, still claimed the privilege of torturing in certain cases not permitted by the ordinance, *e.g.* where there was only one witness.[17]

The law of 1670 continued to be the basis of criminal procedure in the Austrian Netherlands until 1787. In the United Provinces it was not repealed until 1798. The principal text-writers are Damhouder,[18] van Leeuwen[19] and Voet. Van Leeuwen lays down as a fundamental principle that no one was to be condemned to death without confession, and such confession, if attainable in no other way, ought to be elicited by torture. Witnesses could be tortured only if they varied on confrontation. One of the *indicia* not always recognized by jurists was previous conviction for a similar crime. Voet's commentary *ad Pandectas*[20] is interesting for its taking the same view as St Augustine as to the uselessness of torture, and compares its effect with that of the trial by battle. At the same time he allows it to be of some value in the case of very grave crimes. The value of torture was doubted by others as well as Voet, *e.g.* by A. Nicholas[21] and by van Essen.[22] At the same time a writer was found to compose a work on the unpromising subject of the rack.[23]

Scandinavian Countries.—There is a notice of torture in the Icelandic Code known as the Grágás (about 1119). Judicial torture is said to have been introduced into Denmark by Valdemar I. in 1157.[24] In the code of Christian V. (1683) it was limited to cases of treason.[25] It was abolished by the influence of Struensee in 1771, but notwithstanding this he was threatened with it, though it was not actually inflicted, before his execution in 1772. In Sweden torture never existed as a system, and in the code of 1734 it was expressly forbidden.[26] It was however occasionally inflicted, as in England, by extrajudicial authorities, called secret committees.

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[1] vi. 4, 5.

[2] *Partida*, vii. 30. It was one of the earliest books printed in Spain, the earliest edition appearing in 1491.

[3] Cited Hallam, *Middle Ages*, iii. 76.

[4] Du Cange, *s.v.* *Fame necare*.

[5] In all the Latin countries the idea of torture had become a commonplace. The dramatists contain frequent allusions to it. In Lope de Vega's *El Perro del hortelano* ("The Dog in the Manger"), one of the characters says, "Here's a pretty inquisition!" to which the answer is, "The torture will be next applied." Molière and Racine both make use of it. In *L'Avare*, act iv. sc. 7, Harpagon threatens to put his whole household to the question. In *Les Plaideurs* Dandin invites Isabelle to see *la question* as a mode of passing an hour or two. In England Bacon (Essay lvi.) says, "There is no worse torture than the torture of laws." The same idea occurs again in the *Advancement of Learning*, viii. 3, 13, "It is a cruel thing to torture the laws that they may torture men."

[6] *Praxis ecclesiastica et saecularis*, vol. i. pt. v. § 3 (Salamanca, 1583).

[7] *Variae resolutiones*, p. 412 (Antwerp, 1593).

[8] *Judex perfectus* (Lausanne, 1740).

[9] *Curia filipica* (Madrid, 1825).

[10] *Repertorio geral das leis extravagantes*, p. 381 (Coimbra, 1815).

[11] Paschal Freirus, *Inst. jur. crim. lusitani*, p. 203 (Lisbon, 1794).

[12] Extracts from these and other writers will be found in Lea, *Superstition and Force*, and in R. Quanter, *Die Folter in der deutschen Rechtspflege sonst und jetzt* (Berlin, 1900).

[13] Chs. 33-44.

[14] Art. 38 (Vienna, 1769).

[15] This statement is made on the authority of a work attributed to Frederick himself, *Dissertation sur les raisons d'établir ou d'abroger les lois* (1748).

[16] A list of the numerous commentaries on this code will be found in Nybels, *Les Ordonnances criminelles de Philippe II. de 1570*, p. 23 (Brussels, 1856).

[17] Nybels, pp. 31, 33.

[18] *Pratique judiciaire en causes criminelles* (Antwerp, 1564).

[19] *Censura forensis*, pt. ii. bk. ii. chs. 8, 9 (Leiden, 1677).

[20] On *Dig.* xlviii. 18. There are numerous editions of Voet, the sixth (generally found in libraries) is the Hague (1734).

[21] *Si la torture est un moyen sûr à vérifier les crimes* (Amsterdam, 1681). Also by an anonymous writer thirty years earlier, *De Pijnbank wedersproken en bematigt* (Rotterdam, 1651).

[22] *Jus ecclesiasticum universum* (Louvain, 1720).

[23] *Hieronymi Magii Anglarensis de equuleo liber postumus* (Amsterdam, 1664). There are several works dealing with torture in witchcraft proceedings. A large number of cases will be found in J. Scheltema, *Geschiedenis der Hexen-processen* (Haarlem, 1828). For torture in the 18th century see E. Hubert, *La Torture aux Pays Bas autrichiens pendant la xviiie siècle* (Brussels, 1897).

[24] Baden, *Dansk juridisk Ordbog*, *s.v.* "Tortur" (Copenhagen, 1828).

[25] Kolderup-Rosenvinge, *Udvalg af gamle Danske-Domme*, bk. i. c. 20 (Copenhagen, 1848).

[26] *Cod. leg. suecicarum*, pp. 233, 370 (Stockholm, 1743).

The "cave of roses," where reptiles were kept for the purpose of torture, was closed by Gustavus III. in 1772.

Slav Countries.—The earliest mention of torture seems to be that of the mutilation provided for certain offences by the code of Stephen Dushan in 1349. In Russia torture does not occur in the recensions of the earlier law. It was possibly of Tatar origin, and the earliest mention of it in an official document is probably in the *Sudebnik* of Ivan the Terrible (1497). In the ordinance of 1556 there are elaborate regulations, which one learns from history were not always observed in periods of political disturbance, and torture seems to have been used even as a means of enforcing payment of debts. The reaction begins with Peter the Great and culminates with Catharine II., who was largely influenced by the opinions of Beccaria and Voltaire. In the instructions to the commission for framing a criminal code (1766), it is declared that all punishments by which the body is maimed ought to be abolished,[1] and that the torture of the rack violates the rules of equity and does not produce the end proposed by the laws.[2] It was formally abolished by Alexander I. in 1801, and in 1832 the *Svod Zakonov* subjected to penalties any judge who presumed to order it. But even as late as 1847 it seems to have been inflicted in one or two exceptional cases.[3]

Authorities.—For England Jardine's is still the standard work. Much general information and numerous authorities will be found in Lipenius, *Bibliotheca realis Juridica, s.v.* "Tortura" (Frankfort, 1679), and in the more modern work of J. Helbing, *Die Tortur* (Berlin, 1902). For those who can obtain access to it the catalogue issued at the sale of M. G. Libri (1861) is valuable. He had collected most of the books on the subject. There are several publications dealing with cases of individuals in addition to the numerous ones on witchcraft trials, *e.g.* those of William Lithgow, the Amboyna case, Dellon and Van Halen. Lithgow's story has been republished (Glasgow, 1907). (J. W.)

TORUS, a Latin word, meaning a round swelling or protuberance, applied to a convex moulding in architecture, which in section is generally a semicircle. The earliest examples are found in Egypt, where it was carried up the angles of the pylon and temple walls and horizontally across the same. Its most frequent employment is in the bases of columns; in the Roman Doric order being the lowest moulding; in the Ionic orders there are generally two torus mouldings separated by a scotia with fillets. Both in Greek and Roman bases sometimes the torus is elaborately carved. (See Moulding.)

TORZHOK, a town of Russia, in the government of Tver, on the river Tvertsa, 21 m. by rail S.W. of the Likhoslavl, station of the St Petersburg & Moscow railway Pop. (1900), 15,119. It dates from the 11th century, and the name (market-place) shows that this dependency of Novgorod was a commercial centre. It was fortified with a stone wall, which only partially protected it from the attacks of Mongols, Lithuanians and Poles. Torzhok is celebrated in Russia for its embroidered velvet and embroidered leather-work, for the manufacture of travelling bags, and for its trade in corn and flour.

TOSCANELLA (anc. *Tuscana*, *q.v.*), a town of the province of Rome, Italy, 15 m. N.E. of Corneto by road, 545 ft. above sea-level. Pop. (1901), 4839. The medieval walls with their towers are still preserved. On the ancient citadel hill is the Romanesque church of S. Pietro, belonging to four different periods—739, 1093 (the date of the reconstruction of the crypt), the middle of the 12th and the end of the 12th century. It has the shape of a Roman basilica, with a nave and two aisles and one apse. The elaborate façade with its rose window also belongs to the 12th century. S. Maria in the valley below dates from 1050 to 1206, and has a similar façade and a massive square campanile. In the town are two other Romanesque churches.

See G. T. Rivoira, *Origini dell architettura Lombarda* i. 146 (Rome 1901).

TOSTIG (d. 1066), earl of Northumbria, was a son, probably the third, of Earl Godwine, and in 1051 married Judith, sister or daughter of Baldwin V., count of Flanders. In the year of his marriage he shared the short exile of his father, returning with him to England in 1052, and became earl of Northumbria after the death of Earl Siward in 1055. He was very intimate with his brother-in-law, Edward the Confessor, and in 1061 he visited Pope Nicholas II. at Rome in the company of Aldred, archbishop of York. By stern and cruel measures Tostig introduced a certain amount of order into the wild northern district under his rule; this severity made him exceedingly unpopular, and in 1065 Northumbria broke into open revolt. Declaring Tostig an outlaw and choosing Morkere in his stead, the rebels marched southwards and were met at Oxford by Earl Harold, who, rather against the will of the king, granted their demands. Tostig sailed to Flanders and thence to Normandy, where he offered his services to Duke William, who was related to his wife and who was preparing for his invasion of England. He then harried the Isle of Wight and the Kentish and Lincolnshire coasts, and, after a stay in Scotland and possibly a visit to Norway, joined another invader, Harald III. Hardrada, king of Norway, in the Tyne. Together they sailed up the Humber and at Gate Fulford, near York, defeated Earls Morkere and Edwine and entered York. But Harold, now king, was hurrying to the north. Taking the Norwegians by surprise at Stamford Bridge he destroyed their army on the 25th of September 1066, and in this battle both Tostig and the king of Norway were slain. Tostig's two sons appear to have taken refuge in Norway, and his widow Judith married Welf, duke of Bavaria.

See E. A. Freeman, *The Norman Conquest*, vols. ii. and iii. (1870–1876).

TOTANA, a town of eastern Spain, in the province of Murcia, on the Lorca-Murcia railway. Pop. (1900), 13,703. The town, which consists of two parts, the Barrio de Sevilla and Barrio de Triana, contains several handsome public buildings, among them the church of Santiago, with its three naves. Water is conveyed to Totana from the Sierra de Espuña by an aqueduct 7 m. long. Saltpetre is obtained among the hills, and there is a thriving trade in wheat, oranges, olives, almonds, and wine from the Sangonera valley. Other industries are the manufacture of linen, leather and the earthenware jars called *tinajas*, which are used for the storage of oil and wine.

TOTEMISM. The word "totem" is used in too many varying senses by students of early society and religion. The term came into the English language in the form of "totam," through a work of 1791, by J. Long, an interpreter between the whites and the Red Indians of North America.[4] Long himself seems to have used the word to denote the protective familiar, usually an animal, which each Indian selected for himself, generally through the monition of a dream during the long fast of lads at their initiation. Such selected (or, when bestowed by medicine-men or friends, "given") totems are styled "personal totems" and have no effect in savage law, nor are they hereditary, with any legal consequences.

In stricter terminology "totem" denotes the object, generally of a natural species, animal or vegetable, but occasionally rain, cloud, star, wind, which gives its name to a *kindred* actual or supposed, among many savages and barbaric races in America, Africa, Australia and Asia and the isles. Each child, male or female, inherits this name, either from its mother ("female descent") or from its father ("male descent"). Between each person and his or her name-giving object, a certain mystic *rapport* is supposed to exist. Where descent wavers, persons occasionally have, in varying degrees, the totems of both parents.

Religious Aspect of the Totem.—As a rule, by no means invariable, the individual may not kill or eat the name-giving object of his kin, except under dire necessity; while less usually it is supposed to protect him and to send him monitory dreams. This is the "religious" or semi-religious aspect of the totem, or this aspect is, by some students, called "religious."

We also hear of customs of burying and lamenting dead animals which are regarded with reverence by this or that "family," or "clan." This custom is reported among the Samoans, and one "clan" was said to offer first-fruits to its sacred animal, the eel; while the "clan" that revered the pigeon kept and fed a tame specimen.[5] But in Samoa, though the sacred animals of "clans" or "families" are, in all probability, survivals of totemism, they are now regarded by the people as the vehicles of "clan" or "family" gods, and therefore receive honours not paid to the hereditary totems of Australia and North America, which have nothing godlike. It is to be presumed that "totem dances" in which some Australian tribes exhibit, in *ballets d'action*, the incidents of a myth concerning the totem, are, in a certain sense, "religious"; when they are not magical, and intended to foster and fertilize the species, animal or vegetable or other to which the totem belongs.

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[1] Art. 96.

[2] Ibid. 192–197.

[3] See the various histories of Russian law, such as Maceiovski, Lange and Zagoskin, under the heads of *puitka* or *muchenie*.

[4] Long, *Voyages and Travels of an Indian Interpreter* (1791), p. 86.

[5] Turner, *Samoa*, p. 71.

The magical performances for the behoof of the totem creatures may be studied in the chapters on "Intichiuma" in Messrs Spencer and Gillen's *Native Tribes of Central Australia*, and *Native Tribes of Northern Australia*. Among the many guesses at the original purpose of totemism, one has been that the primal intention of totem sets of human beings was to act as magical co-operative stores for supplying increased quantities of food to the tribe. But this opinion has gone the way of other conjectures. The "religious" status of the totem is lowest among peoples where its influence on social regulations is greatest, and vice versa, a topic to which we recur.

There are also various rites, in various tribes, connecting the dead man with his totem at his funeral; perhaps at his initiation, when a boy, into the esoteric knowledge and rules of his tribe. Men may identify themselves with their totems, or, mark themselves as of this or that totem by wearing the hide or the plumage of the bird or beast, or by putting on a mask resembling its face. The degree of "religious" regard for the revered object increases in proportion as it is taken to contain the spirit of an ancestor or to be the embodiment of a god: ideas not found among the most backward savages.

The supreme or superior being of low savage religion or mythology is never a totem. He may be able, like Zeus in Greek mythology, to assume any shape he pleases; and in the myths of some Australian tribes he ordained the institution of totemism. Byamee, among the Euahlayi tribe of north-west New South Wales, had all the totems in him, and when he went to his paradise, Bullimah, he distributed them, with the marriage rules, among his people.[1] In other legends, especially those of central and northern Australia, the original totem creatures, animal in form, with bestial aspect, were developed in a marine or lacustrine environment, and from them were evolved the human beings of each totem kin. The rule of non-intermarriage within the totem was, in some myths, of divine institution; in others, was invented by the primitive wandering totemic beings; or was laid down by the wisdom of mere men who saw some unknown evil in consanguine unions. The strict regard paid to the rule may be called "religious"; in so far as totemists are aware of no secular and social *raison d' être* of the rule it has a mysterious character. But whereas to *eat* the totem is sometimes thought to be automatically punished by sickness or death, this danger does not attach to *marriage* within the totem save in a single known case. The secular penalty alone is dreaded; so there seems to be no religious fear of offending a superior being, or the totem himself: no tabu of a mystic sort.

Social Aspect of the Totem.—The totem has almost always a strong influence on or is associated with marriage law, and except in the centre of Australia, and perhaps in the little-known West, men and women of the same totem may not intermarry, "however far apart their hunting grounds," and though there is no objection on the score of consanguinity.

This is the result, in Australia, of the custom, there almost universal, which causes each individual to belong, by birth, to one or other of the two main exogamous and intermarrying divisions of the tribe (usually called "phratries"). The phratries (often known by names of animals, as Eagle Hawk and Crow, Crow and White Cockatoo) contain each a number of totem kins, as Dog, Wild Cherry, Wombat, Frog, Owl, Emu, Kangaroo, and so on, and (except among the Arunta "nation" of five tribes in Central Australia) the same totem kin never occurs in both phratries. Thus as all persons except in the Arunta nation, marry out of their own phratry, none can marry into his or her totem kin.

In some parts of North America the same rule prevails, with this peculiarity that the phratries, or main exogamous divisions, are not always two, as in Australia, but, for example, among the Mohegans three—Wolf, Turtle, and Turkey.[2] In Wolf all the totems are quadrupeds; under Turtle they are various species of turtles and the yellow eel; and under Turkey all the totems are birds.

Clearly this ranking of the totems in the phratries is the result of purposeful design, not of accident. Design may also be observed in such phratries of Australian tribes as are named after animals of contrasted colours, such as White Cockatoo and Crow, Light Eagle Hawk and Crow. It has been supposed by Mr J. Mathew, Père Schmidt and others that these Australian phratries arose in an alliance with *connubium* between a darker and a lighter race.[3] But another hypothesis is not less probable; and as we can translate only about a third of Australian phratry names, conjecture on this subject is premature.

Both in Australia and America the animals, as Eagle Hawk and Crow, which give their names to the phratries, are almost always totem kins within their own phratries.[4]

The Moquis of Arizona are said to have ten phratries, by Captain Ulick Bourke in his *Snake Dance of the Moquis*, but possibly he did not use the term "phratry" in the sense which we attach to it.

Among the Urabunna of Southern Central Australia, and among the tribes towards the Darling River, a very peculiar rule is said to prevail. There are two phratries, and in each are many totem kins, but each totem kin may intermarry with only one totem kin which must be in the opposite phratry.[5] Thus there are as many exogamous divisions as there are totems in the tribes, which reckon descent in the female line; children inheriting the mother's totem only. Corroboration of these statements is desirable, as the tribes implicated are peculiarly "primitive," and theirs may be the oldest extant set of marriage rules.

The existence of two or more main exogamous divisions, named or unnamed, is found among peoples where there are either no totem kins, or where they have fallen into the background, as in parts of Melanesia, among the Todas and Meitchis of India and the Wanika in East Africa.[6]

An extraordinary case is reported from South Australia where people must marry in their own phratry, while their children belong to the opposite phratry.[7] This awaits corroboration.

We now see some of the numerous varieties which prevail in the marriage rules connected with the totems. Even among a tribe whose members, it is reported, may marry into their own phratries, it appears that they must not marry within their own totem kins. This is, indeed, the rule wherever totemic societies are found in anything approaching to what we deem their most archaic constitution as in south-east Australia and some tribes of North America.

Exogamy: The Arunta Abnormality.—Meanwhile, in Central Australia, in the Arunta "nation," the rule forbidding marriage within the totem kin does not exist. Totems here are not, as everywhere else, inherited from either parent, but a child is of what we may call "the local totem" of the place where its mother first became conscious of its life within her. The idea is that the spirits of a primal race, in groups each of one totem only ("Alcheringa folk"), haunt various localities; or spirits (*ratapa*) emanating from these primal beings do so; they enter into passing married women, and are incarnated and born again.[8]

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[1] Mrs Langloh Parker, *The Euahlayi Tribe.*

[2] Morgan, *Ancient Society*, p. 174.

[3] Mathew, *Eagle Hawk and Crow*; Schmidt, *Anthropos* (1909).

[4] See Lang, *The Secret of the Totem*, pp. 154, 170; and N. W. Thomas, *Kinship and Marriage in Australia*, pp. 9, 31.

[5] Howitt, *Native Tribes of South-East Australia*, pp. 93, 181, 188; Spencer and Gillen, *Native Tribes of Central Australia*, pp. 60, 61, *Northern Tribes*, p. 71; Lang, *Anthropological Essays*; Tylor's *Festschrift*, pp. 203–210.

[6] Thomas, *ut supra*, p. 10. See, for numerous examples, T. G. Frazer, *Totemism* (1910).

[7] *MS.* of Mrs Bates.

[8] It is necessary to state here the sources of our information about the central, north, north-western and south-eastern forms of

Thus if a woman, whatever her own totem, and whatever her husband's may be, becomes conscious of her child's life in a known centre of Wild Cat spirits, her child's totem is Wild Cat, and so with all the rest.

As a consequence, a totem sometimes here appears in what the people call the "wrong" (*i.e.* not the original) exogamous division; and persons may marry within their own totem name, if that totem be in the "right" exogamous division, which is not theirs. Each totem spirit is among the Arunta associated with an amulet or *churinga* of stone; these are of various shapes, and are decorated with concentric circles, spirals, *cupules*, and other archaic patterns. These amulets are only used in this sense by the Arunta nation and their neighbours the Kaitish, "and it is this idea of spirit individuals associated with *churinga* and resident in certain definite spots that lies at the root of the present totemic system of the Arunta," says Messrs Spencer and Gillen.[1] Every Arunta born incarnates a pre-existent primal spirit attached to one of the stone *churinga* dropped by primal totemic beings, all of one totem in each case, at a place called an *oknanikilla* Each child belongs to the totem of the primal beings of the place, where the mother became aware of the child's life.

Thus the peculiar causes which have produced the unique Arunta licence of marrying within the totem are conspicuously obvious

Contradictory Theories about the Arunta Abnormal Totemism.—At this point theories concerning the origin of totemism begin to differ irreconcilably. Mr Frazer, Mr Spencer, and, apparently Dr Rivers, hold that, in Australia at least, totemism was originally "conceptional" It began in the belief by the women that pregnancy was caused by the entrance into them of some spirit associated with a visible object, usually animal or vegetable; while the child born, in each case, was that object. Hence that class of objects was tabued to the child, was its totem, but such totems were not hereditary

Next, for some unknown reason, the tribes were divided into two bodies or segments. The members of segment A may not intermarry; they must marry persons of segment B, and vice versa. Thus were evolved the primal forms of totemism and exogamy now represented in the law of the Arunta nation alone. Here, and here alone, marriage within the totem is permitted. The theory is, apparently, that, in all other exogamous and totemic peoples, totems had been, for various reasons, made hereditary, before exogamy was enforced by the legislator in his wisdom. Thus, all over the totemic world, except in the Arunta nation, the method of the legislator was simply to place one set of totem kins in tribal segment A, and the other in segment B, and make the segments exogamous and intermarrying. Thus it was impossible for any person to marry another of the same totem This is the theory of Mr Frazer.

Upholders of the contradictory system maintain that the Arunta nation has passed through and out of the universal and normal system of hereditary and exogamous totemism into its present condition, by reason of the belief that children are incarnations of pre-existing animal or vegetable spirits, *plus* the unique Arunta idea of the connexion of such spirits with their stone *churinga*. Where this combination of the two beliefs does not occur, there the Arunta non-hereditary and non-exogamous totemism does not occur. It would necessarily arise in any normal tribe which adopted the two Arunta beliefs, which are not "primitive."

Arguments against Mr Frazer's Theory.—There was obviously a time, it is urged, when all totems were, as everywhere else,

totemism. About the central Arunta tribe with its neighbours, the Urabunna, we have the evidence very carefully collected by Mr Gillen, a protector of the aborigines, and Professor Baldwin Spencer (*Native Tribes of Central Australia*). Concerning the peoples north from the centre to the Gulf of Carpentaria, the same scholars furnish a copious account in their *Northern Tribes*. These two explorers had the confidence of the blacks; witnessed their most secret ceremonies, magical and initiatory, and collected their legends. Their books, however, contain no philological information as to the structure and interrelation of the dialects, information which is rarely to be found in the works of English observers in Australia. As far as appears, the observers conversed with the tribes only in "pidgin English." If this be the case that *lingua franca* is current among some eighteen central-northern tribes speaking various native dialects. We are told nothing about the languages used in each case; perhaps the Arunta men who accompanied the expedition arranged a system of interpreters.

For the Dieri tribe, neighbours of the Urabunna, we have copious evidence in *Native Tribes of South-East Australia* by the late Mr A. W. Howitt, who studied the peoples for forty years; was made free of their initiatory ceremonies; and obtained intelligence from settlers in regions which he did not visit. We have also legends with Dieri texts and translations from the Rev. Mr Siebert, a missionary among the Dieri. That tribe appears now to exist in a very dwindled condition under missionary supervision. The accounts of tribes from the centre to the south-east by Mr R. E. Mathew, are scattered in many English, Australian and American learned periodicals. Mr Mathew has given a good deal of information about some of the dialects. His statements as to the line of descent and on other points among certain tribes are at variance with those of Messrs Spencer and Gillen (see an article by Mr A. R. Brown in *Man*, March 1910). Mr Mathew, however, does not enable us to test the accuracy of his informants among the northern tribes, which is unfortunate. For the Aranda (or Arunta) of a region apparently not explored by Messrs Spencer and Gillen, and for the neighbouring Loritja tribe, we have *Die Aranda und Loritja Stämme*, two volumes by the Rev. C. Streblow (Baer, Frankfurt am Main, 1907, 1908). Mr Strehlow is a German missionary who, after working among the Dieri and acquiring their language, served for many years among a branch of the Arunta (the Aranda), differing considerably in dialect, myths and usages from the Arunta of Messrs Spencer and Gillen. In some points, for example as to the primal ancestors and the spirits diffused by them for incarnation in human bodies, the Aranda and Loritja are more akin to the northern tribes than to Mr Spencer's Arunta. In other myths they resemble some south-eastern tribes reported on by Mr Howitt. Unlike the Arunta of Messrs Spencer and Gillen, but like the Arunta described by Mr Gillen earlier in *The Horn Expedition*, they believe in "a magnified non-natural man," Altjira, with a goose-foot, dwelling in the heavens. Unlike the self-created Atnatu of the Kaitish of Messrs Spencer and Gillen, he is not said to have created things, or to take any concern about human beings, as Atnatu does in matters of ceremonial. Mr Strehlow gives Aranda and Lortija texts in the original, with translations and philological remarks.

Mr Frazer, in his *Totemism*, makes no use of Mr Strehlow's information (save in a single instance). To us it seems worthy of study. His reason for this abstention is that, in a letter to him (Melbourne, March 10, 1908), Mr Spencer says that for at least twenty years the Lutheran Missions have taught the natives "that altjira means 'god'; have taught that their sacred ceremonies and secular dances are 'wicked'; have prohibited them, and have never seen them. Flour and tobacco, &c., are only given to natives who attend church and school. Natives have been married who, according to native customary law, belong to groups to which marriage is forbidden. For these reasons Mr Frazer cannot attempt "to filter the native liquor clear of its alien sediment," (*Totemism*. i. 186, note 2).

Against this we may urge that, as regards the goose-footed sky-dweller, Mr Strehlow reports less of his active interest in human affairs than Mr Gillen does concerning his "Great Ulthaana of the heavens" among the Arunta. Mr Strehlow's being, Altjira, has a name apparently meaning "mystic" or sacred, which is applied to other things, for example to the inherited maternal totem of each native. His names for Altjira (god) and for the totemic ancestors (totem gods), are inappropriate, but may be discounted. Many other tribes who *are* discussed by Mr Frazer have been long under missionary influence as well as the Aranda. According to Mr Frazer the Dieri tribe had enjoyed a German Lutheran mission station (since 1866) for forty-four years up to 1910. About 150 Dieri were alive in 1909 (*Totemism*, iii. 344). Nevertheless the Dieri myths published by Mr Siebert in the decadence of the tribe, and when the remnant was under missionaries, show no "alien sediment." Nor do the traditions of Mr Strehlow's Aranda. Their traditions are closely akin, now to those of the Arunta, now to those of the northern tribes, now to those of the Euahlayi of Mrs Langloh Parker (*The Euahlayi Tribe*) in New South Wales, and once more to those of Mr Howitt's south-eastern tribes. There is no trace of Christian influence in the Aranda and Loritja matter, no vestige of "alien" (that is, of European) "sediment," but the account of Atnatu among the Kaitish reported on by Messrs Spencer and Gillen reads like a savage version of Milton's "Fall of the Angels" in *Paradise Lost*. For these reasons we do not reject the information of Mr Strehlow, who is master of several tribal languages, and, of course, does not encourage wicked native rites by providing supplies of flour, tobacco, &c., during the performances, as Mr Howitt and others say that they found it necessary to do. Sceptical colonists have been heard to aver that natives will go on performing rites as long as white men will provide supplies.

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[1] *Native Tribes of Central Australia*, p. 123.

in what the Arunta call "the right" divisions; Arunta, that is, were so arrayed that no totem existed in more than one division. Obliged, as now, to marry out of their own exogamous division (one of four sub-classes among the Arunta) into one of the four sub-classes of the opposite side, no man could then find in it a woman of his own totem to marry. But when Arunta ceased to be hereditary, and came to be acquired, as now, by the local accident of the totem spirits—all, in each case, of one totem name, which haunt the supposed place of a child's conception—some totems inevitably would often get out of their original sub-class into another, and thus the same totems are in several divisions. But granting that a man of division A may legally marry a woman of division B, he is not *now* prevented from doing so because his totem (say Wild Cat) is also hers. His or hers has strayed, by accident of supposed place of conception, out of its "right" into its "wrong" division. The words "right" and "wrong" as here used by the Arunta make it certain that they still perceive the distinction, and that, before the Arunta evolved the spiritual view of conception, they had, like other people, their totems in each case confined to a single main exogamous division of their tribe, and therefore no persons could then marry into their own totems.

But when the theory of spiritual conception arose, and was combined, in the Arunta set of tribes alone (it is common enough elsewhere in northern and western Australia), with the *churinga* doctrine, which gave totems by accident, these two factors, as Messrs Spencer and Gillen say, became the causes—"lie at the root"—of the present Arunta system by which persons may marry others of "the right" division, but of "the wrong" totem. That system is strictly confined to the group of tribes (Ilpirra, Loritja, Unmaterja, Kaitish, Arunta) which constitute "the Arunta nation." Elsewhere the belief in spiritual conception widely prevails, but *not* the belief in the connexion of spirits of individuals with the stone *churinga* of individuals. Consequently the Arunta system of marriage within the totem exists nowhere, and the non-exogamous non-hereditary totem exists nowhere, except in the Arunta region. Everywhere else hereditary totems are exogamous.[1]

Thus the practice of acquiring the totem by local accident is absolutely confined to five tribes where the *churinga* doctrine coexists with it. That the *churinga* belief, coexistent with the spiritual theory of conception, is of relatively recent origin is a demonstrable fact. Had it always been present among the Arunta the inevitable result, in the course of ages, would be the scattering of the totems almost equally, as chance would scatter them among the eight exogamous divisions.

This can be tested by experiment. Take eight men, to represent the eight exogamous divisions, and set them apart in two groups of four. Take four packs of cards, 208 cards, to represent the Arunta totems, which are over 200 in number. Deal the cards round in the usual way to each of the eight men; each will receive 26 cards. It will not be found that group A has "the great majority" of spades and clubs, while group B has "the great majority" of diamonds and hearts, and neither group will have "the great majority" of court cards. Accident does not work in that way. But while accident alone *now* determines the totem to which an Arunta shall belong, nevertheless "in the Arunta, as a general rule, the great majority of the members of any one totemic group belong to one moiety of the tribe; but this is by no means universal . . ."—that is, of the totems the great majority in each case, as a rule, belongs to one or the other set of four exogamous sub-classes.[2]

The inference is obvious. While chance has now placed only the small minority of each totem in all or several of the eight exogamous divisions, the great majority of totems is in *one or another* of the divisions. This great majority cannot come by chance, as Arunta totems *now* come; consequently it is but lately that chance has determined the totem of each individual. Had chance from the first been the determining cause, each totem would not be fairly equally present in each of the two sets of four exogamous divisions. But determination by accident has only existed long enough to affect "as a general rule" a small minority of cases. "The great majority" of totems remain in what is recognized as "the right," the original divisions, as elsewhere universally. Arunta myth sometimes supports, sometimes contradicts, the belief that the totems were originally limited, in each case, to one or other division only, and, being self-contradictory, has no historic value.

A further proof of our point is that the northern neighbours of the Arunta, the Kaitish, have only partially accepted Arunta ideas, religious and social. Unlike the Arunta they have a creative being, Atnatu, from whom half of the population descend; the other half were evolved out of totemic forms.[3] In the same way the Kaitish totems "are more strictly divided between the two moieties" (main exogamous divisions) "of the tribe."[4] Consequently a man *may* marry a woman of his own totem if she be in the right exogamous division. "She is not actually forbidden to him, as a wife becomes of this identity and totem, as she would be in the Warramunga neighbouring tribe . . ." "It is a very rare thing for a man to marry a woman of the same totem as himself,"[5] naturally, for the old rule holds, in sentiment, and a totem is still very rarely in the wrong division. The Arunta system of accidental determination of the totem has as yet scarcely produced among the Kaitish any of its natural and important effects.

This view of the case seems logical: Arunta non-exogamous non-hereditary totemism is the result, as Messrs Spencer and Gillen show, of the theory of spiritual conception and the theory of the relation of the spirit part of each individual to his *churinga*. These two beliefs have already caused a minority of Arunta totems to get out of the original and into the wrong exogamous Arunta divisions. The process is not of old standing; if it were, *all* totems would now be fairly distributed among the divisions by the laws of chance. In the Kaitish tribe, on the other hand, the processes must be of very recent operation, for they have only begun to produce their necessary effects. The totemism of the Arunta is thus the reverse of "primitive," and has but slightly affected the Kaitish.

Precisely the opposite view of the facts is taken by Mr Frazer in his erudite and exhaustive work *Totemism*. In the Kaitish, he writes, "we may detect the first stage in the transition from promiscuous marriage and fortuitous descent of the totem to strict exogamy of the totem clans and strict heredity of the totems in the paternal line."[6] By "promiscuous marriage," marriage within or without the totem, at pleasure, is obviously intended, for the Arunta do not marry "promiscuously"—do not marry their nearest kin.

How, on Mr Frazer's theory, was the transition from the condition of the Arunta to that of the Kaitish made? If the Kaitish were once in the actual Arunta stage of totemism, how did their totems come now to be much more strictly divided between the two moieties, though "the division is not so *absolute* as amongst the Urabunna in the south and the tribes farther north . . ."? How did this occur? The Kaitish have not made totems hereditary by law; they are acquired by local accident. They have not made a rule that all totems should, as among the more northern neighbours of the Arunta, be regimented so that no totem occurs in more than one division: to this rule there are exceptions. A man "is not actually forbidden" to marry a woman of his own totem provided she be of "the right division," but it is clear that he "does not usually do so." This we can explain as the result of a survival in manners of the old absolute universal prohibition.

Meanwhile our view of the facts makes all the phenomena seem natural and intelligible in accordance with the statement of the observers, Messrs Spencer and Gillen, that the cause of the unique non-hereditary non-exogamous totems of the Arunta is the combination of the *churinga* spiritual belief with the belief in spiritual conception. This cause, though now present among the Kaitish, has, so far, operated but faintly. We have been explicit on these points because on them the whole problem of the original form of totemism hinges. In our view, for the reasons stated, the Arunta system of non-exogamous non-hereditary totemism is a peculiarity of comparatively recent institution. But Mr Frazer, and the chief observer of the phenomena, Mr Spencer, consider the Arunta system, non-exogamous and non-hereditary, to be the most archaic form of totemism extant.

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[1] *N.T.C.A.* p. 257; cf. Frazer, *Totemism*, i. 200–201.

[2] *Northern Tribes*, pp. 151 sqq.

[3] *Northern Tribes*, pp. 153, 154, 175.

[4] Ibid. p. 152.

[5] Ibid. p. 175.

[6] *Totemism*, i. 244.

As to non-hereditary, we find another report of the facts in *Die Aranda und Loritja Stämme*, by the Rev. Mr Strehlow, who has a colloquial and philological knowledge of the language of these tribes. As he reports, among other things, that the Aranda (Arunta) in his district *inherit* their mother's totems, in addition to their "local totems," they appear to retain an archaic feature from which their local totem system and marriage rules are a departure.[1]

The hereditary maternal totem is, in Mr Strehlow's region, the protective being (*altjira*) of each Arunta individual.

Are the Arunta "Primitive" or not?—In the whole totemic controversy the question as to whether the non-exogamous non-hereditary totemism of the Arunta or the hereditary and exogamous totemism of the rest of Australia and of totemic mankind, be the earlier, is crucial.

That Arunta totemism is a freak or "sport," it is argued, is made probable first by the fact that the Arunta inherit all things hereditable in the male line, whereas inheritance in the female descent is earlier. (To this question we return; see below, *Male and Female Lines of Descent.*) M. Van Gennep argues that tribes in contact, one set having female, the other male, descent, "like the Arunta have combined the systems."[2] But several northern tribes with male descent of the totem which are *not* in contact with tribes of female descent show much stronger traces of the "combination" than the Arunta, who intermarry freely with a tribe of female descent, the Urabunna; while the Urabunna, though intermarrying with the Arunta who inherit property and tribal office in the male line, show no traces of "combination." Thus the effects occur where the alleged causes are not present; and the alleged causes, in the case of the Urabunna and Arunta, do not produce the effects.

Next the Arunta have no names for their main exogamous divisions, these names being a very archaic feature which in many tribes with sub-classes tend to disappear. In absence of phratry names the Arunta are remote from the primitive. M. Van Gennep replies that perhaps the Arunta have not yet made the names, or have not yet borrowed them. This is also the view of Mr Frazer. As he says, the Southern Arunta lived under the rule of eight classes, but of these four were anonymous, till the names for them were borrowed from the north. The people can thus have anonymous exogamous divisions; the two main divisions, or phratries, of the Arunta may, therefore, from the first, have been anonymous.

To this the reply is that people borrow, if they can, what they need. The Arunta found names for their four hitherto anonymous classes to be convenient, so they borrowed them. But when once class-names did, as they do, all that is necessary, the Arunta had no longer any use for the names of the two primary main divisions: these were forgotten; there is nothing to be got by borrowing that; while four Arunta "sub-classes" are gaining their names, the "classes" (phratries or main divisions) have lost them. It is perfectly logical to hold that while things useful, but hitherto anonymous, are gaining names, other things, now totally useless, are losing their names. One process is as natural as the other. In all Australia tribes with two main divisions and no sub-classes, the names of the two main divisions are found, because the names are useful. In several tribes with named sub-classes, which now do the work previously thrown on the main divisions, the names of the main divisions are unknown: the main divisions being now useless, and superseded by the sub-classes. The absence of names of the two main divisions in the Arunta is merely a result, often found, of the rise of the sub-classes, which, as Mr Frazer declares, are not primitive, but the result of successive later legislative acts of division.[3]

Manifestly on this point the Arunta are at the farthest point from the earliest organization: their loss of phratry names is the consequence of this great advance from the "primitive."

All Arunta society rests on a theory of reincarnated spirits, a theory minutely elaborated. M Van Gennep asks "why should this belief not be primitive?" Surely neither the belief in spirits, nor the elaborate working out of the belief connecting spirits with manufactured stone amulets, can have been primitive. Nobody will say that peculiar stone amulets and the Arunta belief about spirits associated with them are primitive. To this M Van Gennep makes no reply.[4]

The Arunta belief that children are spirit-children (*ratapa*) incarnated is very common in the other central and northern tribes, and, according to Mrs Bates, in Western Australia; Dr Roth reports the same for parts of Queensland. It is alleged by Messrs Spencer and Gillen that the tribes holding this belief deny any connexion between sexual unions and procreation. Mr Strehlow, on the other hand, says that in his region the older Arunta men understand the part of the male in procreation; and that even the children of the Loritja and Arunta understand, in the case of animals.[5] (Here corroboration is desirable and European influence may be asserted.) Dr Roth says that the Tully River blacks of Queensland admit procreation for all other animals, which have no Koi or soul, but not for men, who have souls. (Their theory of human birth, therefore, merely aims primarily at accounting for the spiritual part of man.)[6]

According to Mrs Bates, some tribes in the north of South Australia, tribes with the same "class" names as the Arunta, hold that to have children a man must possess two spirits (*ranee*). If he has but one, he remains childless. If he has two, he can dream of an animal, or other object, which then passes into his wife, and is born as a child, the animal thus becoming the child's totem. This belief does not appear to apply to reproduction in the lower animals. It is a spiritual theory of the begetting of a soul incarnated. If a man has but one spirit, he cannot give one to a child, therefore he is childless.

It is clear that this, and all other systems in which reproduction is explained in spiritual terms, can only arise among peoples whose whole mode of thinking is intensely "animistic." It is also plain that all such myths answer two questions—(1) How does a being of flesh and spirit acquire its spiritual part?—(2) How is it that every human being is in mystical *rapport* with an animal, plant, or other object, the totem? Manifestly the second question could not arise and need answer *before mankind were actually totemists.* It may be added that in the south of Western Australia the name for the mythical "Father of All" (a being not there worshipped, though images of him are made and receive some cult at certain licentious festivals) and the name for "father-stock" is *maman*, which Mrs Bates finds to be the native term for *membrum virile.* All this appears to be proof of understanding of the male part in reproduction, though that understanding is now obscured by speculation about spirits.

The question arises then, is the ignorance of procreation, where that ignorance exists, "primitive," and is the Arunta totemism also "primitive," being conditioned, as we are told it is, by the unique belief in some *churinga*? Or is the ignorance due to attempts of native thinkers to account for the spirit in man as a pre-existing entity that has been from the beginning? The former view is that of Messrs Spencer and Gillen, and Mr Frazer. For the latter see Lang, *Anthropological Essays presented to E. B. Tylor*, pp. 210–218. We can hardly call people primitive because they have struggled with the problem "how has material man an indwelling spirit?"

Theories of the Origin of Totemic Exogamy.—Since the word "exogamy" as a name for the marriage systems connected (as a rule) with totemism was used by J. F. McLennan in his

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[1] Strehlow, ii. 57 (1908).

[2] *Mythes et légendes d'Australie*, p. xxxii.

[3] *Totemism*, i. 282, 283.

[4] Van Gennep, pp. xxxiii–xxxv.

[5] *Loritja Stämme*, p. 52, note 7.

[6] Roth, *Bulletin*, No. 5, pp. 17, 22, 65, 81.

Primitive Marriage (1866), theories of the origin of exogamy have been rife and multifarious. All, without exception, are purely conjectural. One set of disputants hold that man (whatever his original condition may have been) was, when he first passed an Act of Exogamy, a member of a *tribe*. Howitt's term for this tribe was "the undivided commune." It had, according to him, its inspired medicine-man, believed to be in communication with some superior being. It had its probouleutic council of elders or "headmen" and its general assembly. Such was man's political condition.[1] It is not distinguishable from that of many modern Australian tribes. Other tribes, said by some to be the most primitive, the Arunta and their neighbours, pay no attention to the dictates of a superior being, and the Arunta of Spencer and Gillen seem to know no such entity, though as Atnatu, Tukura, Altjira, and "the Great Ulthaana of the heavens," he exists in a dwindled form among the Kaitish, Loritja and outlying portions of the Arunta tribe. In religion Howitt's early men were already in advance of Mr Spencer's Arunta. Socially, man, at this date, according to Howitt, at first left the relations of the sexes wholly unregulated; the nearest kinsfolk by blood coupled at will, though perfectly aware that they were, at least on the maternal side, actual brothers and sisters, parents and children.

Upholders of the first theory, that man lived promiscuously in a tribal state with legislative assemblies and then suddenly reformed promiscuity away, must necessarily differ in their opinion as to the origins of totems and exogamy from the friends of the second theory, who believe that man never was "promiscuous," and given to sexual union with near kin. Why man, on the first theory—familiar as he was with unions of the nearest kin—suddenly abolished them is explained in four or five different ways. Perhaps the most notable view is Mr Frazer's; he easily confutes, in thirty-five pages, the other hypotheses.[2] Man saw, or thought he saw, injurious consequences to the wedded near-related couples, and therefore he prohibited, first, unions between mothers and sons, and brothers and sisters.[3] But, in his fourth volume, Mr Frazer sees conclusive objections to this view and prefers another. Some peoples, far above the estate of savagery, believe that human incest blights and sterilizes the crops, women and animals. "If any such belief were entertained by the founders of exogamy, they would clearly have been perfectly sufficient motives for instituting the system, for they would perfectly explain the horror with which incest has been regarded and the extreme severity with which it has been punished."[4] That is to say, people had a horror and hatred of incest because they supposed that it blighted the crops and other things. Mr Frazer had previously written (iv. 108) "It is important to bear steadily in mind that the dislike of certain marriages must always have existed in the minds of the people, or at least of their leaders, before that dislike, so to say, received legal sanction by being embodied in an exogamous rule."

Again (iv. 112) "There had, for some reason unknown to us, been long growing up a strong aversion to consanguineous unions"—before any legislative bar was raised against them. This is insisted on. The prohibition "must have answered to certain general sentiments of what was right and proper" (iv. 121). But here the theorist has to explain the origin of the strong aversion, the general sentiment that unions of near kin are wrong and improper. But Mr Frazer does not seem to explain the point that most needs explanation. That "strong aversion," that "general sentiment," cannot have arisen from a growing belief that unions of close kin spoiled the crops or the natural resources of the country. That superstition could only arise as a consequence of the horror and aversion with which "incest" was regarded. Now no idea corresponding to "incest" could arise before unions of near kin were deemed abominable. When once such unions were thought hateful to gods and men, and an upsetting of the cosmic balance, then, but not till then, they might be regarded as injurious to the crops. All such beliefs are sanctions of ideas already in strong force. The idea that such or such a thing is wrong begets the prohibition, followed by the sanction—the belief that the practice of the thing is injurious in a supernormal way: where that belief exists. We do not know it in Australia, for example.

A belief that close sexual unions were maleficent cosmic influences could not possibly arise previous to, and could not then cause, "the dislike of certain marriages"; "the strong aversion to consanguineous unions"—which existed already. This latest guess of Mr Frazer at the origin of the idea of "incest"—of the abomination of certain unions—is untenable. What he has to explain is the origin of the dislike, the aversion, the horror. Once that has arisen, as he himself observes, the prohibition follows, and then comes the supernormal sanction. Thus no theory of exogamous rules as the result of legislation to prevent the unions of persons closely akin, can produce, or has produced, any reason for the aversion to such unions arising among people to whom, on the theory, they were familiar. Mr Frazer has confuted the guesses of MacLennan, Morgan, Durkheim and others; but his own idea is untenable.

The Supposed Method of Reform.—On Mr Frazer's theory the reformers first placed half of the mothers of the tribe, with their children, in division A; and the rest of the mothers, with their children, in division B. The members of each division (phratry) must marry out of it into the other, and thus no man could marry his sister or mother. (The father could marry his daughter, but in tribes with no exogamous explicit rule against the union, he never does.) Later the two divisions were bisected each into a couple of pairs (classes) preventing marriage between father and daughter; and another resegmentation prohibited the unions of more distant relations. These systems, from the simplest division into two phratries, to the more complex with two "sub-classes" in each phratry, and the most elaborate of all with four sub-classes in each phratry, exist in various tribes. Environment and climate have nothing to do with the matter. The Urabunna and the Arunta live in the same climate and environment, and intermarry. The Urabunna have the most primitive, the Arunta have the most advanced of these organizations. While the rules are intended to prevent consanguineous marriages, the names of the "sub-classes" (when translatable, the names of animals) cannot perhaps be explained. They have a totemic appearance.

Totems in Relation to Exogamy.—So far, in this theory nothing has been said of totems, though it is an all but universal rule that people of the same totem may not intermarry, even if the lovers belong to tribes separated by the breadth of the continent. In fact, according to the hypothesis which has been set forth, totems, though now exogamous, played no *original* part in the evolution of exogamy. They came in by accident, not by design, and dropped into their place in a system carefully devised.

Originally, on this theory, a totem came to a child, not as is usual now, by inheritance, but by pure accident; the mother supposing that any object which caught her attention at the moment when she first felt the life of her child, or any article of food which she had recently eaten, became incarnate in her, so that the emu (say) which she saw, or had eaten of, was her child. He or she was an Emu man or woman, by totem was an Emu.

Certain localities, later, were somehow associated each with one given object—cat, kangaroo, grub, or anything else, and now "local totems" (if the phrase may be used) took the place of "conceptional totems," as among the Arunta. The child inevitably was of the *local* totem and its supposed place of conception.

Finally all tribes except the Arunta "nation." made the totem hereditary, either from mother or father; and as the mother or father, an Emu, was in division A, so was the child, and he or she must marry out of that division into the other, B.[6]

The objections taken to this theory are now to be stated:

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[1] *N.T.S.E.A.* pp. 89, 90.

[2] *Totemism*, iv. 75–120.

[3] Ibid. i. 165.

[4] Ibid. iv. 155, 156.

[5] Ibid. iv. 158.

[6] Frazer, *Totemism*, i. 157–167.

(i.) The theory can by no possibility apply to tribes with three or more main exogamous divisions or phratries, such as we find in North America. In a three-phratry tribe we are reduced to suppose that there were three sexes, or resort to some other solution not perhaps compatible with the theory. (ii.) We have no evidence that any totemic people, except the Navajoes, think the closest sexual unions injurious to the parties or their offspring. The theory is thus merely extracted from the facts—certain unions are forbidden, therefore they *must* have been deemed injurious. Now, even if they were generally thought injurious, the belief would be a mere inference from the fact that they were forbidden. (iii.) The supposed original legislative exogamous division produced a very different effect than that said to be aimed at, namely, the prohibition of marriage between brothers and sisters. It forbade to every man marriage with half the women of his tribe, most of whom were not, even in the wide native use of the term, his "tribal" sisters, that is, women in a man's phratry of the same status as his own sisters. Such relationships, of course, could not exist before they were created by the supposed Act of Division. It would have been easy to prohibit marriages of brothers with sisters directly, just as, though no exogamous rule forbids, the father, in tribes of female descent, is *directly* forbidden to marry his daughters. The natives can take a simple instead of a bewildering path. To this natural objection Mr Frazer replies:[1] "If we assume, as we have every right to do, that the founders of exogamy in Australia recognized the classificatory system of relationship, and the classificatory system of relationship only, we shall at once perceive that what they intended to prevent was not merely the marriage of a man with his sister, his mother, or his daughter in the physical sense in which we use these terms; their aim was to prevent his marriage with his sister, his mother and his daughter in the classificatory sense of these terms; that is, they intended to place bars to marriage not between individuals merely but between the whole groups of persons who designated their group, not their individual relationships, their social, not their consanguineous ties, by the names of father and mother, brother and sister, son and daughter. And in this intention the founders of exogamy succeeded perfectly." Mr Frazer's theory of the origin of exogamy appears now to waver. It was[2] that the primal bisection of the tribe was "deliberately devised and adopted as a means of preventing the marriage, at first, of brother with sisters. . . ." Here was the place to say, if it was then intended to say, that the Australians "recognized the classificatory system of relationships only." As a matter of fact they recognize both the consanguine and the classificatory systems. It is not the case that "the savage Australian, it may be said with truth, has no idea of relationships as we understand them, and does not discriminate between his actual father and mother and the men and women who belong to the group, each member of which might have lawfully been either his father or his mother, as the case may be."

This statement is made inadvertently and unfortunately by Messrs Spencer and Gillen,[3] but it is contradicted by their own observations. An Arunta can tell you, if asked, which of all the men whom he calls "father" is his very own father.[4] The Dieri have terms for "great" (actual) and "little" (tribal) father, and so for other relationships. In Arunta orgies a woman's "tribal" "fathers" and "brothers" and "sons" are admitted to her embraces; her actual father and brothers and sons are excluded.[5] Thus, if the prohibition be based on aversion to unions of persons closely akin by blood, as the actual father is excluded, the actual father, among the Arunta, is, or has been, amongst that people, regarded as near of blood to his daughters. The Arunta are ignorant, we are told, of the part of the male in procreation. Be it so, but there has been a time when they were not ignorant, and when the father was recognized as of the nearest kin by blood to his daughters. If not, and if the prohibition is based on hatred of unions of close kin, why is the father excluded? Nothing, in short, can be more certain than that Australian tribes distinguish between "social" or "tribal" relations on the one hand, and close consanguine relations on the other. Among the Arunta office is inherited by a man from his mother's husband, his father *quem nuptiae demonstrant*; not from any "tribal" father.[6]

Mr Frazer[7] apparently meant in his earlier statement that brothers and sisters consanguine, and these only, were to be excluded from intermarriage, because he went on to say that science cannot decide as to whether the closest interbreeding is injurious to the offspring of healthy parents, however near in blood; and that very low savages could not discover what is hidden from modern science. He had therefore marriages of consanguine brothers and sisters present to his mind: "the closest interbreeding." Brothers and sisters were finally forbidden, on this theory, to intermarry, not because of any dread of injury to the offspring. "The only alternative open to us seems to be to infer that these unions were forbidden because they were believed to be injurious to the persons engaged in them, even when they were both in perfect health."[8] These "incestuous unions" are between brothers and sisters, mothers and sons. Here brothers and sisters consanguine, children of the same mother in each case, certainly appear to be intended. Who else, indeed, *can* be intended? But presently[9] we are to assume that the Australians, before they made the first exogamous division of the tribe "recognized the classificatory system of relationship, and the classificatory system only." They meant, *now*, to bar marriage between "whole groups of persons," related by "social, not consanguineous ties." But this seems to be physically impossible. These "whole groups" never existed, and never could exist, as far as we can see, till they were called into being by the legislative division of the tribe into two exogamous phratries—which had not yet been made. How could a man call a whole group of women "nupa," as at present (the word being applied to his wife and to all women of the opposite phratry to his whom he might legally marry) before the new law had constituted such a group? In what sense, again, were all women of a certain status called my "sisters" (like my actual sisters) before the new law made a new group of them—in regard to marriage as sacred as my own sisters now were to me? It cannot be said that *all* women of my status were called, collectively, my "sisters" before the new division of the tribe and new rule arose, because previously, all women of my status in the tribe have been my "sisters." Who else could be collectively my "sisters"? If to marry a "sister" were reckoned dangerous to her and to me, I must have been forbidden to marry all the women of my status in the tribe. How could a law which merely halved the number of my "sisters" remove the unknown danger from half of them? If any women except my actual sisters were, before the new rule, reckoned as *socially* my sisters, all women in the tribe of a certain status must have been so reckoned. If all dangerous, I must marry none of them. But by the new rule, I may marry half of them! Why have they ceased to be dangerous?

If the theory be that originally only brothers and sisters consanguine were thought dangerous to each other in sexual relations, and the superstition was later extended so as to include all "classificatory" brothers and sisters, *who* were in these days (before the exogamous division) classificatory brothers and sisters? How and for what reason were some marriageable girls in the tribe classificatory sisters of a young man while others, equally young and marriageable, were not? The classificatory brothers and sisters must have been all the marriageable youth of both sexes in a generation, in the tribe.

But then if all the youth of a generation, of both sexes, were classificatory brothers and sisters, and if therefore their unions were dangerous to themselves, or to the crops, the danger could not be prevented by dividing them into two sets, and allowing each set of brothers to marry each set of sisters. The only way to parry the danger was to force all these brothers and sisters to marry out of the local tribe into another local tribe with the same superstition. When that was done, the two local tribes, exogamous and intermarrying, were constituted into the two phratries of one local tribe. But that is not the theory of observers on the spot: their hypothesis is that a promiscuous and communistic local tribe, for no known or conceivable reason, bisected itself into two exogamous and intermarrying "moieties."

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[1] *Totemism*, i. 288.

[2] Ibid. i. 163.

[3] *Northern Tribes*, pp. 95 seq.; *Totemism*, i. 289.

[4] *Central Tribes*, p. 57.

[5] Ibid. p. 97.

[6] See *Proceedings of British Academy*, iii. 4. Lang, "Origin of Terms of Human Relationships."

[7] *Totemism*, i. 163.

[8] Ibid. i. 165.

[9] Ibid. i. 288.

On the face of it, it is a fatal objection to the theory that when men dwelt in an undivided commune they recognized no system of relationships but the classificatory, yet were well aware of consanguineous relationships; were determined to prohibit the marriages of people in such relationships; and included in the new prohibition people in no way consanguineous, but merely of classificatory kin. The reformers, by the theory, were perfectly able to distinguish consanguineous kinsfolk, so that they might easily have forbidden them to intermarry; while if *all* the members of the tribe were not in the classificatory degrees of relationship, who were? How were persons in classificatory relationships with each other discriminated from other members of the tribe who were not? They were easily discriminated as soon as the phratries were instituted, but, we think, not before.

Term of Classificatory Relationships.—Here it is necessary to say a few words about "classificatory" terms of relationship. Among many peoples the terms or names which with us denote relationships of consanguinity or affinity, such as Father, Mother, Brother, Sister, Son, Daughter, Husband, Wife, are applied both to the individuals actually consanguineous in these degrees, and also to all the other persons in the speaker's own main exogamous division or phratry who are of the same "age-grade" and social status as the Father, Mother, Brother, Sister, Son, Daughter, Husband, Wife, and so forth. As a man thus calls all the women whom he might legally have married by the same term as he calls his wife, and calls all children of persons of his own "age-grade," class and status by the same name as he calls his own children, many theorists hold this to be a proof of the origin of the nomenclature "in a system of group marriage in which groups of men exercised marital rights over groups of women, and the limitation of one wife to one husband was unknown. Such a system would explain very simply why every man gives the name of wife to a whole group of women, and every woman gives the name of husband to a whole group of men," and so on with all such collective terms of relationship.[1]

Certainly this is a very simple explanation. But if we wished to explain why every Frenchman applies the name which he gives to his "wife" (*femme*) to every "woman" in the world, it would be rather simpler than satisfactory to say that this nomenclature arose when the French people lived in absolute sexual promiscuity. The same reasoning applies to English "wife," German *Weib*, meaning "woman," and so on in many languages. Moreover the explanation, though certainly very simple, is not "the only reasonable and probable explanation." Suppose that early man, as in a hypothesis of Darwin's, lived, not in large local tribes with the present polity of such tribes in Australia, but in "cyclopean families," where the sire controlled his female mates and offspring; and suppose that he, from motives of sexual jealousy, and love of a quiet life, forbade amours between his sons and daughters. Suppose such a society to reach the dimensions of a tribe. The rules that applied to brothers and sisters, mothers and sons, would persist, and the original names for persons in such relationships in the family would be extended, in the tribe, to all persons of the same status: new terms being adopted, or old terms extended, to cover new social relationships created by social laws in a wider society.

Another Theory of the Origin of Totemism and Exogamy.—How this would happen may be seen in studying the other hypothesis of exogamy and totemism.[2] Man was at first, as Darwin supposed, a jealous brute who expelled his sons from the neighbourhood of his women; he thus secured the internal peace of his fire circle; there were no domestic love-feuds. The sons therefore of necessity married out—were exogamous. As man became more human, a son was permitted to abide among his kin, but he had to capture a mate from another herd (exogamy).

The groups received sobriquets from each other, as Emu, Frog, and so forth, a fact illustrated copiously in the practice of modern and English and ancient Hebrew villages.[3]

The rule was now that marriage must be outside of the local group-name. Frog may not marry Frog, or Emu, Emu. The usual savage superstition which places all folk in mystic *rapport* with the object from which their *names* are derived gradually gave a degree of sanctity to Emu, Frog and the rest. They became totems.

Perhaps the captured women in group Emu retained and bequeathed to their children their own group-names; the children were Grubs, Ants, Snakes, &c. in Emu group. Let two such groups, Emu and Kangaroo, tired of fighting for women, make peace with *connubium*, then we have two phratries, exogamous and intermarrying, Emu and Kangaroo, with totem kins within them. (Another hypothesis is necessary if the original rule of all was, as among the Urabunna and other tribes, that each totem kin must marry out of itself into only one other totem kin.[4] But we are not sure of the fact of one totem to one totem marriage.) In short, the existence of the two main exogamous divisions in a tribe is the result of an alliance of two groups, already exogamous and intermarrying, not of a deliberate dissection of a promiscuous horde.[5]

The first objection to this system is that it is not held by observers on the spot, such as Mr Howett and Mr Spencer. But while all the observed facts of these observers are accepted (when they do not contradict their own statements, or are not corrected by fresh observations), theorists are not bound to accept the *hypotheses* of the observers. Every possible respect is paid to facts of observation. Hypotheses as to a stage of society which no man living has observed may be accepted as freely from Darwin as from Howitt, Spencer and L. Morgan.

It is next objected that "the only ground for denying that the elaborate marriage-system" (systems?) "of the Australian aborigines has been devised by them for the purpose which it actually serves, appears to be a preconceived idea that these savages are incapable of thinking out and putting in practice a series of checks on marriage so intricate that many civilized persons lack either the patience or the ability to understand them . . . The truth is that all attempts to trace the origin and growth of human institutions without the intervention of human intelligence and will are radically vicious and foredoomed to failure."[6] But nobody is denying that the whole set of Australian systems of marriage is the result of human emotions, intelligence and will. Nobody is denying that, in course of time, the aborigines have thought out and by successive steps have elaborated their systems. The only questions are, what were the human motives and needs which, in the first instance, set human intelligence and will to work in these directions; and how, in the first instance, did they work? The answers given to these questions are purely and inevitably hypothetical, whether given by observers or by cloistered students.

It is objected, as to the origin of totemism, that too much influence is given to accident, too little to design. The answer is that "accident" plays a great part in all evolution, and that,

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[1] *Totemism*, i. 304.

[2] Lang and Atkinson, *Social Origins and Primal Law*: Lang, *Secret of the Totem*.

[3] Lang, *Social Origins* and *Secret of the Totem*.

[4] *Anthropological Essays*, pp. 206–209.

[5] This theory, already suggested by the Rev. J. Mathew, and Mr Daniel McLennan, occurred independently to M. Van Gennep, who, in *Mythes et légendes d'Australie*, suppressed his chapter on it, after reading *The Secret of the Totem*. The conclusions were almost identical with those of that work (*Op. cit.* pp. vi. xxxiv.). The details of the evolution, which are many, may be found in *Social Origins and Primal Law*, and revised in *The Secret of the Totem*.

[6] *Totemism*, i. 280, 281.

In the opposed theory, the existence and actual exogamous function of totems is also accidental, arising from ignorance and a peculiar superstition. It is urged that no men would accept a nickname given from without by hostile groups. This is answered by many examples of cases in which tribes, clans, political parties, and, of course, individuals, have accepted sobriquets from without, and even when these were hostile and derisive.[1] It is asked, Why, on this theory, are there but two exogamous divisions in the tribe? The reply is that in America there may be three or more: that in the Urabunna there are as many exogamous divisions (dual) as there are totems, and that these, like the main exogamous divisions, go in pairs, because marriage is between two contracting parties.[2]

It is maintained in this theory that Australian blacks, who are reflective and by no means illogical men, have long ago observed that certain marriages are rigorously barred by their social system, for no obvious reason. Thus a man learns that he must not marry in his own main exogamous division, say Eagle Hawk. He must choose a wife from the opposite division, Crow. She must belong to a certain set of women in Crow, whose tribal status is precisely that, in Crow, of his own sisters, and his "little sisters" (the women of his sister's status) in Eagle Hawk. The reflective tribesman does not know *why* these rules exist. But he perceives that the marriageable women in his own main division bear the same title as his sisters by blood. He therefore comes to the conclusion that they are all what his own sisters manifestly are, "too near flesh," as the natives say in English; and that the purpose of the rule is to bar marriage to him with all the women who bear the name "sisters" that denotes close consanguinity. Presently he thinks that other kinsfolk, actual, or bearing the same collective title as actual kinsfolk of his, are also "too near flesh," and he goes on to bar *them* till he reaches the eight class model; or like some south-eastern tribes, drops the whole cumbrous scheme in favour of one much like our own.

The reflective savage, in short, acts exactly as the Church did when she extended to cousins the pre-existing Greek and Roman prohibitions against the marriages of very near kin; and, again, extended them still further, to exclude persons not consanguineous at all but called by the same title as real consanguines, "father," "mother" and "child" in "gossipred"—godfather, godmother, godchild.

The savage and ecclesiastical processes are parallel and illustrate each other. Probably when a tribe with two main exogamous and intermarrying divisions came into existence in the way which we have indicated, the names used in *families* for father, mother, daughter, son, husband, wife, brother, sister, were simply extended so as to include, in each case, all persons in the tribe who were now of the same status, socially, with the same rights, restrictions and duties, as had been theirs in the fire-circle before the tribe was made a tribe by the union of two exogamous and previously hostile intermarrying local groups; or two sets of such groups. The process is natural; the wide extension now given to old names of relationships saved the trouble of making new names. Thus we have found a reasonable and probable way of accounting for classificatory terminology without adopting the hypothesis that it arose out of "group-marriage" and asking "But how did group-marriage arise?"

There is no accident here, all is deliberate and reflective design, beginning with the purely selfish and peace-loving design of the jealous sire. Meanwhile the totemic prohibition, "no marriage in the same totem name," has been retained and expanded even beyond the tribe, and "however remote the hunting grounds" of two persons, they may not intermarry if their totem name be the same.

Such are the two chief opposed theories of the origins of exogamy, and of the connexions of exogamy with totemism. The second does not enjoy the benefit of notice and criticism in Mr Frazer's *Totemism.*

Relations of the Social and Religious Aspects of Totemism.—It is a curious fact (if it be accepted as a fact) that the social aspect of totemism—the prohibition to marry a person of the same hereditary totem name—is sometimes strongest where the "religious" prohibition against killing or eating the totem is weakest; while the highest regard is paid to the totem, or to the god which is supposed to inhabit the totem species, where there is no prohibition on marrying within the totem name. Thus in Australia, where (except in the centre, among the Arunta) almost all tribes prohibit marriages within the totem name, it is scarcely possible to find an instance in which irreligious treatment of the totem, killing or eating it, is (as among many other totemic peoples) thought to be automatically or "religiously" punished by illness, death or miscarriage. Religion, in these cases, does not hold that the injured majesty of the totem avenges itself on the malefactor. On the other hand the Samoans, who pay no regard to the sacred animal of each community in the matter of not marrying within his name, believe that he will inflict death if one of his species be eaten—and if no expiatory rite be performed.[3] In Samoa, we saw, the so-called totem is the vehicle of a God; in Australia no such idea is found.

Meanwhile the offence of marrying within the totem name is nowhere automatically punished in any way except among the American Navajos, where, to make certain, the totem kin also inflicts secular penalties;[4] and it is part of the magic of the *Intichiuma* rites for the behoof of the totem that his kin should eat of him sparingly, as on all occasions they may do. In all other quarters, where marriage within the totem kin is forbidden, the penalty of a breach of law has been death or tribal excommunication. The offence is secular. The Euahlayi, who never marry within the totem name, "may and do eat their hereditary totems with no ill effects to themselves."[5] This is very common in South Australia. As a rule, however, in Australia some respect is paid to the actual plant or animal, and some Northern tribes who inherit the paternal totem respect it almost as much as the maternal totem. As they also inherit property in the maternal line, it seems clear that they have passed from female to male descent, as regards the totem, but not as regards inheritance.[6]

Male and Female Descent of the Totem.—It was the almost universal opinion of anthropologists that, in the earliest totemic societies, the totem was inherited from the mother, and that inheritance from the father was a later development. But when the peculiar totemism of the Arunta was discovered, and it was desired to prove that this non-exogamous totemism was the most primitive extant, it was felt to be a difficulty that the Arunta reckon descent of everything hereditable in the male, not the female line. If then, the Arunta were not primitive but advanced, in this matter as well as in their eight sub-classes and ceremonies, how could their totemism be primitive? It would have been easy to reply that a people might be "primitive" in some details though advanced in others—the fact is notorious. But to escape from the dilemma the idea was proposed that neither male nor female descent was more primitive than the other. One tribe might begin with male, one with female descent. Nobody *can* prove that it was not so, but "whereas evidence of the passage from female to male reckoning may be observed, there is virtually none of a change in the opposite direction."[7]

Thus the Worgaia and Northern neighbours of the Arunta, with male descent, have certainly passed through a system of female descent of the totem, and actually inherit property in the female line, while Strehlow's Aranda or Arunta inherit their *mothers'* totems. Moreover Howitt shows us at least one tribe with female descent, the Dieri, actually in the process of diverging from female to male descent of the totem. "A step further is when a man gives his totem name to his son, who then has those of both father and mother. This has been done even in the Dieri tribe," which appears to mean that it is also done in other tribes.[1]

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[1] *The Secret of the Totem*, pp. 128, 134.

[2] For other arguments explaining the duality of the divisions see Van Gennep, *ut supra*, p. xxxiv. and note 1.

[3] Turner, *Samoa*, p. 31, sqq.

[4] Bourke, *Snake Dance of the Moquis*, p. 279.

[5] Mrs Langloh Parker, *The Euahlayi Tribe*, p. 279.

[6] See for Worgaia and Warramunga reverence of the mother's totem, though they inherit the father's, Spencer and Gillen, *Northern Tribes*, p. 166. That these tribes, though reckoning descent in the paternal line, inherit property in the maternal is certain, see pp. 523, 524.

[7] Thomas, *ut supra*, p. 15.

A difficult case in marriage law is explained by saying that "possibly some man, as is sometimes the case, gave his *Murdu* (totem) to his son, who was then of two *Murdus*, and so could not marry a girl of one of his two totems."[2] We thus see how the change from female to male descent of the totem is "directly led to," as Mr Howitt says,[3] by a man's mere fatherly desire to have his son made a member of his own totem kin. On the other hand, we never read that with male descent of the totem a mother gives hers to son or daughter. All these facts make it hard to doubt (though absolute proof is necessarily impossible) that female everywhere preceded male descent of the totem.

Proof of transition from female to male descent of the totem appears to be positive in some tribes of the south of South Australia. Among them each person inherits his mother's totem, and may not marry a woman of the same. But he also inherits his father's totem, which "takes precedence," and gives its name to the local group. No person, as apparently among the Dieri when a father has "given his totem" to a son, may marry into either his father's or his mother's totem kin (Mrs Bates).

Thus we have a consecutive series of evolutions: (*a*) All inherit the maternal totem only, and must not marry within it. This is the rule in tribes of south-east Australia with female descent. (*b*) Some fathers in this society give their totems to sons, who already inherit their maternal totems. Such sons can marry into neither the paternal nor maternal totems. This was a nascent rule among the Dieri. (*c*) All inherit both the paternal and the maternal totem, and may marry into neither (southern South Australia). (*d*) All inherit the religious regard for the maternal totem, but may marry within it, while they may not marry within the paternal totem (Worgaia and Warramunga of north central Australia). (*e*) The paternal totem alone is religiously regarded, and alone is exogamous (tribes of south-east Australia with male descent). (*f*) The totem is neither hereditary on either side nor exogamous (Spencer's Arunta). (*g*) The maternal totem is hereditary and sacred, but not exogamous (Strehlow's Arunta).

In this scheme we give the degrees by which inheritance of the totem from the mother shades into inheritance of the totem from both parents (Dieri), thence to inheritance of both the maternal and paternal totem while the paternal alone regulates marriage (Worgaia and Warramunga), thence to exclusive inheritance of the paternal, without any regard paid to the maternal totem (some tribes of South Australia), and so on..

Meanwhile we hear of no tribe with paternal descent of the totem in which mothers are giving their own totems also to their children. We cannot expect to find more powerful presumptions in favour of the opinion that tribes having originally only maternal have advanced by degrees to only paternal descent of the totem. Mr Frazer says, "So far as I am aware, there is no evidence that any Australian tribe has exchanged maternal for paternal descent, and until such evidence is forthcoming we are justified in assuming that those tribes which now trace descent from the father formerly traced it from the mother."[4]

We have now provided, however, the evidence for various transitional stages from maternal to paternal descent, but have found no traces of the contrary process, nor more than one way of interpreting the facts. It is admitted by Mr Frazer that in several North American tribes the change from female to male descent has to all appearance been made.[5] Among the Delawares the initial process was much akin to that of the Dieri, who, in a tribe of female descent, "gives" his own totem to his sons. "The Delawares had a practice of sometimes naming a child into its father's clan," and a son thus became a member of his father's clan. This "may very well have served to initiate a change of descent from the female to the male line."[6] Howitt says precisely the same thing about the paternal practice of the Dieri. Thus there is no reason for denying that the change from female to male descent can be made by Australian as readily as by American tribes. We have given evidence for every step in the transition. The opposite opinion arose merely in an attempt to save the primitiveness of the Arunta, some of whom actually still make the maternal totem hereditary.

The change to male descent is socially very important. The totem kin of a man, for example, takes up his blood feud. Where the descent is female a "man may probably have some (totemic) kinsmen in the same group, but equally a considerable number of members of other totem kins." But it is clear that the rule of male descent gives far greater security to the members of a local group; for they are surrounded by kinsmen, local totem groups only occurring where male descent of the totem prevails, or is predominant.[7] The change from female to male descent of the totem, or the adoption of male descent from the first (if it ever occurred) is thus a great social advantage.

The Ways out of Totemism.—While Howitt believed (though later he wavered in his opinion) that female had always preceded male descent of the totem, he also observed that with male descent came in abnormal developments. One of these is that the people of a district with male descent are often known by the name of the region, or of some noted object therein (say wild cherries).[8] They may even regard (or white observers suppose that they regard) some object as their "local totem," yet they marry within that so-called totem. But they take to marrying, not out of the hereditary totem kin, which becomes obsolescent, but out of their own region into some other given locality. Thus in the Kurnai tribe there were no inevitable hereditary totems, but *thundung* were given by the fathers to lads "when about ten years old or at initiation."[9] The animal *thundung* (elder brother) was to protect the boy, or girl (the girl's *thundung* was called *banung*). The names of the creatures, in each case, appear to have been given to their human brothers and sisters; the *thundung* name descended to a man's sons. "The names are perpetuated" (under male descent) "from generation to generation in the same locality."[10]

Thus it appears that when a Kurnai wishes to marry he goes to a locality where he finds girls of *banung* names into which he may lawfully wed. So far he seems, in fact, to practise totemic exogamy; that he has to travel to a particular locality is merely an accident. Though the *thundung* and *banung* names are not inherited at birth by the children, they are given by the father when the child is old enough to need them.[11]

On the whole, we seem to see, in tribes where male descent is of old standing, that the exogamous function of the totem becomes obsolete, but a shadow of him, as *thundung*, retains a sort of "religious" aspect and even an unappreciated influence in marriage law.

In Fiji and Samoa, in Melanesia[12] and British New Guinea, many types of contaminated and variegated survivals of totemism may be studied. In the Torres Islands[13] hero-worship blends with totemic survivals. As in parts of South Africa, where a *tribe*, not a kin, has a sacred animal, as in Fiji, he seems to be the one survivor of many totems, the totem of some dominant local totem group, before which the other totems have fled, or but dimly appear, or are vehicles of gods, or, in Africa, of ancestral spirits. (These African tribal sacred animals are called Siboko[1].) Some tribes explain that the Siboko originated in an animal sobrique, as ape, crocodile, given from without.[2] Sibokoism, the presence of a sacred animal in a *local tribe*, can hardly be called totemism, though it is probable that the totem of the leading totem kin, among several such totem kins in a tribe, has become dominant, while the others have become obsolete. On the Gold Coast of Africa as long ago as 1819, Bowdich[3] found twelve "families," as he called them, of which most were called by the name of an animal, plant or other object, more or less sacred to them. They might not marry a person of the same kindred name, and there can be little doubt that totemism, with exogamy, had been the rule. But now the rules are broken down, especially in the peoples of the coast. The survivals and other information may be found in the *Journal of the Anthropological Institute* (1906) xxxvi. 178, 188.

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[1] *N.T.S.E.A.* p. 284.
[2] Ibid. p. 167.
[3] Ibid. p. 284.
[4] *Totemism*, i. 317.
[5] Ibid. iii. 42, 58, 72, 80.

[6] *Totemism*, iii. 42.

[7] Except among the Arunta, where, though totems come by change, local groups are usual. See Spencer and Gillen, *Central Tribes*, p. 9. How this occurs we can only guess. See *Folk Lore*, vol. xx., No. 2, pp. 229–231. Here it is conjectured that adults of the totem congregate for the purpose of convenience in performing *Intichiuma*, or magical services for the propagation of the totem as an article of food. For the nature of these rites, common in the central and northern but unknown to the south-eastern tribes, see *Central Tribes*, pp. 167–212, and *Northern Tribes*, pp. 283–320. The Arunta totem aggregates are magical local societies.

[8] *Central Tribes*, pp. 8, 9.
[9] *N.T.S.E.A.* p. 146.
[10] Ibid. p. 146.
[11] Cf. Howitt, ibid. pp. 270–279.

[12] Rivers, "Totemism in Polynesia and Melanesia," *Journ. Anthrop. Inst.* vol. xxxix.

[13] Haddon, *Cambridge Expedition*, vol. v.

There are fainter traces of totemism in the Awemba between Lake Tanganyika and Lake Bangweolo.[4] A somewhat vague account of Bantu totems in British East Africa, by Mr C. W. Hobley, indicates that among exogamous "clans" a certain animal is forbidden as food to each "clan."[5] The largest collection of facts about African totemism, from fresh and original sources, is to be found in Mr Frazer's book. For totemism in British Columbia the writings of Mr Hill Tout may be consulted.[6] The Thlinkit tribes have the institution in what appears to be its earliest known form, with two exogamous phratries and female descent. Among the Salish tribes "personal" totems are much more prominent. Mr Hill Tout, with Professor F. Boas, considers the hereditary exogamous totem to have its origin in the non-exogamous personal totem, which is acquired in a variety of ways. The Salish are not exogamous, and have considerable property and marked distinctions of rank. It does not, therefore, appear probable that their system of badges or crests and personal totems is more primitive than the totemic rules of the less civilized Thlinkits, who follow the form of the south-east Australian tribes.[7]

Other very curious examples of what we take to be aberrant and decadant totemism in New Guinea are given by Mr Seligmann (*Man*, 1908, No. 89), and by Dr Rivers for Fiji (*Man*, 1908, No. 75). Mr Seligmann (*Man*, 1908, No. 100) added to the information and elucidated his previous statements. The "clans" in British south-east New Guinea usually bear geographical names, but some are named after one of the totems in the "clan." "Every individual in the clan has the same linked totems," of which a bird, in each case, and a fish seem to be predominant and may not be eaten. "The clans are exogamous . . . and descent is in the female line." It appears, then, that a man, having several totems, all the totems in his "clan," must marry a woman of another "clan" who has all the totems of her "clan."

Similar multiplicity of totems, each individual having a number of totems, is described in Western Australia (Mrs Bates). In this case the word "totem" seems to be used rather vaguely and the facts require elucidation and verification. In this part of Australia, as in Fiji[8] "pour la naissance . . . l'apparition du totem-animal avait toujours lieu." In Fiji the mother sees the animal, which does not affect conception, and "is merely an omen for the child already conceived." But in Western Australia, as we have seen, the husband dreams of an animal, which is supposed to follow him home, and to be the next child borne by his wife If it is correctly stated that when the husband has dreamed of no animal, while nevertheless his wife has a baby, the husband spears the man whom he suspects of having dreamed of an animal, the marital jealousy takes an unusual form and human life becomes precarious. But probably the husband has some reason for the direction of his suspicions. He never suspects a woman.

"The Banks' Islanders," says Mr Frazer, "have retained the primitive system of conceptional totemism."[9] On the other hand Dr Rivers, who is here our authority, writes "totemism is absent" from "the northern New Hebrides, the Banks' and the Terres groups."[10] In a place where totemism is absent it does not prima facie seem likely that we shall discover "the primitive system of conceptional totemism." The Banks' Islanders have no totemism at all. But they have a certain superstition applying to certain cases, and that superstition resembles Arunta and Loritja beliefs, in which Mr Frazer finds the germs of totemism. The superstition, however, has not produced any kind of totemism in the Banks' group of isles, at least, no totemism is found. "There are," writes Dr Rivers, "beliefs which would seem to furnish the most natural starting-point for totemism, beliefs which Dr Frazer has been led by the Australian evidence" (by part of the Australian evidence, we must say) "to regard as the origin of the institution." Thus, in Banks' Islands we have the starting-point of the institution, without the institution itself, and in many Australian tribes we have the institution—without the facts which are "the most natural starting-point." As far as they go these circumstances look as if "the most natural" were not the actual starting-point. The facts are these: in the Isle of Mota, Banks' group, "many individuals" are under a tabu not to eat, in each case, a certain animal or fruit, or to touch certain trees, because, in each case, "the person is believed to be the animal or fruit in question."

This tabu does not, as in totemism, apply to every individual; but only to those whose mothers, before the birth of the individuals, "find an animal or fruit in their loin-cloths." This, at least, "is usually" the case. No other cases are given. The women, in each case, are informed that their child "will have the qualities of the animal" (or fruit) "or even, it appeared would be himself or herself the animal" (or fruit). A coco-nut or a crocodile, a flying fox or a brush turkey, could not get inside a loin-cloth; the animal and fruits must be of exiguous dimensions. When the animal (or fruit) disappears "it is believed that it is because the animal has at the time of its disappearance entered into the woman. It seemed quite clear that there was no belief in physical impregnation on the part of the animal nor of the entry of a material object in the form of the animal . . , but, so far as I could gather, an animal found in this way was regarded as more or less supernatural, a spirit animal and not one material, from the beginning."

"There was no ignorance of the physical rôle of the human father, and the father played the same part in conception as in cases unaccompanied by an animal appearance." The part played by the animal or fruit is limited to producing a tabu against the child eating it, in each case, and some community of nature with the animal or fruit. Nothing here is hereditary. The superstition resembles some of those of the Arunta, Loritja and Euahlayi. Among the Euahlayi the superstition has no influence; normal totemism prevails; among the Arunta nation it is considered to be, and Dr Rivers seems to think that it is, likely to have been the origin of totemism. In Mota, however, it either did not produce totemism, or it did; and, where the *germ* has survived in certain cases, the institution has disappeared —while the germinal facts have vanished in the great majority of totemic societies. Dr Rivers does not explain how a brush turkey, a sea snake or a flying fox can get into a woman's loin-cloth, yet these animals, also crabs, are among those tabued in this way. Perhaps they have struck the woman's fancy without getting into her loin-cloth.

It is scarcely correct to say that "the Banks' Islanders have retained the primitive system of conceptional totemism." They only present, in certain instances, features like those which are supposed to be the germs of a system of conceptional totemism. In the case of the Arunta we have demonstrated that hereditary and exogamous totemism of the normal type preceded the actual conceptional method of acquiring, by local accident, "personal totems." If the Banks' Islanders were ever totemists they have ceased to be so, and merely retain, in cases, a superstition analogous to that which, among the Arunta, with the aid of the stone *churinga*, has produced the present unique and abnormal state of affairs totemic.

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[1] Frazer, "Totemism, South Africa," *Man* (1901), No. iii.

[2] See *Secret of the Totem*, pp. 25, 26.

[3] *Mission to Ashanti.*

[4] *Journ. Anthrop. Inst.* (1906), xxxvi. 154.

[5] Ibid. (1903), xxxiii. 346–348.

[6] Ibid. (1903–1904).

[7] See discussion in *Secret of the Totem* for details and references.

[8] Père Schmidt, *Man* (1908), No. 84, quoting Père de Marzan, *Anthropos*, ii. 400–405.

[9] *Man*, iv. 128.

[10] "Totemism in Polynesia and Melanesia," *Journ. Anthrop. Inst.* xxxix. 173, sqq.

For totemism in India, see Dalton, *Descriptive Ethnology of Bengal*; for the north of Asia, Strahlenberg's *Description*, &c. (1738); and in all instances Mr Frazer's book.

Myths of Totem Origins.—The myths of savages about the origin of totemism are of no historical value. Not worshipping ancestral spirits, an Australian will not, like an ancestor-worshipping African, explain his totem as an ancestral spirit. But where, as in the north and centre, he has an elaborate philosophy of spirits, there the primal totems exude spirits which are incarnated in women.

In their myths as to the origin of totemism, savages vary as much as the civilized makers of modern hypotheses. Some claim descent from the totem object; others believe that an original race of animals peopled the world; animals human in character, but bestial, vegetable, astral or what not, in form. These became men, while retaining the *rapport* with their original species; or their spirits are continually reincarnated in women and are born again (Arunta of Messrs Spencer and Gillen); or spirits emanating from the primal forms, or from objects in nature, as trees or rocks, connected with them, enter women and are reincarnated (Arunta of Mr Strehlow and some Australian north-western tribes, studied by Mrs Bates). Other Australians believe that the All-Father, Baiame, gave totems and totemic laws to men.[1] There are many other explanatory myths wherever totemism, or vestiges thereof, is found in Australia, Africa, America and Asia.

All the myths of savages, except mere romantic *Märchen*, and most of the myths of peoples who, like the Greeks, later became civilized, are "aetiological," that is, are fanciful hypotheses made to account for everything, from the universe, the skies, the sun, the moon, the stars, fire, rites and ceremonies, to the habits and markings of animals. It is granted that almost all of these fables are historically valueless, but an exception has been made, by scholars who believe that society was deliberately reformed by an act bisecting a tribe into two exogamous divisions, for savage myths which hit on the same explanation. We might as well accept the savage myths which hit on other explanations, for example the theory that Sibokoism arose from animal sobriquets. Exceptions are also made for Arunta myths in which the primal ancestors are said to feed habitually if not exclusively on their own totems. But as many totems, fruit, flowers, grubs, and so on are only procurable for no longer than the season of the May-fly or the March-brown, these myths are manifestly fabulous.

Again the Arunta primal ancestors are said to have cohabited habitually with women of their own totem, though without prejudice against women of other totems whom they encountered in their wanderings. These myths are determined by the belief in *oknanikilla*, or spots haunted by spirits all of one totem, which, again, determine the totem of every Arunta. The idea being that the fabled primal ancestors male and female in each wandering group of miracle-workers were always all of one totem, it follows that, if not celibate, which these savages never are, they must have cohabited with women of their own totem, and, by the existing Arunta system, there is no reason why they should not have done so. In no other field of research is historical value attributed to savage legends about the inscrutable past that lies behind existing institutions.

We are thus confronted by an institution of great importance socially where it regulates marriages and the blood-feud, or where it is a bond of social union between kinsmen in the totem or members of a society which does magic for the behoof of its totem (central and north-western Australia), and is of some "religious" and mythical importance when, as in Samoa, the sacred animal is regarded as the vehicle of a god. Of the origin of these beliefs, which have practical effects in the evolution of society and religion, much, we saw, is conjectured, but as we know no race in the act of becoming totemic—as in all peoples which we can study totemism is an old institution, and in most is manifestly decaying or being transmuted—we can only form the guesses of which examples have been given. Others may be found in the works of Herbert Spencer and Lord Avebury, and criticisms of all of them may be read in A. Lang's *Social Origins*.

Whether or not survivals of totems are to be found in the animal worship of ancient Egypt, in the animal attendants of Greek gods, in Greek post-Homeric legends of descent from gods in various bestial disguises, and in certain ancient Irish legends, it is impossible to be certain, especially as so many gods are now explained as spirits of vegetation, to which folk-lore assigns carnal forms of birds and beasts.

Other Things called Totems.—As has been said, the name "totem" is applied by scholars to many things in nature which are not hereditary and exogamous totems. The "local totem" (so called) has been mentioned, also "linked totems."

Personal Totems.—This is the phrase for any animal or other object which has been "given" to a person as a protective familiar, whether by a sorcerer[2] or by a father, or by a congress of spaewives at birth, or whether the person selects it for himself, by the monition of a dream or by caprice. The Euahlayi call the personal totem *Yunbeai*, the true totem they style *Dhe* They may eat their real but not their personal totems, which answer to the hares and black cats of our witches.

Three or four other examples of tribes in which "personal totems" are "given" to lads at initiation are recorded by Howitt.[3] The custom appears to be less common in Australia than in America and Africa (except in South Australia, where people may have a number of "personal totems"). In one case the "personal totem" came to a man in a dream, as in North America.[4] Here it may be noted that the simplest and apparently the easiest theory of the origin of totemism is merely to suppose that a man, or with female descent a woman, made his or her personal totem hereditary for ever in his or her descendants. But nobody has explained how it happened that while all had evanescent personal totems those of a few individuals only become stereotyped and hereditary for ever.

Sex-Totems.—The so-called "sex totem" is only reported in Australia. Each sex is supposed by some tribes to have its patron animal, usually a bird, and to injure the creature is to injure the sex. When lovers are backward the women occasionally kill the animal patron of the men, which produces horseplay, and "a sort of jolly fight," like sky-larking and flirtation.[5] The old English "jolly kind of fight," between girls as partisans of ivy, and men as of the holly "sex-totem," is a near analogue. It need not be added that "sex-totems" are exogamous, in the nature of things.

Sub-Totems.—This is the name of what are also styled "multiplex totems," that is, numerous objects claimed for their own by totem kins in various Australian regions. The Emu totem kin, among the Euahlayi tribe, claims as its own twenty-three animals and the north-west wind.[6] The whole universe, including mankind, was apparently divided between the totem kins. Therefore the list of sub-totems might be extended indefinitely.[7] These "sub-totems" are a savage effort at universal classification.

Conclusion.—We have now covered the whole field of controversy as to the causes and origins of totemic institutions. Australia, with North America, provides the examples of those institutions which seem to be "nearest to the beginning," and in Australia the phenomena have been most carefully and elaborately observed among peoples the least sophisticated. In North America most that we know of many great tribes, Iroquois, Hurons, Delawares and others, was collected long ago, and when precision was less esteemed, while the tribes have been much contaminated by our civilization. It has been unavoidably necessary to criticize, at almost every stage, the conclusions and hypotheses of the one monumental collection of facts and theories, Mr Frazer's *Totemism* (1910). Persons who would pursue the subject further may consult the books mentioned in the text, and they will find a copious, perhaps an exhaustive bibliography in the references of Mr Frazer's most erudite volumes, with their minute descriptive account not only of the totemism, but of the environment and general culture of hundreds of human races, in Savagery and in the Lower and Higher Barbarism. (A. L.)

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[1] Mrs Langloh Parker, *The Euahlayi Tribe*.

[2] *The Euahlayi Tribe*, p. 21.

[3] *N.T.S.E.A.* pp. 144-148.

[4] Ibid. p. 154.

[5] Ibid. pp. 148-151.

[6] *The Euahlayi Tribe*, p. 15.

[7] *N.T.S.E.A.* p. 454.

TOTILA (d. 552), king of the Ostrogoths, was chosen king after the death of his uncle Ildibad in 541, his real name being, as is seen from the coinage issued by him, Baduila. The work of his life was the restoration of the Gothic kingdom in Italy and he entered upon the task at the very beginning of his reign, collecting together and inspiring the Goths and winning a victory over the troops of the emperor Justinian, near Faenza. Having gained another victory in 542, this time in the valley of Mugello, he left Tuscany for Naples, captured that city and then received the submission of the provinces of Lucania, Apulia and Calabria. Totila's conquest of Italy was marked not only by celerity but also by mercy, and Gibbon says " none were deceived, either friends or enemies, who depended on his faith or his clemency." Towards the end of 545 the Gothic king took up his station at Tivoli and prepared to starve Rome into surrender, making at the same time elaborate preparations for checking the progress of Belisarius who was advancing to its relief. The Imperial fleet, moving up the Tiber and led by the great general, only just failed to succour the city, which must then, perforce, open its gates to the Goths. It was plundered, although Totila did not carry out his threat to make it a pasture for cattle, and when the Gothic army withdrew into Apulia it was from a scene of desolation. But its walls and other fortifications were soon restored, and Totila again marching against it was defeated by Belisarius, who, however, did not follow up his advantage. Several cities were taken by the Goths, while Belisarius remained inactive and then left Italy, and in 549 Totila advanced a third time against Rome, which he captured through the treachery of some of its defenders. His next exploit was the conquest and plunder of Sicily, after which he subdued Corsica and Sardinia and sent a Gothic fleet against the coasts of Greece. By this time the emperor Justinian was taking energetic measures to check the Goths. The conduct of a new campaign was entrusted to the eunuch Narses; Totila marched against him and was defeated and killed at the battle of Tagina in July 552.

See E. Gibbon, *Decline and Fall*, edited by J. B. Bury (1898), vol. iv; T. Hodgkin, *Italy and her Invaders* (1896), vol. iv. and Kampfner, *Totila, König der Ostgoten* (1889).

TOTNES, GEORGE CAREW, or Carey, Earl of (1555-1629), English politician and writer, son of Dr George Carew, dean of Windsor, a member of a well-known Devonshire family, and Anne, daughter of Sir Nicholas Harvey, was born on the 29th of May 1555,[1] and was educated at Broadgates Hall, Oxford, where he took the degree of M.A. in 1588. He distinguished himself on the field on several occasions and filled important military commands in Ireland. In 1584 he was appointed gentleman-pensioner to Queen Elizabeth, whose favour he gained. In 1586 he was knighted in Ireland. Refusing the embassy to France, Sir George Carew was made master of the ordnance in Ireland in 1588, in 1590 Irish privy councillor; and in 1592 lieutenant-general of the ordnance in England, in which capacity he accompanied Essex in the expedition to Cadiz in 1596 and to the Azores in 1597. In 1598 he attended Sir Robert Cecil, the ambassador, to France. He was appointed treasurer at war to Essex in Ireland in March 1599, and on the latter's sudden departure in September of the same year, leaving the island in disorder, Carew was appointed a lord justice, and in 1600 president of Munster, where his vigorous measures enabled the new lord deputy, Lord Mountjoy, to suppress the rebellion. He returned to England in 1603 and was well received by James I., who appointed him vice-chamberlain to the queen the same year, master of the ordnance in 1608, and privy councillor in 1616; and on the accession of Charles I. he became treasurer to Queen Henrietta Maria in 1626. He sat for Hastings in the parliament of 1604, and on the 4th of June 1605 was created Baron Carew of Clopton, being advanced to the earldom of Totnes on the 5th of February 1626. In 1610 he revisited Ireland to report on the state of the country; and in 1618 pleaded in vain for his friend Sir Walter Raleigh. He died on the 27th of March 1629, leaving no issue. He married Joyce, daughter of William Clopton, of Clopton in Warwickshire.

Besides his fame as president of Munster, where his administration forms an important chapter in Irish history, Carew had a considerable reputation as an antiquary. He was the friend of Camden, of Cotton and of Bodley. He made large collections of materials relating to Irish history and pedigrees, which he left to his secretary, Sir Thomas Stafford, reputed on scanty evidence to be his natural son; while some portion has disappeared, 39 volumes after coming into Laud's possession are now at Lambeth, and 4 volumes in the Bodleian Library. A calendar of the former is included in the State Papers series edited by J. S. Brewer and W. Bullen. His correspondence from Munster with Sir Robert Cecil was edited in 1864 by Sir John Maclean, for the Camden Society, and his letters to Sir Thomas Roe (1615-1617) in 1860. Other letters or papers are in the Record Office; among the MSS. at the British Museum and calendared in the *Hist. MSS. Com. Series, Marquess of Salisbury's MSS.* Stafford published after Carew's death *Pacata Hibernia, or the History of the Late Wars in Ireland* (1633), the authorship of which he ascribes in his preface to Carew, but which has been attributed to Stafford himself. This was reprinted in 1810 and re-edited in 1896. *A Fragment of the History of Ireland*, a translation from a French version of an Irish original, and *King Richard II.... in Ireland* from the French, both by Carew, are printed in Walter Harris's *Hibernica* (1757). According to Wood, Carew contributed to the history of the reign of Henry V. in Speed's *Chronicle.* His opinion on the alarm of the Spanish invasion in 1596 has also been printed.

See also the *Life of Sir P. Carew*, ed. by Sir J. Maclean (1857).

TOTNES, a market town and municipal borough in the Totnes parliamentary division of Devonshire, England, on the Dart, 29 m. S.S.W. of Exeter, by the Great Western railway. Pop. (1901), 4035. It stands on the west bank of the river, and is joined by a bridge to the suburb of Bridgetown. It was formerly a walled town, and two of the four gates remain. Many old houses are also preserved, and in High Street their overhanging upper stories, supported on pillars, form a covered way for foot-passengers. The castle, founded by the Breton Juhel, lord of the manor after the Conquest, was already dismantled under Henry VIII.; but its ivy-clad keep and upper walls remain. The grounds form a public garden. Close by are the remains of St Mary's Priory, which comprise a large Perpendicular gatehouse, refectory, precinct wall, abbot's gate and still-house. A grammar school, founded 1554, occupied part of the Priory, but was removed in 1874 to new buildings. The Perpendicular church of St Mary contains a number of interesting tombs and effigies dating from the 15th century onwards, and much excellent carved work. The guildhall is formed from part of the Priory. Vessels of 200 tons can lie at the wharves near the bridge. The industries include brewing, flour milling, and the export of agricultural produce, chiefly corn and cider. Trout and salmon are plentiful in the river. The town is governed by a mayor, 4 aldermen and 12 councillors. Area 1423 acres.

Totnes (*Totencis, Totton*) was a place of considerable importance in Saxon times; it possessed a mint in the reign of Æthelred, and was governed by a portreeve. In the Domesday Survey it appears as a mesne borough under Juhel of Totnes, founder of the castle and priory; it had 95 burgesses within and 15 without the borough, and rendered military service according to the custom of Exeter. In 1215 a charter from John instituted a gild merchant with freedom from toll throughout the land. A mayor is mentioned in the court roll of 1386–1387, and a charter from Henry VII. in 1505 ordered that the mayor should be elected on St Matthew's day, and should be clerk of the market. The present governing charter was granted by Elizabeth in 1596, and instituted a governing body of a mayor, fourteen masters or councillors, and an indefinite number of burgesses, including a select body called "the Twenty-men." A fresh charter of incorporation from James II. in 1689 made no alterations of importance. The borough was represented in parliament by one member in 1295, and by two members from 1298 until disfranchised by the act of 1867. A market on Saturday existed at least as early as 1255, and in 1608 is described as well stocked with provisions. The charter of Elizabeth granted a three days' fair at the feast of SS Simon and Jude (Oct. 28), and in 1608 fairs were also held on May day and at the feast of St James (July 25). The market day has been transferred to Friday, but the May and October fairs are continued. The town was formerly noted for serges, and in 1641 the inhabitants represented their distress owing to the decline of the woollen trade. The industry is now extinct. During the Civil War General Goring quartered his troops at Totnes, and Fairfax also made it his temporary station.

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[1] According to his own statement, *Archaeologia*, xii. 401. In the introduction, however, to the Calendar of Carew MSS. the date of his birth is given as 1558, and his admission into Broadgates Hall in 1572, aged 15. In the preface to Carew's Letters to Roe it is given as 1557.

See *Victoria County History; Devonshire*; *The History of Totnes, its neighbourhood and Berry Pomeroy Castle* (Totnes, 1825); William Cotton, *A Graphic and Historical Sketch of the Antiquities of Totnes* (London, 1858).

TOTONICAPAM, or TOTONICAPAN, the capital of the department of Totonicapam, Guatemala, on the same high plateau as Quezaltenango, the nearest railway station, from which it is 12 m. E.N.E. Pop. (1905) about 28,000. Totonicapam is inhabited mainly by Quiché Indians, employed in the making of cloth, furniture, pottery and wooden musical instruments. There are hot mineral springs in the neighbourhood. In 1838 Totonicapam was declared an independent republic, in which the adjoining departments of Sololá and Quezaltenango were included. This state existed for two years, and was then again merged in the republic of Guatemala. Totonicapam suffered greatly in the earthquake of the 18th of April 1902.

TOTTENHAM, an urban district in the Tottenham parliamentary division of Middlesex, England, forming a north suburb of London, 6½ m. north of London Bridge, adjoining Edmonton on the south. Pop. (1901), 102,541. Its full name, not now in use, was Tottenham High Cross, from the cross near the centre of the township. The origin and significance of this cross are doubtful. The present structure was erected *c.* 1600, and ornamented with stucco in 1809. In the time of Isaak Walton there stood by it a shady arbour to which the angler was wont to resort. Formerly Tottenham was noted for its "greens," in the centre of one of which stood the famous old elm trees called the "Seven Sisters"; these were removed in 1840, but the name is preserved in the Seven Sisters Road. Bruce castle, on the site of the old mansion of the Bruces, but built probably by Sir William Compton in the beginning of the 16th century, was occupied by a boarding-school founded by Mr (afterwards Sir) Rowland Hill in 1827 on the system instituted by him at Hazlewood, Birmingham. It became public property in 1892. The church of All Hallows, Tottenham, was given by David, king of Scotland (*c.*1126), to the canons of the church of Holy Trinity, London. It retains Perpendicular portions, a south porch of brick of the 16th century and numerous ancient monuments and brasses. The grammar school was enlarged and endowed in 1686 by Sarah, dowager duchess of Somerset. The urban district formerly included Wood Green to the west, but this became a separate urban district in 1888 (pop. 34,233).

In the reign of Edward the Confessor the manor of Tottenham was possessed by Earl Waltheof. It was inherited by his daughter Maud, who was married first to Simon de St Liz and afterwards to David, son of Malcolm III., king of Scotland, who was created by Henry I. earl of Huntingdon, and received possession of all the lands formerly held by Earl Waltheof. The manor thus descended to William the Lion, king of Scotland, and was granted by him in 1184 to his brother David, earl of Angus and Galloway, the grant being confirmed in 1199 by King John of England, who created him earl of Huntingdon. He married Maud, heiress of Hugh, earl of Chester, and his son John inherited both earldoms. The son married Helen, daughter of Llewelyn, prince of Wales, by whom he was poisoned in 1237, dying without issue. She retained possession till 1254, when the manor was divided between his coheirs Robert de Brus, John de Baliol and Henry de Hastings, each division forming a distinct manor bearing the name of its owner. In 1429 they were reunited in the possession of John Gedeney, alderman of London.

William Bedwell, the Arabic scholar, was vicar of Tottenham, and published in 1632 a *Briefe Description of the Towne of Tottenham*, in which he printed for the first time the burlesque poem, the *Turnament of Tottenham*.

TOTTENVILLE, a former village of Richmond county, New York, U.S.A., and since 1898 a part of New York City. It is on the southern shore of Staten Island in New York Bay and on Staten Island Sound, about 20 m. S.W. of the south extremity of Manhattan Island, and is the terminus of the Staten Island Rapid Transit railway. Marine engines, terra-cotta and boats are manufactured here, and there are oyster fisheries. The "Billopp House" here (still standing) was the scene of the conference, on the 11th of September 1776, between Lord Howe, representing Lord North, and Benjamin Franklin, John Adams and Edward Rutledge, representing the Continental Congress, with regard to Lord North's offer of conciliation. This house, originally called the "Manor of Bentley," was built by Captain Christopher Billopp (1638–1726), who sailed from England in an armed vessel, the "Bentley," in 1667, and, by circumnavigating Staten Island in 24 hours, made it, under the ruling of the duke of York, a part of New York. From the duke of York he received 1163 acres of land, including the present site of Tottenville. The village was long known as Bentley, but in 1869 was incorporated (under a faulty charter, revised in 1894) as Tottenville, apparently in honour of Gilbert Totten, a soldier in the War of Independence.

TOUCAN, the Brazilian name of a bird,[1] long since adopted into nearly all European languages, and apparently first given currency in England (though not then used as an English word) in 1668[2] by W. Charleton (*Onomasticon*, p. 115), but the bird, with its enormous beak and feather-like tongue, was described by Oviedo in his *Sumario de la historia natural de las Indias*, first published at Toledo in 1527 (ch. 42),[3] and, to quote the translation of part of the passage in F. Willughby's *Ornithology* (p. 129), "there is no bird secures her young ones better from the *Monkeys*, which are very noisom to the young of most Birds. For when she perceives the approach of those Enemies, she so settles her self in her Nest as to put her Bill out at the hole, and gives the *Monkeys* such a welcome therewith, that they presently pack away, and glad they scape so." Indeed, so remarkable a bird must have attracted the notice of the earliest European invaders of America, the more so since its gaudy plumage was used by the natives in the decoration of their persons and weapons. In 1555 P. Belon (*Hist. nat. oyseaux*, p. 184) gave a characteristic figure of its beak, and in 1558 Thevet (*Singularitez de la France antarctique*, pp. 88–90) a long description, together with a woodcut (in some respects inaccurate, but quite unmistakable) of the whole bird, under the name of "Toucan," which he was the first to publish. In 1560 C. Gesner (*Icones avium*, p. 130) gave a far better figure (though still incorrect) from a drawing received from Ferrerius, and suggested that from the size of its beak the bird should be called *Burhynchus* or *Ramphestes*. This figure, with a copy of Thevet's and a detailed description, was repeated in the posthumous edition (1585) of his larger work (pp. 800, 801). By 1579 Ambroise Paré (*Œuvres*, ed. Malgaigne, iii. 783) had dissected a toucan that belonged to Charles IX. of France, and about the same time Léry (*Voyage fait en la terre du Brésil*, ch. xi.), whose chief object seems to have been to confute Thevet, confirmed that writer's account of this bird in most respects. In 1599 Aldrovandus (*Ornithologia*, i. 801–803), always ready to profit by Gesner's information, and generally without acknowledgment, again described and repeated the former figures of the bird; but he corrupted his predecessor's *Ramphestes* into *Ramphastos*, and in this incorrect form the name, which should certainly be *Rhamphestes* or *Rhamphastas*, was subsequently adopted by Linnaeus and has since been recognized by systematists. Into the rest of the early history of the toucan's discovery it is needless to go.[1] Additional particulars were supplied by many succeeding writers, until in 1834 J. Gould completed his *Monograph* of the family[2] (with an anatomical appendix by R. Owen), to which, in 1835, he added some supplementary plates; and in 1854 he finished a second and much improved edition. The most complete compendium on toucans is J. Cassin's "Study of the Ramphastidae," in the *Proceedings* of the Philadelphia Academy for 1867 (pp. 100–124).

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[1] Commonly believed to be so called from its cry; but Skeat (*Proc. Philolog. Society*, May 15, 1885) adduces evidence to prove that the Guarani *Tuca* is from *ti*, nose, and *cáng*, bone, *i.e.* nose of bone.

[2] In 1656 the beak of an "Aracari of Brazil," which was a toucan of some sort, was contained in the *Musaeum tradescantianum* (p. 2), but the word toucan does not appear there.

[3] The writer has only been able to consult the reprint of this rare work contained in the *Biblioteca de autores españoles* (xxii. 473-515), published at Madrid in 1852.

By recent systematists 5 genera and from 50 to 60 species of the family are recognized; but the characters of the former have never been satisfactorily defined, much less those of numerous subdivisions which it has pleased some writers to invent. There can be little doubt that the bird first figured and described by the earliest authors above named is the *R. toco* of nearly all ornithologists, and as such is properly regarded as the type of the genus and therefore of the family. It is one of the largest, measuring 2 ft. in length, and has a wide range throughout Guiana and a great part of Brazil. The huge beak, looking like the great claw of a lobster, more than 8 in. long and 3 high at the base, is of a deep orange colour, with a large black oval spot near the tip. The eye, with its double iris of green and yellow, has a broad blue orbit, and is surrounded by a bare space of deep orange skin. The plumage generally is black, but the throat is white, tinged with yellow and commonly edged beneath with red; the upper tail-coverts are white, and the lower scarlet. In other species of the genus, 14 to 17 in number, the bill is mostly particoloured—green, yellow, red, chestnut, blue and black variously combining so as often to form a ready diagnosis; but some of these tints are very fleeting and often leave little or no trace after death. Alternations of the brighter colours are also displayed in the feathers of the throat, breast and tail-coverts, so as to be in like manner characteristic of the species, and in several the bare space round the eye is yellow, green, blue or lilac. The sexes are alike in coloration, the males being largest. The tail is nearly square or moderately rounded. In the genus *Pteroglossus*, the "Aracaris" (pronounced Arassari), the sexes more or less differ in appearance, and the tail is graduated. The species are smaller in size, and nearly all are banded on the belly, which is generally yellow, with black and scarlet, while except in two the throat of the males at least is black. One of the most remarkable and beautiful is *P. beauharnaisi*, by some authors placed in a distinct genus and called *Beauharnaisius ulocomus*. In this the feathers of the top of the head are very singular, looking like glossy curled shavings of black horn or whalebone, the effect being due to the dilatation of the shaft and its coalescence with the consolidated barbs. Some of the feathers of the straw-coloured throat and cheeks partake of the same structure, but in a less degree, while the subterminal part of the *lamina* is of a lustrous pearly-white.[3] The beak is richly coloured, being green and crimson above and lemon below. The upper plumage generally is dark green, but the mantle and rump are crimson, as are a broad abdominal belt, the flanks and many crescentic markings on the otherwise yellow lower parts.[4] The group or genus *Selenodera*, proposed by J. Gould in 1837 (*Icones avium*, pt. 1), contains some 6 or 7 species, having the beak, which is mostly transversely striped, and tail shorter than in *Pteroglossus*. Here the sexes also differ in coloration, the males having the head and breast black, and the females the same parts chestnut; but all have a yellow nuchal crescent (whence the name of the group). The so-called hill-toucans have been separated as another genus, *Andigena*, and consist of some 5 or 6 species chiefly frequenting the slopes of the Andes and reaching an elevation of 10,000 ft., though one, often placed among them, but perhaps belonging rather to *Pteroglossus*, the *A. bailloni*, remarkable for its yellow-orange head, neck and lower parts, inhabits the lowlands of southern Brazil. Another very singular form is *A. laminirostris*, which has affixed on either side of the maxilla, near the base, a quadrangular ivory-like plate, forming a feature unique in this or almost in any family of birds. The group *Aulacorhamphus*, or "groove-bills," with a considerable but rather uncertain number of species, contains the rest of the toucans.

The monstrous serrated bill that so many toucans possess was by G. L. L. Buffon accounted a grave defect of nature, and it must be confessed that no one has given what seems to be a satisfactory explanation of its precise use, though on evolutionary principles none will now doubt its fitness to the bird's requirements. Solid as it looks, its weight is inconsiderable, and the perfect hinge by which the maxilla is articulated adds to its efficiency as an instrument of prehension. W. Swainson (*Classif. Birds*, ii. 138) imagined it merely "to contain an infinity of nerves, disposed like net-work, all of which lead immediately to the nostrils," and add to the olfactory faculty. This notion seems to be borrowed from J. W. H. Trail (*Trans. Linn. Society*, xi. 289), who admittedly had it from Waterton, and stated that it was "an admirable contrivance of nature to increase the delicacy of the organ of smell;" but R. Owen's description showed this view to be groundless, and he attributed the extraordinary development of the toucan's beak to the need of compensating, by the additional power of mastication thus given, for the absence of any of the grinding structures that are so characteristic of the intestinal tract of vegetable-eating birds—its digestive organs possessing a general simplicity of formation. The nostrils are placed so as to be in most forms invisible until sought, being obscured by the frontal feathers or the backward prolongation of the horny sheath of the beak. The wings are somewhat feeble, and the legs have the toes placed in pairs, two before and two behind. The tail is capable of free vertical motion, and controlled by strong muscles, so that, at least in the true toucans, when the bird is preparing to sleep it is reverted and lies almost flat on the back, on which also the huge bill reposes, pointing in the opposite direction.

The toucans are limited to the new world, and by far the greater number inhabit the north of South America, especially Guiana and the valley of the Amazons. Some three species occur in Mexico, and several in Central America. One, *R. vitellinus*, which has its headquarters on the mainland, is said to be common in Trinidad, but none are found in the Antilles proper. They compose the family Rhamphastidae of Coraciiform birds, and are associated with the woodpeckers (Picidae) and puff-birds and jacamars (Galbulidae); their nearest allies perhaps exist among the Capitonidae, but none of these is believed to have the long feather-like tongue which is so characteristic of the toucans, and is, so far as known, possessed besides only by the Momotidae (see MOTMOT). But of these last there is no reason to deem the toucans close relatives, and according to W. Swainson, who had opportunities of observing both, the alleged resemblance in their habits has no existence. Toucans in confinement feed mainly on fruit, but little seems amiss to them, and they swallow grubs, reptiles and small birds with avidity. They nest in hollow trees, and lay white eggs. (A. N.)

TOUCH (derived through Fr. *toucher* from a common Teutonic and Indo-Germanic root, cf. "tug," "tuck," O. H. Ger. *zucchen*, to twitch or draw), in physiology, a sense of pressure, referred usually to the surface of the body. It is often understood as a sensation of contact as distinguished from pressure, but it is evident that, however gentle be the contact, a certain amount of pressure always exists between the sensitive surface and the body touched. Mere contact in such circumstances is gentle pressure; a greater amount of force causes a feeling of resistance or of pressure referred to the skin; a still greater amount causes a feeling of muscular resistance, as when a weight is supported on the palm of the hand; whilst, finally, the pressure may be so great as to cause a feeling of pain. The force may not be exerted vertically on the sensory surface, but in the opposite direction, as when a hair on a sensory surface is pulled or twisted. Touch is therefore the sense by which mechanical force is appreciated, and it presents a strong resemblance to hearing, in which the sensation is excited by intermittent pressures on the auditory organ. In addition to feelings of contact or pressure referred to the sensory surface, contact may give rise to a sensation of temperature, according as the thing touched feels hot or cold. These sensations of contact, pressure or temperature are usually referred to the skin or integument covering the body, but they are experienced to a greater or less extent when any serous or mucous surface is touched. The skin being the chief sensory surface of touch, it is there that the sense is most highly developed both as to delicacy in detecting minute pressures and as to the character of the surface touched. Tactile impressions, properly so called, are absent from internal mucous surfaces, as has been proved in men having gastric, intestinal and urinary fistulae. In these cases, touching the mucous surface caused pain, and not a true sensation of touch.

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[1] One point of some interest may, however, be noticed. In 1705 Plot (*N.H. Oxfordshire*, p. 182) recorded a toucan found within two miles of Oxford in 1644, the body of which was given to the repository in the medical school of that university, where, he said, "it is still to be seen." Already in 1700 Leigh in his *Lancashire* (i. 195, Birds, tab. 1, fig. 2) had figured another which had been found dead on the coast of that county about two years before. The bird is easily kept in captivity, and no doubt from early times many were brought alive to Europe. Besides the one dissected by Paré, as above mentioned, Joh. Faber, in his additions to Hernandez's work on the Natural History of Mexico (1651), figures (p. 697) one seen and described by Puteus (Dal Pozzo) at Fontainebleau.

[2] Of this the brothers Sturm in 1841 published at Nuremberg a German version.

[3] This curious peculiarity naturally attracted the notice of the first discoverer of the species, Poeppig, who briefly described it in a letter published in Froriep's *Notizen* (xxxii. 146) for December 1831.

[4] Readers of F. Bates's *Naturalist on the River Amazons* will recollect the account (ii. 344) and illustration there given of his encounter with a flock of this species of toucan. His remarks on the other species with which he met are also excellent.

In the article Nerve (*Spinal*) the cutaneous distribution of the organs of touch is dealt with.

The Amphibia and Reptilia do not show any special organs of touch. The lips of tadpoles have tactile papillae. Some snakes have a pair of tentacles on the snout, but the tongue is probably the chief organ of touch in most serpents and lizards. All reptiles possessing climbing powers have the sense of touch highly developed in the feet.

Birds have epithelial papillae on the soles of the toes that are no doubt tactile. These are of great length in the capercailzie (*Tetrax urogallus*), "enabling it to grasp with more security the frosted branches of the Norwegian pine trees" (Owen). Around the root of the bill in many birds there are special tactile organs, assisting the bird to use it as a kind of sensitive probe for the detection in soft ground of the worms, grubs and slugs that constitute its food. Special bodies of this kind have been detected in the beak and tongue of the duck and goose, called the tactile corpuscles of F. S. Merkel, or the corpuscles of Grandry (fig. 1). Similar bodies have been found in the epidermis of man and mammals, in the outer root-sheath of tactile hairs or feelers. They consist of small bodies composed of a capsule enclosing two or more flattened nucleated cells, piled in a row. Each corpuscle is separated from the others by a transparent protoplasmic disk. Nerve fibres terminate either in the cells (Merkel) or in the protoplasmic intercellular matter (Ranvier, Hesse, Izquierdo). Another form of end-organ has been described by Herbst as existing in the mucous membrane of the duck's tongue. These corpuscles of Herbst are like small Pacinian corpuscles with thin and very close lamellae. Developments of integument devoid of feathers, such as the "wattles" of the cock, the "caruncles" of the vulture and turkey, are not tactile in their function.

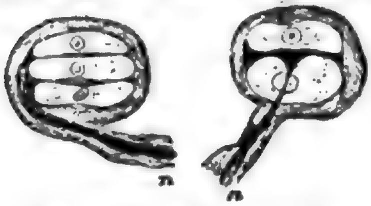


Fig. 1.—Tactile Corpuscles from duck's tongue.
n, Nerve.

In the great majority of Mammalia the general surface of the skin shows sensitiveness, and this is developed to a high degree on certain parts, such as the lips, the end of a teat and the generative organs. Where touch is highly developed, the skin, more especially the epidermis, is thin and devoid of hair. In the monkeys tactile papillae are found in the skin of the fingers and palms, and in the skin of the prehensile tails of various species (*Ateles*). Such papillae also abound in the naked skin of the nose or snout, as in the shrew, mole, pig, tapir and elephant. In the *Ornithorhynchus* the skin covering the mandibles is tactile (Owen). In many animals certain hairs acquire great size, length and stiffness. These constitute the vibrissae or whiskers. Each large hair grows from a firm capsule sunk deep in the true skin, and the hair bulb is supplied with sensory nerve filaments. In the walrus the capsule is cartilaginous in texture. The marine Carnivora have strong vibrissae which "act as a staff, in a way analogous to that held and applied by the hand of a blind man" (Owen). Each species has hairs of this kind developed on the eyebrows, lips or cheeks, to suit a particular mode of existence, as, for example, the long fine whiskers of the night-prowling felines, and in the aye-aye, a monkey having nocturnal habits. In the Ungulata the hoofs need no delicacy of touch as regards the discrimination of minute points. Such animals, however, have broad, massive sensations of touch, enabling them to appreciate the firmness of the soil on which they tread, and under the hoof we find highly vascular and sensitive lamellae or papillae, contributing no doubt, not only to the growth of the hoof, but also to its sensitiveness. The Cetacea have numerous sensory papillae in the skin. Bats have the sense of touch strongly developed in the wings and external ears, and in some species in the flaps of skin found near the nose. There is little doubt that many special forms of tactile organs will be found in animals using the nose or feet for burrowing. A peculiar end-organ has been found in the nose of the mole, while there are "end-capsules" in the tongue of the elephant and "nerve rings" in the ears of the mouse.

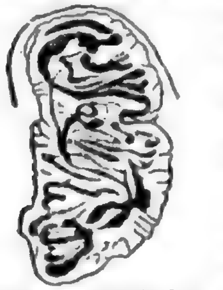


Fig. 2.—Tactile Corpuscle from the hand.

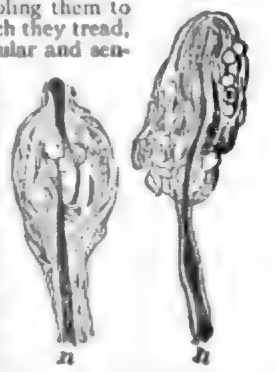


Fig. 3.—Tactile Corpuscles from clitoris of rabbit.
n, Nerve.

End-Organs of Touch in Man.—In man three special forms of tactile end-organs have been described, and can be readily demonstrated.

1. *The End-Bulbs of Krause.*—These are oval or rounded bodies, from $\frac{1}{360}$ to $\frac{1}{150}$ of an inch long. Each consists of a delicate capsule, composed of nucleated connective tissue enclosing numerous minute cells. On tracing the nerve fibre, it is found that the nerve sheath is continuous with the capsule, whilst the axis cylinder of the nerve divides into branches which lose themselves among the cells. W. Waldeyer and Longworth state that the nerve fibrils terminate in the cells, thus making these bodies similar to the cells described by F. S. Merkel (*ut supra*). (See fig. 4.) These bodies are found in the deeper layers of the conjunctiva, margins of the lips, nasal mucous membrane, epiglottis, fungiform and circumvallate papillae of the tongue, glans penis and clitoris, mucous membrane of the rectum of man, and they have also been found on the under surface of the "toes of the guinea-pig, ear and body of the mouse, and in the wing of the bat" (Landois and Stirling). In the genital organs aggregations of end-bulbs occur, known as the "genital corpuscles of Krause" (fig. 3). In the synovial membrane of the joints of the fingers there are larger end-bulbs, each connected with three four nerve-filaments.

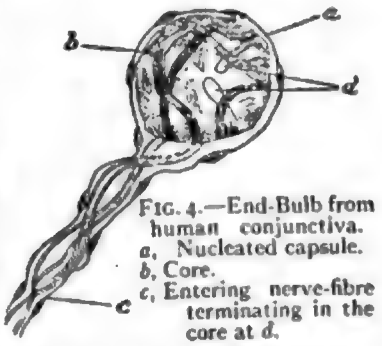


Fig. 4.—End-Bulb from human conjunctiva.
a, Nucleated capsule.
b, Core.
c, Entering nerve-fibre terminating in the core at *d*.

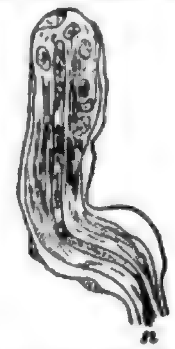
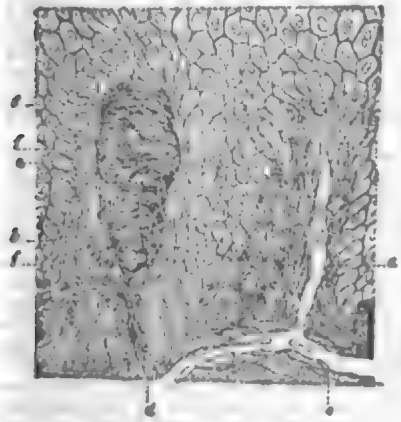


Fig. 5.—End-Bulb from conjunctiva of calf.
n, Nerve.

(2) *The Touch Corpuscles of Wagner and Meissner.*—These are oval bodies, about $\frac{1}{300}$ of an inch long by $\frac{1}{500}$ of an inch in breadth. Each consists of a series of layers of connective tissue arranged transversely, and containing in the centre granular matter with nuclei (figs. 2, 3 and 6). One, two or three nerve fibres pass to the lower end of the corpuscle, wind transversely around it, lose the white substance of Schwann, penetrate into the corpuscle, where the axis cylinders, dividing, end in some way unknown. The corpuscles do not contain any soft core, but are apparently built up of irregular septae of connective tissue, in the meshes of which the nerve fibrils end in expansions similar to Merkel's cells. Thin describes simple and compound corpuscles according to the number of nerve fibres entering them. These bodies are found abundantly

in the palm of the hand and sole of the foot, where there may be as many as 21 to every square millimetre (1 mm. = 1/25 inch). They are not so numerous on the back of the hand or foot, mamma, lips and tip of the tongue, and they are rare in the genital organs.

3. *The Corpuscles of Vater or Pacini.*—These, first described by Vater so long ago as 1741, are small oval bodies, quite visible to the naked eye, from 1/16 to 1/10 of an inch long and 1/25 to 1/16 of an inch in breadth, attached to the nerves of the hands and feet. They can be readily demonstrated in the mesentery of the cat (fig. 7). Each corpuscle consists of 40 to 50 lamellae or coats, like the folds of an onion, thinner and closer together on approaching the centre. Each lamella is formed of an elastic material mixed with delicate connective-tissue fibres, and the inner surface of each is lined by a single continuous layer of endothelial cells. A double-contoured nerve fibre passes to each. The white substance of Schwann becomes continuous with the lamellae, whilst the axis cylinder passes into the body, and ends in a small knob or in a plexus. Sometimes a blood-vessel also penetrates the Pacinian body, entering along with the nerve. Such bodies are found in the subcutaneous tissue on the nerves of the fingers and toes, near joints, attached to the nerves of the abdominal plexuses of the sympathetic, on the coccygeal gland, on the dorsum of the penis and clitoris, in the meso-colon, in the course of the intercostal and periosteal nerves, and in the capsules of lymphatic glands.



(From Landois and Stirling, after Biesiadecki.)

FIG. 6.—Vertical Section of the Skin of the Palm of the Hand.

a, Blood-vessel.
b, Papilla of the cutis vera.
c, Capillary.
d, Nerve-fibre passing to a touch-corpuscle.
e, Wagner's touch-corpuscle.
f, Nerve-fibre, divided transversely.
g, Cells of the Malpighian layer of the skin.

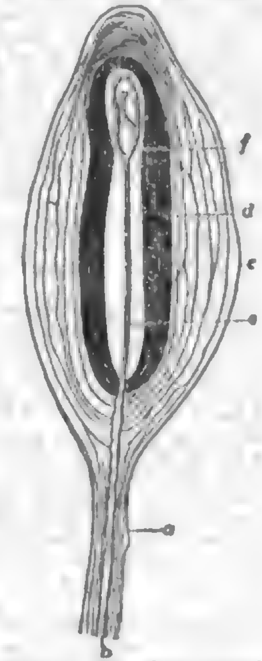


FIG. 7.—Vater's or Pacini's Corpuscle.

a, Stalk.
b, Nerve-fibre entering it.
c, *d*, Connective-tissue envelope.
e, Axis cylinder, with its end divided at *f*.

Physiology of Touch in Man.—Such are the special end-organs of touch. It has also been ascertained that many sensory nerves end in a plexus or network, the ultimate fibrils being connected with the cells of the particular tissue in which they are found. Thus they exist in the cornea of the eye, and at the junctions of tendons with muscles. In the latter situation "flattened end-flakes or plates" and "elongated oval end-bulbs" have also been found. A consideration of these various types of structure show that they facilitate intermittent pressure being made on the nerve endings. They are all, as it were, elastic cushions into which the nerve endings penetrate, so that the slight variation of pressure will be transmitted to the nerve. Probably also they serve to break the force of a sudden shock on the nerve endings.

Sensitiveness and Sense of Locality.—The degree of sensitiveness of the skin is determined by finding the smallest distance at which the two points of a pair of compasses can be felt. This method first followed by Weber, is employed by physicians in the diagnosis of nervous affections involving the sensitiveness of the skin. The following table shows the sensitiveness in millimetres for an adult.

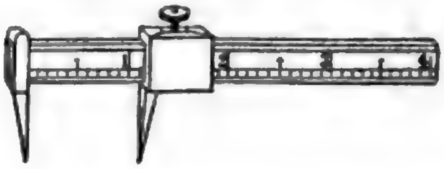


FIG. 8.—Aesthesiometer of Sieveking.

	Mm.
Tip of tongue	1·1
Third phalanx of finger, volar surface	2–2·3
Red part of the lip	4·5
Second phalanx of finger, volar surface	4–4·5
First phalanx of finger, volar surface	5–5·5
Third phalanx of finger, dorsal surface	6·8
Tip of nose	6·8
Head of metacarpal bone, volar	5–6·8
Ball of thumb	6·5–7
Ball of little finger	5·5–6
Centre of palm	8–9
Dorsum and side of tongue; white of the lips; metacarpal part of the thumb	9
Third phalanx of the great toe, plantar surface	11·3
Second phalanx of the fingers, dorsal surface	11·3
Back	11·3
Eyelid	11·3
Centre of hard palate	13·5
Lower third of the forearm, volar surface	15
In front of the zygoma	15·8
Plantar surface of the great toe	15·8
Inner surface of the lip	20·3
Behind the zygoma	22·6
Forehead	22·6
Occiput	27·1
Back of the hand	31·6
Under the chin	33·8
Vertex	33·8
Knee	36·1
Sacrum (gluteal region)	44·6
Forearm and leg	45·1
Neck	54·1
Back of the fifth dorsal vertebra; lower dorsal and lumbar region	54·1
Middle of the neck	67·7
Upper arm; thigh; centre of the back	67·7

These investigations show not only that the skin is sensitive, but that one is able with great precision to distinguish the part touched. This latter power is usually called the *sense of locality*, and it is influenced by various conditions. The greater the number of sensory nerves in a given area of skin the greater is the degree of accuracy in distinguishing different points. Contrast in this way the tip of the finger and the back of the hand. Sensitiveness increases from the joints towards the extremities, and sensitiveness is great in parts of the body that are actively moved. The sensibility of the limbs is finer in the transverse axis than in the long axis of the limb, to the extent of [illegible] on the flexor surface of the upper limb and [illegible] on the extensor surface. It is doubtful if exercise improves sensitiveness, as Francis Galton found that the performances of blind boys were not superior to those of other boys, and he says that "the guidance of the blind depends mainly on the multitude of collateral indications, to which they give much heed, and not their superiority to any one of them." When the skin is moistened with indifferent fluids sensibility is increased. Suslowa made the curious discovery that, if the area between two points distinctly felt be tickled or be stimulated by a weak electric current, the impressions are fused. Stretching the skin, and baths in water containing carbonic acid or common salt, increase the power of localizing tactile impressions. In experimenting with the compasses, it will be found that a smaller distance can be distinguished if one proceeds from greater to smaller distances than in the reverse direction. A smaller distance can also be detected when the points of the compasses are placed one after the other on the skin than when they are placed simultaneously. If the points of the compasses are unequally heated, the sensation of two contacts becomes confused. An anaemic condition, or a state of venous congestion, or the application of cold, or violent stretching of the skin, or the use of such substances as atropine, daturin, morphia, strychnine, alcohol, bromide of potassium, cannabin and hydrate of chloral blunt sensibility. The only active substance said to increase it is caffein.

Absolute sensitiveness, as indicated by a *sense of pressure*, has been determined by various methods. Two different weights are placed on the part, and the smallest difference in weight that can be perceived is noted. Weber placed small weights directly on the skin; Aubert and Kammler loaded small plates; Dohrn made use of a balance, having a blunt point at one end of the beam, resting on the skin, whilst weights were placed on the other end of the beam to equalize the pressure; H. Eulenberg invented an instrument like a spiral spring paper-clip or balance (the baraesthesiometer), having an index showing the pressure in grammes; F. Goltz employed an India-rubber tube filled with water, and this, to ensure a constant surface of contact, bent at one spot over a piece of cork, is touched at that spot by the cutaneous part to be examined, and, by rhythmically exerted pressure, waves analogous to those of the arterial pulse are produced in the tube; and L. Landois invented a mercurial balance, enabling him to make rapid variations in the weight without giving rise to any shock. These methods have given the following general results. (1) The greatest acuteness is on the forehead, temples and back of the hand and forearm, which detect a pressure of 0·002 gramme; fingers detect 0·005 to 0·015 gramme; the chin, abdomen and nose 0·04 to 0·05 gramme. (2) Goltz's method gives the same general results as Weber's experiment with the compasses, with the exception that the tip of the tongue has its sensation of pressure much lower in the scale than its sensation of touch. (3) Eulenberg found the following gradations in the fineness of the pressure sense: the forehead, lips, back of the cheeks, and temples appreciate differences of $\frac{1}{40}$ to $\frac{1}{30}$ (200: 205 to 300: 310 grammes). The back of the last phalanx of the fingers, the forearm, hand, first and second phalanges, the palmar surface of the hand, forearm and upper arm distinguish differences of $\frac{1}{10}$ to $\frac{1}{20}$ (200: 220 to 200: 210 grammes). The front of the leg and thigh is similar to the forearm. Then follow the back of the foot and toes, the sole of the foot, and the back of the leg and thigh. Dohrn placed a weight of 1 gramme on the skin, and then determined the least additional weight that could be detected, with this result: third phalanx of finger 0·499 gramme; back of the foot, 0·5 gramme; second phalanx, 0·771 gramme; first phalanx, 0·82 gramme; leg, 1 gramme; back of hand, 1·156 grammes; palm, 1·108 grammes; patella, 1·5 grammes; forearm, 1·99 grammes; umbilicus, 3·5 grammes; and back, 3·8 grammes. (4) In passing from light to heavier weights, the acuteness increases at once, a maximum is reached, and then with heavy weights the power of distinguishing the differences diminishes. (5) A sensation of pressure after the weights have been removed may be noticed (*after-pressure sensation*), especially if the weight be considerable. (6) Valentine noticed that, if the finger were held against a blunt-toothed wheel, and the wheel were rotated with a certain rapidity, he felt a *smooth* margin. This was experienced when the intervals of time between the contacts of successive teeth were less than from $\frac{1}{480}$ to $\frac{1}{640}$ of a second. The same experiment can be readily made by holding the finger over the holes in one of the outermost circles of a large syren rotating quickly: the sensations of individual holes become fused, so as to give rise to a feeling of touching a slit. (7) Vibrations of strings are detected even when the number is about 1500 per second; above this the sensation of vibration ceases. By attaching bristles to the prongs of tuning-forks and bringing these into contact with the lip or tongue, sensations of a very acute character are experienced, which are most intense when the forks vibrate from 600 to 1500 per second.

Information from Tactile Impressions.—These enable us to come to the following conclusions. (1) We note the existence of something touching the sensory surface. (2) From the intensity of the sensation we determine the weight, tension or intensity of the pressure. This sensation is in the first instance referred to the skin, but after the pressure has reached a certain amount muscular sensations are also experienced—the so-called muscular sense. (3) The locality of the part touched is at once determined, and from this the probable position of the touching body. Like the visual field, to which all retinal impressions are referred, point for point, there is a tactile field, to which all points on the skin surface may be referred. (4) By touching a body at various points, from the difference of pressure and from a comparison of the positions of various points in the tactile field we judge of the configuration of the body. A number of "tactile pictures" are obtained by passing the skin over the touched body, and the shape of the body is further determined by a knowledge of the muscular movements necessary to bring the cutaneous surface into contact with different portions of it. If there is abnormal displacement of position, a false conception may arise as to the shape of the body. Thus, if a small marble or a pea be placed between the index and middle finger so as to touch (with the palm downwards) the outer side of the index finger and the inner side of the middle finger, a sensation of touching *one* round body is experienced; but if the fingers be crossed, so that the marble touches the inner side of the index finger and the outer side of the middle finger, there will be a feeling of *two* round bodies, because in these circumstances there is added to the feelings of contact a feeling of distortion (or of muscular action) such as would take place if the fingers, for purposes of touch, were placed in that abnormal position. Again, as showing that our knowledge of the tactile field is precise, there is the well-known fact that when a piece of skin is transplanted from the forehead to the nose, in the operation for removing a deformity of the nose arising from lupus or other ulcerative disease, the patient feels the new nasal part as if it were his forehead, and he may have the curious sensation of a nasal instead of a frontal headache. (5) From the number of points touched we judge as to the smoothness or roughness of a body. A body having a uniformly level surface, like a billiard ball, is smooth; a body having points irregular in size and number in a given area is rough, and if the points are very close together it gives rise to a sensation, like that of the pile of velvet almost intolerable to some individuals. Again, if the pressure is so uniform as not to be felt, as when the body is immersed in water (paradoxical as this may seem, it is the case that the sensation of contact is felt only at the limit of the fluid), we experience the sensation of being in contact with a fluid. (6) Lastly, it would appear that touch is always the result of variation of pressure. No portion of the body when touching anything can be regarded as absolutely motionless, and the slight oscillations of the sensory surface, and in many cases of the body touched, produce those variations of pressure on which touch depends.

To explain the phenomenon of the tactile field, and more specially the remarkable variations of tactile sensibility above described, various theories have been advanced, but none are satisfactory. (See article "Cutaneous Sensations" by C. S. Sherrington in Schäfer's *Physiology*, ii. 920). Research shows that the sensation of touch may be referred to parts of the skin which do not contain the special end organs associated with this sense, and that filaments in the Malpighian layer (the layer immediately above the papillae of the true skin) may form the anatomical basis of the sense. The skin may be regarded, also, as an extensive surface containing nervous arrangements by which we are brought into relation with the outer world. Accordingly, touch is not the only sensation referred to the skin, but we also refer sensations of temperature (heat and cold), and often those peculiar sensations which we call pain.

Sensations of Temperature.—These depend on thermic irritation of the terminal organs, as proved by the following experiment of E. H. Weber: "If the elbow be dipped into a very cold fluid, the cold is only felt at the immersed part of the body (where the fibres terminate); pain, however, is felt in the terminal organs of the ulnar nerve, namely, in the finger points; this pain, at the same time, deadens the local sensation of cold." If the sensation of cold were due to the irritation of a specific-nerve fibre, the sensation of cold would be referred to the tips of the fingers. When any part of the skin is above its normal mean temperature, warmth is felt; in the opposite case, cold. The normal mean temperature of a given area varies according to the distribution of hot blood in it and to the activity of nutritive changes occurring in it. When the skin is brought into contact with a good conductor of heat there is a sensation of cold. A sensation of heat is experienced when heat is carried to the skin in any way. The following are the chief facts that have been ascertained regarding the temperature sense: (1) E. H. Weber found that, with a skin temperature of from 15·5° C. to 35° C., the tips of the fingers can distinguish a difference of 0·25° C. to 0·2° C. Temperatures just below that of the blood (33°–27° C.) are distinguished by the most sensitive parts, even to 0·05° C. (2) The thermal sense varies in different regions as follows: tip of tongue, eyelids, cheeks, lips, neck, belly. The "perceptible minimum" was found to be, in degrees C.: breast 0·4°; back, 0·9°; back of hand, 0·3°; palm, 0·4°; arm, 0·2°; back of foot, 0·4°; thigh, 0·5°; leg, 0·6° to 0·2°; cheek, 0·4°; temple, 0·3°. (3) If two different temperatures are applied side by side and simultaneously, the impressions often fuse, especially if the areas are close together. (4) Practice is said to improve the thermal sense. (5) Sensations of heat and cold may curiously alternate; thus when the skin is dipped first into water at 10° C. we feel cold, and if it be then dipped into water at 16° C. we have at first a feeling of warmth, but soon again of cold. (6) The same temperature applied to a large area is not appreciated in the same way as when applied to a small one; thus "the whole hand when placed in water at 29·5° C. feels warmer than when a finger is dipped into water at 32° C."

There is every reason to hold that there are different nerve fibres and different central organs for the tactile and thermal sensations, but nothing definite is known. The one sensation undoubtedly affects the other. Thus the minimum distance at which two compass points are felt is diminished when one point is warmer than the other. Again, a colder weight is felt as heavier, "so that the apparent difference of pressure becomes greater when the heavier weight is at the same time colder, and less when the lighter weight is colder, and difference of pressure is felt with equal weights of unequal temperature" (E. H. Weber). Great sensibility to differences of temperature is noticed after removal, alteration by vesicants, or destruction of the epidermis, and in the skin affection called herpes zoster. The same occurs in some cases of locomotor ataxy. Removal of the epidermis, as a rule, increases tactile sensibility and the sense of locality. Increased tactile sensibility is termed *hyperpselaphesia*, and is a rare phenomenon in nervous diseases. Paralysis of the tactile sense is called *hypopselaphesia*, whilst its entire loss is *apselaphesia*. Brown-Séquard mentions a case in which contact of two points gave rise to a sense of a third point of contact. Certain conditions of the nerve centres affect the senses both of touch and temperature. Under the influence of morphia the person may feel abnormally enlarged or diminished in size. As a rule the senses are affected simultaneously, but cases occur where one may be affected more than the other

Sensations of heat and cold are chiefly referred to the skin, and only partially to some mucous membranes, such as those of the alimentary canal. Direct irritation of a nerve does not give rise to these sensations. The exposed pulp of a diseased tooth, when irritated by hot or cold fluids, gives rise to pain, not to sensations of temperature. It has now been ascertained that there are minute areas on the skin in which sensations of *heat* and *cold* may be more acutely felt than in adjoining areas; and, further, that there are points stimulated by addition of heat, hot spots, while others are stimulated by withdrawal of heat, cold spots.

A simple method of demonstrating this phenomenon is to use a solid cylinder of copper, 8 in. in length by ¼ in. in thickness, and sharpened at one end to a fine pencil-like point. Dip the pointed end into very hot water, close the eyes, and touch parts of the skin. When a hot spot is touched, there is an acute sensation of burning. Such a spot is often near a hair. Again, in another set of experiments, dip the copper pencil into ice-cold water and search for cold spots. When one of these is touched, a sensation of cold, as if concentrated on a point, is experienced. Thus it may be demonstrated that in a given area of skin there may be hot spots, cold spots and touch spots

Cold spots are more abundant than hot spots. The spots are arranged in curved lines, but the curve uniting a number of cold spots does not coincide with the curve forming a chain of hot spots. By Weber's method it will be found that we can discriminate cold spots at a shorter distance from each other than hot spots. Thus on the forehead cold spots have a minimum distance of 8 mm., and hot spots 4 mm.; on the skin of the breast, cold spots 2 mm., and hot spots 5 mm.; on the back, cold spots 1·5 mm., and hot spots 4 to 6 mm.; on the back of the hand, cold spots 3 mm., and hot spots 4 mm.; on the palm, cold spots 8 mm., and hot spots 2 mm.; and on the thigh and leg, cold spots 3 mm., and hot spots 3·5 mm. Electrical and mechanical stimulation of the hot or cold spots call forth the corresponding sensation. No terminal organ for discrimination of temperature has yet been found. It will be observed that the sensation of heat or cold is excited by *change* of temperature, and that it is more acute and definite the more sudden the change. Thus discrimination of temperature is similar to discrimination of touch, which depends on more or less sudden change of pressure. The term cold means, physiologically, the sensation we experience when heat is abstracted, and the term heat, the sensation felt when heat is added to the part. Thus we are led to consider that the skin contains at least two kinds of specific terminal organs for sensations of touch and temperature, and two sets of nerve fibres which carry the nervous impulses to the brain. In all probability, also, these fibres have different central endings, and in their course to the brain run in different tracts in the spinal cord. This will explain cases of disease of the central nervous system in which, over certain areas of skin, sensations of touch have been lost while sensations of temperature and pain remain, or vice versa. Tactile and thermal impressions may influence each other. Thus a leg sent to "sleep" by pressure on the sciatic nerve will be found to be less sensitive to heat, but distinctly sensitive to cold. In some cases of disease it has been noticed that the skin is sensitive to a temperature above that of the limb, but insensitive to cold. It is highly probable that just as we found in the case of touch (pressure), the terminal organs connected with the sense of temperature are the fine nerve filaments that have been detected in the deeper strata of the Malpighian region of the epidermis, immediately above the true skin, and it is also probable that certain epidermic (epithelial) cells in that region play their part in the mechanism. Sensations of a painful character may also, in certain circumstances, be referred to the viscera, and to mucous and serous surfaces. Pain is not a sensation excited by irritating the end organs either of touch or of temperature, nor even by irritating directly the filaments of a sensory nerve. Even if sensory nerves are cut or bruised, as in surgical operations, there may be no sensations of pain; and it has been found that muscles, vessels and even the viscera, such as the heart, stomach, liver or kidneys, may be freely handled without giving rise to any feeling of pain, or indeed to any kind of sensation. These parts, in ordinary circumstances appear to be insensitive, and yet they contain afferent nerves. If the sensibility of these nerves is heightened, or possibly if the sensitiveness of the central terminations of the nerves is raised, then we may have sensations to which we give the name of pain. In like manner the skin is endowed with afferent nerves, distinct from those ministering to touch and to temperature, along which nervous impulses are constantly flowing. When these nervous impulses reach the central nervous system in ordinary circumstances they do not give rise to changes that reach the level of consciousness, but they form, as it were, the warp and woof of our mental life, and they also affect metabolisms, that is to say, nutritive changes in many parts of the body. They may also, as is well known, affect unconsciously such mechanisms as those of the action of the heart, the calibre of the blood-vessels and the movements of respiration. If, however, this plane of activity is raised, as by intermittent pressure, or by inflammatory action, or by sudden changes of temperature, as in burning, scalding, &c., such nervous impulses give rise to pain. Sometimes pain is distinctly located, and in other cases it may be irradiated in the nerve centres, and referred to areas of skin or to regions of the body which are not really the seat of the irritation. Thus irritation of the liver may cause pain in the shoulder; disease of the hip-joint often gives rise to pain in the knee; and renal colic, due to the passage of a calculus down the ureter, to severe pain even in the abdominal walls. These are often termed *reflex pains* and their interpretation is of great importance to physicians in the diagnosis of disease. Their frequent occurrence has also directed attention to the distribution in the skin and termination in the brain of the sensory nerves. It is also noticeable that a sensation of pain gives us no information as to its cause; we simply have an agonizing sensation in a part to which, hitherto, we probably referred no sensations. The acuteness or intensity of pain depends partly on the intensity of the irritation, and partly on the degree of excitability of the sensory nerves at the time.

Pain.—In addition to sensations of touch and of temperature referred to the skin, there is still a third kind of sensation, unlike either, namely, pain. This sensation cannot be supposed to be excited by irritations of the end organs of touch, or of specific thermal end organs (if there be such), but rather to irritation of ordinary sensory nerves, and there is every reason to believe that painful impressions make their way to the brain along special tracks in the spinal cord. If we consider our mental condition as regards sensation at any moment, we notice numerous sensations more or less definite, not referred directly to the surface, nor to external objects, such as a feeling of general comfort, free or impeded breathing, hunger, thirst, malaise, horror, fatigue and pain. These are all caused by the irritation of ordinary sensory nerves in different localities, and if the irritation of such nerves, by chemical, thermal, mechanical or nutritional stimuli, passes beyond a certain maximum point of intensity the result is pain. Irritation of a nerve, in accordance with the law of "peripheral reference of sensation," will cause pain. Sometimes the irritation applied to the trunk of a sensory nerve may be so intense as to destroy its normal function, and loss of sensation or anaesthesia results. If then the stimulus be increased further, pain is excited which is referred to the end of the nerve, with the result of producing what has been called *anaesthesia dolorosa*. Pains frequently cannot be distinctly located, probably owing to the fact of irradiation in the nerve centres and subsequent reference to areas of the body which are not really the seat of irritations. The intensity of pain depends on the degree of excitability of the sensory nerves, whilst its massiveness depends on the number of nerve fibres affected. The quality of the pain is probably produced by the kind of irritation of the nerve, as affected by the structure of the part and the greater or less continuance of severe pressure. Thus there are piercing, cutting, boring, burning, throbbing, pressing, gnawing, dull and acute varieties of pain. Sometimes the excitability of the cutaneous nerves is so great that a breath of air or a delicate touch may give rise to suffering. This *hyperalgia* is found in inflammatory affections of the skin. In *neuralgia* the pain is characterized by its character of shooting along the course of the nerve and by severe exacerbations. In many nervous diseases there are disordered sensations referred to the skin, such as alternations of heat and cold, burning, creeping, itching and a feeling as if insects were crawling on the surface (formication). This condition is termed *paralgia*. The term *hypalgia* is applied to a diminution and *analgia* to paralysis of pain, as is produced by anaesthetics.

Muscular Sense.—The sensory impressions considered in this article are closely related to the so-called muscular sense, or that sense or feeling by which we are aware of the state of the muscles of a limb as regards contraction or relaxation. Some have held that the muscular sense is really due to greater or less stretching of the skin and therefore to irritation of the nerves of that organ. That this is not the case is evident from the fact that disordered movements indicating perversion or loss of this sense are not affected by removal of the skin (Claude Bernard). Further, cases in the human being have been noticed where there was an entire loss of cutaneous sensibility whilst the muscular sense was unimpaired. It is also known that muscles possess sensory nerves, giving rise, in certain circumstances, to fatigue, and, when strongly irritated, to the pain of cramp. Muscular sensations are really excited by irritation of sensory nerves passing from the muscles themselves. There are specialized spindle-like bodies in many muscles, and there are organs connected with tendons which are regarded as sensory organs by which pressures are communicated to sensory nerve-filaments. We are thus made conscious of whether or not the muscles are contracted, and of the amount of contraction necessary to overcome resistance, and this knowledge enables us to judge of the amount of voluntary impulse. Loss or diminution of the muscular sense is seen in chorea and especially in locomotor ataxy. Increase of it is rare, but it is seen in the curious affection called *anxietas tibiarum*, a painful condition of unrest, which leads to a continual change in the position of the limbs (see EQUILIBRIUM).

(J. G. M.)

TOUL, a garrison town of north-eastern France, capital of an arrondissement in the department of Meurthe-et-Moselle, 21 m. W. of Nancy on the Eastern railway Pop. (1906), town 9523; commune, 13,663. Toul is situated in a plain on the left bank of the Moselle, which skirts the town on the S. and S. E., while on the N. it is bordered by the Marne-Rhine canal. It is principally important as being the centre of a great entrenched camp close to the German frontier. Immediately after the Franco-German War the whole system of frontier defence was revised, and of all the new fortresses of the Meuse and Moselle Toul is perhaps the most formidable. The works were begun in 1874 by the construction of four outlying forts north, north-east and south of the town, but these soon became merely an inner line of defence. The principal defences now lie much farther out on all sides. The west front of the new line of forts occupies a long line of high ground (the watershed of the Meuse and the Moselle), the north front, about 4 m. from Toul, is in undulating country, while facing towards Nancy and forming the chord of the arc which the Moselle describes from Fontenay below to Villey-le-Sec above, is the strong east front, the outlying works of which extend far to the east (Fort Frouard and other works about Nancy) and to the south-east (Pont St Vincent). The south front extends from the Moselle at Villey-le-Sec south-westwards till it meets the southern end of the west front on the high ground overlooking the Meuse valley. The fort at Pagny on the Meuse to the south-west may be considered an outwork of this line of defence. The perimeter of the Toul defences proper is nearly 30 m., and their mean distance from the town about 6 m. Northward, along the Meuse, Toul is connected with the fortress of Verdun by the "Meuse line" of barrier forts, the best known of which are Gironville, Liouville and Troyon. South of Toul the country was purposely left unfortified as far as Épinal (*q.v.*) and this region is known as the Trouée d'Épinal.

The town itself forms an oval within a bastioned enceinte pierced by three gateways. It has two important churches. That of St Étienne (formerly a cathedral) has a choir and transept of the 13th century; the nave and aisles are of the 14th, and the façade, the finest part of the building, of the last half of the 15th. The two western towers, which have no spires, reach a height of 246 ft. The two large lateral chapels of the nave are in the Renaissance style. The chief features of the interior are its stained glass and organ loft. South of the church there is a fine cloister of the end of the 13th century which was much damaged at the Revolution. The church of St Gengoult, which dates chiefly from the late 13th or early 14th century, has a façade of the 15th century and a cloister in the Flamboyant Gothic style of the 16th century. The hôtel-de-ville occupies a building of the 18th century, once the episcopal palace, and contains the library and museum. Toul is the seat of a sub-prefect and has a tribunal of commerce and a communal college among its public institutions. The industries include the manufacture of porcelain; trade is in wine and brandy.

Toul (*Tullum*) is one of the oldest towns of France; originally capital of the Leuci, in the Belgic Confederation, it acquired great importance under the Romans. It was evangelized by St Mansuy in the latter half of the 4th century, and became one of the leading sees of north-east Gaul. After being sacked successively by Goths, Burgundians, Vandals and Huns, Toul was conquered by the Franks in 450. Under the Merovingians it was governed by counts, assisted by elective officers. The bishops became sovereign counts in the 10th century, holding only of the emperor, and for a period of 300 years (13th to 16th centuries) the citizens maintained a long struggle against them. Together with Verdun and Metz the town and its domain formed the territory of the Trois-Evêchés. Toul was forced to yield for a time to the count of Vaudémont in the 12th century, and twice to the duke of Lorraine in the 15th, and was thrice devastated by the plague in the 16th century. Charles V. made a solemn entry into the town in 1544, but in the following year, at the instance of the cardinal of Lorraine, it placed itself under the perpetual protection of the kings of France. Henry II. took possession of the Trois-Evêchés in 1552, but the territory was not officially incorporated with France till 1648. Henry IV. was received in state in 1603, and in 1637 the parlement of Metz was transferred to Toul. In 1700 Vauban reconstructed the fortifications of the town. In 1790 the bishopric was suppressed and the diocese united to that of Nancy. Toul, which had then no modern defences, capitulated in 1870 after a bombardment of twelve days.

TOULON, a seaport and first-class fortress and naval station of France, department of Var, capital of the arrondissement of Toulon, on the Mediterranean, 42 m. E.S.E. of Marseilles. Pop. (1886), 53,941; (1901), 101,602. The bay, which opens to the east. has two divisions, the Grande Rade and the Petite Rade; it is sheltered on the north and west by high hills, closed on the south by the peninsula of capes Sicié and Cépet, and protected on the east by a huge breakwater, the entrance, 1300 ft. wide, being defensible by torpedoes. A ship coming from the open sea must first pass the forts of St Marguerite, of Cap Brun, of Lamalgue and of St Louis to the north, and the battery of the signal station to the south; before reaching the Petite Rade it must further pass under the guns of the battery of Le Salut to the east, and of the forts of Balaguier and L'Aiguillette to the west. The Bay of La Seyne lies west of the Petite Rade, and is defended by the forts of Six-Fours, Napoléon (formerly Fort Caire), and Malbousquet, and the batteries of Les Arènes and Les Gaus. To the north of Toulon rise the defensive works of Mont Faron and Fort Rouge, to the east the forts of Artigues and St Catherine, to the north-east the formidable fort of Coudon, and to the south-east that of Colle Noire, respectively dominating the highway into Italy and the valley of Hyères with the Bay of Carqueiranne. The town, enlarged to the north under the Second Empire, has on that side a fine modern quarter; but in the old town the streets are for the most part narrow, crooked and dirty, and to their insanitary state the cholera epidemic of 1884 was attributed. The chief buildings are the former cathedral of St Marie Majeure (from the 5th century Toulon was a bishop's see till 1801, when it was annexed to that of Fréjus), the church of St Louis, the naval and military hospital, with a natural history collection and an anatomical museum attached, a naval school of medicine, a school of hydrography, and large barracks. In 1883–1887 a handsome Renaissance building was erected to accommodate the picture gallery and the town library. The monument in commemoration of the centenary of the French Revolution was erected in 1890 in the Place de la Liberté, the finest in the new town. The imports are wine, corn, wood, coal, hemp, iron, sugar, coffee and fresh fish; the exports are salt, copper ore, barks for tanning and oils. The principal industries, apart from the arsenal, are shipbuilding, fishing, lace-making and wine-growing. Toulon possesses an observatory and a botanical garden. The interesting buildings and gardens of the hospital of St Mandrier stand on the peninsula of Cape Cépet, and near them is the *lazaretto*.

Toulon is the most important of the French dockyards, and is the headquarters of the Mediterranean fleet. The arsenal, which was created by Louis XIV.—Vauban being the engineer of the works—lies on the north side of the Petite Rade. This is approached from the Grande Rade by passages at the north and south ends of a long breakwater which extends from the direction of Le Mourillon towards the Cépet Peninsula. The water space within the moles amounts to about 150 acres, while the quays approach 4 m. in length. Outside in the Petite Rade is a splendid protected anchorage for a great fleet, the whole being commanded by many forts and batteries. There are four great basins approached from the Petite Rade—the Vielle Darse, to the east, on the side of Le Mourillon; the Darse Vauban, next to it; and the Darse de Castigneau and the Darse Missiessy, farther to the west. In the Darse Vauban are three dry docks, two of them 246 ft. long, with a depth of water on the sill of about 20 ft.; while the third is 283 ft. long, with a depth of over 24 ft. Three other dry docks are in the Darse de Castigneau, of which one is in two sections. The largest of the docks is 385 ft. long, and the depth of water on the sill in all these docks averages 30 ft. In the Darse Missiessy are two dry docks, 426 ft. long, with a depth on the sill of over 32 ft. There are several building slips, and the yard is supplied with a gun foundry and wharf, fitting-shops, boiler works, victualling and other establishments, rolling mills and magazines. Le Mourillon is a subsidiary yard at Toulon, devoted chiefly to ship-building, and possessing large facilities, including five covered slips.

The Roman Telo Martius is supposed to have stood near the lazaretto. The town was successively sacked by Goths, Burgundians, Franks and Saracens. During the early middle ages, and till conquered by Charles of Anjou in 1259, it was under lords of its own, and entered into alliance with the republics of Marseilles and Arles. St Louis, and especially Louis XII. and Francis I. strengthened its fortifications. It was seized by the emperor Charles V. in 1524 and 1536. Henry IV. founded a naval arsenal at Toulon, which was further strengthened by Richelieu, and Vauban made the new dock, a new enceinte, and several forts and batteries. In 1707 the town was unsuccessfully besieged by the duke of Savoy, Prince Eugene and an English fleet. In 1720 there was an outbreak of the plague. In 1792 after great and sanguinary disorder, the royalists of the town sought the support of the English and Spanish fleets cruising in the neighbourhood. The Convention having replied by putting the town "hors la loi," the inhabitants opened their harbour to the English. The army of the republic now (1793) laid siege to the town, and on this occasion Napoleon Bonaparte first made his name as a soldier. The forts commanding the town having been taken, the English ships retired after setting fire to the arsenal. The conflagration was extinguished by the prisoners, but not before 38 out of a total of 56 vessels had been destroyed. Under the Directory Toulon became the most important French military fort on the Mediterranean; here Napoleon organized the Egyptian campaign, and the expedition against Algiers set out from Toulon in 1830. The fortifications have been strengthened by Napoleon I., Louis Philippe, Napoleon III., and since 1870.

Battle of Toulon,—This naval battle took place on the 11th of February 1744, near the port of Toulon. A British fleet of thirty sail of the line under command of Thomas Mathews, who combined the offices of naval commander-in-chief in the Mediterranean and envoy to the courts of Sardinia and the Italian princes, engaged a combined force of Spaniards under Don José Navarro and French under M. de Court. They were in all twenty-seven sail. The allies left Toulon on the 9th of February. Mathews was at anchor in Hyères Bay to watch them, for though France and Great Britain were already engaged as allies on opposite sides in the War of the Austrian Succession, there had been no declaration of war between them. It was known that the allies meant to transfer Spanish troops to Italy to serve against the Austrians, and Mathews had no hesitation in attacking them, Great Britain being at war with Spain. He left Hyères in very light wind with a heavy westerly swell, and with his fleet in confusion. The British ships were straggling over a distance of ten miles, but he put himself between the enemy and Toulon. Mathews was on bad terms with his second in command, Lestock, who commanded the rear division and showed little disposition to support his superior. By the morning of the 11th the interval between the van and centre of the British fleet and its rear had increased in the light breezes, and also through the voluntary or involuntary misapprehension of Mathews's orders by Lestock. The allies were in a fairly well-formed line, heading to the south, and southward of the British. Mathews pursued, and at 1.30 p.m., when his leading ship was abreast of the centre ship of the allies, he attacked. Some hot fighting took place between Mathews and the Spaniards who formed the allied rear. The action was notable as the last occasion on which an attempt was made to use a fireship on the open sea. One was sent against the "Real" (114), the Spanish flagship, but she was reduced to a sinking state by the fire of the Spaniards, and blew up prematurely, with the loss of all on board. At about five o'clock, the French in the van turned back to support the Spaniards, and Mathews drew off. One Spanish ship, the "Poder" (60), which had surrendered was recaptured, and then set on fire by the allies. Mathews made only a feeble attempt to renew the battle on the following days, and on the 13th returned towards the coast of Italy, which he said he had to defend. The British rear division had not come into action at all.

The battle, though a miserable affair in itself, is of great importance in naval history because of the pronouncement of doctrine to which it led. Mathews, who was dissatisfied with his subordinate, Lestock, suspended him from command and sent him home for trial. Several of the captains had behaved ill, and the failure of a superior British fleet to gain a success over the allies caused extreme discontent at home. A parliamentary inquiry was opened on the 12th of March 1745, which on the 18th of April, after a confused investigation, ended in a petition to the king to order trials by court-martial of all the officers accused of misconduct. A long series of courts-martial began on the 11th of September 1745, and did not end till the 22nd of October 1746. Several captains were sentenced to be dismissed the service. Lestock was acquitted, but Mathews was condemned and sentenced to dismissal. The finding of the court, which blamed the officer who actually fought, and acquitted the other who did not, puzzled and angered public opinion. The technical points were not appreciated by laymen. The real evil done by the condemnation of Mathews was not understood even in the navy. Mathews was blamed on the ground that he had not waited to engage till his van ship was abreast of the van ship of the enemy. By this declaration of principle the court confirmed the formal system of naval tactics which rendered all sea-fighting between equal or nearly equal forces so ineffective for two generations.

See Beatson, *Naval and Military Memoirs*, i. 197 seq. (London, 1804), a full and fair narrative. (D. H.)

TOULOUSE, LOUIS ALEXANDRE DE BOURBON, Count of (1678–1737), third son of Louis XIV. and Mme de Montespan was born on the 6th of June 1678. At the age of five he was created admiral of France. He distinguished himself during the War of the Spanish Succession, and inflicted a severe defeat on Admiral Rooke near Malaga in 1704. He kept aloof from the intrigues of his sister-in-law, the duchess of Maine, and died on the 1st of December 1737. His son, Louis Jean Marie de Bourbon, duc de Penthièvre (1725–1793), succeeded his father in his posts, among others in that of grand admiral. He served under Marshal de Noailles, and fought brilliantly at Dettingen (1743) and Fontenoy (1745). He then lived in retreat at Rambouillet and Sceaux, protecting men of letters, and particularly the poet Florian, and dispensing charity. He lost his son, the prince of Lamballe, in 1768, and survived his daughter-in-law, Louise Marie Thérèse of Savoy-Carignan, the friend of Marie Antoinette, who was killed by the populace on the 3rd of September 1792. He died on the 4th of March 1793; his daughter and heiress, Louise Marie Adélaïde, married Philippe (Égalité), duke of Orleans.

TOULOUSE, a city of south-western France, capital of the department of Haute-Garonne, 443 m. S. by W. of Paris by the Orleans railway, and 159 m. S.E. of Bordeaux by the Southern railway. Pop. (1906), town, 125,856; commune, 149,438. Toulouse is situated on the right bank of the Garonne, which here changes a north-easterly for a north-westerly direction, describing a curve round which the city extends in the form of a crescent. On the left bank is the suburb of St Cyprien, which is exposed to the inundations of the river owing to its low situation. The river is spanned by three bridges—that of St Pierre to the north, that of St Michel to the south, and the Pont Neuf in the centre; the last, a fine structure of seven arches was begun in 1543 by Nicolas Bachelier, the sculptor, whose work is to be seen in many of the churches and mansions of the city. East and north of the city runs the Canal du Midi, which here joins the lateral canal of the Garonne. Between the Canal du Midi and the city proper extends a long line of boulevards leading southwards by the Allée St Étienne to the Grand Rond, a promenade whence a series of allées branch out in all directions. South-west the Allée St Michel leads towards the Garonne, and south the Grande Allée towards the Faubourg St Michel. These boulevards take the place of the old city walls. Between them and the canal lie the more modern faubourgs of St Pierre, Arnaud-Bernard, Matabiau, &c. The Place du Capitole, to which streets converge from every side, occupies the centre of the city. Two broad straight thoroughfares of modern construction, the Rue de Metz and the Rue d'Alsace-Lorraine, intersect one another to the south of this point, the first running east from the Pont Neuf, the other running north and south. The other streets are for the most part narrow and irregular.

The most interesting building in Toulouse is the church of St Sernin or Saturnin, whom legend represents as the first preacher of the gospel in Toulouse, where he was perhaps martyred about the middle of the 3rd century. The choir, the oldest part of the present building, was consecrated by Urban II. in 1096. The church is the largest Romanesque basilica in existence, being 375 ft. from east to west and 210 ft. in extreme breadth. The nave (12th and 13th centuries) has double aisles. Four pillars, supporting the central tower, are surrounded by heavy masonry, which somewhat spoils the general harmony of the interior. In the southern transept is the "portail des comtes," so named because near it lie the tombs of William Taillefer, Pons, and other early counts of Toulouse. The little chapel in which these tombs (ascribed to the 11th century) are found was restored by the capitols of Toulouse in 1648. Another chapel contains a Byzantine Christ of late 11th-century workmanship. The choir (11th and 12th centuries) ends in an apse, or rather chevet, surrounded by a range of columns, marking off an aisle, which in its turn opens into five chapels. The stalls are of 16th-century work and grotesquely carved. Against the northern wall is an ancient *table d'autel*, which an 11th-century inscription declares to have belonged to St Sernin. In the crypts are many relics, which, however, were robbed of their gold and silver shrines during the Revolution. On the south there is a fine outer porch in the Renaissance style; it is surmounted by a representation of the Ascension in Byzantine style. The central tower (13th century) consists of five storeys, of which the two highest are of later date, but harmonize with the three lower ones. A restoration of St Sernin was carried out in the 19th century by Viollet-le-Duc.

The cathedral, dedicated to St Stephen, dates from three different epochs. The walls of the nave belong to a Romanesque cathedral of the 11th century, but its roof dates from the first half of the 13th century. The choir was begun by Bishop Bertrand de l'Ile (*c.* 1272), who wished to build another church in place of the old one. This wish was unfulfilled and the original nave, the axis of which is to the south of that of the choir, remains. The choir was burned in 1690 but restored soon after. It is surrounded by seventeen chapels, finished by the cardinal d'Orléans, nephew of Louis XI., about the beginning of the 16th century, and adorned with glass dating from the 15th to the 17th century. The western gate, flanked by a huge square tower, was constructed by Peter du Moulin, archbishop of Toulouse, from 1439 to 1451. It has been greatly battered, and presents but a poor approximation to its ancient beauty. Over this gate, which was once ornamented with the statues of St Sernin, St Exuperius and the twelve apostles, as well as those of the two brother archbishops of Toulouse, Denis (1423–1439) and Peter du Moulin, there is a beautiful 13th-century rose-window, whose centre, however, is not in a perpendicular line with the point of the Gothic arch below.

Among other remarkable churches may be noticed Notrè-Dame de la Daurade, near the Pont Neuf, built on the site of a 9th-century Benedictine abbey and reconstructed towards the end of the 18th century; and Notre-Dame de la Dalbade; perhaps existing in the 11th, but in its present form dating from the 16th century, with a fine Renaissance portal. The church of the Jacobins, held by Viollet-le-Duc to be "one of the most beautiful brick churches constructed in the middle ages," was built towards the end of the 13th century, and consists of a nave divided into two aisles by a range of columns. The chief exterior feature is a beautiful octagonal belfry. The church belonged to a Dominican monastery, of which part of the cloister, the refectory, the chapter-hall and the chapel also remain and are utilized by the lycée. Of the other secular buildings the most noteworthy are the capitole and the museum. The capitole has a long Ionic façade built from 1750 to 1760. The theatre is situated in the left wing. Running along almost the whole length of the first floor is the *salle des illustres* adorned with modern paintings and sculptures relating to the history of the town. The museum (opened in 1795) occupies, besides a large modern building, the church, cloisters and other buildings of an old Augustinian convent. It contains pictures and a splendid collection of antiquities, notably a series of statues and busts of Roman emperors and others and much Romanesque sculpture. There is an auxiliary museum in the old college of St Raymond. The natural history museum is in the Jardin des Plantes. The law courts stand on the site of the old Château Narbonais, once the residence of the counts of Toulouse and later the seat of the parlement of Toulouse. Near by is a statue of the jurist Jacques Cujas, born at Toulouse.

Toulouse is singularly rich in mansions of the 16th and 17th centuries. Among these may be mentioned the Hôtel Bernuy, a fine Renaissance building now used by the lycée and the Hôtel d'Assézat of the same period, now the property of the *Académie des Jeux Floraux* (see below), and of the learned societies of the city. In the court of the latter there is a statue of Clémence Isaure, a lady of Toulouse, traditionally supposed to have enriched the Académie by a bequest in the 15th century. The Maison de Pierre has an elaborate stone façade of 1612.

Toulouse is the seat of an archbishopric, of a court of appeal, a court of assizes and of a prefect. It is also the headquarters of the XVII. army corps and centre of an educational circumscription (*académie*). There are tribunals of first instance and of commerce, a board of trade-arbitration, a chamber of commerce and a branch of the Bank of France. The educational institutions include faculties of law, medicine and pharmacy, science and letters, a Catholic institute with faculties of theology and letters, higher and lower ecclesiastical seminaries, lycées and training colleges for both sexes, and schools of veterinary science, fine arts and industrial sciences and music.

Toulouse, the principal commercial and industrial centre of Languedoc, has important markets for horses, wine, grain, flowers, leather, oil and farm produce. Its pastry and other delicacies are highly esteemed. Its industrial establishments include the national tobacco factory, flour-mills, saw-mills, engineering workshops and factories for farming implements, bicycles, vehicles, artificial manures, paper, boots and shoes, and flour pastes.

Tolosa, chief town of the Volcae Tectosages, does not seem to have been a place of great importance during the early centuries of the Roman rule in Gaul, though in 106 B.C. the pillage of its temple by Q. S. Cepio, afterwards routed by the Cimbri, gave rise to the famous Latin proverb *habet aurum Tolosanum*, in allusion to ill-gotten gains. It possessed a circus and an amphitheatre, but its most remarkable remains are to be found on the heights of Old Toulouse (*vetus Tolosa*) some 6 or 7 m. to the east, where huge accumulations of broken pottery and fragments of an old earthen wall mark the site of an ancient settlement. The numerous coins that have been discovered on the same spot do not date back farther than the 2nd century B.C., and seem to indicate the position of a Roman manufacturing centre then beginning to occupy the Gallic hill-fortress that, in earlier days, had in times of peril been the stronghold of the native tribes dwelling on the river bank. Tolosa does not seem to have been a Roman colony; but its importance must have increased greatly towards the middle of the 4th century. It is to be found entered in more than one itinerary dating from about this time; and Ausonius, in his *Ordo nobilium urbium*, alludes to it in terms implying that it then had a large population. In 419 it was made the capital of his kingdom by Wallia, king of the Visigoths, under whom or whose successors it became the seat of the great Teutonic kingdom of the West-Goths—a kingdom that within fifty years had extended itself from the Loire to Gibraltar and from the Rhone to the Atlantic. On the defeat of Alaric II. (507) Toulouse fell into the hands of Clovis, who carried away the royal treasures to Angoulême. Under the Merovingian kings it seems to have remained the greatest city of southern Gaul, and is said to have been governed by dukes or counts dependent on one or other of the rival kings descended from the great founder of the Frankish monarchy. It figures prominently in the pages of Gregory of Tours and Sidonius Apollinaris. About 628 Dagobert erected South Aquitaine into a kingdom for his brother Charibert, who chose Toulouse as his capital. For the next eighty years its history is obscure, till we reach the days of Charles Martel, when it was besieged by Sema, the leader of the Saracens from Spain (*c.* 715–720), but delivered by Eudes, "princeps Aquitaniae," in whom later writers discovered the ancestor of all the later counts of Toulouse. Modern criticism, however, has discredited this genealogy; and the real history of Toulouse recommences in 780 or 781, when Charlemagne appointed his little son Louis king of Aquitaine, with Toulouse for his chief city.

During the minority of the young king his tutor Chorson ruled at Toulouse with the title of duke or count. Being deposed at the Council of Worms (790), he was succeeded by William Courtnez, the traditional hero of southern France, who in 806 retired to his newly founded monastery at Gellone, where he died in 812. In the unhappy days of the emperor Louis the Pious and his children Toulouse suffered in common with the rest of western Europe. It was besieged by Charles the Bald in 844, and taken four years later by the Normans, who in 843 had sailed up the Garonne as far as its walls. About 852 Raymond I., count of Quercy, succeeded his brother Fridolo as count of Rouergue and Toulouse; it is from this noble that all the later counts of Toulouse trace their descent. Raymond I.'s grandchildren divided their parents' estates; of these Raymond II. (d. 924) became count of Toulouse, and Ermengaud, count of Rouergue, while the hereditary titles of Gothia, Quercy and Albi were shared between them. Raymond II.'s grandson, William Taillefer (d. *c.* 1037), married Emma of Provence, and handed down part of that lordship to his younger son Bertrand.[1] William's elder son Pons left two children, of whom William IV. succeeded his father in Toulouse, Albi, Quercy, &c.; while the younger, Raymond IV. of St Gilles (*c.* 1066), made himself master of the vast possessions of the counts of Rouergue, married his cousin the heiress of Provence, and about 1085 began to rule the immense estates of his elder brother, who was still living.

From this time the counts of Toulouse were the greatest lords in southern France. Raymond IV., the hero of the first crusade, assumed the formal titles of marquis of Provence, duke of Narbonne and count of Toulouse. While Raymond was away in the Holy Land, Toulouse was seized by William IX., duke of Aquitaine, who claimed the city in right of his wife Philippa, the daughter of William IV., but was unable to hold it long (1098–1100). Raymond's son and successor Bertrand followed his father's example and set out for the Holy Land in 1109, leaving his great estates at his death to his brother Alphonse Jourdain. The rule of this prince was disturbed by the ambition of William IX. and his grand-daughter Eleanor, who urged her husband Louis VII. to support her claims to Toulouse by war. On her divorce from Louis and her marriage with Henry II., Eleanor's claims passed on to this monarch, who at last forced Raymond V. to do him homage for Toulouse in 1173. Raymond V., the patron of the troubadours, died in 1194, and was succeeded by his son Raymond VI., under whose rule Languedoc was desolated by the crusaders of Simon de Montfort, who occupied Toulouse in 1215, but lost his life in besieging it in 1218. Raymond VII., the son of Raymond VI. and Princess Joan of England, succeeded his father in 1222, and died in 1249, leaving an only daughter Joan, married to Alfonso the brother of Louis IX. On the death of Alfonso and Joan in 1271 the vast inheritance of the counts of Toulouse lapsed to the Crown.[2] From the middle years of the 12th century the people of Toulouse seem to have begun to free themselves from the most oppressive feudal dues. An act of Alphonse Jourdain (1141) exempts them from the tax on salt and wine; and in 1152 we have traces of a "commune consilium Tolosae" making police ordinances in its own name "with the advice of Lord Raymond, count of Toulouse, duke of Narbonne, and marquis of Provence." This act is witnessed by six "capitularii," four duly appointed judges (*judices constituti*), and two advocates. Twenty-three years later there are twelve capitularii or consuls, six for the city and six for its suburbs, all of them elected and sworn to do justice in whatever municipal matters were brought before them. In 1222 their number was increased to twenty-four; but they were forbidden to touch the city property, which was to remain in the charge of certain "communarii" chosen by themselves. Early in the 14th century the consuls took the name of "domini de capitulo," or, a little later, that of "capitulum nobilium." From the 13th century the consuls met in their own house, the "palatium communitatis Tolosae" or hôtel-de-ville. In the 16th century a false derivation changed the ancient consuls (*domini de capitulo*) into the modern "capitouls" (*domini capitolii tolosani*), a barbarous etymology which in its turn has, in the present century, transformed the old assembly house of Toulouse into the capitole. The parlement of Toulouse was established as a permanent court in 1443. Louis XI. transferred it to Montpellier in 1467, but restored it to Toulouse before the close of the next year. This parlement was for Languedoc and southern France what the parlement of Paris was for the north. During the religious wars of the 16th century the Protestants of the town made two unsuccessful attempts to hand it over to the prince de Condé. After St Bartholomew's Day (1572) 300 of the party were massacred. Towards the end of the 16th century, during the wars of the League, the parlement was split up into three different sections, sitting respectively at Carcassonne or Béziers, at Castle Sarrasin, and at Toulouse. The three were reunited in 1596. Under Francis I. it began to persecute heretics, and in 1619 rendered itself notorious by burning the philosopher Vanini. In 1762 Jean Calas, an old man falsely accused of murdering his eldest son to prevent him becoming a Roman Catholic, was broken on the wheel. By the exertions of Voltaire his character was afterwards rehabilitated. The university of Toulouse owes its origin to the action of Gregory IX., who in 1229 bound Raymond VII. to maintain four masters to teach theology and eight others for canon law, grammar, and the liberal arts. Civil law and medicine were taught only a few years later. The famous "Floral Games" of Toulouse, in which the poets of Languedoc contended (May 1–3) for the prize of the golden amaranth and other gold or silver flowers, given at the expense of the city, were instituted in 1323–1324. The *Académie des Jeux Floraux* still awards these prizes for compositions in poetry and prose. In 1814 the duke of Wellington defeated Marshal Soult to the north-east of the town.

See L. Ariste and L. Brand, *Histoire populaire de Toulouse depuis les origines jusqu'à ce jour* (Toulouse, 1898). This work contains an exhaustive bibliography.

TOUNGOO, or TAUNG-NGU, a town and district in the Tenasserim division of Lower Burma. The town is situated on the right bank of the river Sittang, 166 m. by rail N. from Rangoon. Pop. (1901), 15,837. From the 14th to the 16th century it was the capital of an independent kingdom. After the second Burmese War it was an important frontier station, but the troops were withdrawn in 1893. The district of Toungoo has an area of 6172 sq. m.; pop. (1901), 279,315, showing an increase of 32% in the preceding decade. Three mountain ranges traverse the district—the Pegu Yomas, the Karen, and the Nat-taung or "Great Watershed"—all of which have a north and south direction, and are covered for the most part with dense forest. The Pegu Yomas have a general elevation of from 800 to 1200 ft., while the central range averages from 2000 to 3000 ft. The rest of Toungoo forms the upper portion of the valley of the Sittang, the only large river in the district, the chief tributaries of which are the Shwa, Hkabaung, Hpyu Thank-ye-Kat and Yank-thua-wa, all navigable for a great portion of their course. Limestone appears in various places, and in the north-east a light grey marble is quarried for lime. The rivers form the chief means of communication during the rainy season. The rainfall in 1905 was 80·30 in. There are 14 railway stations in the district. Rice is the staple crop; there are promising plantations of coffee and rubber. Forests cover more than 5000 sq. m., of which 1337 sq. m. have been reserved, yielding a large revenue.

TOUP, JONATHAN [JOANNES TOUPIUS] (1713–1785), English classical scholar and critic, was born at St Ives in Cornwall, and was educated at a private school and Exeter College, Oxford. Having taken orders, he became rector of St Martin's Exeter, where he died on the 19th of January 1785. Toup established his reputation by his *Emendationes in Suidam* (1760–1766, followed in 1775 by a supplement) and his edition of *Longinus* (1778), including notes and emendations by Ruhnken. The excellence of Toup's scholarship was "known to the learned throughout Europe" (so epitaph on the tablet in the church of East Looe set up by the delegates of the Clarendon Press), but his overbearing manner and extreme self-confidence made him many enemies.

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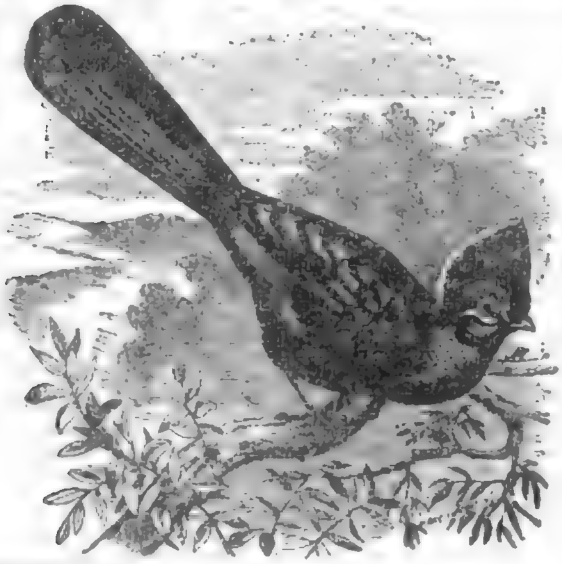
[1] About 975 there was a partition of the estates which William Taillefer and his cousin Raymond II. of Auvergne held in common,—Albi, Quercy, &c., falling to William, and Gothia, &c., to Raymond.

[2] List of the counts of Toulouse:

Chorson	778–790
William I.	790–806
Raymond Rafinel	*c.* 812–818
Berenger	818–835
Bernard I.	835–844
Warin	844–845
William II.	845–850
Fridolo	850–852
Raymond I.	852–864
Bernard	864–875
Eudo	875–918
Raymond II.	918–*c.* 924
Raymond III.	924–*c.* 950
William Taillefer	*c.* 950–*c.* 1037
Pons	1037–1060
William IV.	1060–*c.* 1093
Raymond IV.	1093–1096
Bertrand	1096–1109
Alphonse Jourdain	1109–1148
Raymond V.	1148–1194
Raymond VI.	1194–1222
Raymond VII.	1222–1249
Alfonso and Joan	1249–1271

TOURACOU, the name, evidently already in use, under which in 1743 G. Edwards figured a pretty African bird,[1] and presumably that applied to it in Guinea, whence it had been brought alive. It is the *Cuculus persa* of Linnaeus, and *Turacus* or *Corythaix persa* of later authors. Cuvier in 1799 or 1800 Latinized its native name (adopted in the meanwhile by both French and German writers) as above, for which barbarous term J. K. W. Illiger, in 1811, substituted a more classical word. In 1788 Isert described and figured (*Beobacht. Gesellsck. naturf. Freunde*, iii. 16–20, pl. 1) a bird, also from Guinea, which he called *Musophaga violacea*. Its affinity to the original Touracou was soon recognized, and both forms have been joined by modern systematists in the family Musophagidae, commonly Englished Plantain-eaters or Touracous.



(After Schlegel.)

White-Crested Touracou (*Turacus albicristatus*).

To take first the Plantain-eaters proper, or the genus *Musophaga*, of which only two species are known. One, about the size of a crow, is comparatively common in museums, and has the horny base of its yellow bill prolonged backwards over the forehead in a kind of shield. The top of the head and the primaries, except their outer edge and tip, are deep crimson; a white streak extends behind the eye; and the rest of the plumage is glossy purple. The second species, *M. rossae*, which is rare, chiefly differs by wanting the white eye-streak. Then of the Touracous—the species originally described is about the size of a jay, and has the head, crest (which is vertically compressed and tipped with red), neck and breast of grass-green, varied by two white streaks—one, from the gape to the upper part of the crimson orbit, separated by a black patch from the other, which runs beneath and behind the eye. The wing-coverts, lower part of the back, and tail are of steel-purple, the primaries deep crimson, edged and tipped with bluish black. Over a dozen other congeneric species, more or less resembling this, have been described, and all inhabit some district of Africa. One, found in the Cape Colony and Natal, where it is known as the "Lory" (cf. xv. 7, note 1), though figured by Daubenton and others, was first differentiated in 1841 by Strickland (*Ann. Nat. History*, vii. 33) as *Turacus albicristatus*—its crest having a conspicuous white border, while the steel-purple of *T. persa* is replaced by a rich and glossy bluish green of no less beauty. In nearly all the species of this genus the nostrils are almost completely hidden by the frontal feathers; but there are two others in which, though closely allied, this is not the case, and some systematists would place them in a separate genus *Gallirex*; while another species, the giant of the family, has been moved into a third genus as *Corythaeola cristata*. This differs from any of the foregoing by the absence of the crimson coloration of the primaries, and seems to lead to another group, *Schisorrhis*, in which the plumage is of a still plainer type, and, moreover, the nostrils here are not only exposed but in the form of a slit, instead of being oval as in all the rest. This genus contains about half-a-dozen species, one of which, *S. concolor*, is the Grey Touracou of the colonists in Natal, and is of an almost uniform slaty brown. A good deal has been written about these birds, which form the subject of a beautiful monograph—*De Toerako's afgebeld en beschreven*—by Schlegel and Westerman, brought out at Amsterdam in 1860; while further information is contained in an elaborate essay by Schalow (*Journ. f. ornithologie*, 1886, pp. 1–77). Still, much remains to be made known as to their distribution throughout Africa and their habits. They seem to be all fruit-eaters, and to frequent the highest trees, seldom coming to the ground. Very little can be confidently asserted as to their nidification, but at least one species of *Schizorrhis* is said to make a rough nest and therein lay three eggs of a pale blue colour. An extraordinary peculiarity attends the crimson coloration which adorns the primaries of so many of the Musophagidae. So long ago as 1818, Jules Verreaux observed (*Proc. Zool. Society*, 1871, p. 40) that in the case of *T. albicristatus* this beautiful hue vanishes on exposure to heavy rain and reappears only after some interval of time and when the feathers are dry.[2]

The Musophagidae form a distinct family, of which the Cuculidae are the nearest allies, the two being associated to form the Cuculine as compared with the Psittacine division of Cuculiform birds (see Bird and Parrot). T. C. Eyton pointed out (*Ann. Nat. History*, 3rd series, vol. ii. p. 458) a feature possessed in common by the latter and the Musophagidae, in the "process attached to the anterior edge of the ischium," which he likened to the so-called "marsupial" bones of Didelphian mammals. J. T. Reinhardt has also noticed (*Vidensk. meddels. naturhist. forening*, 1871, pp. 326–341) another Cuculine character offered by the *os uncinatum* affixed to the lower side of the ethmoid in the Plantain-eaters and Touracous; but too much dependence must not be placed on that, since a similar structure is presented by the frigate-bird (*q.v.*) and the petrels (*q.v.*). A corresponding process seems also to be found in Trogon (*q.v.*). The bill of nearly all the species of Musophagidae is curiously serrated or denticulated along the margin and the feet have the outer toe reversible, but usually directed backwards. No member of the family is found outside of the continental portion of the Ethiopian region. (A. N.)

TOURAINE, an old province in France, which stretched along both banks of the Loire in the neighbourhood of Tours, the river dividing it into Upper and Lower Touraine. It was bounded on the N. by Orléanais, W. by Anjou and Maine, S. by Poitou and E. by Berry, and it corresponded approximately to the modern department of Indre et Loire. Touraine took its name from the Turones, the tribe by which it was inhabited at the time of Caesar's conquest of Gaul. They were unwarlike, and offered practically no resistance to the invader, though they joined in the revolt of Vercingetorix in A.D. 52. The capital city, Caesarodunum, which was built on the site of the eastern part of the present city of Tours, was made by Valentinian the metropolis of the 3rd Lyonnaise, which included roughly the later provinces of Touraine, Brittany, Maine and Anjou. Christianity seems to have been introduced into Touraine not much earlier than the beginning of the 4th century, although tradition assigns St Gatien, the first bishop of Tours, to the 3rd. The most famous of its apostles was St Martin (*fl.* 375-400), who founded the abbey of Marmoutier, near Tours, and whose tomb in the city became a celebrated shrine. Tours was besieged by the Visigoths in 428, and though it offered a successful resistance on this occasion it was included fifty years later in the territory of the Visigoths. The Tourangeans refused to adopt the Arian heresy of their conquerors, and this difference in religion materially assisted in 507 the conquest of the province by Clovis, whose orthodoxy was guaranteed by the miraculous intervention of St Martin. St Clotilda, wife of Clovis, spent the last years of her life in retreat at Tours. The possession of Touraine was constantly the subject of dispute between the Merovingian princes, and the province enjoyed no settled peace until the reign of Charlemagne. He established Alcuin as abbot of St Martin of Tours, and under his auspices the school of Tours became one of the chief seats of learning in the middle ages. In the 9th century Tours also became the ecclesiastical metropolis of Brittany, Maine and Anjou, and when the empire was divided by Louis the Pious into various districts or *missatica*, Tours was the centre of one of these, the boundaries of which corresponded roughly with those of the ecclesiastical jurisdiction of the city. Touraine suffered from the invasions of the Northmen, who massacred the monks of Marmoutier in 853, but never pillaged Tours. The administration of Touraine was entrusted, from Merovingian times onward, to counts appointed by the crown. The office became hereditary in 940 or 941 with Thibault the Old or the "Tricheur." His son Odo I. was attacked by Fulk the Black, count of Anjou, and despoiled of part of his territory. His grandson Thibault III., who refused homage to Henry I., king of France, in 1044, was entirely dispossessed by Geoffrey of Anjou, called the Hammer (d. 1060). The 7th count, Fulk (d. 1109), ruled both Anjou and Touraine, and the county of Touraine remained under the domination of the counts of Anjou (*q.v.*) until Henry II. of England deprived his brother Geoffrey of Touraine by force of arms. Henry II. carried out many improvements, but peace was destroyed by the revolt of his sons. Richard Coeur de Lion, in league with Philip Augustus, had seized Touraine, and after his death Arthur of Brittany was recognized as count. In 1204 it was united to the French crown, and its cession was formally acknowledged by King John at Chinon in 1214. Philip appointed Guillaume des Roches hereditary seneschal in 1204, but the dignity was ceded to the crown in 1312. Touraine was granted from time to time to princes of the blood as an appanage of the crown of France. In 1328 it was held by Jeanne of Burgundy, queen of France; by Philip, duke of Orleans, in 1344; and in 1360 it was made a peerage duchy on behalf of Philip the Bold, afterwards duke of Burgundy. It was the scene of dispute between Charles, afterwards Charles VII., and his mother, Isabel of Bavaria, who was helped by the Burgundians. After his expulsion from Paris by the English Charles spent much of his time in the châteaux of Touraine, although his seat of government was at Bourges. He bestowed the duchy successively on his wife Mary of Anjou, on Archibald Douglas and on Louis III. of Anjou. It was the dower of Mary Stuart as the widow of Francis II. The last duke of Touraine was Francis, duke of Alençon, who died in 1584. Plessis-les-Tours had been the favourite residence of Louis XI., who granted many privileges to the town of Tours, and increased its prosperity by the establishment of the silk-weaving industry. The reformed religion numbered many adherents in Touraine, who suffered in the massacres following on the conspiracy of Amboise; and, though in 1562 the army of Condé pillaged the city of Tours, the marshal of St André reconquered Touraine for the Catholic party. Many Huguenots emigrated after the massacre of St Bartholomew, and after the revocation of the Edict of Nantes the silk industry, which had been mainly in the hands of the Huguenots, was almost destroyed. This migration was one of the prime causes of the extreme poverty of the province in the next century. At the Revolution the nobles of Touraine made a declaration expressing their sympathy with the ideas of liberty and fraternity. Among the many famous men who were born within its boundaries are Jean le Meingre Boucicaut, marshal of France, Béroalde de Verville, author of the *Moyen de parvenir*, Rabelais, Cardinal Richelieu, C. J. Avisseau, the potter (1796–1861), the novelist Balzac and the poet Alfred de Vigny.

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[1] Apparently the first ornithologist to make the bird known was Albin, who figured it in 1738 from the life, yet badly, as "The Crown-bird of Mexico." He had doubtless been misinformed as to its proper country; but Touracous were called "Crown-birds" by the Europeans in West Africa, as witness Bosman's *Description of the Coast of Guinea* (2nd ed., 1721), p. 251, and W. Smith's *Voyage to Guinea* (1745), p. 149, though the name was also given to the crowned cranes, *Balearica*.

[2] The fact of this colouring matter being soluble in water was incidentally mentioned at a meeting of the Zoological Society of London by W. B. Tegetmeier, and brought to the notice of Professor A. H. Church, who, after experiment, published in 1868 (*Student and Intellectual Observer*, i. 161–168) an account of it as "Turacin, a new animal pigment containing copper." Further information on the subject was given by Monteiro (*Chem. News*, xxviii. 201; *Quart. Journ. Science*, 2nd series, vol. iv. p. 132). The property is possessed by the crimson feathers of all the birds of the family.

See the quarterly publication of the *Mémoires* of the *Société archéologique de Touraine* (1842, &c.) which include a *Dictionnaire géographique, historique et biographique* (6 vols., 1878–1884), by J. X. Carré de Busserolle. There are histories of Touraine and its monuments by Chalmel (4 vols. Paris, 1828), by S. Bellanger (Paris, 1845), by Bourrassé (1858). See also Dupin de Saint André, *Hist. du protestantisme en Touraine* (Paris, 1885); T. A. Cook, *Old Touraine* (2 vols. London, 1892).

TOURCOING, a manufacturing town of northern France in the department of Nord, less than a mile from the Belgian frontier, and 8 m. N.N.E. of Lille on the railway to Ghent. Pop. (1906), 62,694 (commune, 81,671), of whom about one-third are natives of Belgium. Tourcoing is practically one with Roubaix to the south, being united thereto by a tramway and a branch of the Canal de Roubaix. The public institutions comprise a tribunal of commerce, a board of trade arbitrators, a chamber of commerce, an exchange and a conditioning house for textiles. Together with Roubaix, Tourcoing ranks as one of the chief textile centres of France. Its chief industry is the combing, spinning and twisting of wool carried on in some eighty factories employing between 10,000 and 12,000 workpeople. The spinning and twisting of cotton is also important. The weaving establishments produce woollen and mixed woollen and cotton fabrics together with silk and satin drapery, swanskins, jerseys and other fancy goods. The making of velvet pile carpets and upholstering materials is a speciality of the town. To these industries must be added those of dyeing, the manufacture of hosiery, of the machinery and other apparatus used in the textile factories and of soap.

Famed since the 12th century for its woollen manufactures, Tourcoing was fortified by the Flemings in 1477, when Louis XI. of France disputed the inheritance of Charles the Bold with Mary of Burgundy, but in the same year was taken and pillaged by the French. In 1794 the Republican army, under Generals Moreau and Souham, gained a decisive victory over the Austrians, the event being commemorated by a monument in the public garden. The inhabitants, 18,000 in 1789, were reduced by the French Revolution to 10,000.

TOURMALINE, a mineral of much interest to the physicist on account of its optical and electrical properties; it is also of some geological importance as a rock-constituent (see SCHORL), whilst certain transparent varieties have economic value as gem-stones. The name is probably a corruption of *turmali*, or *toramalli*, the native name applied to tourmaline and zircon in Ceylon, whence specimens of the former mineral were brought to Europe by the Dutch in 1703. The green tourmaline of Brazil had, however, been known here much earlier; and coarse varieties of the mineral had passed for centuries under the German name of *Schörl*, an old mining word of uncertain origin, possibly connected with the old German *Schor* (refuse), in allusion to the occurrence of the mineral with the waste of the tin-mines. The German village of Schorlau may have taken its name from the mineral. It has been suggested that the Swedish form *skörl* has possible connexion with the word *skör*, brittle.

Tourmaline crystallizes in the rhombohedral division of the hexagonal system. The crystals have generally a prismatic habit, the prisms being longitudinally striated or even channelled. Trigonal prisms are characteristic, so that a transverse section becomes triangular or often nine-sided. By combination of several prisms the crystals may become sub-cylindrical. The crystals when doubly terminated are often hemimorphic or present dissimilar forms at the opposite ends; thus the hexagonal prisms in fig. 1 are terminated at one end by rhombohedral faces, *o*, P, and at the other by the basal plane *k*′. Doubly-terminated crystals, however, are comparatively rare; the crystals being usually attached at one end to the matrix. It is notable that prismatic crystals of tourmaline have in some cases been curved and fractured transversely; the displaced fragments having been cemented together by deposition of fresh mineral matter. Tourmaline is not infrequently columnar, acicular or fibrous; and the fibres may radiate from a centre so as to form the so-called "tourmaline suns." Crystals of tourmaline present no distinct cleavage, but break with a sub-conchoidal fracture; and whilst the general lustre of the mineral is vitreous, that of the fractured surface is rather pitchy. The hardness is slightly above that of quartz (7). The specific gravity varies according to chemical composition, that of the colourless varieties being about 3, whilst in schorl it may rise to 3·2.

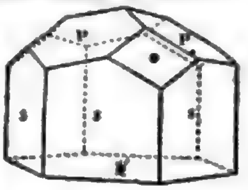


FIG. 1.

Tourmaline has a great range of colour, and in many cases the crystals are curiously parti-coloured. Occasionally, though rarely, the mineral is colourless, and is then known as achroite, a name proposed by R. Hermann in 1845, and derived from the Greek ἄχροος (uncoloured). Red tourmaline, which when of fine colour is the most valued of all varieties, is known as rubellite (*q.v.*). Green tourmaline is by no means uncommon, but the blue is rather rare and is distinguished by the name indigolite, generally written indicolite. Brown is a common colour, and black still more common, this being the usual colour of schorl, or common coarse tourmaline. Thin splinters of schorl may, however, be blue or brown by transmitted light.

The double refraction of tourmaline is strong. The mineral is optically negative, the ordinary index being about 1·64, and the extraordinary 1·62. Coloured tourmalines are intensely pleochroic, the ordinary ray, which vibrates perpendicular to the principal axis, being much more strongly absorbed than the extraordinary; hence a slice cut in the direction of the principal or optic axis transmits sensibly only the extraordinary ray, and may consequently be used as a polarizing medium. The brown tourmaline of Ceylon and Brazil is best adapted for this purpose, but the green is also used. Two plates properly mounted form the instrument used by opticians for testing spectacle-lenses, and are known as the "tourmaline tongs." In order to secure the best colour-effect when used as a gem-stone, the tourmaline should be cut with the table parallel to the optic axis.

It was in tourmaline that the phenomenon of pyroelectricity was first observed. On being heated in peat ashes its attractive power was observed by the Dutch, in the early part of the 18th century; and this curious character obtained for it the name of *aschtrekker*, or ash-drawer. J. R. Haüy first pointed out the relation of pyroelectricity with hemimorphism. Tourmaline is also piezoelectric, that is, it becomes electric by pressure. If a crystal be subjected to pressure along the optic axis, it behaves as though it were contracting by reduction of temperature. The mineral may also be rendered electric by friction, and retains the charge for a long time.

Tourmaline is a boro-silicate of singularly complex composition. Indeed the word tourmaline is sometimes regarded as the name of a group of isomorphous minerals rather than that of a definite species. Numerous analyses have been made, and the results discussed by a large number of authorities. In the view of S. L. Penfield and H. W. Foote all tourmaline may be derived from a boro-silicic acid of the formula $H_{20}B_2Si_4O_{21}$. It is believed that the hydrogen is present as hydroxyl, and that this may be partially replaced by fluorine. The tourmaline acid has probably the constitution $H_{18}(B{\cdot}OH)_2Si_4O_{19}$. Nine atoms of hydrogen are replaced by three of aluminium, and the remaining nine in part by other metals. Lithium is present in red tourmaline; magnesium dominates in brown; iron, manganese and sometimes chromium are found in green; and much iron occurs in the black varieties. Four groups are sometimes recognized, characterized by the presence of (1) lithium, (2) ferrous iron, (3) ferric iron and (4) magnesium.

Tourmaline occurs commonly in granite, greisen, gneiss and crystalline schists. In many cases it appears to have been formed by pneumatolysis, or the action on the rocks of heated vapours containing boron and fluorine, as in many tin-bearing districts, where tourmaline is a characteristic mineral. Near the margin of a mass of granite the rock often becomes schorlaceous or tourmaliniferous, and may pass into "tourmaline-rock," which is usually an aggregate of tourmaline and quartz. Tourmaline is an essential constituent of the west of England rocks called luxullianite (luxulyanite) and trowlesworthite. It occurs embedded in certain metamorphic limestones, where it is possibly due to fumarolic action. Microscopic crystals are common in clay-slate. By resistance to decomposition, tourmaline often survives the disintegration of the matrix, and thus passes into sands, clays, marls and other sedimentary deposits.

Many of the finest crystals of tourmaline occur in druses in granitic rocks, such as those of San Piero in Elba, where some of the pale pink and green prisms are tipped with black, and have consequently been called "nigger-heads." Lepidolite is a common associate of tourmaline, as at Rozena in Moravia. Tourmaline occurs, with corundum, in the dolomite of Campolongo, in canton Ticino, Switzerland. Fine black crystals, associated with apatite and quartz, were formerly found in granite at Chudleigh, near Bovey Tracey in Devonshire. The Russian localities for tourmaline are mentioned under RUBELLITE. Most of the tourmaline cut for jewelry comes from the gem-gravels of Ceylon. The green tourmaline has generally a yellowish or olive-green colour, and is known as "Ceylon chrysolite." Fine green crystals are found in Brazil, notably in the topaz-locality of Minas Novas; and when of vivid colour they have been called "Brazilian emeralds." Green tourmaline is a favourite ecclesiastical stone in South America Blue tourmaline occurs with the green; this variety is found also at Utö in Sweden (its original locality) and notably near Hazaribagh in Bengal. Certain kinds of mica occasionally contain flat crystals of tourmaline between the cleavage-planes.

Many localities in the United States are famous for tourmaline. Magnificent specimens have been obtained from Mt Mica, near Paris, Maine, where the mineral was accidentally discovered in 1820 by two students, E. L. Hamlin and E. Holmes. It occurs in granite, with lepidolite, smoky quartz, spodumene, &c.; and some of the prismatic crystals are notable for being red at one end and green at the other. Mt Rubellite at Hebron, and Mt Apatite at Auburn, are other localities in Maine which have yielded fine tourmaline. At Chesterfield, Massachusetts, remarkable crystals occur, some of which show on transverse section a triangular nucleus of red tourmaline surrounded by a shell of green. Red and green tourmalines, with lepidolite and kunzite, are found in San Diego county, California. Fine coloured tourmalines occur at Haddam Neck, Connecticut; and excellent crystals of black tourmaline are well known from Pierrepont, New York, whilst remarkable brown crystals occur in limestone at Gouverneur in the same state. Canada is rich in tourmaline, notably at Burgess in Lanark county, Ontario, and at Grand Calumet Island in the Ottawa river. Heemskirk Mountain, Tasmania, and Kangaroo Island, South Australia, have yielded fine coloured tourmaline fit for jewelry. Madagascar is a well-known locality for black tourmaline in large crystals.

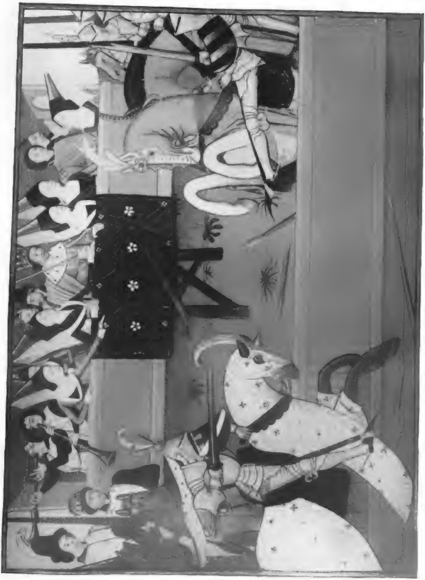
Many varieties of tourmaline have received distinctive names, some of which are noticed above. Dravite is G. Tschermak's name for a brown tourmaline, rich in magnesia but with little iron, occurring near Unter Drauburg in the Drave district in Carinthia. Taltalite was a name given by I. Domeyko to a mixture of tourmaline and copper ore from Taltal in Chile. The colourless Elba tourmaline was called apyrite by J. F. L. Hausmann, in allusion to its refractory behaviour before the blow-pipe; whilst a black iron-tourmaline from Norway was termed aphrazite by J. B. d'Andrada, in consequence of its intumescence when heated. (F. W. R.*)

TOURNAI (Flemish *Doornik*), a city of Belgium, in the province of Hainaut, situated on the Scheldt. Pop. (1904), 36,744. Although in the course of its long history it has undergone many sieges and was sacked at various epochs by the Vandals, Normans, French and Spaniards, it preserves many monuments of its ancient days. Among these is the cathedral of Notre-Dame, one of the finest and best preserved Romanesque and Gothic examples in Belgium (for plan, &c., see ARCHITECTURE: *Romanesque and Gothic in Belgium*). Its foundation dates from the year 1030, while the nave is Romanesque of the middle of the 12th century, with much pointed work. The transept was added in the 13th century. The first choir was burned down in 1213, but was rebuilt in 1242 at the same time as the transept, and is a superb specimen of pointed Gothic. There are five towers with spires, which give the outside an impressive appearance, and much has been done towards removing the squalid buildings that formerly concealed the cathedral. There are several old pictures of merit, and the shrine of St Eleuthère, the first bishop of Tournai in the 6th century, is a remarkable product of the silversmith's art. The belfry on the Grand Place was built in 1187, partly reconstructed in 1391 and finally restored and endowed with a steeple in 1852. The best view of the cathedral can be obtained from its gallery. The church of St Quentin in the same square as the belfry is almost as ancient as Notre-Dame, and the people of Tournai call it the "little cathedral." In the church of St Brice is the tomb of Childeric discovered in 1655. Among the relics were three hundred small golden models of bees. These were removed to Paris, and when Napoleon was crowned emperor a century and a half later he chose Childeric's bees for the decoration of his coronation mantle. In this manner the bee became associated with the Napoleonic legend just as the lilies were with the Bourbons. The Pont des Trous over the Scheldt, with towers at each end, was built in 1290, and among many other interesting buildings there are some old houses still in occupation which date back to the 13th century. On the Grand Place is the fine statue of Christine de Lalaing, princess d'Epinoy, who defended Tournai against Parma in 1581. Tournai carries on a large trade in carpets (called Brussels), bonnet shapes, corsets and fancy goods generally. With regard to the carpet manufactory, it is said locally to date from the time of the Crusades, and it is presumed that the Crusaders learnt the art from the Saracens.

The history of Tournai dates from the time of Julius Caesar, when it was called *civitas Nerviorum* or *castrum Turnacum*. In the reign of Augustus, Agrippa fixed the newly mixed colony of Suevi and Menapii at Tournai, which continued throughout the period of Roman occupation to be of importance. In the 5th century the Franks seized Tournai, and Merovaeus made it the capital of his dynasty. This it remained until the subdivision of the Frank monarchy among the sons of Clovis. When feudal possessions, instead of being purely personal, were vested in the families of the holder after the death of Charlemagne, Tournai was specially assigned to Baldwin of the Iron Arm by Charles

TOURNAMENT

PLATE I.

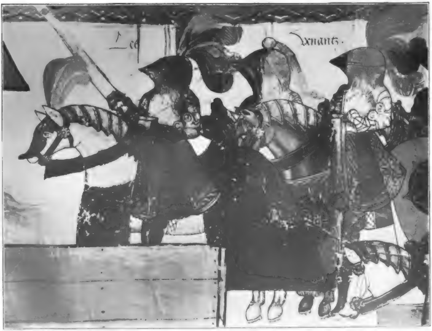


Knights Jousting. From a French MS. of the latter half of the XV Century. (Cotton MS. Nero D. ix.)

PLATE II.

TOURNAMENT

Knights Jousting with Cronells on their Lances. French MS. early XIV Century. (Royal MS. 14 E. iii.)



English Knights Riding into the Lists. From the Great Tournament Roll of 1511; by permission of the College of Arms.

the Bald, whose daughter Judith he had abducted, on receiving the hereditary title of count of Flanders. During the Burgundian period it was the residence of Margaret of York, widow of Charles the Bold; and the pretender Perkin Warbeck, whom she championed, if not born there, was the reputed son of a Jew of Tournai. In the early 16th century Tournai was an English possession for a few years and Henry VIII. sold it to Francis I. It did not long remain French, for in 1521 the count of Nassau, Charles V.'s general, took it and added it to the Spanish provinces. During the whole of the middle ages Tournai was styled the "seigneurie de Tournaisis," and possessed a charter and special privileges of its own. Near Tournai was fought, on the 11th of May 1745, the famous battle of Fontenoy. (D. C. B.)

TOURNAMENT, or TOURNEY (Fr. *tournement*, *tournoi*, Med. Lat. *torneamentum*, from *tourner*, to turn), the name popularly given in the middle ages to a species of mock fight, so called owing to the rapid *turning* of the horses (Skeat). Of the several medieval definitions of the tournament given by Du Cange (*Glossarium*, *s.v.* "Tourneamentum"), the best is that of Roger of Hoveden, who described tournaments as "military exercises carried out, not in the spirit of hostility (*nullo interveniente odio*), but solely for practice and the display of prowess (*pro solo exercitio, atque ostentatione virium*)." Men who carry weapons have in all ages played at the game of war in time of peace. But the tournament, properly so called, does not appear in Europe before the 11th century, in spite of those elaborate fictions of Ruexner's *Thurnierbuch* which detail the tournament laws of Henry the Fowler. More than one chronicler records the violent death, in 1066, of a French baron named Geoffroi de Preulli, who, according to the testimony of his contemporaries, "invented tournaments." In England, at least, the tournament was counted a French fashion, Matthew Paris calling it *conflictus gallicus*.

By the 12th century the tournament had grown so popular in England that Henry II. found it necessary to forbid the sport which gathered in one place so many barons and knights in arms. In that age we have the famous description by William FitzStephen of the martial games of the Londoners in Smithfield. He tells how on Sundays in Lent a noble train of young men would take the field well mounted, rushing out of the city with spear and shield to ape the feats of war. Divided into parties, one body would retreat, while another pursued striving to unhorse them. The younger lads, he says, bore javelins disarmed of their steel, by which we may know that the weapon of the elders was the headed lance. William of Newbury tells us how the young knights, balked of their favourite sport by the royal mandate, would pass over sea to win glory in foreign lists. Richard I. relaxed his father's order, granting licences for tournaments, and Jocelin of Brakelond has a long story of the great company of cavaliers who held a tournament between Thetford and Bury St Edmunds in defiance of the abbot. From that time onward unlicensed tourneying was treated as an offence against the Crown, which exacted heavy fees from all taking part in them even when a licence had been obtained. Often the licence was withheld, as in 1255, when the king's son's grave peril in Gascony is alleged as a reason for forbidding a meeting. In 1299 life and limb were declared to be forfeit in the case of those who should arrange a tourney without the royal licence, and offenders were to be seized with horse and harness. As the tournament became an occasion for pageantry and feasting, new reason was given for restraint: a simple knight might beggar himself over a sport which risked costly horses and carried him far afield. Jousters travelled from land to land, like modern cricketers on their tours, offering and accepting challenges. Thus Edward I., before coming to the throne, led eighty knights to a tournament on the Continent. Before the jousts at Windsor on St George's Day in 1344 heralds published in France, Scotland, Burgundy, Hainault, Flanders, Brabant and the domains of the emperor the king's offer of safe conduct for competitors. At the weddings of princes and magnates and at the crowning of kings the knights gathered to the joustings, which had become as much a part of such high ceremonies as the banquet and the minstrelsy. The fabled glories of the Round Table were revived by princely hosts, who would assemble a gallant company to keep open house and hold the field against all comers, as did Mortimer, the queen's lover, when, on the eve of his fall, he brought all the chivalry of the land to the place where he held his Round Table. About 1292 the "Statute of Arms for Tournaments" laid down, "at the request of the earls and barons and of the knighthood of England," new laws for the game. Swords with points were not to be used, nor pointed daggers, nor club nor mace. None was to raise up a fallen knight but his own appointed squires, clad in his device. The squire who offended was to lose horse and arms and lie three years in gaol. A northern football crowd would understand the rule that forbade those coming to see the tournament to wear harness or arm themselves with weapons. Disputes were to be settled by a court of honour of princes and earls. That such rules were needful had been shown at Rochester in 1251, where the foreign knights were beaten by the English and so roughly handled that they fled to the city for refuge. On their way the strangers were faced by another company of knights who handled them roughly and spoiled them, thrashing them with staves in revenge for the doings at a Brackley tournament. Even as early as the 13th century some of these tournaments were mere pageants of horsemen. For the Jousts of Peace held at Windsor Park in 1278 the sword-blades are of whalebone and parchment, silvered; the helms are of boiled leather and the shields of light timber. But the game could make rough sport. Many a tournament had its tale of killed and wounded in the chronicle books. We read how Roger of Lemburn struck Arnold de Montigny dead with a lance thrust under the helm. The first of the Montagu earls of Salisbury died of hurts taken at a Windsor jousting, and in those same lists at Windsor the earl's grandson Sir William Montagu was killed by his own father. William Longéspee in 1256 was so bruised that he never recovered his strength, and he is among many of whom the like is written. Blunted or "rebated" lance-points came early into use, and by the 14th century the coronall or cronell head was often fitted in place of the point. After 1400 the armourers began to devise harness with defences specially wrought for service in the lists. But the joust lost its chief perils with the invention of the tilt, which, as its name imports, was at first a cloth stretched along the length of the lists. The cloth became a stout barrier of timber, and in the early 16th century the knight ran his course at little risk. Locked up in steel harness, reinforced with the grand-guard and the other jousting pieces, he charged along one side of this barrier, seeing little more through the pierced sight-holes of the helm than the head and shoulders of his adversary. His bridle arm was on the tilt-side, and thus the blunted lance struck at an angle upon the polished plates. Mishaps might befall. Henry II. of France died from the stroke of Gabriel de Montgomeri, who failed to cast up in time the truncheon of his splintered lance. But the 16th-century tournament was, in the main, a bloodless meeting.

The 15th century had seen the mingling of the tournament and the pageant. Adventurous knights would travel far afield in time of peace to gain worship in conflicts that perilled life and limb, as when the Bastard of Burgundy met the Lord Scales in 1466 in West Smithfield under the fair and costly galleries crowded with English dames. On the first day the two ran courses with sharp spears; on the second day they tourneyed on horseback, sword in hand; on the third day they met on foot with heavy pole-axes. But the great tournament held in the market-place of Bruges, when the jousting of the Knights of the Fleece was part of the pageant of the Golden Tree, the Giant and the Dwarf, may stand as a magnificent example of many such gay gatherings. When Henry VIII. was scattering his father's treasure the pageant had become an elaborate masque. For two days after the crowning of the king at Westminster, Henry and his queen viewed from the galleries of a fantastic palace set up beside the tilt-yard a play in which deer were pulled down by greyhounds in a paled park, in which the Lady Diana and the Lady Pallas came forward, embowered in moving castles, to present the champions. Such costly shows fell out of fashion after the death of Henry VIII.; and in England the tournament remained, until the end, a martial sport. Sir Henry Lee rode as Queen Elizabeth's champion in the tilt-yard of Whitehall until his years forced him to surrender the gallant office to that earl of Cumberland who wore the Queen's glove pinned to the flap of his hat. But in France the tournament lingered on until it degenerated to the carrousel, which, originally a horseman's game in which cavaliers pelted each other with balls, became an unmartial display when the French king and his courtiers pranced in such array as the wardrobe-master of the court ballets would devise for the lords of Ind and Africk.

The tournament was, from the first, held to be a sport for men of noble birth, and on the Continent, where nobility was more exactly defined than in England, the lists were jealously closed to all combatants but those of the privileged class. In the German lands, questions as to the purity of the strain of a candidate for admission to a noble chapter are often settled by appeal to the fact that this or that ancestor had taken part in a tournament. Konrad Grünenberg's famous heraldic manuscript shows us the *Helmschau* that came before the German tournament of the 15th century—the squires carrying each his master's crested helm, and a little scutcheon of arms hanging from it, to the hall where the king of arms stands among the ladies and, wand in hand, judges each blazon. In England several of those few rolls of arms which have come down to us from the middle ages record the shields displayed at certain tournaments. Among the illustrations of the article HERALDRY will be seen a leaf of a roll of arms of French and English jousters at the Field of the Cloth of Gold, and this leaf is remarkable as illustrating also the system of "checques" for noting the points scored by the champions. (O. BA.)

TOURNEFORT, JOSEPH PITTON DE (1656–1708), French botanist, was born at Aix, in Provence, on the 5th of June 1656. He studied in the convent of the Jesuits at Aix, and was destined for the Church, but the death of his father left him free to follow his botanical inclinations. After two years' collecting, he studied medicine at Montpellier, but was appointed professor of botany at the Jardin des Plantes in 1683. By the king's order he travelled through western Europe, where he made extensive collections, and subsequently spent three years in Greece and Asia Minor (1700–1702). Of this journey a description in a series of letters was posthumously published in 3 vols. (*Relation d'un voyage du Levant*, Lyons, 1717). His principal work is entitled *Institutiones rei herbariae* (3 vols. Paris, 1700), and upon this rests chiefly his claims to remembrance as one of the most eminent of the systematic botanists who prepared the way for Linnaeus. He died on the 28th of December 1708.

TOURNEUR, CYRIL (*c.* 1575–1626), English dramatist, was perhaps the son of Captain Richard Turner, water-bailiff and subsequently lieutenant-governor of Brill in the Netherlands. Cyril Tourneur also served in the Low Countries, for in 1613 there is a record made of payment to him for carrying letters to Brussels. He enjoyed a pension from the government of the United Provinces, possibly by way of compensation for a post held before Brill was handed over to the Dutch in 1616. In 1625 he was appointed by Sir Edward Cecil, whose father had been a former governor of Brill, to be secretary to the council of war. This appointment was cancelled by Buckingham, but Tourneur sailed in Cecil's company to Cadiz. On the return voyage from the disastrous expedition he was put ashore at Kinsale with other sick men, and died in Ireland on the 28th of February 1626. (M. BR.)

An allegorical poem, worthless as art and incomprehensible as allegory, is his earliest extant work; an elegy on the death of Prince Henry, son of James I., is the latest. The two plays on which his fame rests, and on which it will rest for ever, were published respectively in 1607 and 1611, but all students have agreed to accept the internal evidence which assures us that the later in date of publication must be the earlier in date of composition. His only other known work is an epicede on Sir Francis Vere, of no great merit as poetry, but of some value as conveying in a straightforward and masculine style the poet's ideal conception of a perfect knight or "happy warrior," comparable by those who may think fit to compare it with the more nobly realized ideals of Chaucer and of Wordsworth. But if Tourneur had left on record no more memorable evidence of his powers than might be supplied by the survival of his elegies, he could certainly have claimed no higher place among English writers than is now occupied by the Rev. Charles Fitzgeoffrey, whose voluminous and fervent elegy on Sir Francis Drake is indeed of more actual value, historic or poetic, than either or than both of Tourneur's elegiac rhapsodies. The singular power, the singular originality and the singular limitation of his genius are all equally obvious in *The Atheist's Tragedy*, a dramatic poem no less crude and puerile and violent in action and evolution than simple and noble and natural in expression and in style. The executive faculty of the author is in the metrical parts of his first play so imperfect as to suggest either incompetence or perversity in the workman; in *The Revenger's Tragedy* it is so magnificent, so simple, impeccable and sublime that the finest passages of this play can be compared only with the noblest examples of tragic dialogue or monologue now extant in English or in Greek. There is no trace of imitation or derivation from an alien source in the genius of this poet. The first editor of Webster has observed how often he imitates Shakespeare; and, in fact, essentially and radically independent as is Webster's genius also, the sovereign influence of his master may be traced not only in the general tone of his style, the general scheme of his composition, but now and then in a direct and never an unworthy or imperfect echo of Shakespeare's very phrase and accent. But the resemblance between the tragic verse of Tourneur and the tragic verse of Shakespeare is simply such as proves the natural affinity between two great dramatic poets, whose inspiration partakes now and then of the quality more proper to epic or to lyric poetry. The fiery impulse, the rolling music, the vivid illustration of thought by jets of insuppressible passion, the perpetual sustenance of passion by the implacable persistency of thought, which we recognise as the dominant and distinctive qualities of such poetry as finds vent in the utterances of Hamlet or of Timon, we recognise also in the scarcely less magnificent poetry, the scarcely less fiery sarcasm, with which Tourneur has informed the part of Vindice—a harder-headed Hamlet, a saner and more practically savage and serious Timon. He was a satirist as passionate as Juvenal or Swift, but with a finer faith in goodness, a purer hope in its ultimate security of triumph. This fervent constancy of spirit relieves the lurid gloom and widens the limited range of a tragic imagination which otherwise might be felt as oppressive rather than inspiriting. His grim and trenchant humour is as peculiar in its sardonic passion as his eloquence is original in the strenuous music of its cadences, in the roll of its rhythmic thunder. As a playwright, his method was almost crude and rude in the headlong straightforwardness of its energetic simplicity; as an artist in character, his interest was intense but narrow, his power magnificent but confined; as a dramatic poet, the force of his genius is great enough to ensure him an enduring place among the foremost of the followers of Shakespeare. (A. C. S.)

BIBLIOGRAPHY.—The complete list of his extant works runs: *The Atheists Tragedie; or, The Honest Man's Revenge* (1611); *A Funerall Poeme Upon the Death of the Most Worthie and True Soldier, Sir Francis Vere, Knight* . . . (1609); "A Griefe on the Death of Prince Henrie, Expressed in a Broken Elegie . . .," printed with two other poems by John Webster and Thomas Haywood as *Three Elegies on the most lamented Death of Prince Henry* (1613); *The Revengers Tragaedie* (1607 and 1608); and an obscure satire, *The Transformed Metamorphosis* (1600). The only other play of Tourneur's of which we have any record is *The Nobleman*, the MS. of which was destroyed by John Warburton's cook. This was entered on the Stationers' Register (Feb. 15, 1612) as a "Tragecomedye called The Nobleman written by Cyrill Tourneur." In 1613 a letter from Robert Daborne to Henslowe states that he has commissioned Cyril Tourneur to write one act of the promised *Arraignment of*

London. "The Character of Robert, earl of Salisburye, Lord High Treasurer of England . . . written by Mr Sevill Turneur . . .," in a MS in possession of Lord Mostyn (Hist. MSS. Commission, 4th Report, appendix, p. 361) may reasonably be assigned to Tourneur. Although no external evidence is forthcoming, Mr R. Boyle names Tourneur as the collaborator of Massinger in *The Second Maid's Tragedy* (licensed 1611).

The Revenger's Tragedy was printed in Dodsley's *Old Plays* (vol. iv., 1744, 1780 and 1825), and in *Ancient British Drama* (1810, vol. ii.). The best edition of Tourneur's works is *The Plays and Poems of Cyril Tourneur, edited with Critical Introduction and Notes*, by J. Churton Collins (1878). See also the two plays printed with the masterpieces of Webster, with an introduction by J A. Symonds, in the "Mermaid Series" (1888 and 1903). No particulars of Tourneur's life were available until the facts given above were abstracted by Mr Gordon Goodwin from the *Calendar of State Papers* ("Domestic Series," 1628–1629, 1629–1631, 1631–1633) and printed in the *Academy* (May 9, 1891). A critical study of the relation of *The Atheist's Tragedy* to *Hamlet* and other revenge-plays is given in Professor A. H. Thorndike's "Hamlet and Contemporary Revenge Plays" (*Publ. of the Mod. Lang. Assoc.*, Baltimore, 1902). For the influence of Marston on Tourneur see E. E. Stoll, *John Webster* . . . (1905, Boston, Massachusetts); pp. 105–116. (M. Br.)

TOURNEUX, JEAN MAURICE (1849–), French man of letters and bibliographer, son of the artist and author J. F E. Tourneux, was born in Paris on the 12th of July 1849. He began his career as a bibliographer by collaborating in new editions of the *Supercheries littéraires* of Joseph Quérard and the *Dictionnaire des anonymes* of Antoine Barbier. His most important bibliographical work was the *Bibliographie de l'histoire de Paris pendant la révolution française* (3 vols. 1890–1901), which was crowned by the Academy of Inscriptions. This valuable work serves as a guide for the history of the city beyond the limits of the Revolution.

His other works include bibliographies of Prosper Mérimée (1876), of Théophile Gautier (1876), of the brothers de Goncourt (1897) and others; also editions of F. M. Grimm's *Correspondance littéraire*, of Diderot's *Neveu de Rameau* (1884), of Montesquieu's *Lettres persanes* (1886), &c.

TOURNON, a town of south-western France, capital of an arrondissement in the department of Ardèche, on the right bank of the Rhone, 58 m. S. of Lyons by rail. Pop. (1906), town, 3642; commune, 5003. Tournon preserves a gateway of the 15th century and other remains of fortifications and an old castle used as town hall, court-house and prison and containing a Gothic chapel. The church of St Julian dates chiefly from the 14th century. The lycée occupies an old college founded in the 16th century by Cardinal François de Tournon. Of the two suspension bridges which unite the town with Tain on the left bank of the river, one was built in 1825 and is the oldest in France. A statue to General Rampon (d. 1843) stands in the Place Carnot. Wood-sawing, silk-spinning, and the manufacture of chemical manures, silk goods and hosiery are carried on in the town, which has trade in the wine of the Rhone hills. Tournon had its own counts as early as the reign of Louis I. In the middle of the 17th century the title passed from them to the dukes of Ventadour.

TOURNUS, a town of east-central France, in the department of Saône-et-Loire, on the right bank of the Saône, 20 m. N. by E. of Mâcon on the Paris-Lyons railway. Pop. (1906), 3787. The church of St Philibert (early 11th century) once belonging to the Benedictine abbey of Tournus, suppressed in 1785, is in the Burgundian Romanesque style. The façade lacks one of the two flanking towers originally designed for it. The nave is roofed with barrel vaulting, supported on tall cylindrical columns. The choir beneath which is a crypt of the 11th century has a deambulatory and square chapels. In the Place de l'Hôtel de Ville stands a statue of J. B. Greuze, born in the town in 1725. There are vineyards in the surrounding district and the town and its port have considerable commerce in wine and in stone from the neighbouring quarries. Chair-making is an important industry.

TOURS, a town of central France, capital of the department of Indre-et-Loire, 145 m. S.W. of Paris by rail. Pop. (1906), town 61,507; commune, 67,601. Tours lies on the left bank of the Loire on a flat tongue of land between that river and the Cher a little above their junction. The right bank of the Loire is bordered by hills at the foot of which lie the suburbs of St Cyr and St Symphorien. The river is crossed by two suspension bridges, partly built on islands in the river, and by a stone bridge of the second half of the 18th century, the Pont de Tours. Many foreigners, especially English, live at or visit Tours, attracted by the town itself, its mild climate and situation in "the garden of France," and the historic châteaux in the vicinity. The Boulevard Béranger, with its continuation, the Boulevard Heurteloup, traverses Tours from west to east dividing it into two parts; the old town to the north, with its narrow streets and ancient houses, contains the principal buildings, the shops and the business houses, while the new town to the south, centring round a fine public garden, is almost entirely residential. The Rue Nationale, the widest and handsomest street in Tours, is a prolongation of the Pont de Tours and runs at right angles to the boulevards, continuing under the name of the Avenue de Grammont until it reaches the Cher.

St Gatien, the cathedral of Tours, though hardly among the greatest churches of France, is nevertheless of considerable interest. A cathedral of the first half of the 12th century was burnt in 1166 during the quarrel between Louis VII. of France and Henry II. of England. A new cathedral was begun about 1170 but not finished till 1547. The lower portions of the west towers belong to the 12th century, the choir to the 13th century; the transept and east bays of the nave to the 14th; the remaining bays, a cloister on the north, and the façade, profusely decorated in the Flamboyant style, to the 15th and 16th centuries, the upper part of the towers being in the Renaissance style of the 16th century. In the interior there is fine stained glass, that of the choir (13th century) being especially remarkable. The tomb of the children of Charles VIII., constructed in the first years of the 16th century and attributed to the brothers Juste is also of artistic interest.

An example of Romanesque architecture survives in the great square tower of the church of St Julien, the rest of which is in the early Gothic style of the 13th century, with the exception of two apses added in the 16th century. Two towers and a Renaissance cloister are the chief remains of the celebrated basilica of St Martin built mainly during the 12th and 13th centuries and demolished in 1802. It stood on the site of an earlier and very famous church built from 466 to 472 by bishop St Perpetuus and destroyed together with many other churches in a fire in 998. Two other churches worthy of mention are Notre-Dame la Riche, originally built in the 13th century, rebuilt in the 16th, and magnificently restored in the 19th century; and St Saturnin of the 15th century. The new basilica of St Martin and the church of St Étienne are modern. Of the old houses of Tours the hôtel Gouin and that wrongly known as the house of Tristan l'Hermite (both of the 15th century) are the best known. Tours has several learned societies and a valuable library, including among its MSS. a gospel of the 8th century on which the kings of France took oath as honorary canons of the church of St Martin. The museum contains a collection of pictures, and the museum of the Archaeological Society of Touraine has valuable antiquities; there is also a natural history museum.

The chief public monuments are the fountain of the Renaissance built by Jacques de Beaune (d. 1527), financial minister, the statues of Descartes, Rabelais and Balzac, the latter born at Tours, and a monument to the three doctors Bretonneau, Trousseau and Velpeau. Tours is the seat of an archbishop, a prefect, and a court of assizes, and headquarters of the IX. Army Corps and has tribunals of first instance and of commerce, a board of trade arbitration, a chamber of commerce and a branch of the Bank of France. Among its educational institutions are a preparatory school of medicine and pharmacy, lycées for both sexes, a training college for girls and schools of fine art and music. The industrial establishments of the town include silk factories and numerous important printing-works, steel works, iron foundries and factories for automobiles, machinery, oil, lime and cement, biscuits, portable buildings, stained glass, boots and shoes and porcelain. A considerable trade is carried on in the wine of the district and in brandy and in dried fruits, sausages and confectionery, for which the town is well known. Three-quarters of a mile to the south-west of Tours lie unimportant remains of Plessis-les-Tours, the chateau built by Louis XI., whither he retired before his death in 1483. On the right bank of the Loire 2 m. above the town are the ruins of the ancient and powerful abbey of Marmoutier. Five miles to the north-west is the large agricultural reformatory of Mettray founded in 1839.

Tours (see Touraine), under the Gauls the capital of the Turones or Turons, originally stood on the right bank of the Loire, a little above the present village of St Symphorien. At first called *Altionos*, the town was afterwards known as *Caesarodunum*. The Romans removed the town from the hill where it originally stood to the plain on the left bank of the river. Behind the present cathedral, remains of the amphitheatre (443 ft. in length by 394 in breadth) built towards the end of the 2nd century might formerly be seen. Tours became Christian about 250 through the preaching of Gatien, who founded the bishopric. The first cathedral was built a hundred years later by St Litorius. The bishopric became an archbishopric when Gratian made Tours the capital of Lugdunensis Tertia though the bishops did not adopt the title of archbishop till the 9th century. About the beginning of the 5th century the official name of Caesarodunum was changed for that of *Civitas Turonorum*. St Martin, the great apostle of the Gauls, was bishop of Tours in the 4th century, and he was buried in a suburb which soon became as important as the town itself from the number of pilgrims who flocked to his tomb. Towards the end of the 4th century, apprehensive of barbarian invasion, the inhabitants pulled down some of their earlier buildings in order to raise a fortified wall, the course of which can still be traced in places. Their advanced fort of Larcay still overlooks the valley of the Cher. Affiliated to the Armorican confederation in 435, the town did not fall to the Visigoths till 473, and the new masters were always hated. It became part of the Frankish dominions under Clovis, who, in consideration of the help afforded by St Martin, presented the church with rich gifts out of the spoils taken from Alaric, confirmed and extended its right of sanctuary, and accepted for himself and his successors the title of canon of St Martin. At the end of the 6th century the bishopric was held by St Gregory of Tours. Tours grew rapidly in prosperity under the Merovingians, but abuse of the right of sanctuary led to great disorder, and the church itself became a hotbed of crime. Charlemagne re-established discipline in the disorganized monastery and set over it the learned Alcuin, who established at Tours one of the oldest public schools of Christian philosophy and theology. The arts flourished at Tours in the middle ages and the town was the centre of the Poitevin Romanesque school of architecture. The abbey was made into a collegiate church in the 11th century, and was for a time affiliated to Cluny, but soon came under the direct rule of Rome, and for long had bishops of its own. The suburb in which the monastery was situated became as important as Tours itself under the name of Martinopolis. The Normans, attracted by its riches, pillaged it in 853 and 903. Strong walls were erected from 906 to 910, and the name was changed to that of Châteauneuf. Philip Augustus sanctioned the communal privileges which the inhabitants forced from the canons of St Martin and the innumerable offerings of princes, lords and pilgrims maintained the prosperity of the town all through the middle ages. A 13th-century writer speaks with enthusiasm of the wealth and luxury of the inhabitants of Châteauneuf, of the beauty and chastity of the women and of the rich shrine of the saint. In the 14th century Tours was united to Châteauneuf within a common wall, of which a round tower, the Tour de Guise, remains, and both towns were put under the same administration. The numerous and long-continued visits of Charles VII., Louis XI., who established the silk-industry, and Charles VIII. during the 15th century favoured the commerce and industry of the town, then peopled by 75,000 inhabitants. In the 15th and 16th centuries the presence of Jean Fouquet the painter of Michel Colomb and the brothers Juste the sculptors, enhanced the fame of the town in the sphere of art. In 1562 Tours suffered from the violence of both Protestants and Catholics, and enjoyed no real security till after the pact entered into at Plessis-lès-Tours between Henry III. and Henry of Navarre in 1589. In the 17th and 18th centuries Tours was the capital of the government of Touraine. Its manufactures, of which silk weaving was the chief, suffered from the revocation of the Edict of Nantes (1685). In 1772 its mint, whence were issued the "livres" of Tours (*librae Turonenses*) was suppressed. During the Revolution the town formed a base of operations of the Republicans against the Vendeans. In 1870 it was for a time the seat of the delegation of the government of national defence. In 1871 it was occupied by the Germans from the 10th of January to the 8th of March.

See P. Vitry, *Tours et les châteaux de Touraine* (Paris, 1905); E. Giraudet, *Histoire de la ville de Tours* (Tours, 1873); *Les Artistes tourangeaux* (Tours, 1885).

TOURVILLE, ANNE-HILARION DE COTENTIN (or Costantin), Comte de (1642–1701), French admiral and marshal of France, was the son of César de Cotentin, or Costantin, who held offices in the household of the king and of the prince of Condé. He is said to have been born at Tourville in Normandy, but was baptized in Paris on the 24th of November 1642, was commonly known as M. de Tourville, and was destined by his family to enter the Order of Malta. From the age of fourteen to the age of twenty-five, he served with the galleys of the Order. At that time the knights were still fighting the Barbary pirates of Algiers and Tunis. The young Anne-Hilarion is said to have been distinguished for courage. His life during these years, however, is little known. The supposed *Memoirs* bearing his name were published by the Abbé de Magron in the 18th century and belong to the large class of historical romances which professed to be biographies or autobiographies. In 1667 he was back in France, and was incorporated in the corps of officers of the French Royal navy which Louis XIV. was then raising from the prostration into which it had fallen during his minority. The positions of French naval officer and knight of Malta were not incompatible. Many men held both. The usual practice was that they did not take the full vows till they were in middle life, and had reached the age when they were entitled to hold one of the great offices. Until then they were free to marry, on condition of renouncing all claim to the chief places. As Anne-Hilarion de Cotentin married a wealthy widow, the marquise de Popelinière, in 1689 at which time he was made count of Tourville, he severed his connexion with the Order. Nor does he appear to have served with it at all after his return to France in 1667. He was at first employed in cruising against the Barbary pirates and the Turks. In the expedition sent against Crete in 1668–69 under command of the Duc de Beaufort he had command of the "Croissant" (44). The Duc de Beaufort was killed, and the expedition was a failure. When the war with Holland in which France and England acted as allies began in 1670, Tourville commanded the "Page" (50), in the squadron of the comte d'Estrées (1624–1707) sent to co-operate with the duke of York. He was present at the battle of Solebay (June 7, 1672), and in the action on the coast of Holland in the following year, when Prince Rupert commanded the English fleet. When England withdrew from the alliance, the scene of the naval war was transferred to the Mediterranean, where Holland was co-operating with the Spaniards. Tourvillle served under Abraham Duquesne in his battles with De Ruyter. He particularly distinguished himself at the battle of Palermo on the 2nd of June 1676. By this time he was known as one of the best officers in the service of King Louis XIV. Unlike many employed by the king to command his ships in the earlier part of his reign, Tourville was a seaman. He had the reputation of being able to do all the work required in a ship, and he had made a study of naval warfare. The great treatise on naval tactics afterwards published under the name of his secretary, the Jesuit Hoste or l'Hoste, was understood to have been inspired by him. In 1683 he was chef d'escadre—rear admiral—with Duquesne in operations against the Barbary pirates, and he continued on that service with D'Estrées. By 1689 he had been promoted lieutenant-général des armées navales, and was named vice-admiral du Levant or of the East. In June of that year he took up the commandership-in-chief of the French naval forces in the war against England and her continental allies which had begun in the previous year. From this time till the failure of his resources compelled King Louis XIV. to withdraw his fleets from the sea, Tourville continued to command the naval war in the Channel and the Atlantic. His conduct and example during this period were the source of the system of manœuvring to gain an advantage by some method other than plain fighting. The personal character of Tourville must be held to account largely for the timidity of the principles he established. Tourville's personal valour was of the finest quality, but like many other brave men, he was nervous under the weight of responsibility. It is no less clear that anxiety to avoid risking a disaster to his reputation was of more weight with him than the wish to win a signal success. He belonged to the type of men in whose minds the evil which may happen is always more visible than the good. In 1690 he had an opportunity which might well have tempted the most cautious, and he missed it out of sheer care to keep his fleet safe against all conceivable chances, aided perhaps by a pedantic taste for formal, orderly movement. He was opposed in the channel by the allies, who had only fifty-six ships, while his own force, though it included some vessels of no serious value, was from seventy to eighty sail strong. He was feebly attacked by Admiral Arthur Herbert, the newly created earl of Torrington, off Beachy Head on the 10th of July. The Dutch ships in the van were surrounded. The allies had to retreat in disorder, and Tourville followed in "line of battle" which limited his speed to that of his slowest ship. So his enemy escaped with comparatively little loss. In the following year he performed his famous "off shore cruise," in the Bay of Biscay. He moved to and fro in fine order avoiding being brought to battle, but also failing to inflict any harm on his opponent. In the meantime the cause of King James II. was ruined in Ireland. In 1692 the Mediterranean fleet having failed to join him, he was faced by a vastly superior force of the allies. The French king had prepared a military force to invade England, and Tourville was expected to prepare the way. Having at least a clear indication that he was expected to act with vigour, if not precise orders to fight against any odds, he made a resolute attack on the centre of the allies on the 29th of May off Cape Barfleur, and drew off before he was surrounded. This action which with the pursuit of the following days made up what is called the battle of La Hogue, from the Bay where some of the fugitive French ships were destroyed, or Barfleur, proved his readiness to face danger. But his inability to take and act on a painful decision was no less proved in the retreat. He hesitated to sacrifice his crippled flagship, and thereby detained his whole fleet. The result was that the "Soleil Royale" herself and fifteen other ships were cut off and destroyed at La Hogue. In 1693 he was again at sea with a great fleet, and had a chance to inflict extreme injury on the allies by the capture of the Smyrna convoy which included their whole Mediterranean trade for the year. He did it a great deal of harm outside the Straits of Gibraltar, but again he kept his fleet in battle order, and a large part of the convoy escaped. King Louis XIV. who had a strong personal regard for him, continued to treat him with favour. Tourville was made Marshal of France in 1693, but the growing exhaustion of the French treasury no longer allowed the maintenance of great fleets at sea. Tourville remained generally at Toulon, and had no more fighting. He died in Paris in 1701. His only son, a colonel in the army, was killed at Denain in 1712.

The English account of the battles of Beachy Head and La Hogue will be found in Ledyard's Naval History. Troude's *Batailles navales de la France* gives the French version of these and the other actions in which Tourville was concerned. Tourville is frequently mentioned in the *Life of Duquesne* by M. Jal. (D. H.)

TOUSSAINT L'OUVERTURE (or Louverture), **PIERRE-DOMINIQUE** (*c.* 1746–1803), one of the liberators of Haiti, claimed to be descended from an African chief, his father, a slave in Haiti, being the chief's second son. He was at first surnamed Breda, but this was afterwards changed to L'Ouverture in token of the results of his valour in causing a gap in the ranks of the enemy. From childhood he manifested unusual abilities and succeeded, by making the utmost use of every opportunity, in obtaining a remarkably good education. He obtained the special confidence of his master, and was made superintendent of the other negroes on the plantation. After the insurrection of 1791 he joined the insurgents, and, having acquired some knowledge of surgery and medicine, acted as physician to the forces. His rapid rise in influence aroused, however, the jealousy of Jean François, who caused his arrest on the ground of his partiality to the whites. He was liberated by the rival insurgent chief Baisson, and a partisan war ensued, but after the death of Baisson he placed himself under the orders of Jean François. Subsequently he joined the Spaniards, but, when the French government ratified the act declaring the freedom of the slaves, he came to the aid of the French. In 1796 he was named commander-in-chief of the armies of St Domingo, but, having raised and disciplined a powerful army of blacks, he made himself master of the whole country, renounced the authority of France, and announced himself "the Buonaparte of St Domingo." He was taken prisoner by treachery on the part of France, and died in the prison of Joux, near Besançon, on the 27th of April 1803.

See Toussaint l'Ouverture's own *Mémoires*, with a life by Saint Remy; (Paris, 1850); Gragnon-Laconte, *Toussaint Louverture* (Paris, 1887); Schölcher, *Vie de Toussaint Louverture* (Paris, 1889); and J. R. Beard, *Life of Toussaint Louverture* (1853).

TOW, the term given in textile manufacture to the short fibres formed during the processes of scutching and hackling, and also to the yarns which are made from these fibres. A special machine termed a carding engine or a tow card is used to form these fibres into a sliver, this sliver then passes to the drawing frames, and thereafter follows the same process as line yarns in flax spinning.

TOWANDA, a borough and the county-seat of Bradford county, Pennsylvania, U.S.A., on the west bank of the Susquehanna river, about 50 m. N.W. of Wilkes-Barré. Pop. (1890), 4169; (1900), 4663 (322 foreign-born); (1910) 4281. Towanda is served by the Lehigh Valley and the Susquehanna & New York railways. It is situated about 730 ft. above the sea, and is surrounded by high hills. Towanda contains the museum of the Bradford County Historical Society. The borough is in a farming, dairying and stock-raising region, and has various manufactures. The first settlement was made by William Means in 1786, the village was laid out in 1812, became the county-seat in the same year, was variously known for some years as Meansville, Overton, Williamson, Monmouth and Towanda, and in 1828 was incorporated as the borough of Towanda. Its name is an Indian word said to mean "where we bury the dead."

TOWCESTER, a market town in the southern parliamentary division of Northamptonshire, England, 8 m. S.S.W. of Northampton, on the East & West Junction and the Northampton & Banbury Junction railways. Pop. (1901), 2371. It is pleasantly situated on the small river Tove, a left-bank affluent of the Ouse. The church of St Lawrence is a good Early English, Decorated and Perpendicular building, with a fine western Perpendicular tower. There are a considerable agricultural trade and a manufacture of boots and shoes.

Here was a Roman town or village situated on Watling Street. The site has yielded a considerable number of relics. In the 10th century a fortress was maintained here against the invading Danes. The site of both this and the Roman station is marked by an artificial mound known as Burg Hill, not far from the church, above the river. Towcester, with the whole of this district, witnessed a large part of the operations during the Civil War of the 17th century.

TOWEL, a cloth used for the purpose of drying the hands, face or body after bathing or washing. These cloths are made of different materials, known as "towellings," the two principal kinds are "huckaback," a slightly roughened material for chamber towels for face and hands, and Turkish towelling, with a much rougher surface, for bath towels; finer towellings are made of linen or damask. The term has a particular ecclesiastical usage as applied to a linen altar cloth or to a rich cloth of embroidered silk, velvet, &c., covering the altar at all "such periods when Mass is not being celebrated."

The Mid. Eng. *towaille* comes through the O. Fr. *touaille* from the Low Lat. *toacula*, represented in other Romanic languages by Sp. *toalla*, Ital. *tovaglia*; this is to be referred to the Teutonic verb meaning "to wash," O. H. G. *twahon*, M. H. G. *dwahen*, O. Eng. *þwean*, and cf. Ger. *Zwehle*, provincial Eng. *dwile*, a dish-cloth.

TOWER (Lat. *turris*; Fr. *tour, clocher*; Ital. *torre*; Ger. *Thurm*), the term given to a lofty building originally designed for defence, and, as such, attached to and forming part of the fortifications of a city or castle. Towers do not seem to have existed in Egypt, but in Mesopotamia from the earliest times they form the most important feature in the city walls, and are shown in the bas-reliefs of the Assyrian palaces at Nimroud and elsewhere. The earliest representation is perhaps that engraved on the tablet in the lap of Gudea the priest king of Lagash (2700 B.C.), whose statue, found at Tello, is now in the Louvre; the drawing is that of a large fortified enclosure, with gates, bastions and towers, corresponding with remains of similar structures of the same and later periods. In the discoveries made here, at Susa and at Dom Sargoukin, the towers were about 40 ft. square, projecting from 16 to 20 ft. in front of the curtain walls which connected them, and standing about 80 ft. apart. In Roman and Byzantine times this distance was increased, owing probably to the greater speed of projectiles, and in the wall built by Theodosius at Constantinople the towers were 150 ft. apart (see also CASTLE and FORTIFICATION).

From the architectural point of view, the towers which are of chief interest are those of ecclesiastical and secular buildings, those in Italy being nearly always isolated and known as campanili (see CAMPANILE). In England the earliest known are the Anglo-Saxon towers, the best examples of which are those at Earl's Barton, Monkwearmouth, Barnack, Barton-on-Humber and Sompting; they were nearly always square on plan and situated at the west end, in an axial line with the nave, their chief characteristics being the long-and-short work of the masonry at the quoins, the decoration of the wall with thin pilaster strips, and the slight setting back of the storeys as they rose. There are a few examples of central Anglo-Saxon towers, as at St Mary's, Dover; Breamore, Hants; and Dunham Major, Norfolk; and, combined with western towers, at Ramsay and Ely; twin western towers existed at Exeter. Contemporary with these Saxon towers are many examples in France, but they are invariably central towers, as at Germigny-des-Près and at Querqueville in Normandy; in Germany the twin towers of Aix-la-Chapelle are the best known. As a rule the single western tower is almost confined to England, prior to the end of the 11th century, when there are many examples throughout Germany. In Norman times in England, central towers are more common, and the same obtains in France, where, however, they are sometimes carried to a great height, as at Périgueux, where the wall decoration consists of pilasters in the lower storeys, and semi-detached columns above, probably based on that of the Roman amphitheatre there: otherwise the design of the Romanesque church towers is extremely simple, depending for its effect on the good masonry and the enrichment of the belfry windows. In later periods flat buttresses are introduced, and these gradually assume more importance and present many varieties of design; greater apparent height is given to the tower by the string courses dividing the second storeys, and by rich blank arcading on them, the upper storey with the belfry windows forming always the most important feature of the tower. In those towers which are surmounted by spires (*q.v.*) the design of the latter possesses sometimes a greater interest both in England and France. A very large number of the towers of English cathedrals and churches have flat roofs enclosed with lofty battlemented parapets and numerous pinnacles and finials; in France such terminations are not found, and in Germany the high pitched roof is prevalent everywhere, so that the numerous examples in England have a special interest; sometimes the angle buttresses are grouped to carry octagonal pinnacles, and sometimes, as at Lincoln and Salisbury, octagonal turrets rise from the base of the tower.

Among the finest examples are those of Canterbury, Ely, York, Gloucester, Lincoln and Worcester cathedrals; among churches, those of the minster at Beverley; St Mary's, St Neots (Huntingdonshire); St Stephen's, Bristol, St Giles, Wrexham (Denbighshire—in many respects the most beautiful in England); St Mary Magdalene, Taunton; Magdalen College, Oxford, St Botolph, Boston, crowned with an octagonal tower, St Mary's, Ilminster (Somersetshire) and Malvern (Worcestershire); and the isolated towers at Chichester, Evesham and Bury St Edmund's.

So far reference has been made only to central and western towers, the latter not always placed, like the Anglo-Saxon towers, in the axial line of the nave, but sometimes on the north or south side of the west end; and as a rule these are only found in England. In France and Germany, however, they are greatly increased in number; thus in Reims seven towers with spires were contemplated, according to Viollet-le-Duc, but never completed; at Chartres eight towers, and at Laon seven, of which six are completed; in Germany the cathedrals of Mayence and Spires and two of the churches in Cologne have from four to seven towers; and at Tournai cathedral, in Belgium, are seven towers. In many of the churches in Norfolk and Suffolk the western tower is circular, owing probably to the fact that, being built with stone of small dimensions, the angles of the quoins would have been difficult to construct. In some of the French towns, isolated towers were built to contain bells, and were looked upon as municipal constructions; of these there are a few left, as at Béthune, Évreux, Amiens and Bordeaux, the latter being a double tower, with the bells placed in a roof between them.

The towers of secular buildings are chiefly of the town halls, of which there are numerous examples throughout France and Belgium, such as those of the hôtel de ville at St Antonin (13th century) and Compiègne, both in France; at Lübeck, Danzig and Munster in Germany; and Brussels, Bruges and Oudenarde in Belgium.

(R. P. S.)

TOWER OF LONDON, THE, an ancient fortress on the east side of the City of London, England, on the north bank of the river Thames. On a slight elevation now called the Tower Hill, well protected by the river and its marshes, and by woods to the north, there was a British stronghold. Tradition, however, pointed to Julius Caesar as the founder of the Tower (Shakespeare, *Richard III.*, III., i; and elsewhere), and remains of Roman fortifications have been found beneath the present site. The Tower contains barracks, and is the repository of the regalia. It covers an irregular hexagonal area, and is surrounded by a ditch, formerly fed by the Thames, but now dry. Gardens surround it on the north and west, and an embankment borders the river on the south. Two lines of fortifications enclose the inner bail, in which is the magnificent White Tower or Keep, flanked by four turrets. This was built by Gundulf, bishop of Rochester, *c.* 1078. Its exterior was restored by Sir Christopher Wren, but within the Norman work is little altered. Here may be seen a collection of old armour and instruments of torture, the rooms said to have been Sir Walter Raleigh's prison, and the magnificent Norman chapel of St John. Among the surrounding buildings are the barracks, and the chapel of St Peter ad Vincula, dating from the early part of the 14th century, but much altered in Tudor times. The Ballium Wall, the inner of the two lines of fortification, is coeval with the keep. Twelve towers rise from it at intervals, in one of which, the Wakefield Tower, the Regalia or crown jewels are kept. The chief entry to the fortress is through the Middle Tower on the west, across the bridge over the moat, and through the Byward Tower. The Lion Gate under the Middle Tower took name from a menagerie kept here from Norman times until 1834. On the south, giving entry from the river through St Thomas Tower and the Bloody Tower, is the famous Traitor's Gate, by which prisoners of high rank were admitted. The chief historical interest of the Tower lies in its association with such prisoners. The Beauchamp Tower was for long the place of confinement, but dungeons and other chambers in various parts of the building are also associated with prisoners of fame. Executions took place both within the Tower and on Tower Hill. Many of those executed were buried in the chapel of St Peter ad Vincula, such as Sir Thomas More, Henry VIII.'s queens, Anne Boleyn and Katharine Howard, Lady Jane Grey and her husband Dudley, Sir Walter Raleigh, and the duke of Monmouth. The Tower was not only a prison from Norman times until the 19th century, but was a royal residence at intervals from the reign of Stephen, if not before. The royal palace was demolished by order of Cromwell. The tower is under the governorship of a constable. The attendant staff, called Yeomen of the Guard or familiarly "Beefeaters," still wear their picturesque Tudor costume.

Authorities.—W. Hepworth Dixon, *Her Majesty's Tower* (London, 1869); Lord Ronald Sutherland Gower, *The Tower of London* (London, 1901).

TOWN, in its most general sense, a collection or aggregation of inhabited houses larger than a village. The O. Eng. *tun* (M. Eng. *toun*) meant originally a fence or enclosure, cf. Ger. *zaun*, hedge, hence an enclosed place. The Scottish and Northern English use of the word for a farmhouse and its buildings, a farmstead, preserves this original meaning, and is paralleled by the Icel. *tun*, homestead, dwelling-house. A cognate Celtic form meaning a fastness, a strong place, appears in Gael. and Irish *dun*, Welsh, *din*, fortress, hill-fort (cf. Welsh *dinas*, town). This is familiar from the many Latinized names of places, *e.g. Lugdunum*, *Augustodunum*, &c. In English law "town" is not a word defined by statute. For purposes of local government there are boroughs, urban districts and rural districts, but many urban districts are rural in character and the distinction is purely an administrative one (see Borough; City; Commune (Medieval); Municipium; England: *Local Government*, and the sections on local administration under various country headings). The meaning attached to the term "township" in the local administration of the United States is treated under United States: *Local Government*.

TOWNELEY (or Townley), **CHARLES** (1737–1805), English archaeologist and collector of marbles, was born at Towneley, the family seat, near Burnley in Lancashire, on the 1st of October 1737. He was educated at the college of Douai, and subsequently under John Turberville Needham, the physiologist and divine. In 1758 he took up his residence at Towneley, where he lived the ordinary life of a country gentleman until about 1765, when he left England to study ancient art, chiefly at Rome. He also made several excursions to the south of Italy and Sicily. In conjunction with Gavin Hamilton, the artist, and Thomas Jenkins, a banker in Rome, he got together a splendid collection of antiquities, which was deposited in two houses bought by him for the purpose in Park Street, Westminster, where he died on the 3rd of January 1805. His solitary publication was an account of an ancient helmet found at Ribchester. His marbles, bronzes, coins, and gems were purchased by the British Museum for about £28,000, and form part of the Graeco-Roman collection.

For an account of the antiquities see Sir Henry Ellis's *The Townley Gallery* (1836), and A. T. F. Michaelis's *Ancient Marbles in Great Britain* (1882).

TOWNLEY, JAMES (1714–1778), English dramatist, second son of Charles Townley, merchant, was born in London on the 6th of May 1714. Educated at Merchant Taylors' School and at St John's College, Oxford, he took holy orders, being ordained priest on the 28th of May 1738. He was lecturer at St Dunstan's in the East, chaplain to the lord mayor, then under-master at Merchant Taylors' School until 1753, when he became grammar master at Christ's Hospital. In 1760 he became head master of Merchant Taylors' School, where in 1762 and 1763 he revived the custom of dramatic performances. He retained his head-mastership until his death on the 5th of July 1778. He took a keen interest in the theatre, and it has been asserted that many of David Garrick's best productions and revivals owed much to his assistance. He was the author, although the fact was long concealed, of *High Life below Stairs*, a two-act farce presented at Drury Lane on the 31st of October 1759; also of *False Concord* (Covent Garden, March 20, 1764) and *The Tutor* (Drury Lane, Feb. 4, 1765).

TOWNSHEND, CHARLES (1725–1767), English politician, was the second son of Charles, 3rd Viscount Townshend, who married Audrey (d. 1788), daughter and heiress of Edward Harrison of Ball's Park, near Hertford, a lady who rivalled her son in brilliancy of wit and frankness of expression. Charles was born on the 29th of August 1725, and was sent for his education to Leiden and Oxford. At the Dutch university, where he matriculated on the 27th of October 1745, he associated with a small knot of English youths, afterwards well known in various circles of life, among whom were Dowdeswell, his subsequent rival in politics, Wilkes, the witty and unprincipled reformer, and Alexander Carlyle, the genial Scotchman, who devotes some of the pages of his *Autobiography* to chronicling their sayings and their doings. He represented Great Yarmouth in parliament from 1747 to 1761, when he found a seat for the treasury borough of Harwich. Public attention was first drawn to his abilities in 1753, when he delivered a lively attack, as a younger son who might hope to promote his advancement by allying himself in marriage to a wealthy heiress, against Lord Hardwicke's marriage bill. Although this measure passed into law, he attained this object in August 1755 by marrying Caroline (d. 1794), the eldest daughter of the 2nd duke of Argyll and the widow of Francis, Lord Dalkeith, the eldest son of the 2nd duke of Buccleuch. In April 1754 Townshend was transformed from the position of a member of the board of trade, which he had held from 1749, to that of a lord of the admiralty, but at the close of 1755 his passionate attack against the policy of the ministry, an attack which shared in popular estimation with the scathing denunciations of Pitt, the supreme success of Single-Speech Hamilton, and the hopeless failure of Lord Chesterfield's illegitimate son, caused his resignation. In the administration which was formed in November 1756, and which was ruled by Pitt, the lucrative office of treasurer of the chamber was given to Townshend, and in the following spring he was summoned to the privy council.

With the accession of the new monarch in 1760 this volatile politician transferred his attentions from Pitt to the young king's favourite, Bute, and when in 1761, at the latter's instance, several changes were made in the ministry, Townshend was promoted to the post of secretary-at-war. In this place he remained after the great commoner had withdrawn from the cabinet, but in December 1762 he threw it up. Bute, alarmed at the growth in numbers and in influence of his enemies, tried to buy back Townshend's co-operation by sundry tempting promises, and at last secured his object in March 1763 with the presidency of the board of trade. When Bute retired and George Grenville accepted the cares of official life, the higher post of first lord of the admiralty fell to Townshend's lot, but with his usual impetuosity he presumed to designate one of his satellites, Sir William Burrell (1732–1796), to a place under him at the board, and the refusal to accept the nomination led to his exclusion from the new administration. While in opposition his mind was swayed to and fro with conflicting emotions of dislike to the head of the ministry and of desire to share in the spoils of office. The latter feeling ultimately triumphed; he condescended to accept in the dying days of Grenville's cabinet, and to retain through the "lutestring" administration of Lord Rockingham—"pretty summer wear," as Townshend styled it, "but it will never stand the winter"—the highly paid position of paymaster-general, refusing to identify himself more closely with its fortunes as chancellor of the exchequer. The position which he refused from the hands of Lord Rockingham he accepted from Pitt in August 1766, and a few weeks later his urgent appeals to the great minister for increased power were favourably answered, and he was admitted to the inner circle of the cabinet. The new chancellor proposed the continuance of the land tax at four shillings in the pound, while he held out hopes that it might be reduced next year to three shillings, whereupon his predecessor, William Dowdeswell, by the aid of the landed gentlemen, carried a motion that the reduction should take effect at once. This defeat proved a great mortification to Lord Chatham, and in his irritation against Townshend for this blow, as well as for some acts of insubordination, he meditated the removal of his showy colleague. Before this could be accomplished Chatham's mind became impaired, and Townshend, who was the most determined and influential of his colleagues, swayed the ministry as he liked, pledging himself to find a revenue in America with which to meet the deficiency caused by the reduction in the land tax. His wife was created (August 1767) baroness of Greenwich, and his elder brother George, the 4th viscount, was made lord-lieutenant of Ireland. He himself delivered in the House of Commons many speeches unrivalled in parliamentary history for wit and recklessness; and one of them still lives in history as the "champagne speech." His last official act was to carry out his intention by passing through parliament resolutions, which even his colleagues deprecated in the cabinet, for taxing several articles, such as glass, paper and tea, on their importation into America, which he estimated would produce the insignificant sum of £40,000 for the English treasury, and which shrewder observers prophesied would lead to the loss of the American colonies. Soon after this event he died somewhat suddenly on the 4th of September 1767.

The universal tribute of Townshend's colleagues allows him the possession of boundless wit and ready eloquence, set off by perfect melody of intonation, but marred by an unexampled lack of judgment and discretion. He shifted his ground in politics with every new moon, and the world fastened on him the nickname, which he himself adopted in his "champagne" speech, of the weathercock. His official knowledge was considerable; and it would be unjust to his memory to ignore the praises of his contemporaries or his knowledge of his country's commercial interests. The House of Commons recognized in him its spoilt child, and Burke happily said that "he never thought, did or said anything" without judging its effect on his fellow members.

A *Memoir* by Percy Fitzgerald was published in 1866. See also W. E. H. Lecky, *History of England* (1892); and Horace Walpole, *Memoirs of the Reign of George III.*, edited by G. F. R. Barker (1894).

TOWNSHEND, CHARLES TOWNSHEND, 2nd Viscount (1674–1738), English statesman, was the eldest son of Sir Horatio Townshend, Bart. (*c.* 1630–1687), a zealous supporter of Charles II., who was created Baron Townshend in 1661 and Viscount Townshend of Raynham in 1682. The old Norfolk family of Townshend, to which he belonged, is descended from Sir Roger Townshend (d. 1493) of Raynham, who acted as legal adviser to the Paston family, and was made a justice of the common pleas in 1484. His descendant, another Sir Roger Townshend (*c.* 1543–1590), had a son Sir John Townshend (1564–1603), a soldier, whose son, Sir Roger Townshend (1588–1637), was created a baronet in 1617. He was the father of Sir Horatio Townshend.

Charles Townshend succeeded to the peerage in December 1687, and was educated at Eton and King's College, Cambridge. He had Tory sympathies when he took his seat in the House of Lords, but his views changed, and he began to take an active part in politics as a Whig. For a few years after the accession of Queen Anne he remained without office, but in November 1708 he was appointed captain of the yeomen of the guard, having in the previous year been summoned to the privy council. He was ambassador extraordinary and plenipotentiary to the states-general from 1709 to 1711, taking part during these years in the negotiations which preceded the conclusion of the treaty of Utrecht. After his recall to England he was busily occupied in attacking the proceedings of the new Tory ministry. Townshend quickly won the favour of George I., and in September 1714, the new king selected him as secretary of state for the northern department. The policy of Townshend and his colleagues, after they had crushed the Jacobite rising of 1715, both at home and abroad, was one of peace. The secretary disliked the interference of England in the war between Sweden and Denmark, and he promoted the conclusion of defensive alliances between England and the emperor and England and France. In spite of these successes the influence of the Whigs was gradually undermined by the intrigues of Charles Spencer, earl of Sunderland, and by the discontent of the Hanoverian favourites. In October 1716, Townshend's colleague, James Stanhope, afterwards 1st Earl Stanhope, accompanied the king on his visit to Hanover, and while there he was seduced from his allegiance to his fellow ministers by Sunderland, George being led to believe that Townshend and his brother-in-law, Sir Robert Walpole, were caballing with the prince of Wales, their intention being that the prince should supplant his father on the throne. Consequently in December 1716 the secretary was dismissed and was made lord-lieutenant of Ireland, but he only retained this post until the following April.

Early in 1720 a partial reconciliation took place between the parties of Stanhope and Townshend, and in June of this year the latter became president of the council, a post which he held until February 1721, when, after the death of Stanhope and the forced retirement of Sunderland, a result of the South Sea bubble, he was again appointed secretary of state for the northern department, with Walpole as first lord of the treasury and chancellor of the exchequer. The two remained in power during the remainder of the reign of George I., the chief domestic events of the time being the impeachment of Bishop Atterbury, the pardon and partial restoration of Lord Bolingbroke, and the troubles in Ireland caused by the patent permitting Wood to coin halfpence. Townshend secured the dismissal of his rival, John Carteret, afterwards Earl Granville, but soon differences arose between himself and Walpole, and he had some difficulty in steering a course through the troubled sea of European politics. Although disliking him, George II. retained him in office, but the predominance in the ministry passed gradually but surely from him to Walpole. Townshend could not brook this. So long, to use Walpole's witty remark, as the firm was Townshend and Walpole all went well with it, but when the positions were reversed jealousies arose between the partners. Serious differences of opinion concerning the policy to be adopted towards Prussia and in foreign politics generally led to a final rupture in 1730. Failing, owing to Walpole's interference, in his efforts to procure the dismissal of a colleague and his replacement by a personal friend, Townshend retired on the 15th of May 1730. His remaining years were passed at Raynham, where he interested himself in agriculture and was responsible for introducing into England the cultivation of turnips on a large scale and for other improvements of the kind. He died at Raynham on the 21st of June 1738.

Townshend was twice married—first to Elizabeth (d. 1711), daughter of Thomas Pelham, 1st Baron Pelham of Laughton, and secondly to Dorothy (d. 1726), sister of Sir Robert Walpole. He had eight sons. The eldest son, Charles, the 3rd viscount (1700–1764), was called to the House of Lords in 1723. The second son, Thomas Townshend (1701–1780), was member of parliament for the university of Cambridge from 1727 to 1774; his only son, Thomas Townshend (1733–1800), who was created Baron Sydney in 1783 and Viscount Sydney in 1789, was a secretary of state and leader of the House of Commons from July 1782 to April 1783, and from December 1783 to June 1789 again a secretary of state, Sydney in New South Wales being named after him; his grandson, John Robert Townshend (1805–1890), the 3rd viscount, was created Earl Sydney in 1874, the titles becoming extinct at his death. Charles Townshend's eldest son by his second wife was George Townshend (1715–1769), who after serving for many years in the navy, became an admiral in 1765. The third viscount had two sons, George, 1st Marquess Townshend, and Charles Townshend, who are separately noticed.

For the 2nd viscount see W. Coxe, *Memoirs of Sir Robert Walpole* (1816); W. E. H. Lecky, *History of England in the 18th Century* (1892); and Earl Stanhope, *History of England*.

TOWNSHEND, GEORGE TOWNSHEND, 1st Marquess (1724–1807), eldest son of Charles, 3rd Viscount Townshend (1700–1764), and brother of the politician Charles Townshend (*q.v.*), was born on the 28th of February 1724, his godfather being George I. Joining Cope's dragoons as a captain, he saw some service in the Netherlands in 1745, and as a member of the duke of Cumberland's staff was present at Culloden. Afterwards he accompanied the duke to the Netherlands, and was present at Lauffeld. By 1750 he had become lieutenant-colonel in the 1st Foot Guards, but differences with the duke of Cumberland led to his retirement in that year. This difference soon became hostility, and, coupled with his dread of permanent armies, caused him to give vehement support to the Militia Bill. In this matter his views and his methods of expressing them raised up a host of enemies. The retirement of the duke after the disastrous campaign in North Germany in 1757 brought Townshend back to active service as a colonel, and in 1758 he sailed for North America as one of Wolfe's three brigadiers. In the long and painful operations against Quebec he showed himself a capable officer, but his almost open dissatisfaction with Wolfe's methods sensibly added to the difficulty of the enterprise. At the battle of the Heights of Abraham the command, on the death of Wolfe and the wounding of Monckton, devolved upon Townshend, whose over-caution for a time imperilled the success of the British arms The loss of Montcalm, however, had similarly paralyzed the French, and the crisis passed. Townshend sent home a despatch, announcing the fall of Quebec, which at once became the butt of the wits and the object of criticism of a more serious kind; and when, Monckton having taken over the command in Canada, Townshend returned to England to enjoy, as he hoped, the hero-worship of the public, he was soon involved in bitter controversies. He succeeded to the title in 1764 on his father's death, and in 1767, through his brother's influence, was made lord-lieutenant of Ireland. The story of his viceroyalty may be read in the article on him in the *Dict. Nat. Biog.*, and in Lecky's *History of England in the 18th Century* (vol. iv.). With the best will in the world, and in spite of excellent capacity, he came into continual conflict with the Irish House of Commons in his attempt to form an English party in Ireland, and he excited unmeasured abuse. In 1772 he was recalled. In 1787 he was created Marquess Townshend of Rainham. He died on the 14th of September 1807.

Townshend was twice married—first to Charlotte, Baroness de Ferrars (d. 1770) and secondly to Anne Montgomery (d. 1819). His eldest son George (1755–1811), who became the second marquess, had succeeded to the barony of de Ferrars in 1770 and had been created earl of Leicester in 1784. Although he was in turn master of the mint, joint postmaster-general and lord steward of the royal household, he did not take much part in politics, but showed a great taste for antiquarian studies. His elder son, George Ferrars Townshend, the 3rd marquess (1778–1855), was disinherited by his father for conduct which also compelled him to reside outside England. When he died at Genoa in December 1855 the earldom of Leicester became extinct. The marquessate, however, passed to a cousin, John Townshend (1798–1863), who became the 4th marquess. John James Dudley Stuart Townshend (b. 1866), who became the 6th marquess in 1899, came prominently before the public in 1906 in consequence of a judicial inquiry into his sanity, the decision being that he was not capable of managing his own affairs.

TOWNSVILLE, a town of Elphinstone county, Queensland, Australia, 870 m. direct N.W. of Brisbane. Pop. (1901), 12,717. It is the seat of the Anglican bishop of North Queensland and has a cathedral and several handsome buildings, including the supreme court and the custom-house. It is picturesquely situated partly on the slopes of Castle Hill and Melton Hill, and partly on the banks of Ross Creek, which is spanned by the Victoria Bridge, a swing bridge 550 ft. in length, worked by hydraulic power. The tidal harbour is enclosed by stone breakwaters, and large vessels enter and load frozen meat direct from the refrigerator cars. The port is an outlet for a wide area of pastoral country and for several goldfields, and has regular communication with all ports north and south by lines of steamers. The immigration barracks on Ross Island have accommodation for five hundred persons. The railway station is the terminus of the Northern line, which extends 236 m. to Hughenden. Townsville was founded in 1864 by John Medwin Black and named after his partner Captain Towns. A municipal charter was granted in 1866.

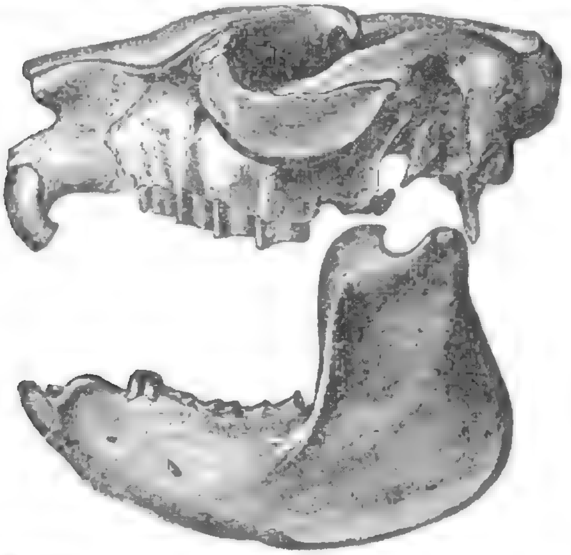
TOWTON, a village of Yorkshire, England, 2½ m. S. of Tadcaster, the scene of a battle fought on Palm Sunday, the 29th of March 1461, between the armies of York and Lancaster. The party of Lancaster had lately won the battle of St Albans, but, unable to gain admission into London, and threatened by the approach of Edward the young duke of York from the west of England, was compelled to fall back northward. York, having been proclaimed as Edward IV. on the 2nd, 3rd and 4th of March 1460/1461, followed them up into Yorkshire, and on the 27th his leading troops surprised the passage of the Aire at Ferrybridge. The Lancastrians were encamped at Towton, some miles away, covering Tadcaster and York; but a force under Lord Clifford was promptly sent out, recaptured Ferrybridge by surprise, and cut to pieces the Yorkist garrison. About the same time, however, Edward's van, under Lord Fauconberg, an experienced soldier, crossed the Aire higher up, and Clifford was compelled to retire. He was closely pressed, and at Dintingdale, within a few furlongs of his own camps, was cut off and killed with nearly all his men. Edward's main body was now close at hand, and the Lancastrians drew up on their chosen battlefield early on the 29th. This field was an elevated plateau, with steep slopes, between the present Great North Road and the river Cock, cut in two by a depression called Towton Dale. On opposite sides of this depression stood the two armies, that of York facing north, their opponents southward. Both lines of battle were very dense. On a front of little more than a thousand yards the Lancastrian party had nearly 60,000 men. Edward's force (less than 50,000) was not all present, the rear "battle" under Norfolk being still distant. Snow and sleet blew in the faces of the Lancastrians and covered the field of battle. The skilful Fauconberg used this advantage to the utmost. Aided by the wind, his archers discharged flights of arrows against the enemy, who replied blindly and feebly, hampered by snow and wind. The Yorkists withdrew until the enemy had exhausted their quivers, and then advanced afresh. Their arrows soon stung the Lancastrians into a wild and disorderly charge. Suffering severe losses the latter closed with Edward's line of battle. No quarter was given by either party, and on the narrow front the numerical superiority of the Lancastrians counted for little. The long, doubtful and sanguinary struggle was only decided by the arrival of Norfolk's corps, which charged the enemy in flank. Driven backwards and inwards, the Lancastrians were in a desperate position, for their only way of escape to Tadcaster crossed the swollen waters of the Cock by a single narrow and difficult ford, and when, after a stubborn struggle, they finally broke and fled, they were slaughtered in thousands as they tried to cross. At the close of the day the defeated army had ceased to exist. Twenty-five thousand Lancastrian and eight thousand Yorkist dead were buried in and about Towton. The neighbourhood of the battlefield contains many relics and memorials of this, the greatest battle hitherto fought on English soil. Particularly well preserved is the tomb of Lord Dacre, a prominent Lancastrian, in Saxton churchyard.

See R. Brooke, *Visits to English Battlefields* (London, 1857); C. R. B. Barrett, *Battles and Battlefields of England* (London, 1896); H. B. George, *Battles of English History* (London, 1895).

TOXICOLOGY, the name of that branch of science which deals with poisons, their effects and antidotes, &c. For the general treatment of the subject and for the law relating to the sale thereof see POISONS, and for the criminal law see MEDICAL JURISPRUDENCE. The term "toxic," meaning poisonous, is derived from Gr. τόξον, bow, owing to the custom of smearing arrows with poison.

TOXODONTIA, a sub-order of extinct South American Tertiary ungulate mammals typified by the genus *Toxodon*, so named from the bow-like curvature of the molar teeth. They all show signs of distant kinship to the Perissodactyla, as regards both limb-structure and dentition; while some exhibit resemblance to the Rodents and Hyraxes—resemblances which, however, are probably to be attributed to parallelism in development.

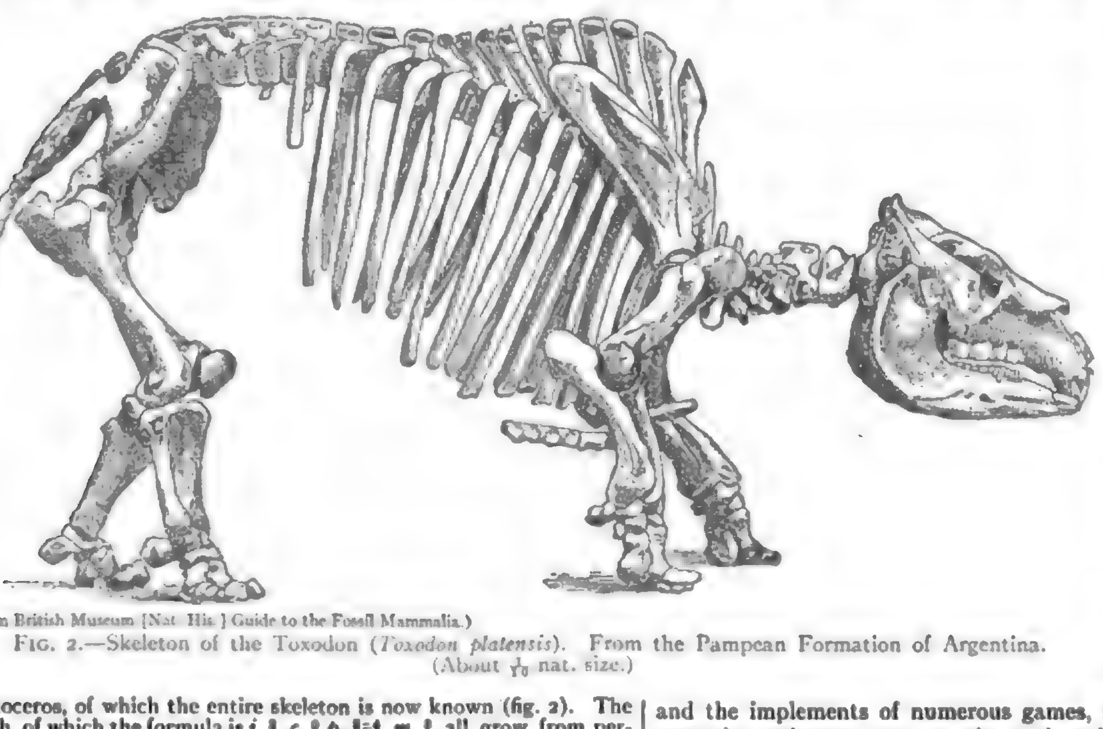
Under the sub-order Toxodontia may be included not only the typical *Toxodon*, but the more aberrant *Typotherium* (fig. 1) of the Pleistocene of Buenos Aires and the smaller *Pachyrucus* and *Hegetotherium* of the Patagonian Santa Cruz beds. All the members of the sub-order have tall-crowned and curved cheek-teeth, some or all of which generally have persistent pulps, while at least one pair of incisors in each jaw is rootless. The bodies of the cervical vertebrae have flat articular surfaces, the bones of the two rows of the carpus alternate, and in the tarsus the navicular articulates with the calcaneum, which, as in the Artiodactyla, is articulated to the fibula, while the astragalus, which is slightly grooved above, is formed on the Perissodactyle plan. The number of toes varies between three and five, of which the middle one is the largest, and the femur may or may not have a third trochanter The Typotheriidae and Pachyrucidae are remarkable among the Ungulates for the retention of clavicles, and for their curious approximation in dentition and certain characters of the skeleton to the Rodentia. The dental formula of *Typotherium* is *i.* $\frac{1}{2}$, *c.* $\frac{0}{0}$, *p.* $\frac{2}{1}$, *m.* $\frac{3}{3}$; that of the smaller Patagonian forms differs by the larger number ($\frac{3}{3}$) of premolars. The toes were unguiculate rather than ungulate in character, except the hind ones (four in number) of *Typotherium*. Certain allied Patagonian forms, such as *Argyrohyrax*, have been supposed to be related to the Hyraxes.



(After Gervais.)

FIG. 1.—Skull of *Typotherium cristatum*, from the Pampas Formation of Buenos Aires.

The Toxodontidae differ from the preceding families by the loss of the clavicles and the reduction of the digits to three in each foot. The typical genus *Toxodon* is represented by animals the size of a rhinoceros, of which the entire skeleton is now known (fig. 2). The teeth, of which the formula is *i.* $\frac{2}{3}$, *c.* $\frac{0}{1}$ *p.* $\frac{4}{3}$–$\frac{3}{3}$, *m.* $\frac{3}{3}$, all grow from persistent pulps; those of the cheek-series are very tall, highly curved, and with a simplified crown-structure. In the older *Nesodon*, on the other hand, the cheek-teeth are shorter-crowned, and depart less widely from a generalized Perissodactyle type, the total number of teeth being forty-four, and there being scarcely any gap in the series. Very remarkable changes occur in the dentition as age advances, most of the teeth eventually developing roots, although the second pair of incisors in each jaw was rootless. The complete skeleton is not yet known, but it is ascertained that the femur differs from that of *Toxodon* in the retention of a third trochanter.



(From British Museum [Nat. His.] Guide to the Fossil Mammalia.)

FIG. 2.—Skeleton of the Toxodon (*Toxodon platensis*). From the Pampean Formation of Argentina. (About $\frac{1}{10}$ nat. size.)

Toxodon is typified by *T. platensis* from the Pampean formation of Buenos Aires. *Toxodontotherium* and *Xotodon* are allied but rather older types. *Nesodon* is from the Santa Cruz beds of Patagonia, the typical *N. imbricatus* having a skull about a foot in length, but *N. ovinus* was a smaller animal, about the size of a sheep.

(R. L.*)

TOY, CRAWFORD HOWELL (1836–), American Hebrew scholar, was born in Norfolk, Virginia, on the 23rd of March 1836. He graduated at the university of Virginia in 1856, and studied at the university of Berlin in 1866–1868. In 1869–1879 he was professor of Hebrew in the Southern Baptist Theological Seminary (first in Greenville, South Carolina, and after 1877 in Louisville, Kentucky), and in 1880 he became professor of Hebrew and Oriental languages in Harvard University, where until 1903 he was also Dexter lecturer on biblical literature.

He wrote *The Religion of Israel* (1882); *Quotations from the Old Testament in the New Testament* (1884); *Judaism and Christianity* (1890); and the *Book of Proverbs* (1899) in the "International Critical Commentary"; and edited a translation of Erdmann's commentary on Samuel (1877) in Lange's commentaries; Murray's *Origin of the Psalms* (1880); and, in Haupt's *Sacred Books of the Old Testament*, the Book of Ezekiel (Hebrew text and English version, 1899).

TOY (an adaptation of Du. *tuig*, tools, implements, stuff, *speltuig*, playthings, *i.e.* stuff to play with, *spelen*, to play), a child's plaything, also a trifle, a worthless, petty ornament, a gew-gaw, a bauble. Children's toys and playthings survive from the most remote periods of man's life on the earth, though many so-called diminutive objects made and used by primitive man, sometimes classified as playthings, may have been workmen's models, votive offerings or sepulchral objects. A large number of wooden, earthenware, stone or metal dolls remain with which the children of ancient Egypt once played; thus in the British Museum collection there is a flat painted wooden doll with strings of mud-beads representing the hair, a bronze woman doll bearing a pot on her head, an earthenware doll carrying and nursing a child; some have movable jointed arms. There are also many toy animals, such as a painted wooden calf, a porcelain elephant with a rider; this once had movable legs, which have disappeared. Balls are found made of leather stuffed with hair, chopped straw and other material, and also of blue porcelain or papyrus. Jointed dolls, moved by strings, were evidently favourite playthings of the Greek and Roman children, and small models of furniture, chairs, tables, sets of jugs painted with scenes of children's life survive from both Greek and Roman times. Balls, tops, rattles and the implements of numerous games, still favourites in all countries and every age, remain to show how little the amusements of children have changed.

See also DOLL; TOP; PLAY; and for the history of toys, with their varying yet unchanging fashions, see H. R. d'Allemagne, *Histoire des Jouets*, and F. N. Jackson, *Toys of other Days* (1908).

TOYNBEE, ARNOLD (1852–1883), English social reformer and economist, second son of Joseph Toynbee (1815–1866), a distinguished surgeon, was born in London on the 23rd of August 1852. He had originally intended to enter the army, but ill health and a growing love of books changed his plans, and he settled down to read for the bar. Here again the same causes produced a change of purpose, and he entered as a student at Pembroke College, Oxford. Finding himself by no means at ease in that college he migrated after two years to Balliol College. Continued ill health prevented his reading for honours, but he made so deep an impression on the authorities of his college that on taking his degree he was appointed lecturer and tutor to students preparing for the Indian civil service. He devoted himself to the study of economics and economic history. He was active also as a practical social reformer, taking part in much public work and delivering lectures in the large industrial centres on economic problems. He overtaxed his strength, and after lecturing in London in January 1883 he had a complete break-down, and died of inflammation of the brain at Wimbledon on the 9th of March.

Toynbee had a striking influence on his contemporaries, not merely through his intellectual powers, but by his strength of character. He left behind him a beautiful memory, filled as he was with the love of truth and an ardent and active zeal for the public good. He was the author of some fragmentary pieces, published after his death by his widow, under the title of *The Industrial Revolution*. This volume deserves attention both for its intrinsic merit and as indicating the first drift of a changing method in the treatment of economic problems. He, however, fluctuated considerably in his opinion of the Ricardian political economy, in one place declaring it to be a detected "intellectual imposture," whilst elsewhere, apparently under the influence of Bagehot, he speaks of it as having been in recent times "only corrected, re-stated, and put into the proper relation to the science of life," meaning apparently, by this last, general sociology. He saw that the great help in the future for the science of economics must come from the historical method, to which in his own researches he gave preponderant weight. Toynbee's interest in the poor and his anxiety to be personally acquainted with them led to his close association with the district of Whitechapel in London, where the Rev. Canon S. A. Barnett (*q.v.*) was at that time vicar—an association which was commemorated after his death by the social settlement of Toynbee Hall, the first of many similar institutions erected in the East End of London for the purpose of uplifting and brightening the lives of the poorer classes.

See F. C. Montague's *Arnold Toynbee* (Johns Hopkins University Studies, 1889); Lord Milner's *Arnold Toynbee: a Reminiscence* (1901); and L. L. Price's *Short History of Political Economy in England* for a criticism of Toynbee as an economist.

TRABEATED, the architectural term given to those styles in which the architrave or beam (Lat. *trabs*) is employed instead of the arch, in the latter case the term "arcuated" being used. The principal trabeated styles are the Egyptian, Persian, Greek, Lycian, nearly all the Indian styles, the Chinese, Japanese and South American styles, in all cases owing their origin to the timber construction, for which reason the term post-and-lintel architecture is sometimes applied to it.

TRACERY, a late coined word from "trace," track, Lat. *trahere*, to draw; the term given in architecture (French equivalents are *réseau*, *remplissage*) to the intersecting ribwork in the upper part of a Gothic window; applied also to the interlaced work of a vault, or on walls, in panels and in tabernacle work or screens. The tracery in windows is usually divided into two sections, plate tracery and rib or bar tracery, the latter rising out of the former, and entirely superseding it in the geometrical, flowing and rectilineal designs. The windows of the Early English period were comparatively narrow slits, and were sometimes grouped together under a single enclosing arch; the piercing of the tympanum of this arch with a circular light produced what is known as plate tracery, which is found in windows of the late 12th century, as in St Maurice, York, but became more common in the first half of the 13th century. In England the opening pierced in the head was comparatively small, its diameter never exceeding the width of one of the windows below, but in France it occupied the full width of the enclosing arch and was filled with cusping, and sometimes, as in Chartres, with cusping in the centre and a series of small quatrefoils round, all pierced on one plane face. In order further to enrich the mullions and arches of the window, they were moulded, as in Stowe church Kent; the other portions were pierced; and finally, to give more importance to the principal lights, additional depth was given to their mouldings, so that they gradually developed into bar or rib tracery, of which the earliest examples in England are those in Westminster Abbey (*c.* 1250) and Netley Abbey near Southampton. Henceforth that which is described in architecture as the "element" ruled the design of the window, and led to the development of geometrical tracery, in which the bars or ribs are all about equidistant from one another. In windows of three lights the heads of the windows consisted of three circular openings, but with four lights they were grouped in two pairs, with a single circle over each and a larger one at the top in the centre. This led to increased dimensions being given to the moulding of the enclosing arches and the upper circle, forming virtually two planes in the tracery. In the great east window at Lincoln, with eight lights, there was a double subdivision and three planes, and here the upper circle was filled with semicircles, so that the openings were all about the same width. In France the upper circle always maintained its predominance, its subdivisions only retaining the scale. The next development, which would seem to have taken place in Gloucester Cathedral, was the omission of portions of the enclosing circle, so as to allow the ribs to run one into the other, forming therefore lines of double curvature, and giving rise to what is known as flowing or flamboyant tracery, of which the great window in Carlisle Cathedral is the most important example. In this window there are nine lights, the four outer ones in each rib being grouped together; these were not subdivided again, and consequently there are only two planes of tracery. The Perpendicular style which followed might perhaps be considered as a reaction against the abuse of the flowing lines in masonry, were it not that in the earlier examples it appears timidly. At Edington church in Wiltshire (1361), in a five-light window, the centre light is wider than the others and its mullions run straight up into the arch mould. In New College chapel, Oxford (1386), the head of the window is subdivided into narrow vertical lights, each half the width of those below, and this is followed in some counties, but not in all, in the east of England the flamboyant tracery being retained a century later. In St Mary's church, Oxford, with seven lights, all the mullions run straight up into the arch mould, and another feature is introduced, already found in New College chapel, and at a much earlier date in domestic work and in spire-lights, viz. the transom. In the later Perpendicular work another change takes place; the pointed arch struck from two centres is replaced by one struck from four centres, and this eventually in domestic work is superseded by the flat arch.

So far reference has been made only to that which may be called the "element" of the window. The enrichment of the lights with cusping gave additional beauty to them, took away the hard wire-drawn effect of the mouldings, and formed openings of great variety: in some of the windows of the Decorated period the ball flower and other foliage is introduced into the mouldings. In French work the geometrical style lasted till the 14th century, and then there was a lapse in building, so that the flamboyant style which followed, and from which at one time it was assumed that the English mason had derived the style, was apparently taken up by the French after its abandonment in England in favour of Perpendicular work. Germany and Spain have always followed in the wake of the French; and in Italy, where architects preferred to decorate their walls with frescoes, the light from stained glass interfered with their effect, so that there was no demand for huge windows or their subdivision with mullions. At the same time there are many beautiful examples of tracery in Italy, generally in marble, such as those of Giotto's Campanile and the cathedral at Florence, in the Ducal and other palaces at Venice, and in the triforium arcades of Pisa and Siena cathedrals; but they destroyed its effect by the insertion of small capitals to the mullions, which gave horizontal lines where they were not wanted, virtually dividing the window into two parts instead of emphasizing, as was done in the Perpendicular period, the verticality of the mullions.

Among the most glorious features in the Gothic architecture of France, England and Spain are the immense rose windows which were introduced, generally speaking, in the transepts of the cathedrals; the tracery of these follows on the lines of those of the windows, changing from geometrical to Decorated and afterwards to flamboyant. In some respects perhaps the finest examples of plate-tracery were produced in the rose windows of the 13th century.

Thus in France in the rose window of Chartres in the west front (1225), and in England in those of Barfreston in Kent (1180) and Beverley Minster in Yorkshire (1220), plate-tracery of such great beauty is found that it is unfortunate it should have been entirely superseded by rib-tracery. The rose window of Lincoln Cathedral in the north transept is a compromise between the two, as all the lights are cut out independently and in one plane, but there are mouldings round each connected with flowers; in its design and effect this window is far superior to the flamboyant circular window in the south transept. Sometimes a rose window is arranged in the upper portion of an ordinary window, as in the west front of Lichfield Cathedral, and this is constantly found in those of the transepts of the French cathedrals. In the south of Italy, at Bari, Bitonto and Troja, and at Orvieto and Assisi, farther north, there are examples of rose windows, but inferior in design to French and English work, though elaborated with carving. The revival of the 16th century was fatal so far as tracery was concerned; in the place of the flamboyant work of the last phase of Gothic in France semicircular and elliptical curves with poor mouldings were introduced, and the elaborate cusping which gave such interest to the light was omitted altogether, as in St Eustache, Paris. There is, however, one remarkable example in the church of Le Grand Andely, in Normandy, dating from the Henri II. period, in which a return was made to the tracery of the 13th century; but the introduction of Renaissance details in the place of the cusping is not altogether satisfactory, though the general design is fine.

The tracery decorating the vault of Gothic work began on the introduction of the fan vault at Gloucester (see Vault); it was only a surface decoration, both rib and web being cut out of the same block of stone, and it received further development in the various phases which followed. In the later Perpendicular work the walls and buttresses were all panelled with blank tracery, the most complete example of which is found in Henry VII.'s chapel, Westminster Abbey.

In tabernacle work the tracery is purely of a decorative character, copied in miniature from the mullions, arch-moulds and crockets of Gothic work.

Some of the most beautiful examples of tracery are those on the rood screens of churches, either in stone as in the Jubé of the Madeleine at Troyes, or in wood as in the rood screens of the churches in East Anglia and in Somersetshire; and with this must be included that which was introduced into the panelling of church doors, choir stalls and other church fittings; this was continued, first in the early Renaissance of the 16th century, the finest examples being those of the stalls of King's College, Cambridge, and afterwards in the Jacobean style, in the church at Croxcombe near Shepton Mallet, and the church of St John at Leeds, the two latter ranking as the best work of that late period. (R. P. S.)

TRACHELIUM (Gr. *τράχηλος*, neck), the term in architecture given to the neck of the capital of the Doric and Ionic orders. In the Greek Doric capital it is the space between the annulets of the echinus and the grooves which marked the junction of the shaft and capital; in some early examples, as in the basilica and temple of Ceres at Paestum and the temple at Metapontum, it forms a sunk concave moulding, which by the French is called the gorge. In the Roman Doric and the Ionic orders the term is given by modern writers to the interval between the lowest moulding of the capital and the top of the astragal and fillet, which were termed the "hypotrachelium" (*q.v.*).

TRACHEOTOMY, the operation of opening the trachea or windpipe (see Respiratory System) and inserting a tube (*canula*) to provide a means of breathing when the natural air-passage is obstructed. The operation is by no means easy when performed on a small child, for the wind-pipe is deeply placed amongst important structures. The chief anxiety is in connexion with haemorrhage, for the vessels are large and generally overfull on account of the impairment of the respiration. The higher the opening is made in the trachea the easier and safer is the operation.

TRACHIS, a city of ancient Greece, situated at the head of the Malian Gulf in a small plain between the rivers Asopus and Melas, and enclosed by the mountain wall of Oeta which here extended close to the sea and by means of the Trachinian Cliffs completely commanded the main road from Thessaly. The position was well adapted as an advanced post against invaders from the north, and furthermore guarded the road up the Asopus gorge into the Cephissus valley. Strangely enough, it is not recorded what part Trachis played in the defence of Thermopylae against Xerxes. Its military importance was recognized in 427 B.C. by the Spartans, who sent a garrison to guard the Trachinian plain against the marauding highland tribes of Oeta and built a citadel close by the Asopus gorge with the new name of Heraclea. The Spartans failed to safeguard Heraclea against the Oetaeans and Thessalians, and for a short time were displaced by the Thebans (420). After a bloody defeat at the hands of the neighbouring mountaineers (409) the Spartan governor quarrelled with the native settlers, whom he expelled in 399. Four years later Thebes used her new predominance in central Greece to restore the Trachinians, who retained Heraclea until 371, when Jason of Pherae seized and dismantled it. The fortress was rebuilt, and after 280 served the Aetolians as a bulwark against Celts and Macedonians. It was captured in 191 by the Romans, but restored to the Aetolian League until 146. Henceforth the place lost its importance; in Strabo's time the original site was apparently deserted, and the citadel alone remained inhabited.

Strabo p. 428; Herodotus vii. 198–203; Thucydides iii. 92, v. 51–52; Diodorus xiv. 38, 82; Livy xxxvi. 22–24. W. Leake, *Travels in Northern Greece*, iii. 24–31 (London, 1835); G. B. Grundy, *Great Persian War*, pp. 261–264 (London, 1901). (M. O. B. C.)

TRACHOMA, the name given to a chronic destructive form of inflammation of the conjunctiva of the eye (see Eye: *Diseases*), or "granular conjunctivitis" (Egyptian ophthalmia). It is a contagious disease, associated with dirty conditions, and common in Egypt, Arabia and parts of Europe, especially among the lower class of Jews. Hence it has become important, in connexion with the alien immigration into the United Kingdom and America, and the rejection of those who are afflicted with it. It is important that all cases should be isolated, and that the spread of the infection should be prevented.

TRACHYTE (Gr. *τραχύς*, rough), in petrology, a group of volcanic rocks which consist mainly of sanidine (or glassy orthoclase) felspar. Very often they have minute irregular steam cavities which make the broken surfaces of specimens of these rocks rough and irregular, and from this character they have derived their name. It was first given by Haüy to certain rocks of this class from Auvergne, and was long used in a much wider sense than that defined above, in fact it included quartz-trachytes (now known as liparites and rhyolites) and oligoclase-trachytes, which are now more properly assigned to andesites. The trachytes are often described as being the volcanic equivalents of the plutonic syenites. Their dominant mineral, sanidine felspar, very commonly occurs in two generations, *i.e.* both as large well-shaped porphyritic crystals and in smaller imperfect rods or laths forming a finely crystalline groundmass. With this there is practically always a smaller amount of plagioclase, usually oligoclase; but the potash felspar (sanidine) often contains a considerable proportion of the soda felspar, and has rather the characteristics of anorthoclase or cryptoperthite than of pure sanidine.

Quartz is typically absent from the trachytes, but tridymite (which likewise consists of silica) is by no means uncommon in them. It is rarely in crystals large enough to be visible without the aid of the microscope, but in thin slides it may appear as small hexagonal plates, which overlap and form dense aggregates, like a mosaic or like the tiles on a roof. They often cover the surfaces of the larger felspars or line the steam cavities of the rock, where they may be mingled with amorphous opal or fibrous chalcedony. In the older trachytes secondary quartz is not rare, and probably sometimes results from the recrystallization of tridymite.

Of the ferromagnesian minerals present augite is the most common. It is usually of pale green colour, and its small crystals are often very perfect in form. Brown hornblende and biotite occur also, and are usually surrounded by black corrosion borders composed of magnetite and pyroxene. Sometimes the replacement is complete and no hornblende or biotite is left, though the outlines of the cluster of magnetite and augite may clearly indicate from which of these minerals it was derived. Olivine is unusual, though found in some trachytes, like those of the Arso in Ischia. Basic varieties of plagioclase, such as labradorite, are known also as phenocrysts in some Italian trachytes. Dark brown varieties of augite and rhombic pyroxene (hypersthene or bronzite) have been observed but are not common. Apatite, zircon and magnetite are practically always present as unimportant accessory minerals.

The trachytes being very rich in potash felspar, necessarily contain considerable amounts of alkalis; in this character they approach the phonolites. Occasionally minerals of the felspathoid group, such as nepheline, sodalite and leucite, occur, and rocks of this kind are known as phonolitic trachytes. The soda-bearing amphiboles and pyroxenes so characteristic of the phonolites may also be found in some trachytes; thus aegirine or aegironic augite forms outgrowths on diopside crystals, and riebeckite may be present in spongy growths among the felspars of the groundmass (as in the trachyte of Berkum on the Rhine). Trachytic rocks are typically porphyritic, and some of the best-known examples, such as the trachyte of Drachenfels on the Rhine, show this character excellently, having large sanidine crystals of tabular form an inch or two in length scattered through their fine-grained groundmass. In many trachytes, however, the phenocrysts are few and small, and the groundmass comparatively coarse. The ferromagnesian minerals rarely occur in large crystals, and are usually not conspicuous in hand specimens of these rocks. Two types of groundmass are generally recognized: the trachytic, composed mainly of long, narrow, sub-parallel rods of sanidine, and the orthophyric, consisting of small, squarish or rectangular prisms of the same mineral. Sometimes granular augite or spongy riebeckite occurs in the groundmass, but as a rule this part of the rock is highly felspathic. Glassy forms of trachyte (obsidians) occur, as in Iceland, and pumiceous varieties are known (in Teneriffe and elsewhere), but these rocks as contrasted with the rhyolites have a remarkably strong tendency to crystallize, and are rarely to any considerable extent vitreous.

Trachytes are well represented among the Tertiary and Recent volcanic rocks of Europe. In Britain they occur in Skye as lava flows and as dikes or intrusions, but they are much more common on the continent of Europe, as in the Rhine district and the Eifel, also in Auvergne, Bohemia and the Euganean Hills. In the neighbourhood of Rome, Naples and the island of Ischia trachytic lavas and tuffs are of common occurrence. In America trachytes are less frequent, being known in S. Dakota (Black Hills). In Iceland, the Azores, Teneriffe and Ascension there are Recent trachytic lavas, and rocks of this kind occur also in New South Wales (Cambewarra range), East Africa, Madagascar, Aden and in many other districts.

Among the older volcanic rocks trachytes also are not scarce, though they have often been described under the names orthophyre and orthoclase-porphyry, while "trachyte" was reserved for Tertiary and Recent rocks of similar composition. In England there are Permian trachytes in the Exeter district, and Carboniferous trachytes are found in many parts of the central valley of Scotland. The latter differ in no essential respect from their modern representatives in Italy and the Rhine valley, but their augite and biotite are often replaced by chlorite and other secondary products. Permian trachytes occur also in Thuringia and the Saar district in Germany.

Closely allied to the trachytes are the *Keratophyres*, which occur mainly in Palaeozoic strata in the Harz (Germany), in the Southern Uplands of Scotland, in Cornwall, &c. They are usually porphyritic and fluidal; and consist mainly of alkali felspar (anorthoclase principally, but also albite and orthoclase), with a small quantity of chlorite and iron oxides. Many of them are lavas, but others are probably dikes or thin intrusions. As the analyses given above will show, they differ from trachytes mainly in being richer in soda. (J. S. F.)

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O
Riebeckite trachyte, Hohenberg, Berkum, Rhenish Prussia	66·06	16·46	2·25	1·10	0·19	0·79	6·81	5·52	0·62
Keratophyre, Hamilton Hill, Peebles, Scotland	64·38	16·98	4·04	—	0·28	1·08	7·57	4·30	1·64
Trachyte (Orthophyre) Garleton Hill, Haddington, Scotland	61·35	16·88	0·41	5·01	0·44	2·39	5·26	6·12	1·70
Trachyte, Monte Nuovo, Phlegraean Fields, near Naples, Italy	60·33	18·74	2·84	1·29	0·38	1·15	7·15	7·30	0·56
Trachyte, Algersdorf, Bohemia	64·69	18·39	—	3·44	0·49	1·72	4·61	6·46	0·24

TRACT (from Lat. *tractare*, to treat of a matter, through Provençal *tractat* and Ital. *trattato*), in the literary signification, a work in which some particular subject, or aspect of a subject, is treated. As far as derivation is concerned, a tract is identical with a *treatise*, but by custom the latter word has come to be used for a lengthy monograph on a subject, dealing with it technically and authoritatively, whereas a tract is understood to be brief and rather argumentative than educational. There is, again, the rarer word *tractate*, which is not a tract, in the precise sense, so much as a short treatise.

The word "tract" has come to be used for brief discourses of a moral and religious character only, and in modern practice it seems to be mainly confined to serious and hortatory themes. An essay on poetry, or the description of a passage of scenery, would not be styled a tract. In the Protestant world, the tract which Luther composed in 1520, on the Babylonish captivity, has been taken more or less as the type of this species of literature, which, however, existed long before his day, both in Latin and in the vernacular tongues of western Europe. It is difficult, if not impossible, in early history, to distinguish the tract from other cognate forms of moralizing literature, but it may perhaps be said that the homilies of Ælfric (955–1025?) are the earliest specimens of this class in English literature. Four centuries later Wyclif issued a series of tracts, which were remarkable for their vigour, and exercised a strong influence on medieval theology. Bishop Reginald Pecock published many controversial tracts between 1440 and 1460. Sir Thomas More, John Fisher (d. 1535) and William Tyndale were prominent writers of controversial treatises. It was the Martin Marprelate agitation, in the reign of Elizabeth, which led from 1588 to 1591 to the most copious production of tracts in English literature; of these nearly thirty survive. On the Puritan side the principal writers were John Udall (1560–1592), Henry Barrowe (d. 1593), John Penry (1559–1593) and Job Throckmorton (1545–1601), the tracts being printed in the house of the last-mentioned; on the side of the Established Church the principal authors were Bishop Thomas Cooper (1517–1594) and the poets Lyly and Nash. An enormous collection of tracts was published between 1717 and 1720 in elucidation of what is known as the Bangorian Controversy, set in motion by a sermon of Benjamin Hoadly, bishop of Bangor, on "The Nature of the Kingdom of Christ" (1717). Convocation considered this a treatise likely to impugn and impeach the royal supremacy in religious questions. A vast number of writers took part in the dispute, and Thomas Sherlock (1678–1761) fell into disgrace through the violence of his contributions to it. Convocation was finally obliged to give way.

The most famous collection of tracts published in the course of the 19th century was that produced from 1833 onwards by Newman, Keble and E. B. Pusey, under the title of "Tracts for the Times." Among these Pusey's "Tract on Baptism" (1835) and his "On the Holy Eucharist" (1836) had a profound effect in leading directly to the foundation of the High Church party, so much so that the epithet "Tractarian" was barbarously coined to designate those who wished to oppose the spread of rationalism by a quickening of the Church of England. In 1841 Newman's "Tract No. XC." was condemned by the heads of houses in Oxford, and led to the definite organization of the High Church forces. (X.)

Tract Societies are agencies for the production and distribution, or the distribution only, of Christian literature, more especially in tract form. They vary in importance from the Society for Promoting Christian Knowledge (London), the Religious Tract Society (London) and the American Tract Society (New York)—all of which are publishing houses of recognized standing—to small and purely local organizations for distributing evangelistic and pastoral literature. It was not until the Evangelical Revival that tract work began to develop along its modern lines. Starting from the provision of simple evangelistic literature for home use, the enterprise grew into the provision of Christian literature, not only for home use, but also for the mission fields of the world. With this growth there proceeded another development, the production of books and magazines being added to that of tracts. The title "Tract Society" has, in fact, become misleading, as suggestive of limitations which had but a brief existence and are no longer recognized by the more important agencies. On the other hand it must not be supposed that because the work has gone beyond the provision of tracts, these are no longer widely employed. Probably their use in various forms at home was never wider than it is to-day; whilst in India, China and elsewhere the attack of the Christian tracts is being met by the circulation of vernacular tracts in defence of the non-Christian faiths.

The Society for Promoting Christian Knowledge, founded in 1698, though most widely known as a publishing agency, assists in a wide variety of ways the work of the Church of England. On its publication side, it is for its own Church both a Bible society and a tract society. Moreover, its publications include not only versions of the Holy Scriptures and of the Liturgy, but also theological and general literature in many forms. It has given much attention to providing good reading for children; whilst its tract catalogue is especially rich in works bearing on Christian evidences, Church seasons and the doctrines of the Anglican Church. To the foreign missions of the Church the S.P.C.K. has been a helper of the utmost value, more especially in regard to their medical missions and their use of Christian literature. In the latter case the help is given by grants of works produced either at home or by mission presses in the field. As early as 1720 it was using Arabic; but it has from time to time been of especial value in helping to found a Christian literature in languages or dialects just reduced to writing. Thus whilst recent publications for the mission field include works in Arabic, Chinese and Urdu, they also include publications in Addo, Lunyoro and Sgau Karen.

The Religious Tract Society, founded in 1799, and thus contemporary with the great missionary agencies and the Bible Society, is, like the last-named, an interdenominational organization. Its earliest publications were in English and were tracts. But it speedily undertook book publications and extended its field of operations. It began to provide tracts for China in 1813, and as early as 1817 an auxiliary tract society was founded at Bellary in India by some men of the 84th Regiment. In undertaking book publication, the society became one of the pioneers in the provision of sound and cheap literature; whilst by the issue of the *Sunday at Home*, the *Leisure Hour*, the *Boy's Own Paper*, the *Girl's Own Paper*, the *Cottager and Artisan* and other periodicals, it helped to lead the work in the provision of popular magazines. Like the S.P.C.K., the R.T.S. now produces general theological literature as well as tracts in a variety of forms, whilst it also gives especial attention to the provision of healthy reading matter for young people. Its grants of books and tracts are open to members of all Protestant denominations. The society aids Protestant communities on the Continent by maintaining depôts at Madrid, Barcelona, Lisbon, Vienna, Budapest and Warsaw; whilst it also assists, by grants, publication work in France, Italy, Russia, Turkey and Scandinavia. In the mission field it works mainly through subsidiary tract societies locally organized. The chief of these tract and book societies are in India carried on at Calcutta, Madras, Bombay, Bangalore, Allahabad and Lahore; in China at Peking, Shanghai, Hong Kong, Canton, Hankow, Chung-king and Mukden; and in Japan at Tokio. The literature produced by these organizations ranges from commentaries on the Holy Scriptures to the simplest tracts and leaflets. In 1908 the society opened a special fund in aid of its Chinese work, and by this means the provision of Christian literature in book and tract form for Chinese readers has been greatly extended. Much literature for various foreign fields is also produced in Great Britain and distributed from the society's headquarters. As with the S.P.C.K., the R.T.S. has been of great service in providing (next to the Holy Scriptures) the earliest literature for some languages. Thus it has helped to provide tracts for the Miaos of west China and for the Baganda, together with the *Pilgrim's Progress* in Bemba and in Ewe, two little-known African tongues. The languages in which works produced or aided by the society have appeared number about 300. In the distribution of its grants of tracts for home work nearly all the great evangelical organizations have a share. In the administration of a subsidiary tract society all the evangelical agencies at work in its field are as a rule represented.

In addition to the work of these societies, the production and distribution of tracts at home is carried on by *The Stirling Tract Enterprise*, which also sends grants of its publications to India, Ceylon and Africa; by *The Children's Special Service Mission*, which also issues publications in Chinese, Japanese and some Indian languages; and by *The Scripture Gift Mission*, which sends its publications into China and the East generally. In the mission field *The Christian Literature Society for India* (formerly the Christian Vernacular Educational Society), established in 1858, has its headquarters in London with auxiliary committees in India and Ceylon. It will always be associated with the name of Dr John Murdoch (d. Aug. 10, 1904), its secretary for nearly half a century. It works on similar lines to the tract societies, but includes a wider range of educational literature, in the provision of which it has been especially helpful to the mission schools of India.

The Christian Literature Society for China (formerly the Society for the Diffusion of Literature and General Knowledge among the Chinese) is incorporated (1909) in Shanghai, but has an advisory committee and an executive committee in London. It has been of great service in approaching the official and upper classes of China by its magazines and books, as well as by the diffusion of more popular literature.

The American Tract Society (New York) works, both in regard to domestic and foreign enterprises, upon similar lines to those of the Religious Tract Society. Upper Canada has its tract society also and similar organizations exist on the continent of Europe.

(A. R. B.)

TRACTION (Lat. *trahere*, to draw), the act of drawing or hauling. As used in this article the term refers to the methods of employing animal and mechanical power for transporting persons or things from place to place in wheeled vehicles.

Animal Traction.—The oldest form of motive power is that of animals, those most commonly employed for draught purposes on ordinary roads being horses, mules, donkeys and oxen. On the continent of Europe dogs are often harnessed to light carts or barrows, but in England their use in this way was prohibited by the Cruelty to Animals Act of 1854. Camels and elephants are only rarely used as draught animals in special circumstances.

When men and animals carry burdens, or draw or propel loads in certain vehicles, it is difficult, and sometimes impossible, to determine the duty performed in foot-pounds of work, because of the uncertainty of the amount in pounds of the resistance overcome. In this case, for the purpose of comparing performances of the same kind with each other, a unit is employed called a *foot-pound of horizontal transport*, meaning the conveying of a load of 1 lb 1 ft. horizontally. The following table, given by W. J. Macquorn Rankine, gives some examples of the daily duty of men and horses in units of horizontal transport, L denoting the load in lb, V the velocity in feet per second, and T the number of seconds per day of working:—

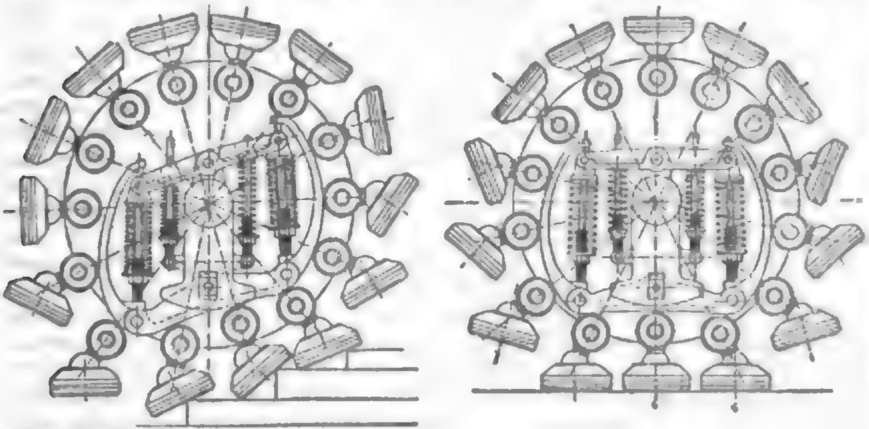
	L.	V.	$\frac{T}{3600}$	LV	LVT.
	lb.	Feet per second.	Hours per day	lb conveyed 1 ft	lb. conveyed 1 ft
MAN—					
Walking unloaded, transport of own weight	140	5·0	10	700	25,200,000
Do. do	140	6·0	10	840	30,240,000
Wheeling load L in two-wheeled barrow, returning empty; V = ½ velocity	224	1·6	10	373	13,428,000
Do. one-wheeled barrow, do.	135	1·6	10	225	8,100,000
Travelling with burden	90	2·5	7	225	5,670,000
Conveying burden, returning unloaded	140	1·6	6	233	5,032,800
Carrying burden for 30 seconds only	252	—	—	—	—
	126	11·7	—	1474·2	—
	—	23·1	—	—	—
HORSE—					
Walking with cart always loaded	1500	3·6	10	5400	194,400,000
Trotting do. do.	750	7·2	4½	5400	87,480,000
Walking with cart, going loaded, returning empty; V = ½ mean velocity	1500	2·0	10	3000	108,000,000
Carrying burden, walking	270	3·6	10	972	34,992,000
Do. trotting	180	7·2	7	1296	32,659,200

For tramway service, horse, or occasionally mule, traction was formerly employed almost universally, but on account of limited speed and high cost it has been generally abandoned, except in a few localities, where the smallness of the line, low value of livestock, labour and feed, and long headway intervals, make it still profitable.

The tractive force required on a straight and level tramway is found to vary from $\frac{1}{150}$ to $\frac{1}{60}$ of the load, according to the condition of the rails. On a tramway having grooved rails in average condition it is about $\frac{1}{100}$. The resistance is thus, at the best, nearly double that on a railway, and sometimes as much as on a good paved road. This is due to the friction of the flange of the wheel in the grooved rail, and to the fact that the latter is always more or less clogged with dirt. The clearance between the flange and the groove is necessarily small, as the former must have sufficient strength, and the latter must be narrow. The least inaccuracy of gauge, therefore, causes extra friction, which is greatly increased on curves. By removing the flanges from two of the four wheels of the tramway car H. E. Tresca (1814–1885) found that the resistance was reduced from $\frac{1}{100}$ to $\frac{1}{140}$ of the load. The resistance due to gravity is of course not lessened on a tramway; and if $\frac{1}{100}$ of the load be the tractive force required on the level, twice as much, or $\frac{1}{50}$ of the load, will be required on a gradient of 1 in 100 and three times as much on a gradient of 1 in 50. To start a tramcar, four or five times as great a pull is required as will keep it in motion afterwards, and the constant starting after stoppages, especially on inclines, is destructive to horses. Horses employed on tramways are worked only a few hours a day, a day's work being a journey of 10 or 12 m., and much less on steep gradients. In London a tramcar horse bought at the age of five years had to be sold at a low price after about four years' work. On the Edinburgh tramways, in consequence of steep gradients, the horses lasted a less time, and had to be constantly shifted from steep to easier gradients. The cost of traction by horses is generally 6d. or 7d. per mile for two horses, and more when the gradients are steep (see also **Tramway**).

Steam Traction.—The most universally used form of motive power is the steam engine, which has been constructed to work on ordinary roads, on tramways and on railways. The road or traction engine comprises a boiler mounted on wheels, and a steam engine usually placed on top of the boiler. The front axle is pivoted so that it may be moved by means of a steering wheel geared to it, and the rear wheels are geared to the engine. The wheel rims are made wide to prevent them from sinking in loose earth or muddy roads. The whole arrangement is similar to the ordinary wheeled portable boiler and engine with the addition of the steering wheel and a gear connexion from the engine to the rear wheels. The tractive power of these engines is high, but their speed low—usually 4 to 6 m. per hour.

A peculiar form of road motor is made by equipping the axles of a traction engine with the so-called "Pedrail" invented by B. J. Diplock. This is an arrangement whereby circular pads or "feet," fastened around the periphery of a wheel, come successively in contact with the ground, the motion approximating to a smooth, even stepping or walking along. Fourteen of these feet are placed around a wheel, and each is attached at the end of a spoke, free to slide radially toward and from the hub of the wheel. Each spoke has fastened to it a helical spring which tends to draw it inwards. On each spoke there is also a roller, which bears against a cam-shaped piece placed inside the periphery of the wheel. The engine is suspended by springs from the cam and is supported by it. The lower edge of the cam is practically straight and horizontal, the length of this straight portion being great enough to subtend an angle equal to the spacing of three spokes, or about 70°. By this means three of the feet are always resting on the roadway and support the engine, which really slides along on the rollers that are at any instant underneath the flat portion of the cam. The feet take successive positions on the ground as the movement of the engine proceeds, and the engine itself rolls along on the rail portion of the cam which rests on the rollers beneath it. Ball and socket joints are used to connect the feet to the spokes so that they may rest on any conformation they may encounter. This machine has shown a remarkable ability to pass over obstacles and rough roads, and even to climb roadless hills. It gives a maximum of adhesion of the drivers, and it is claimed that it will pass over rough roads with the expenditure of less energy than will an ordinary wheeled traction engine. Its speed is necessarily low—about 4 m. per hour.



(From *The Scientific American.*)

Position of the parts in overcoming obstacles.

Position of the parts on a level road.

Fig. 1.—Principle of the Pedrail's operation.

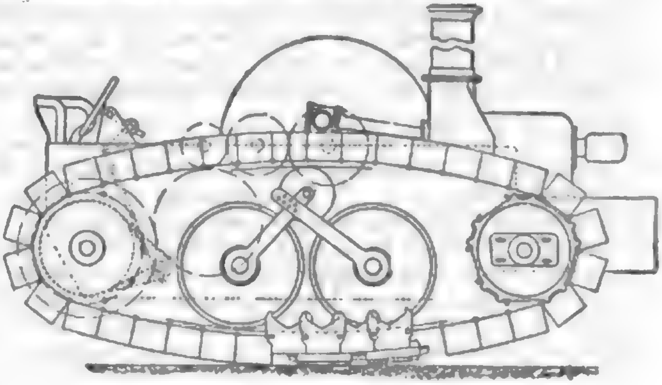


Fig. 2.—Chain Track Tractor.

The Hornsby "Chain Track Tractor" (fig. 2), patented by Mr David Roberts, is provided with two endless chains, one on each side, which constitute the track on which the machine travels. Each chain is carried on two sprocket wheels, placed at the extreme ends of the frame, and is formed of a number of links (fig. 3) so connected that it is free to bend in one direction, as required to pass round the sprocket wheels, but is locked into a rigid bar by pressure acting in the opposite direction. On their outer surfaces these links bear pads or feet, while their inner surfaces compose a track upon which roll the middle or weight-bearing wheels. Power applied to one of the sprocket wheels exerts a pull on the chain, but this being held fast by the weight of the engine pressing the feet to the ground, the effect is to roll the engine along the track, and as this happens the feet at the rear end are one by one lifted off the ground, carried round the sprocket wheels, and relaid at the front of the machine. This construction not only renders the whole weight available for adhesion, but also provides a long supporting base and thus enables the machine to pass over soft ground, loose sand, morasses, &c., in which an ordinary traction engine would certainly sink. Steering is effected by retarding or stopping the motion of the sprocket wheels on the side towards which it is desired to turn.

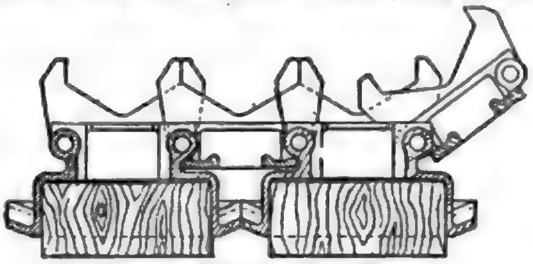


Fig. 3.—Links of Chain Track.

For tramway work steam is scarcely used at all now, though small locomotives—usually having their engines geared to the driving-wheels, instead of the connecting-rods being coupled direct to them—have been used in the past for this work. They were compactly designed and equipped with mufflers to deaden the sound of the exhaust, with other devices to decrease noise and smoke. In some instances, the engine and boiler were placed in the forward end of a car, a partition separating them from the main body of the car in which the passengers were carried.

For description of steam railway engines see **Railways**: *Locomotive Power*, and **Steam Engine**.

Fireless Engines.—Fireless engines were first tried in New Orleans, and were in successful use on tramways in France and

Batavia, Java, for some years. The motive power was obtained from water heated under pressure to a very high temperature in stationary boilers and carried in a reservoir on the engine, where it gave off steam as the pressure and temperature were reduced. Two tons of water heated to give a steam-pressure of 250 ℔ to the square inch served for a run of 8 or 10 m., more than $\frac{8}{10}$ of the water and a pressure of 20 to 25 ℔ above the atmosphere being left on returning to the boiler station. Large boiler-power was required to reheat the engine reservoirs quickly, and this could be afforded for only a few engines; but, when worked on a sufficient scale, the fireless engines were claimed to be economical, the economy resulting from the generation of the steam in large stationary boilers.

Compressed Air.—Compressed air as a motive power offers the advantage of having neither steam nor the products of combustion to be got rid of. In W. D. Scott Moncrieff's engine, which was tried on the Vale of Clyde tramways in 1876, air was compressed to 310 ℔ per sq. in., and expanded in the cylinders from a uniform working pressure to that of the atmosphere. There is a considerable loss of heat during the expansion of the air which is attended with a serious loss of pressure, and in L. Mekarski's system, which was in use for the propulsion of tramcars at Nantes for a number of years, the loss of pressure was considerably lessened by heating the air during expansion. The air, at a pressure of 426 ℔ per sq. in., was stored in cylindrical reservoirs beneath the car, and before use was passed through a vessel three-quarters full of water heated to 300° F., by which it was heated and mixed with steam. The heat of the latter was absorbed by the air during its expansion, first to a working pressure which could be regulated by the driver, and then to atmospheric pressure in the cylinders. At Nantes the average cost for three years of propelling a car holding thirty-four persons was about 6d. per mile. Owing to the heat losses in compressing the air, and other considerable losses incident to its use, the compressed-air systems of traction have been found inefficient and have nearly all been replaced by the more flexible and efficient electric motor.

Cable Traction.—Moving steel cables, propelled by steam engines, have been used for traction. The street railway cars running from New York to Brooklyn, over the Brooklyn Bridge, were for many years propelled by a cable to or from which the cars could be attached or detached at will, and, though electric motors are now used on this line, the cables are still kept in place as a reserve in case of breakdown of the electrical system, and are used whenever an accident to the electrical plant occurs. Before the advent of electric traction, the tramways using cable propulsion were numerous and of great size, as at San Francisco, Chicago, Washington, Baltimore, Philadelphia and New York in America, at Highgate Hill (London) and Edinburgh in the United Kingdom, and at Melbourne in Australia. The Glasgow Subway is so equipped.

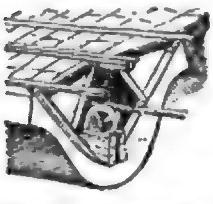


FIG. 4.—Cross-section of Cable Road.

In the usual form, the motive power is transmitted from a stationary engine by a rope of steel wire running always in one direction, up one track and down the other, in a tube midway between the rails, on pulleys (fig. 4) which are arranged so as to suit curves and changes of gradient as well as straight and level lines. Over the rope is a slot ¾ in. wide, in which travels a flat arm of steel connecting the dummy car with the gripper (fig. 5) which grasps the cable. The flat arm is in three pieces, the two outer ones constituting a frame which carries the lower jaw of the gripper, with grooved rollers at each end of it, over which the cable runs when the gripper is not in action. The upper jaw is carried by the middle piece which slides within the outer frame, and can be depressed by a lever or screw, pressing the cable first on the rollers and then on the lower jaw until it is firmly held. The speed of the cable, which is generally 8 to 10 m. an hour, is thus imparted to the car gradually and without jerk. The arrangements for passing the pulleys, for changing the dummy and cars from one line to the other at the end of the road, for keeping the cable uniformly taut, and for crossings and junctions with other lines, are of considerable ingenuity. When the cars are cast off from the cable they must be stopped by hand brakes which, on steep gradients especially, must be of great power.

Gasolene Engine Traction.—Explosive engines using gasolene (petrol) have been used for motive power, and this is the principal form employed in the road motor car. Certain railways in England and America have experimented with cars having a gasolene engine placed in one end to propel the car, the greater part of which is left clear for the accommodation of passengers. These cars are intended for short runs and may in effect be classed as belonging to extended tramway service. They have yielded encouraging results.

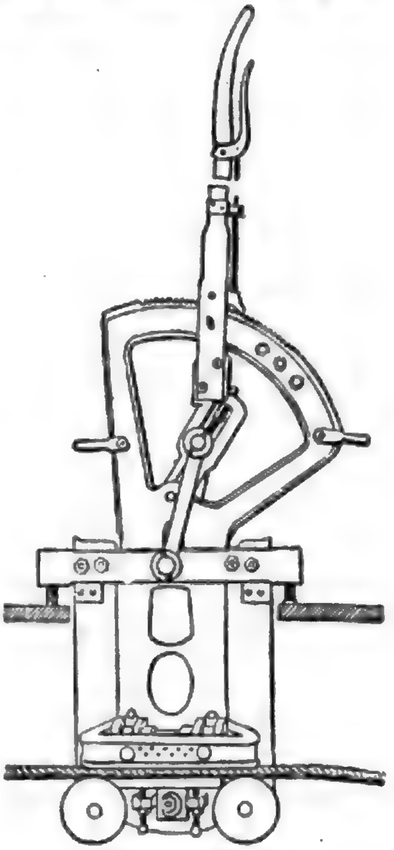


FIG. 5.—Gripper.

Electric Traction.—Electric traction, as treated here, will refer to the operation of vehicles for the transportation of passengers and goods upon tracks, as distinguished from what are known as telpherage systems on the one hand (see CONVEYORS), and automobiles intended to run on common roads on the other (see MOTOR VEHICLES).

Possibly the first electric motor was that made by the Abbé Salvatore dal Negro in Italy in 1830. As early as 1835, Thomas Davenport, a blacksmith of Brandon, Vermont, U.S.A., constructed and exhibited an automobile electric car, operated by batteries carried upon it. Robert Davidson, of Aberdeen, Scotland, began experimenting about 1838 with the electric motor as a means of traction, and constructed a very powerful engine, weighing five tons and carrying a battery of forty cells. This locomotive made several successful trips on Scottish railways, but was finally wrecked by jealous employés of the railway while it was lying in the car sheds at Perth. In 1840 a provisional patent was granted in England to Henry Pinkus, which described a method of supplying electric energy to a moving train from fixed conductors. A little later, in 1845, French and Austrian patents granted to Major Alexander Bessolo described practically what is to-day the third-rail system. In 1847 Professor Moses G. Farmer, of Maine, U.S.A., built a model locomotive operated by electricity, which he exhibited at Dover, New Hampshire, and later at other places in New England. Shortly afterwards Professor C. G. Page, of the Smithsonian Institution in Washington, constructed an electric railway motor, which made a trip on the 29th of April 1851, from Washington, D.C., to Bladensburg, Maryland, over the Baltimore & Ohio railway. This machine carried 100 Grove's cells, and attained speeds as high as 19 m. an hour. Perhaps the beginning of modern electric traction may be said to date from 1879, when the firm of Siemens & Halske put in operation the first electric railway at the Industrial Exposition in Berlin. In America it was not until a year later that real work began and T. A. Edison built an experimental line near his laboratory in Menlo Park, New Jersey. In 1880 a locomotive driven by accumulators was constructed and operated at a linen-bleaching establishment at Breuil-en-Auge, in France; and in 1881 a similar car was worked upon the Vincennes tramway line. On the 12th of May 1881 the first commercial electric railway for regular service was opened for operations at Lichterfelde, in Germany. The first really noteworthy road was that constructed in 1883 at the Giant's Causeway at Portrush, in the north of Ireland. This line was 6 m. long, and the power was obtained from turbine wheels actuated by a cascade on the river Rush. The method of supply was, curiously enough, the third rail.

In 1883 invention in electric railways seems to have taken a decided advance in America. It was in this year that the conflicting interests of Edison and S. D. Field were consolidated; and at the same time C. J. van Depoele and Leo Daft began their experimental work, which later resulted in numerous commercial railways. Next year E. H. Bentley and Walter Knight opened to the public in Cleveland, Ohio, U.S.A., a railway operated by an open-slot conduit, and for the first time worked in competition with horse traction on regular street railway lines. For the next two years much experimental work was done, but it may be said with fairness that the first of the thoroughly modern systems, in which a large railway was equipped and operated under service conditions by electricity, was the line built in Richmond, Virginia, U.S.A., by Frank J. Sprague in 1887. This railway had 13 m. of track, and started with an equipment of forty cars. It has been in continuous and successful commercial operation ever since. The original Richmond system was in all its essential particulars the overhead trolley system now in use. Many improvements have been made in the construction of the motors, the controllers, the trolleys and the various details of car equipment and overhead construction, but the broad principles have not been departed from. The success of the Richmond line called the attention of tramway managers to the advantages of electricity as a motive power, and its substitution for other systems progressed with astonishing rapidity.

The pioneer application of electricity to heavy electric traction was that of the Baltimore & Ohio railway tunnel at Baltimore, Md., U.S.A., and the system was put into operation in 1895. This tunnel is about 1⅓ m. in length and passes under the city of Baltimore. Its route made the expense of ventilation prohibitive, and the smoke and gases from the locomotives made the use of the tunnel impossible without ventilation. The management therefore decided to attempt the use of electric locomotives to haul the trains through, despite the fact that there existed no prior applications of heavy electric motors for even far lighter service than that demanded by the conditions, namely, the propulsion of trains of over 2000 tons up a grade of 42 ft. to the mile. The engineering work and designing of the locomotives were undertaken by Dr Louis Duncan. The locomotives weigh 96 tons and have worked successfully since they were first put into commission. The electric service has been extended 6 m. from the mouth of the tunnel, making a total haul of nearly 8 m. for these locomotives. In 1907 many heavy electric locomotives using continuous current were constructed for the New York Central & Hudson River Railroad Company to operate a distance of about 5 m. from the New York terminus, and others for practically the same service, but using single-phase alternating currents, were put in for the New York, New Haven & Hartford Railroad Company.

It has been fully demonstrated that electricity is superior to its competitors—horses and moving cables—for tramway work. It is cheaper and more flexible. The relative cost of operation varies with the local conditions, but a fair average estimate would be that cable lines cost 25% more to operate than electric, and horse lines 100% more. The increased speed of the electric cars and the comfort rendered possible by larger vehicles always increase the receipts when horse traction is replaced by electric, while the latter, as compared with the cable, allows better and easier control of the car and a much greater possible speed variation. The installation of an overhead electric line costs less than a cable system, though the expense of a conduit electric line is about the same. By the extension of the urban tramway systems into the suburbs and the construction of inter-urban lines, electricity has come into competition with steam. Here the conditions are different. For ordinary suburban service, the electric cars, running through the city streets and on the highways, cannot, in speed, compete with steam trains operated on private rights of way. The fact that they run more frequently and can take up passengers anywhere along the line gives them an advantage, and within limited distances they have taken a large proportion of suburban traffic from steam railways. For long-distance service, in order to compete with steam a speed much greater than that used on ordinary tram-lines must be adopted, while owing to the time spent on the car more attention must be paid to the comfort of the passenger. Speed and comfort being equal, the great advantage of electricity is that, when it is used, the most economical way of transporting a given number of passengers between two points is in a larger number of small trains; with steam the converse is true. A frequent service is a great attraction to passengers.

For freight service, especially on railways having heavy grades, electricity also possesses many advantages, due principally to the peculiarity of the electric locomotive, which admits of its maintaining its tractive effort or so-called "draw-bar pull" when running at relatively high speeds. This steam locomotives cannot do. Thus a steam locomotive weighing 100 tons may exert a draw-bar pull of say 45,000 lb at a speed of 6 m. per hour, while at 15 m. per hour the continuous draw-bar pull will not exceed about 25,000 lb. On the other hand, an electric locomotive weighing 75 tons and having a tractive effort of 34,000 lb at 6 m. per hour will exert a pull of about 27,000 lb at 25 m. per hour. From this it is clear that an electric locomotive may pull a heavier train at a fair speed than can a larger steam locomotive. This admits of more rapid movement of freight trains, and thus decreases the hauling cost. Another advantage the electric system has for freight service is the ability to couple several light locomotives in tandem, all under the control of one driver, and thus pull at a high speed larger trains than may now be drawn by steam locomotives of weights commercially admissible. Also, these lighter motors distribute the weight over the track instead of having it concentrated on a few wheels, and the heavy pounding due to the latter condition is obviated and the maintenance of the track and bridges reduced. Other savings arise from diminished fuel consumption, elimination of water and coal stations with their attendants, and greatly reduced repairs on motive power. The chief disadvantage is the stoppage of all trains on a section if the source of current supply should fail. With proper precautions in design and construction this should be a remote possibility, and since electric rail haulage, in any form attempted up to the present, has shown a reduced cost for a given service as compared with steam traction, it is not improbable that the future will witness great activity in the change from steam to electricity for long-distance railway work.

Systems of electric traction may be divided broadly into two classes, the one employing continuous, the other alternating currents to drive the motors. Both of these classes may be further divided with reference to the conducting system employed between the source of current and the motor. The system may also be divided according to operative units into three classes—the single car, the train pulled by one or more directly controlled locomotives or motor cars, and the train operated by two or more motor cars under a common secondary control. This last is called the "multiple unit system."

Continuous-Current Systems.—The applications of continuous current to electric traction comprise six principal varieties, with numerous modifications and combinations. In all of them the motors are operated under a constant, or approximately constant, potential difference. The system in which cars were connected in series by automatic switches, in limited use in the United States in 1888 and 1889, has now disappeared, and the parallel system of connexion, in which the cars are bridged across between the two conductors of a parallel system, maintained at a substantially constant voltage, has become practically universal.

Overhead Construction.

The overhead conductor and track-return construction is the standard for street railway work in most of the cities where electric traction is employed, though there are some notable exceptions. In its present development the system may be said to have grown out of the work of Sprague in Richmond in 1887. Over the track is suspended a bare wire, generally of hard-drawn copper, known as the trolley wire. The normal practice is to use a wire not less than 0·325 of an inch in diameter to assure permanence, since smaller wires wear out rapidly from the friction of the trolley and the burning of the surfaces of contact. The wire is usually of circular cross-section. Sometimes wires of other sections have been used, notably one having a cross-section similar to the figure 8, but the advantage of these forms is problematical, while the difficulty attending their proper installation is considerable. In some cases the working-conductor, or trolley wire, is suspended at one side of the track, connexion with it being made by a side-bearing trolley, but its usual place is directly over the track, as this arrangement leads to simpler and more efficient construction of the trolleys and their accessory parts. For certain special cases, where very large currents are employed, the overhead conductor is made of bar metal or structural shapes. In the Boston (Massachusetts) subway, where the traffic is very heavy, a bar of rectangular section is used, supported at frequent intervals from the roof. In the Baltimore & Ohio railway tunnel at Baltimore, Md., the steel working-conductor originally consisted of two Z bars forming a trough, the current being collected by an iron shoe, but this form has been replaced by a sectional third rail. But whatever the nature of the conductor, it is usually insufficient to carry the current necessary for the operation of the system without excessive loss. Recourse is therefore had to feeders or reinforcing conductors. These may be of any form, but are most frequently copper wires or cables of large section, connected at intervals of a few hundred feet to the working-conductor. They are sometimes carried on poles, but municipal ordinances frequently require their installation in underground conduits. In general, it is customary to divide the working-conductor into sections of from 1000 to 5000 ft. in length, insulated from one another and fed separately through manual or automatic cut-out switches, so that an accident causing a short-circuit or break in continuity on one section will not impair the operation of others.

In ordinary street railway construction two methods of suspending the trolley wire are in vogue. The most usual construction is to hang it from insulators attached to transverse wires running between pairs of poles set on opposite sides of the track. Bracket arms attached to poles are often used, especially on suburban lines; they are frequently double, or T-shaped, and placed between the two tracks of a double-track line. In the standard construction for either variety of suspension, the insulators are bell-shaped, and composed of some hard moulded or vitreous material. The trolley wire is supported by a clamp about 9 in. long, which embraces about three-quarters of its circumference. This clamp is usually made of bronze, and is now generally fastened to the trolley wire by a screw, causing the two parts of the clamp to close upon the wire as would the jaws of a vice, or is automatic, clamping the wire the more tightly as the strain upon it increases. It was formerly considered expedient to solder the wire into the clamp, but this practice is now generally abandoned. The insulating bell is so designed that its material is subjected only to compression stresses by the weight of the wire. It is provided at its upper part with a single catch for attachment to the transverse wire or to the bracket arm. If a span wire is used it is fastened to the poles, there being turnbuckles to tighten it, while a strain insulator on either side gives a double insulation between the trolley wire and the poles. With a bracket construction it was formerly the custom to attach the insulator directly to the bracket arm, but the blow of the trolley wheel broke great numbers of insulators, and it has therefore become the practice to adopt some more flexible method of attachment, a number of different forms being in use. The poles between which the span wires are stretched, or to which the bracket arms are attached, are of wood or iron. They are firmly set in the ground, usually with concrete.

Catenary Construction.

Another form of overhead construction for high speed service, brought out by the Westinghouse Company and known as the "Catenary" system (fig. 6), is designed to hold the contact or trolley wire in a horizontal position above the track without any dip or sag. Essentially it is made up of a supporting cable made of stranded galvanized steel wire $\frac{7}{16}$ in. in diameter which is firmly fastened to brackets attached to the supporting poles and from which the trolley wire is suspended by means of rigid iron hangers spaced about 10 ft. apart. A proper sag is given the supporting cable, and the lengths of the hangers vary so that the trolley wire is held horizontal without sag. The construction resembles a single supporting cable and suspended chord of a suspension bridge. The trolley wire, the hangers and the suspension cable are all mechanically connected together and in metallic contact, so that the whole system acts as a conductor. The supporting cable is held by insulators at the points where it is supported on the brackets at the poles. For heavy work there the currents taken by the passing cars and locomotives are great, requiring a very large trolley wire, two supporting cables are strung from pole to pole and the trolley wire suspended below and between the two.

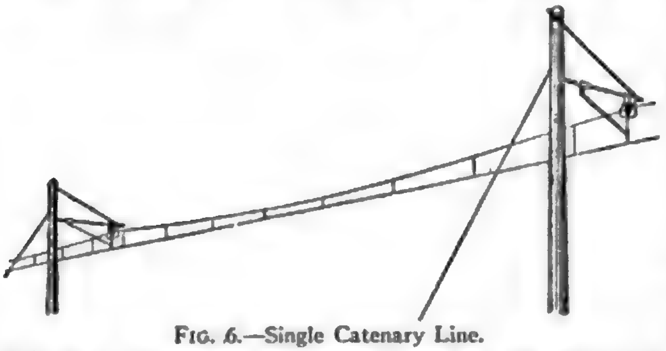


Fig. 6.—Single Catenary Line.

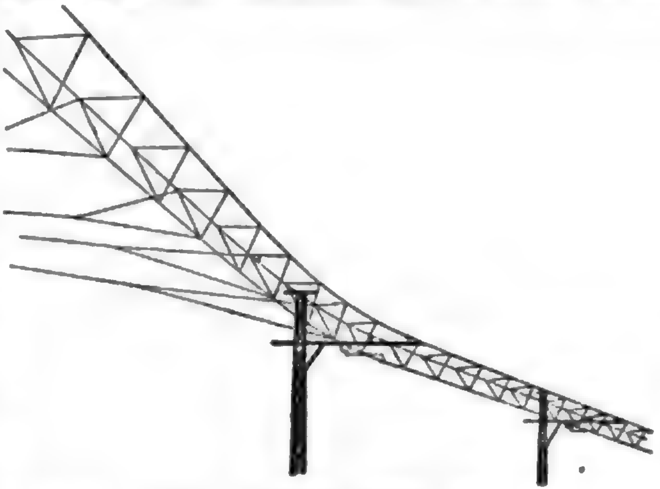


Fig. 7.—Double Catenary Line.

In this case the hangers are triangular in form and hung with the apex of the triangle downward. The two upper angles are fastened to the pair of supporting cables, while to the lower angle is attached the trolley wire. This arrangement is called the "double catenary" construction (fig. 7).

Rail Bonding.

In order to provide a proper return path for the current, the track must be made electrically continuous. This is accomplished by bonding the individual lengths of rail together in some way, or by actually welding them together to form a continuous length. There are many types of rail-bonding. In most of them holes are drilled in the ends of adjacent rails, and a copper conductor inserted between them, its ends being in some way forced against the walls of the holes. In one type the bond is in the form of a hollow cylinder, the ends of which are inserted in the holes in the rails, a tapered steel pin being driven in so as to expand the cylinder out against the rail. In another form the end of the bond is a solid cylinder, which is upset by hydraulic pressure, forcing it against the rail. A semi-plastic amalgam of mercury has been used to give a contact between the adjacent rails and the fish-plate connecting them. The most usual practice is to use a short bond covered and protected by the fish-plates. Tracks used for a return circuit are cross-bonded at intervals. If the track return has too great an electrical resistance it is reinforced by conductors connected to it at intervals and extending back to the power-house. Neglect to provide a proper return circuit has often caused a great loss of energy, and, in many places, excessive electrolytic action on iron pipes, cable sheaths and other metallic bodies buried in the earth. The lightning arresters provided on overhead lines are placed on the poles at intervals determined by the location of the line.

Double Trolley.

In a few places the municipal authorities, in order to avoid the disturbances on telephone lines due to the fluctuation of a trolley current, and the electrolysis of gas and water pipes which may arise from a grounded return, have required the erection of a double overhead system. In this each track has two trolley wires forming a complete metallic circuit. The largest system of this kind is in Cincinnati, Ohio, U.S.A., where there are over 225 m. of tram-lines. The system has the advantages to which it owes its existence, but the multiplicity of wires at crossings, right-angle turnouts and switches is so complicated that automatic switching cannot be attempted. The man in charge of the car removes the double trolley from the wires at such points, and replaces it when they are passed. The construction adopted, except in respect to the points mentioned, is practically similar to that already described for the track-return system.

Open-slot Conduit.

A number of patents have been granted in various countries for electric traction systems in which one or both of the fixed conductors are installed in a conduit underground, communication being had with them by means of an open slot, into which projects a current-taking device of some nature carried by the car as it moves along. A system of this character was installed at Blackpool, England, in 1885, and later one was very successfully operated in Budapest. The first large and important installation of this character to be made was in Washington, D.C., U.S.A., where a considerable system of street railways was changed from horse operation to this new method. The success of this system, and of experiments made on Lenox Avenue, in New York City, led to the construction of many miles of railways of the conduit type in the latter city. It is also used extensively in London. (For details of the construction of the conduits, see TRAMWAY.) This system is much more expensive to install than the overhead trolley system, but experience has shown that it can be as economically operated. Most of the troubles that have occurred have been due to lack of experience, but on the whole they have not been more serious than those experienced with overhead systems.

Closed Conduit.

The great expense of the open conduit has led numerous inventors to bring out systems of operating electric railways by means of closed conduits or sectional third rails, in which the working-conductor is laid on the surface of the ground between the rails, and is connected with the source of current only as the car passes over each section. In this way the immediate section or portion of the working-conductor under the car is electrically active, but other sections are not, and all danger to the passage of street traffic is removed. Up to 1900, nearly one thousand patents for this type of street railway construction, known also as the "surface contact" system, had been granted by the United States patent office alone. So far the system has been introduced in but few places, but its performance has been more than promising, and it is thought that it will be more extensively adopted in the future. Among the more important railways at present equipped with it may be mentioned one in Paris, using the Diatto system, and one at Monte Carlo, where the Westinghouse system is installed. In both these the current is supplied by means of "buttons" or metallic disks laid flush with the surface of the street between the tracks, and connected through switches to a working-conductor. Under the car is installed a current-taking device in the shape of a long runner or skate, which runs over the buttons and is appropriately connected with a storage battery on the car, so that when it touches one of the buttons current is sent from the battery through a system of electro-magnets operating the switches which connect that particular button to the feeding system, and thus the runners are enabled to receive current for the operation of the motors on the car. The various systems differ in the method of connecting the contact rail or button with the live conductors; in some a magnet on the car works a mechanism to make the desired contact, in others a current from batteries on the car actuates a switch located near the track. (See TRAMWAY.)

Third-rail System.

The third-rail system, which is a development of the overhead trolley and track-return system, has been applied to several large and important railway installations, especially in the United States, and in the prolongation of the Orleans railway in Paris from the Place Valhubert to the new station at the Quai d'Orsay. Its name almost sufficiently indicates its method of operation. A rail similar to the track-rails is laid upon insulators and forms the working-conductor. On the elevated railways in New York, Brooklyn, Boston and Chicago and the subway in New York, a pressure of about 600 volts is used between this rail and the track-rails which form the return circuit. Contact is made with the third rail by means of a bronze or cast-iron shoe, either resting upon the rail by its own weight, or pressed down upon it by springs. This is generally attached to some part of the truck of the car in preference to any part of the body of the car, so as to avoid any vibration or swaying due to the movement of the body upon its springs. The third-rail system has been adopted in many instances where large and powerful trains are to be operated on private rights of way, but it is nowhere in use for electric traction upon highways or in streets where there is any passing of foot passengers or vehicles. An excellent example of such construction may be found in the Albany & Hudson railroad, which connects the city of Albany with the city of Hudson, in New York state. Here the length of the road is about 32 m., the track being of standard gauge and laid with a 60-lb T-rail. A T-rail of the same size, raised about 1 ft. above the level of the running-rails, is used for the electrical conductor, and is installed on insulators situated 5 ft. apart on the ends of the cross-ties. All these rails are well bonded with copper bonds at the joints. At road crossings, which on this railroad are at grade, the third rail is omitted for a distance nearly equal to the length of a train. Appropriate cast-iron shoes, fixed to the trucks of the front and rear cars of a train, bridge the space, so that the forward shoes are running on the rail past the break before the rear shoes leave it. Upon this railroad motors of considerable size and power are used, and both passengers and freight in their original cars, as received from connecting steam railways, are transported. Other examples of third-rail construction occur in the extension of the Baltimore & Ohio railway tunnel at Baltimore, the New York Central Railway Company's New York terminal, the underground systems of the City & South London railway, the Waterloo & City railway, and the Central London railway in London, and the Versailles division of the Western railway of France. In some cases, as on the Metropolitan, the District, and several of the "tube" railways in London, the running-rails are not used for the return circuit, which is completed by a fourth rail similar to the conductor rail, laid outside the track.

Accumulators.

One of the oldest forms of electric traction is by accumulators. In brief, its principle is that storage batteries, or accumulators, are carried on the car, which becomes a veritable automobile. It has been the usual practice to instal about 80 cells, giving a pressure of 160 to 175 volts at the motors; these are recharged after the car has run about 25 m. In general, the accumulators are not charged in place, but the car is supplied with a new set, fully charged, at the end of a run of about the length mentioned. The system has been installed in a very large number of places in Europe and America, but has never shown the gratifying commercial success which the direct-conduction systems exhibit, on account of the high cost and depreciation of storage batteries. In some places, notably in Hanover, Germany, where legislative ordinances have forbidden the overhead conducting system in city streets, a combination has been used whereby accumulator cars run in the city districts from the energy stored in their batteries, and in the suburbs operate directly as overhead trolley cars, the batteries being charged at the same time from the overhead system.

Polyphase.

Alternating Current Systems.—Alternating current systems are now being used, both single-phase and three-phase. In the former case the newly-developed single-phase motors, later to be described, are employed, while with three-phase systems induction motors are used. The polyphase current is much used as a means of distributing energy from a central power-station over extended lines of railways, but is generally converted into direct current through the agency of rotary converters, and fed to the lines as such. There are, however, a few railways working directly with induction motors upon a three-phase system of supply. Prominent among these may be mentioned the Valtellina railway in Italy and the Jungfrau railway in Switzerland. Upon these lines the rails are used as one of the three conductors, and two trolley wires are suspended above the track. The locomotive is provided with two trolleys, one running upon each wire, and consists simply of an induction motor coupled through appropriate gearing to the mechanism of the truck. For starting a large resistance is introduced into the rotor or secondary circuit of the motors by means of collecting rings placed on its shaft, upon which bear brushes. This resistance is cut out as the speed increases, until it is all withdrawn and the rotor is short-circuited, when full speed is attained. It has been found that potential differences of about 500 volts in each phase can be safely handled, and it is claimed that the few railways which use polyphase currents have shown gratifying results in practice.

Single-phase.

In the early years of the 20th century single-phase alternating current motors for electric traction were developed, and single-phase systems were extensively installed both in Europe and in America. The simplest type of single-phase motor is a series motor provided with the usual commutator and brushes, in which the current passes through both the field coils and the armature coils. The armature and field windings being traversed by the same current, the reversal of the field magnetization and that of the direction of current flow in the armature are coincident, so that the turning effort or torque, on the armature current produced by the interaction of armature and field magnetization is always in the same direction. Since the alternating current passes through both members of the motor, the armature and field cores are both laminated. In the later types of these motors the field coils are distributed and embedded in the field ring, so that the inner surface of the field ring presents a practically smooth surface to the armature. Troubles were at first experienced with commutation of the heavy alternating currents required for the operation of these motors, vicious sparking taking place at the brushes. This was overcome by the use of auxiliary or "compensating" coils, which are embedded in the field magnet ring, being placed between successive magnet coils. These compensating coils are usually connected in series with the main armature and field circuit. They may each, however, have their two ends joined together, (short-circuited), the currents in them being induced by the alternating magnetic flux of the fields.

Motors of the above types have the general characteristics of direct current series motors, and possess the same general relations between speed and torque that are such an important element in the success of direct current series motors. The efficiency of alternating current motors is not quite so good as that of direct current motors, on account of the rapid reversal of the iron magnetization in the field magnets, but their efficiency is high and their performance in practical work has been excellent (fig. 8).

There is another type of single-phase motor that has been used in Europe, but not in America, which is commonly called the repulsion motor. In these motors the armature is not directly included in the main circuit, but opposite points on the commutator are connected together through brushes. The working current is fed to the field magnets, and the rapid reversals of magnetization induce currents in the armature coils, which currents, working with the field magnetization, cause rotation. Several types of repulsion motors have been developed, and in general their characteristics are similar to those of the plain series type. They have not, however, come into extended commercial use. Single-phase motors for a given power are much larger, heavier and more expensive than the ordinary direct current motors, owing to the low magnetic densities at which the iron is worked. The power factor is between 0·75 and 0·85.

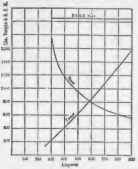


FIG. 8.—Characteristics of Series Single-phase Motor.

The advantages of the single-phase alternating system lie in the fact that it combines the simplicity of the overhead direct current construction with the possibility of exceedingly high voltage. Where heavy traffic is to be handled, and especially where that traffic is scattered, a direct current system, which up to the present has been limited in its voltage, is not commercially possible, as the amount of copper used for distribution and the excessive amount of apparatus required to convert high tension alternating current into low tension direct current, would make the cost prohibitive. In direct current systems for lines of any length, it is the custom to use alternating current of high potential and to reduce it to direct current of low potential at different points along the line. This involves rotary converters, which by their nature require attendance in the sub-stations, while if the traffic is scattered so that the load on the sub-stations may at times be zero, and at other times may be very large, the capacity of the sub-stations must be equal to handling a maximum load, so that the total capacity of each sub-station would be based on the maximum instead of on an average condition. With the single-phase alternating current system, on the contrary, only static transformers in sub-stations along the line are required, and with the high voltages available (voltages as high as 11,000 volts are used at present) the distances between these sub-stations can be greatly increased as compared with the direct current sub-stations, so that each sub-station feeding a much longer portion of the line would have a better average load than in the direct current case. The static transformers do not require attendance, and their efficiency is much higher than that of the rotary converters.

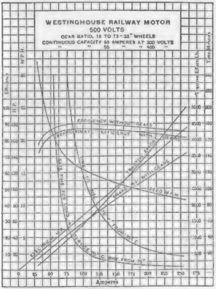


FIG. 9.

Motors.

Electric motors for traction purposes have been highly elaborated and developed. At first they drove the car axles through belts or sprocket chains, the motor being sometimes attached to the car, sometimes to the truck. At Richmond, however, in 1887, the Sprague method of communicating the power from the motor axle to the car axle was put into practical operation, and this has with slight modifications been retained. It consists of sleeving one end of the motor on the axle, suspending the other flexibly from the car body or truck, and driving from the armature through spur gearing. At first the motors were too small for the work demanded of them. Their high speed required a double reduction in gearing, their overheating caused continual burn-outs, and the sparking at the commutators necessitated constant repairs. These defects were gradually eliminated. The motors were made larger, the quality of the iron and insulation was greatly improved, and finally a four-pole motor requiring only a single-speed reduction by spur-gearing was produced. Since that time further improvements in material and design have been introduced, and the present motor has been evolved. Almost all the standard modern traction motors are of the same general design. They are series wound, *i.e.* the same current passes through both the armature and the fields. This gives a strong starting torque or tractive effort, the torque diminishing as the speed increases. This characteristic is particularly suitable for traction. Fig. 9 shows the relation between speed and tractive effort of a standard railway motor of large size and power. The armature is built up of carefully tested iron disks, which are deeply slotted to make room for the coils. These are wound and insulated separately, and placed in the slots in the armature core; sometimes they are held in place by binding wire, sometimes by wedges. The commutator is put in place, the coil connexions soldered to it, and the proper end-coverings put on. The magnet frame is made in two parts, of cast steel, enclosing the entire armature. A lid in the top casting gives access to the brushes, which are of carbon. The field coils are wound on forms and properly insulated. When in operation it is practically water

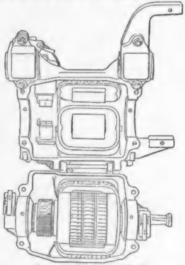


FIG. 10.—Standard Railway Motor.

and dust proof, and with proper attention is a very durable piece of machinery (fig. 10). Although the standard design of motors is at present based on a single-reduction gearing, there are in operation traction-motors which are not geared.

On the locomotives used on the New York Central, the New York, New Haven & Hartford, and the Baltimore & Ohio railways in America, the City & South London railway in England, the armatures surround the driving axles. In all the cases mentioned, except the Baltimore & Ohio railway, the armatures are set directly on and solid with the axles of the driving-wheels, while on the Baltimore & Ohio locomotives the motors are sleeved on the axles, there being a slight play between the sleeve and the axle, which allows a flexible support. The wheels are driven by arms projecting from the armature shaft.

There is no fixed method of rating the output of traction-motors. Most manufacturers, in giving a certain horse-power capacity, mean that at the given rating the motor will run an hour with a rise in temperature of a certain number of degrees, not that it can be run continuously at the power given. Another system of rating depends on the draw-bar pull which the motor can develop under normal conditions of voltage and speed. Uniformity is greatly needed.

Controllers.

One of the most important parts of the equipment of an electric car or locomotive is the controlling device. In the early days of electric traction a number of different methods of regulating the speeds of the cars were used, but they have been reduced to practically one standard method. In the old Sprague system there were at first no resistances outside of the motors themselves, but the field coils of the motors were divided into sections, and by changing the relative connexions of these sections the total resistance of the circuit could be changed; at the same time the strength of the field for a given total current was either increased or decreased. In other systems the fields and armatures of the motors were not changed in their relation to one another, but external resistances were cut out and in by the controller. Usually there are two motors on each car, and it is evident that if the speed of a car be changed within wide limits, all the other factors remaining constant, there will be a very considerable loss by either of these methods of regulating, unless the relative connexions of the motor armatures can be changed. This can be done by putting the two motors in series where low speed is desired, and in parallel where the speed is to be increased. This method was tried in the early days of electric traction at Richmond, and discarded, but it has been again taken up, and is now the standard method of regulation in ordinary tramway work. Roughly speaking, when the car is started the controller connects the two motors in series with an external resistance, then cuts out the external resistance, then breaks the circuit, then connects the two motors in parallel. The external resistance is put again in series with them, and then is gradually cut out as the car speed increases. By this method a considerable range of speed is attained at a fair efficiency. The controller (fig. 11) consists of a cylinder having on it a number of copper segments so arranged that on rotating it different connexions are made between stationary fingers that bear on these segments. In the first types much difficulty was experienced from the burning of the segments and fingers, due to the sparking on breaking the circuit, but this has been to a large extent obviated by using magnetic blow-outs at the point of break. (A magnetic blow-out is simply a magnet so arranged that the arc caused by breaking the circuit takes place in the magnetic field.) There is a reversing lever on the controllers separate from the controller handle, and interlocking with the controller so that the reverse lever may not be moved except when the controller is in the "off" position.

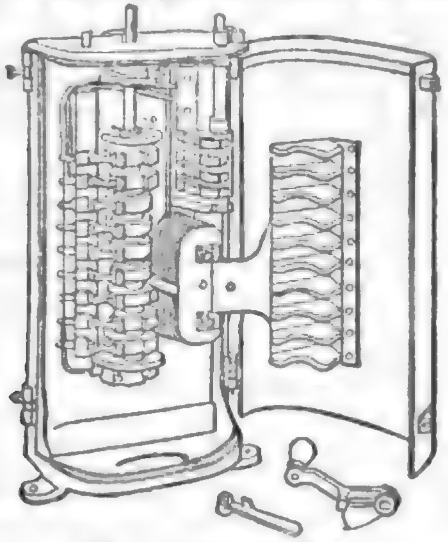


FIG. 11.—Controller (open).

When it is desired to run trains of cars and to accelerate them rapidly, it is sometimes necessary to have more than one car equipped with motors. In this case all the motors must be controlled from one point, and a number of ingenious devices have been evolved to accomplish such "multiple control." In general, each car has its own controller, and all the controllers are operated by electric power from switches on each platform of any of the motor cars.

Regenerative Control.

A motor and controlling system designed to save and utilize the power produced by a car running down an incline has been developed and is termed the "regenerative system." A car running over a line having heavy grades must have sufficient energy given to it to overcome its frictional resistance to motion and also to lift the weight of car and load from the bottom to top of each up-grade. On the return trip, the car "coasts" or runs down the grade without the consumption of current, but is restrained from attaining too high a speed by the brakes, thus wasting the energy existing by reason of the position of the car.

With the regenerative system the motors are caused to act as dynamos which are driven by the motion of the car axles when descending a grade, and, as they are connected to the line by the trolley or contacting device, the current thus generated is fed to the line and may assist other cars climbing grades at some other point on the system. The delivery of electrical energy also puts a resistance on the car axles and produces a braking effect which almost automatically fixes the car speed. If the speed be too high, the excessive current generated will tend to retard the car and reduce its velocity, while if too low the small current produced will set up but little opposition to motion and the car will accelerate.

Obviously, series motors cannot be used for this service. The motors have shunt fields, and their speed is varied by varying the field strength. Motors of this type are larger, more costly and slightly less efficient than series machines, so that a regenerative system has no place on roads that have a fairly level contour. When, however, the grades are frequent and excessive, the power saved more than counterbalances these factors, and the system may prove a valuable one for such service.

Brakes.

For tramcars of ordinary sizes hand-brakes are used, these being generally spindle brakes, with leverage enough to handle the comparatively heavy cars. When the size and speed of the car increases, however, these hand-brakes do not give sufficient control, and power brakes have to be adopted. Of these there are several forms that have proved successful in practice. The one most extensively used in electric railways is the air-brake, which is similar in its mechanical operation to the air-brake used on steam railways. The compressed air required for the operation of the brake is obtained by means of an air-pump driven by an electric motor, the circuit of which is controlled by a switch actuated by the pressure of the air in the receiving tank. When this pressure rises to a predetermined value, the device acts and interrupts the supply of current to the motor, which is thus stopped. When the pressure falls below a determined minimum the device operates in the opposite direction, and the motor and pump start. Of electric brakes there are several varieties. One type consists of two iron disks, one keyed on the axle but capable of moving along it a short distance axially, and the other held firmly on the frame of the truck. By means of a coil, set in a recess of annular form turned in the face of the fixed disk, the disks are magnetized transversely, and are drawn together with greater or less pressure, dependent on the amount of current that is allowed to pass through the coil. It is customary to arrange the current connexions in this form of electric brake so that when the handle of the controller is turned beyond the stopping position the current is cut off from the source of supply, and the motor running as a dynamo furnishes the current to work the brake.

The magnetic track-brake, which is sometimes used on tramway cars, consists of a pair of steel shoes, suspended from the truck frame and hanging near and over the rail, a steel yoke connecting the two shoes together. On this yoke is wound a heavy magnetizing coil which, when energized, strongly magnetizes the two steel shoes and causes them to draw against and adhere to the track. Bracing links connect these track shoes with brake shoes on the wheel rims, and the drag of the track shoes thus applies pressure also to the wheel shoes. The downward pull of the track shoes gives a greater pressure of the wheels against the track than that due to the weight of the car, and the sliding or "skidding" of wheels, with the consequent production of flats, is avoided. A further braking effect comes from the use of the motors as dynamos, driven by the motion of the car, to supply current to the brake magnetizing coils. This therefore is one of the most effective brakes that has been devised. It has, however, not been very extensively used owing to its high cost and difficulties that arise from the track shoes running so close to the rails that any uneven places—frogs, switches, crossings and the like—may rub against them and give a braking effect at times when the car is accelerating or running. A pair of shoes is applied on both sides of the car, one pair being hung over either rail.

Another method of braking is by arranging the connexions of the two motors so that one acts as a dynamo driven by the motion of the car and supplies current to the other, which works as a motor, tending to turn the wheels in the direction opposite to that in which the car is moving. The production of current by the one motor and the reverse effort of the other give a powerful braking effect. The proper connexions are made by constructing the controllers with contacts additional to those required for motor control, which connect the machines in the desired manner when the controller handle is moved round past the "off" position.

Automatic brakes are always preferable to hand-brakes even though they cost much more, because the energy required to propel an ordinary tramcar is from 10 to 25 % more with hand than with automatic brakes. The cause is the constant pressure of the brake shoes of a hand brake against the wheel rims, the shoes being so held by the operator to avoid having too long a hand movement in applying the brake. The maximum pressure possible for any brake should be about 90 % of the weight of the car on the braked wheels. Less than this amount will give an inefficient brake; more will produce sliding or "skidding" of the wheels, producing "flats" on them, and also causing loss of retarding effect.

Accessories.

Of the numerous accessories necessary in the operation of electric railways one of the most important is the trolley. For an overhead system this consists in general of a metallic rod or tube mounted upon the top of the car and pressed upward against the trolley wire by springs. At the upper end of this trolley pole is generally placed a bronze wheel which runs along the under surface of the wire. On the continent of Europe considerable use has been made of bow-trolleys, which consist of light metallic bow-shaped structures, sustained in place by springs and running along on the under side of the wire against which they rub. The designs patented for trolleys are almost innumerable. Besides the trolleys, cars are ordinarily equipped with switches which are used to break the trolley circuit, with fuses or automatic circuit-breakers, with electric lamps, with lightning arresters, and with the necessary car wiring. The fuses or automatic circuit-breakers guard against an excess of current being passed through the motors, and when they are fitted the ordinary platform switch can be dispensed with. These automatic breakers can be set for any desired current.

Generation of Current.

The question of the generation and the distribution of the current belongs to this article only in so far as electric traction has introduced peculiarities in the type of apparatus or the methods of its use. In a continuous current station the current is generated at an approximately constant potential, varying from 500 volts to 700 volts on different systems. As the load is apt to fluctuate, except in large stations, within wide limits, the machinery must be designed to stand the most severe usage. The engines are more massive than would be necessary for constant loads, and the dynamos must be built to stand sudden overloads without destructive sparking; usually, indeed, they are considerably over-compounded, not so much for the sake of raising the voltage as to strengthen the field and prevent sparking on overload. When a number of machines are to be run in parallel—as is usually the case—they are provided with "equalizing" switches, which serve to throw the series fields in parallel. As a result, if one of the machines tends to increase its armature current beyond the proper amount, the current in the series fields does not increase with it, but retains its normal proportion. The armature reaction and resistance fall of potential, in this machine, would both tend to increase, thereby decreasing its armature potential, and therefore its current would return to its proper value. From the dynamos the current from each machine goes through an ammeter and automatic circuit-breaker to the main "omnibus" bars, then through the station ammeter to the feeder "omnibus" bars, then through ammeters and circuit-breakers to the feed-cables. As a rule, watt-meters are provided to measure the output of the station, and, if an overhead system is being supplied, lightning arresters are installed. Where continuous currents are used to operate cars at considerable distances from the generating stations, "boosters" are used. These are series-wound dynamos driven at a constant speed, through which is passed the current that is to feed the distant section of the line. Usually the characteristic of the booster is so calculated that the amount by which it raises the voltage for a given current just equals the fall of potential in the feeding-line for the same current. The result is that the potential at the end of the line will be the same as that at the station. The question of economy, as between putting in additional copper and wasting energy in the booster, is easily calculated; the advantage is more and more on the side of the latter as the distance increases and the car service becomes more infrequent. It is necessary to the satisfactory operation of a system that the variations of voltage should not be too great, so boosters sometimes become a practical necessity, irrespective of the question of economy.

Accumulators are frequently installed in power stations to prevent the heavy load fluctuations which arise from starting and stopping of cars and ascending or descending grades. The generators give an approximately unvarying amount of current. When the load demand is less than that delivered by the generators, the excess current goes into the storage battery, and when the load is greater than the power from the generators the additional current required comes from the battery. The generators, engines and boilers may thus be proportioned for the average instead of the maximum load requirements, and the sizes of these units are thereby reduced.

As traction systems have been combined and extended, the area of operation of many of the companies has grown so that a number of direct-current stations are used for a single system. The limit of distance to which electric energy can be economically supplied at the comparatively low voltages employed is not great, and the advantage of having one or two large stations to supply a system, in place of a number of smaller ones, is evident. This fact has led to the use of high-potential alternating currents for the distribution of energy, the voltage being reduced at the points of consumption, and in most cases changed to a continuous current by rotary converters. If alternating currents are used for the car motors, the economical distribution of energy is greatly simplified, the rotary converters being eliminated and their first cost and losses and expense of operation saved. The expense of operating sub-stations containing rotary converters is necessarily large, and the capital outlay required for them is often greater than for the generating station.

Cars.

As a rule, the cars used for electric traction have varied but slightly from the type of tramway car prevalent in different localities. The tendency, however, has been to increase their size. For electric railway work, as distinguished from tramway work, the cars generally follow the pattern that is standard on American steam lines. The trucks used for electric cars are made of steel, with heavy axles and suspension bars for carrying the electric motors. For smaller vehicles, a single four-wheel truck is used, the wheel base being limited by the curvature of the track, but not as a rule exceeding 7½ ft. For the longer and heavier cars, two four-wheeled bogie trucks are employed. If two motors are used on a double-truck car, and if the grades on the road are very heavy, the trucks are made on the "maximum traction" pattern, in which one pair of wheels in each truck is of smaller diameter than the other and the greater part of the weight of the car is on the larger motor-driven wheels. For very large high-speed cars, trucks are used of practically the same type and weight as are employed on steam railways. (See also TRAMWAY.) (L. Du.)

TRACY, ANTOINE LOUIS CLAUDE DESTUTT, COMTE DE (1754–1836), French philosopher, son of a distinguished soldier, was born in Bourbonnais on the 20th of July 1754. He belonged to a noble family of Scotch descent, tracing its origin to Walter Stutt, who in 1420 accompanied the earls of Buchan and Douglas to the court of France, and whose family afterwards rose to be counts of Tracy. He was educated at home and at the university of Strassburg, where he was chiefly noted for his athletic skill. He went into the army, and when the Revolution broke took an active part in the provincial assembly of Bourbonnais. He was elected a deputy of the nobility to the states-general, where he sat alongside of his friend La Fayette. In the spring of 1792 he received the rank of *maréchal de camp* in command of the cavalry in the army of the north; but the influence of the extremists becoming predominant he took indefinite leave of absence, and settled at Auteuil, where, with Condorcet and Cabanis, he devoted himself to scientific studies. Under the Reign of Terror he was arrested and imprisoned for nearly a year, during which he studied Condillac and Locke, and abandoned the natural sciences for philosophy. On the motion of Cabanis he was named associate of the Institute in the class of the moral and political sciences. He soon began to attract attention by the *mémoires* which he read before his colleagues—papers which formed the first draft of his comprehensive work on ideology. The society of "ideologists" at Auteuil embraced, besides Cabanis and Tracy, Constantin François de Chassebœuf, Comte de Volney and Dominique Joseph Garat (1749–1833), professor in the National Institute. Under the empire he was a member of the senate, but took little part in its deliberations. Under the Restoration he became a peer of France, but protested against the reactionary spirit of the government, and remained in opposition. In 1808 he was elected a member of the French Academy in place of Cabanis, and in 1832 he was also named a member of the Academy of Moral Sciences on its reorganization. He appeared, however, only once at its conferences, owing to his age and to disappointment at the comparative failure of his work. He died at Paris on the 9th of March 1836.

Destutt de Tracy was the last eminent representative of the sensualistic school which Condillac (*q.v.*) founded in France upon a one-sided interpretation of Locke. He pushed the sensualistic principles of Condillac to their last consequences, being in full agreement with the materialistic views of Cabanis, though the attention of the latter was devoted more to the physiological, that of Tracy to the psychological or "ideological" side of man. His ideology, he frankly stated, formed "a part of zoology," or, as we should say, of biology. To think is to feel. The four faculties into which he divides the conscious life—perception, memory, judgment, will—are all varieties of sensation. Perception is sensation caused by a present affection of the external extremities of the nerves; memory is sensation caused, in the absence of present excitation, by dispositions of the nerves which are the result of past experiences; judgment is the perception of relations between sensations, and is itself a species of sensation, because if we are aware of the sensations we must be aware also of the relations between them; will he identifies with the feeling of desire, and therefore includes it as a variety of sensation. It is easy to see that such conclusions ignore important distinctions, and are, indeed, to a large extent an abuse of language. As a psychologist de Tracy deserves credit for his distinction between active and passive touch, which developed into the theory of the muscular sense. His account of the notion of external existence, as derived, not from pure sensation, but from the experience of action on the one hand and resistance on the other, may be compared with the account of Bain and later psychologists.

His chief works are *Eléments d'idéologie* (1817–1818; 2nd ed., 1824–1825), in which he presented the complete statement of his earlier monographs; *Commentaire sur l'esprit des lois de Montesquieu* (1806; 5th ed., 1828; Eng. trans., President Jefferson, 1811); *Essai sur le génie et les ouvrages de Montesquieu* (1808). See histories of philosophy, especially F. Picavet, *Les Idéologues* chs. v. and vi. (Paris, 1891), and *La Philosophie de Biran* (Académie des sci. mor. et pol., 1889); G. H. Lewes, *Hist. of Phil.*

TRACY, BENJAMIN FRANKLIN (1830–), American lawyer and soldier, was born in Owego, New York, on the 26th of April 1830. He was educated at the Owego academy, was admitted to the bar in 1851, was district-attorney of Tioga county in 1853–1859, and was a member of the state Assembly in 1862. In 1862 he organized the 109th and the 137th regiments of New York Volunteer Infantry and (Aug. 28) was made colonel of the former. In September 1864 he became colonel of the 127th United States Colored Infantry; in 1864–1865 was in command of the prison camp at Elmira, New York, and in March 1865 was breveted brigadier-general of volunteers. He received a Congressional medal of honour in 1895 for gallantry at the Wilderness in May 1864. He was United States district-attorney for the eastern district of New York in 1866–1873, and an associate judge of the New York court of appeals in 1881–1882. In 1889–1893 he was secretary of the navy in the cabinet of President Benjamin Harrison, and then resumed the practice of law in New York City. He was chairman of the commission which drafted the charter for Greater New York, and in 1897 was defeated as Republican candidate for mayor of the city. In 1899 he was counsel for Venezuela before the Anglo-Venezuelan boundary arbitration commission in Paris.

TRADE (O. Eng. *trod*, footstep, from *tredan*, to tread; in M. Eng. the forms *tred*, *trod* and *trade* appear, the last in the sense of a beaten track), originally a term meaning track or course, and so surviving in "trade-wind" (*q.v.*), a wind which always blows in one course; hence a way of life, business or occupation, and, specifically, the handicraft in which a man has been trained and which he makes his means of livelihood, or the mercantile business which he carries on for profit, as opposed to the liberal arts or professions. A further development of meaning makes the word synonymous with commerce, comprehending every species of exchange or dealing in commodities.

See COMMERCE; BALANCE OF TRADE; FREE TRADE; PROTECTION; TARIFFS; TRADE ORGANIZATION; and also the sections dealing with trade and commerce under the various countries.

TRADE, BOARD OF. The greater part of such supervision of commerce and industry as exists in the United Kingdom is exercised by the "Committee of Privy Council for Trade" or, as it is usually called, the board of trade. As early as the 14th century councils and commissions had been formed from time to time to advise parliament in matters of trade, but it was not till the middle of the 17th century, under the Commonwealth, that any department of a permanent character was attempted. Cromwell's policy in this respect was continued under the Restoration, and in 1660 a committee of the privy council was appointed for the purpose of obtaining information as to the imports and exports of the country and improving trade. A few years later another committee of the council was appointed to act as intermediaries between the crown and the colonies, or foreign plantations, as they were then called. This joint commission of trade and plantations was abolished in 1675, and it was not until twenty years later that it was revived under William III. Among the chief objects set before this board were the inquiry into trade obstacles and the employment of the poor; the state of the silver currency was also a subject on which John Locke, its secretary, lost no time in making representations to the government. Locke's retirement in 1700 removed any chance of the board of trade advocating more enlightened opinions on commercial subjects than those generally held. It had only a small share in making the constitutions of the American colonies, as only the Carolinas, Pennsylvania, Georgia and Nova Scotia were formed after the reign of Charles II.; and in 1760 a secretary of state for the colonies was appointed, to whom the control drifted away. In 1780 Burke made his celebrated attack on the public offices, which resulted in the abolition of the board. In 1786, however, another permanent committee of the privy council was formed by order in council, and with one or two small exceptions the legal constitution of the board of trade is still regulated by that order. Under it all the principal officers of state, including the first lords of the treasury and admiralty, the secretaries of state, and certain members of the privy council, among whom was the archbishop of Canterbury, obtained seats at the board *ex officio*; and ten unofficial members, including several eminent statesmen, were also placed on the committee. The duties of the revived board were made the same as they were in the beginning of the century, but the growth of commerce necessarily threw new administrative duties upon it. The board of trade thus became a mere name, the president being practically the secretary of state for trade, and the vice-president became, in 1867, a parliamentary secretary, with similar duties to those of a parliamentary under-secretary of state. At present, besides the president, who has usually a seat in the cabinet,[1] and whose salary is £5000 a year, there is a parliamentary secretary with a salary of £1200, a permanent secretary (salary £1500, rising to £1800), and four assistant secretaries (each with a salary of £1200) for the harbour, marine, commercial, labour and statistical, and railway departments. There are also other important officials in charge of different departments, as mentioned below.

1. *The Commercial, Labour and Statistical Department* is the real remains of the original board of trade, as it combines the charge of the trade statistics with the general consultative duties with which King Charles II.'s board was originally entrusted. The statistical work includes compiling abstracts, memoranda, tables and charts relating to the trade and industrial conditions of the United Kingdom, the colonies and foreign countries, the supervision of the trade accounts, the preparation of monthly and annual accounts of shipping and navigation, statistics as to labour, cotton, emigration and foreign and colonial customs, tariffs and regulations. The commercial intelligence department collects and disseminates accurate information on general commercial questions, and collects and exhibits samples of goods of foreign origin competing with similar British goods. It keeps a register of British firms who may desire to receive confidential information relative to their respective trades and supplies that information free of charge. The labour statistics published by the department are exhaustive, dealing with hours of labour, the state of the labour market, the condition of the working classes and the prices of commodities; annual reports are also

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[1] Since 1882 there have been only two occasions on which the president of the board was not included in the cabinet. Frequent suggestions were made as to raising the status and salary of the president of the board, which up to 1900 was £2000. Lord Jersey's committee in 1904 suggested that the president should be put on the same footing as a secretary of state, and be given the title of "minister of commerce and industry." In 1909 the Board of Trade Act repealed the Board of Trade (President) Act 1826, which limited the salary of the president, and enacted that the president should be paid such annual salary as parliament might determine (£5000). The increased salary came into operation in 1910, when a new president of the board came into office.

published of trade unions, of strikes and lock-outs and other important subjects. The staff comprises a controller-general (salary £1200 rising to £1500), a deputy controller-general and labour commissioner, a principal for statistics, a principal of the commercial department, an assistant labour commissioner, a chief staff officer for commercial intelligence, a chief labour correspondent, a special inquiry officer, and a staff of investigators and labour correspondents. The department also edits the *Board of Trade Journal* (started in 1886), giving items of commercial information, trade and tariff notices and various periodical returns. There are also branches which deal with the census of production, labour exchanges, &c.

2. *The Railway Department* was originally constituted in 1840, and performs multifarious duties under various railway acts, including the inspection of railways before they are open, inquiries into accidents, reports on proposed railways, approval of by-laws, appointment of arbitrators in disputes, as well as many duties under private railway acts. The inspection of tramways, their by-laws and "provisional orders" are all dealt with here, as are similar orders relating to gas and water schemes and to electric lighting. There is a special office of inspection of railways with a chief inspecting officer (salary £1400) and an assistant staff. Patents, designs and trade marks are now dealt with by the patent office under the charge of a controller-general (salary £1800), which is subordinate to the railway department, and copyright, art unions and industrial exhibitions are also among the matters dealt with by the department. Annual returns with regard to its business are published by the department.

3. *The Marine Department* was created a separate branch of the board of trade in 1850, about which time many new and important marine questions came under the board of trade, such, for example, as the survey of passenger steamers, the compulsory examination of masters and mates, the establishment of shipping offices for the engagement and discharge of seamen. Further work fell to the marine department by the act of 1853, which gave it the control of lighthouse funds, and to a certain extent of pilotage. The consolidating Merchant Shipping Act of 1854 and subsequent legislation so much increased the department that in 1866 it was divided into three, viz. the present marine department, which deals with ships and seamen, the harbour department and the finance department.

4. *The Harbour Department* was, as stated above, a branch of the marine department until 1866, so far as it is connected with the physical adjuncts of navigation, but various other matters have since been added, *e.g.* the charge of the foreshores belonging to the crown, formerly managed by the commissioners of woods and forests, and the protection of navigable harbours and channels, long under the control of the admiralty, provisional orders under the General Pier and Harbour Acts and under the Pilotage Acts, and the settlement of by-laws made by harbour authorities. Control over the lighthouse funds of the lighthouse authorities of the United Kingdom, the registry of British ships, wreck, salvage and quarantine are all among the matters dealt with by this department, which also has charge of the standards department for weights and measures.

5. *The Finance Department* was, like the harbour department, separated in 1866 from the marine department. The accounts of all the branches of the board of trade are in its charge, including the subordinate offices. It also deals with the accounts of harbours, lighthouses and mercantile marine offices, and of the merchant seamen's fund, and with the consuls' accounts for disabled seamen abroad. Savings banks and seamen's money orders are also among the accounts and payments with which it is charged, and outside these marine matters it has to prepare for parliament the life insurance companies' accounts and to take charge of the bankruptcy estate accounts.

6. *The Bankruptcy Department* was established under the 71st section of the Bankruptcy Act 1883. At its head is the inspector-general in bankruptcy (salary £1200). An account of the duties of the department will be found under BANKRUPTCY.

7. *The Fisheries Department.*—By an act of 1886 the powers of the home office over salmon and other fisheries were transferred to the board of trade, and a small department was consequently created charged with the care of those industries. But by an act of 1903 (3 Ed. VII. c. 31) the powers and duties of the board of trade under this department were transferred to the board of agriculture and fisheries.

TRADE MARKS. A "trade mark" may be defined as a symbol, consisting in general of a picture, a label or a word or words, applied or attached to the goods of a trader for the purpose of distinguishing them from the similar goods of other traders, and of identifying them as his goods, or as those of his successors, in the business in which they are produced or put forward for sale. A trade mark differs in its legal character both from a patent and from a copyright. In the case of a trade mark the property and the right to protection are in the device or symbol adopted to designate the goods to be sold, and not in the article which is manufactured and sold. The article is open to the whole world to manufacture and sell, and all that the owner of the trade mark is entitled to prevent is such use of his mark by other traders as will lead purchasers to buy, as his, goods which are not his. On the other hand, patent-right and copyright protect the substance of the article; and any unauthorized manufacture of it in the former case, or reproduction of it in the latter, while the protection lasts, is prohibited. The grounds, however, on which trade marks, patent-right and copyright obtain legal recognition, though they are to a certain extent dissimilar, have a common element. Patent-right and copyright rest upon the view that the results of the original labour of the inventor and the author ought, as a matter alike of justice and of public policy, to be secured against piracy; while, as regards the proprietor of a trade mark, the question of originality does not arise so long as the mark is sufficiently distinctive really to identify his goods and, for purposes of registration, to satisfy the Trade Marks Acts. In truth, the registration of a trade mark is rather the recognition of a fact than the grant of a privilege (Kerly and Underhay, *Trade Marks Act*, 1905, p. 3). The law as to trade marks as well as that as to patents or copyright is based on a man's rights to have guaranteed to him the profit derivable from his own property. "No man," said James (L.J.), in the case of the *Singer Manufacturing Co.* v. *Loog* (1880, 18 Ch. D., 412), "is entitled to present his goods as being the goods of another man, and no man is permitted to use any mark, sign or symbol, device or means, whereby, without making a direct false representation himself to a purchaser from him, he enables such purchaser to tell a lie or to make a false representation to somebody else who is the ultimate customer."

I. *British Trade Marks before the Registration Acts.*—The existing law in the United Kingdom cannot be properly appreciated unless the subject is approached in the first instance from the historical side. English trade-mark law practically commences with the first years of the 19th century. The use of trade marks was indeed of far earlier date, for in 1742 we find Lord Hardwicke declaring that "every particular trader had some particular mark or stamp." But in the very case in which Lord Hardwicke made that statement (*Blanchard* v. *Hill*, 2 Atkyns, 484) he refused to protect the "Great Mogul" stamp on cards, being apparently under the influence of the notion that the legal recognition of trade marks would involve the creation of a new species of monopoly; and with regard to a case decided in the reign of James I. (*Southern* v. *How*, Cro. Jac. 471), in which a clothier had applied the mark of another clothier to his own inferior goods, the reports leave it doubtful whether the action was brought by the owner of the mark, or by a defrauded customer, in which latter event it would be merely an ordinary action for deceit. But although the actual law of trade marks cannot be traced farther back than the beginning of the 19th century, Lord Eldon repeatedly granted injunctions to restrain one trader from fraudulently "passing off" his goods as those of another, and thus laid a foundation on which the present law has been built up. The stages through which its development passed possess considerable interest, and may be described quite briefly. The first reported case—apart from the doubtful one in the time of James I. above referred to—in which the infringement of a trade mark (a label on blacking) was restrained by the court of chancery was *Day* v. *Day* (Eden on *Injunctions*, ed. 1821, p. 314) in 1816. In 1824 the common law courts, in the case of *Sykes* v. *Sykes* (3 B. & C. 541), established the right of the owner of an infringed trade mark to damages. In 1833 it was held by the court of king's bench that it was not necessary for the plaintiff in an infringement action to prove that the defendant's goods were inferior to his, or that he had suffered special damage by the infringement. Later this became a rule of equity as well as of law. On another point, however, the practice of the courts of common law and equity diverged for a time. It was decided by Lord Cottenham in 1838, in the leading case of *Millington* v. *Fox* (3 Mylne & Craig 338), that an injunction to restrain the infringement of a trade mark could be obtained, even although the defendant had acted without fraudulent intent. On the common law side, on the other hand, fraud was an essential ingredient in the cause of action, and remained so till the fusion of law and equity by the Judicature Acts.

The effect of Lord Cottenham's decision in the case of *Millington* v. *Fox* clearly was to recognize a right of property in trade marks, and the action for infringement became a familiar species of litigation. Under the then existing law, however, the plaintiff in such actions generally found himself in a very disadvantageous and unsatisfactory position. The basis of his action was the reputed association between his trade mark and his goods. This association the defendant—often a person of no means—would deny, and it had to be proved as a fact by witnesses at a cost to the plaintiff which there was little hope of his recovering. Moreover, even if the trade mark proprietor secured a judgment in his favour, it carried with it no immunity from the obligation of again establishing his right to the mark against any subsequent infringer who chose to dispute it. Thus—to take an interesting and pertinent illustration given in *Kerly on Trade Marks* (p. 6)—the case of *Rodgers* v. *Nowill* (22 L. J. Ch. 404) lasted five years and cost the plaintiff £2211, without giving him in the end any security that he might not have to incur equal delay and expense in proving his title to the exclusive use of the trade mark in proceeding against other defendants. To complete this statement of the shortcomings of the law before the Merchandise Marks Act 1862, it should be noted that the infringement of trade marks—except in cases where the seller of spuriously marked goods cheated the buyer—was not a criminal offence. The remedies obviously needed were the establishment of a system of registration of trade marks which would simplify the proof of a plaintiff's title, and the creation of a criminal law of false marking.[1] The first step in the accomplishment of the latter object was taken by the Merchandise Marks Act 1862.

II. *Under the Registration Acts.*—Provision was first made for the registration of trade marks by the Trade Marks Registration Act 1875. That statute made registration in the register of trade marks which it established prima facie evidence of the right of the registered proprietor to the exclusive use of the trade mark in connexion with goods of the class for which it was registered and used, and enacted that it should after the expiration of five years be conclusive proof of such right, provided that the proprietor of the mark remained the owner of the goodwill of the business in which it was used. This provision was carried as to the act of 1883 (s. 76). The act also provided that a person should not be entitled to institute any proceeding to prevent the infringement of trade mark until it was registered, or (a later statutory modification) until, in the case of a mark in use before the passing of the act of 1875, registration of the mark as a trade mark had been refused. The act of 1875 was a considerable success, but no provision was made under it for the registration of words unless they either were old marks or were registered in combination with one or more of the "essential particulars" prescribed by the act, such as a distinctive device, heading, mark, label or ticket. These limitations excluded from registration most of the trade marks ordinarily in use.

The Patents Designs and Trade Marks Act 1883 remedied this defect besides altering the law in other important respects. The act of 1883 was amended in 1888 on the recommendation of a committee presided over by Lord Herschell. Neither the act of 1875 nor those of 1883 and 1888 altered the common law definition of a trade mark, nor contained any definition of the term. The description in the acts of what was registrable as a trade mark led to much litigation, and the interpretations of the judges left commercial men dissatisfied on three points: (1) the number of good and valuable trade marks which were not registrable; (2) that on allowing registration the patent office insisted on disclaimers which hampered the owner in obtaining protection in the colonies and foreign countries; (3) that there was no effective period of limitation to attacks on registered trade marks, because though registration for five years was declared conclusive by s. 76 of the act of 1883, the powers of the court to rectify the register could be invoked even after the lapse of the five years (*re Gestetner's Trade Mark*, 1907, 2 Ch. 478). In re-enacting and enlarging the provisions of the act of 1875 the act of 1883 laid down certain essential particulars of one at least whereof a trade mark must consist to be registrable. These particulars will be considered later in dealing with the present law. The act of 1883 first provided for "word marks," and included among them "a fancy word or words not in common use" [s. 64, (1) (c)].

The expression "fancy word," used in the act of 1883, gave rise to considerable difference of opinion. It was interpreted by the court of appeal as equivalent to "obviously meaningless as applied to the article in question," or "obviously non-descriptive." In accordance with this interpretation, the words "gem" for guns, "melrose" for a hair restorer, "electric" for velveteen, and "washerine" for a soap were all held not to be registrable. On the recommendation, however, in 1887, of a committee appointed by the board of trade, and presided over by Lord Herschell, the expression "invented word" was substituted for "fancy word" by the act of 1888.

In 1905 and 1907 the legislation as to trade marks was amended and remodelled. A bill was introduced in 1905 at the instance of the London Chamber of Commerce, and after consideration by a select committee became the Trade Marks Act 1905. This act repeals the bulk of the provisions of the Patents, &c., Acts of 1883 and 1888 with respect to trade marks, and embodies them with amendments (to be noticed later) in a separate statute. The only portions of the earlier acts left standing with respect to trade marks were ss. 83 and 84 (as amended in 1885 and 1888) with reference to the administration in the patent office of the law as to trade marks (1905, s. 74); ss. 103 and 104 of the act of 1883 (as amended in 1885) relating to registration of trade marks, both as enacted in the acts of 1883 and 1885 and as applied by orders in council, are to be read as applying to trade marks registrable under the act of 1905 (s. 65). The sections of the Patents Acts of 1883, 1885 and 1888, thus preserved as to trade marks, were repealed by the Patents and Designs Act 1907. Sections 62 seq. of this act replace ss. 83 and 84 of the act of 1883, and retain the administration of trade mark law in the patent office; and s. 91 replaces ss. 103 and 104 of the act of 1883 as to international and colonial arrangements for mutual protection (*inter alia*) of trade marks. According to the rule laid down by the Interpretation Act 1889 the references in the act of 1905 to the acts of 1883, &c., are to be read as applying to the above-stated sections of the act of 1907.

The act of 1905 differs from the preceding acts in containing a definition of trade mark for the purposes of the act unless the context otherwise requires; viz. that it "shall mean a mark used or proposed to be used upon *or in connexion* with goods for the purpose of indicating that they are the goods of the proprietor of such mark by virtue of manufacture, selection, certification, dealing with or offering for sale"; and "mark" is defined as *including* "a device, brand, heading, label, name, signature, word, letter, numeral or any combination thereof" (s. 3). The act, modifying to the extent indicated in italics the acts of 1883 and 1888, prescribes (s. 9) that a trade mark to be registrable must contain or consist of at least one of the following essential particulars:—

1. The name of a *company*, individual or firm represented in a *special* or particular manner (under the act of 1883 it has been held that the name must be in the nominative case, and that ordinary printing is not representation in a particular manner).

2. The signature of the applicant for registration or some predecessor in his business. It is not clear that this includes descriptive trading styles.

3. An invented word or words.

4. A word or words having no *direct* reference to the character or quality of the goods, and not being *according to its ordinary signification* a geographical name *or a surname*.

5. *Any other distinctive mark; but a name, signature, or word or words other than such as fall within the descriptions in the above paragraphs 1, 2, 3 and 4, shall not, except by order of the board of trade or of the court, be deemed a distinctive mark.* By distinctive is meant "adapted to distinguish the goods of the proprietor of the trade mark from those of other persons": and "in determining whether a trade mark is so adapted the tribunal may in the case of a trade mark in actual use take into consideration the extent to which such

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[1] Further reference may be made, in regard to the subject of trade marks before the Registration Acts 1883–1888, to an admirable introductory chapter in *Kerly on Trade Marks*, and also to the report of the Merchandise Marks Committee 1862, and the annual reports of the commissioners and the comptroller-general of patents from 1876 to 1884 (2nd report).

user has rendered such trade mark in fact distinctive for the goods in respect of which it is registered or proposed to be registered." Where the mark is limited to specified colours, that fact may be taken into account in deciding whether the mark is distinctive (s. 10). There are certain special rules as to cotton marks.

Trade marks containing the essential particulars are not registrable if they contain any matter which would by reason of its being calculated to deceive or otherwise be disentitled to protection in a court of justice or would be contrary to law or morality, or any scandalous design (s. 11). (See *Eno* v. *Dunn*, 1890, 15 App. Cas. 293, and the "Motricine" case, 1907, 2 Ch. 435.) Registration of the same matter as a trade mark under the act of 1905 and as a design under the Patents and Designs Act (1907) is possible (*re U.S. Playing Card Co.'s Applic.*, 1907, W. N. 251).

Old marks are registrable, *i.e.* any special or distinctive word or words, letter, numeral or combination of letters or numerals, used by the applicant or his predecessors in business before the 14th of August 1875, subject to the qualification that it has "continued to be used either in its original form or with additions or alterations not substantially affecting the same down to the date of the application for registration" (s. 9). In the case of new marks, but not of old marks, a trade mark is not registrable except by order of the court in respect of any goods or description of goods which is identical with a mark already on the register with respect to such goods or description of goods, or so nearly resembles such registered mark as to be calculated to deceive (s. 19).

Invented Words.

Most controversy arose under the acts of 1883 and 1888 as to the meaning of the phrase "invented word" preserved in the act of 1905. An invented word need not be wholly meaningless, nor is it disqualified because words may have suggested it. Thus "mazawattee" was held to be an "invented word," although the latter part of it was a Sinhalese term meaning "estate," and there were estates in Ceylon having names ending with "wattee" from which tea came; and in a leading case on the construction of the clauses under consideration (*Eastman Co.'s Trade Mark*, L. Rep. 1898, A. C. 571), the word "solio" was held to be registrable as a trade mark for photographic printing paper under both clauses, although it was objected that "solio" was equivalent to "sunio." The expression "calculated to deceive" has been considered by the courts in very many cases. It is not merely or chiefly the retailer or dealer who has to be kept in view when the question of the likelihood of deception is under consideration. The courts have regard also, and mainly, to the ultimate purchaser whom the trade mark may reach, and careless or unwary persons are considered as well as those who are careful and intelligent. The judge's eye is the ultimate test as to the degree of resemblance that is calculated to deceive, although expert evidence on the point is admissible. "Savonol" for soap (*J. C. & J. Field Ltd.* v. *Wagel Syndicate Ltd.*, 1900, 17 R.P.C. 266), "tachytype" for typographical and composing machines (in *re Linotype Co.'s Application*, 1900, 17 R.P.C. 380), have been held to be invented words. But the following have been held not invented—"uneeda" (=you need a) in *re National Biscuit Co.* (1902; 1 Ch. 783); "absorbine" for an absorbent preparation (*Christy & Co.* v. *Tipper & Son*, 1905, 21 R.P.C. 97, 775); "bioscope" (*Warwick Trading Co.* v. *Urban*, 1904, 21 R.P.C. 240); "cyclostyle" (*re Gestetner's Trade Mark*, 1907, 2 Ch. 478); and cf. in *re Kodak and Trade Marks* (1903, 20 R.P.C. 337).

Subsections (3) and (4), it should be noted, are independent: the former deals with newly-coined words, the latter deals with the existing words of the English language, or of other languages likely to be known to the public. A word which is really "invented" may be registered, whether it is descriptive or not. An old word used in a new sense is not invented (*Hommel* v. *Bauer & Co.*, 1904, 21 R.P.C. 576). The exact scope of clause (5) as to other distinctive marks has not been much discussed by the courts. Registration was allowed of the word "apollinaris" as a distinctive mark for the mineral waters of the applicants, on an undertaking to apply it only to water from the Neuenahr spring or district (in *re Apollinaris Trade Mark*, 1907, 2 Ch. 178). Under prior legislation the mark had been refused registration as being a geographical name (*re Apollinaris Co.'s Trade Mark*, 1891, 2 Ch. 186).

Identical Marks.

Identical marks (except old marks) may not be registered in respect of the same goods, or goods of the same description, for two different persons (s. 19); and where several applicants make rival claims to identical marks the registrar may refuse to register until their rights have been determined by the court or settled by agreement in manner approved by the registrar, or, on appeal, by the board of trade (s. 20). In the case of honest concurrent user or of other special circumstances making it proper so to do, the court may permit the registration of the same mark or of nearly identical marks for the same goods by more than one owner, subject to such conditions or limitations, if any, as to mode or place of use or otherwise as the court may think it right to impose (s. 21).

Associated Marks.

New provisions were made in 1905 as to what are called "associated trade marks." Where registration is sought for a mark so closely resembling a mark of the applicant already on the register for the same goods as to be calculated to deceive or cause confusion if used by any one but the applicant, the registration of the new mark may be conditional on entering both marks as associated trade marks (s. 24). This section applies only to marks closely resembling one already on the register for the same goods or description of goods, and has nothing to do with identical marks (*Birmingham Small Arms Co.'s Application*, 1907, 2 Ch. 396).

In the case of combined trade marks provision is made for registering as separate trade marks the part in which the applicant has exclusive rights, and as associated marks trade marks of which the exclusive portion forms a part (s. 25).

A series of trade marks of the same owner may be registered on one registration as associated marks (s. 26).

Standardization Marks.

Provision is made for allowing the registration of marks used upon or in connexion with goods by an association (or person) which undertakes the examination of goods in respect of origin, material, mode of manufacture, quality, accuracy, or other characteristic, and certifies the result of the examination by marks used upon or in connexion with the goods. These marks cannot be registered unless the board of trade consider their registration of public advantage. Their registration is not conditional on the association or person being a trader or having goodwill in connexion with the examination or certification. The registration gives the association or person the rights of the owner of a registered trade mark, except that assignment and transmission needs permission of the board of trade (s. 62).

Cotton Marks.

In respect of cotton piece-goods, marks consisting of a line heading alone or a word alone are not registrable, and no word or line heading is treated as distinctive in respect of such goods. In respect of cotton yarn the same rule applies with respect to words, and no registration of any cotton mark gives any exclusive right to the use of a word, letter, numeral, line, heading or combination thereof [s. 64 (10)].

Use of Royal Arms, &c.

By s. 68, which is a re-enactment of s. 105 of the Patents, &c., Act, 1883, it is made illegal for any person without the authority of the king to use the royal arms in any trade in such a manner as to create the belief that he has authority so to do; a similar provision is embodied in the Merchandise Marks Act 1898 of the Isle of Man.

Registries.

The central register of trade marks is kept at the Patent Office, Southampton Buildings, London, and is under the charge of the comptroller-general of patents, designs and trade marks, who is appointed by and acts under the superintendence of the board of trade, and has a deputy—the registrar of trade marks. There is a branch registry at Manchester, whose chief officer is the keeper of cotton marks, which deals with all applications for the registration of trade marks for cotton goods falling within classes 23, 24, 25 in schedule 3 of the Trade Marks Rules 1906. The registry has been long established, but was not recognized by statute till 1905. Records are kept and are open to public inspection of all applications made since 1875, whether granted or refused.

There is a branch registry at Sheffield containing the marks for metal goods ("Sheffield marks") registered by persons carrying on business in or within six miles of Hallamshire. The care of this register is vested in the Cutlers' Company, who are substituted for the comptroller as to registration of "Sheffield marks" (s. 63). Applications made to the company are notified to the registrar, and may not be proceeded with if he objects. Any person aggrieved by the registrar's objection may appeal to the court. Applications made to the registrar for metal marks are notified to the Cutlers' Company. Persons aggrieved by the decision of the Cutlers' Company have an appeal to the courts (s. 64).

In 1906 fourteen applications were made at the head registry which were all dealt with by the Cutlers' Company. That company, by arrangement made with the sanction of the treasury, retain all fees taken at Sheffield with respect to registration up to £400, and half of the fees received in excess of that amount (*Parl. Pap.*, 1907, No. 164, p. 9).

Procedure.

A trade mark must be registered in respect of particular goods or classes of goods (s. 8), and the classification in force is scheduled to the Trade Marks Rules 1906 (R. & O., 1906, No. 233). Doubts as to the class to which the goods in question belong are settled by the registrar. The procedure for obtaining registration is regulated by the act of 1905 and the rules above mentioned. The registrar has power to refuse applications or accept them absolutely or subject to conditions, amendments and modifications (s. 12). His discretion is not absolute, but subject to the provisions of the act (*re Birmingham Small Arms Co.'s Application*, 1907, 2 Ch. 396); and he must if required state his reasons, and his decision is subject to appeal to the board of trade or the court at the option of the applicant [s. 12 (3)].

"New marks" may not be placed on the register except by order of the court for any goods or description of goods which are identical with marks already on the register with respect to the same goods, &c., or so nearly resemble a registered mark as to be calculated to deceive (s. 19). The question whether particular goods are of the same description is not determined solely by reference to the statutory classification. "The true test," says Kerly (*Trade Marks*, p. 181), "would seem to be supplied by the question: Are the two sets of goods so commonly dealt in by the same trader that his customers, knowing his mark in connexion with one set, and seeing it upon the others, would be likely to suppose that it was used upon them also to indicate that they were his goods?" Wine and spirits, beer, and even aperient drinks and baking powder, have been held to be "goods of the same description." When a trade mark contains (1) parts not separately registered as trade marks or (2) matter common to the trade or otherwise of a non-distinctive character, the registrar, or the board of trade or the court, in deciding whether the mark shall be entered or retained on the register, may impose as a condition that the owner shall disclaim all right to exclusive use of any part or parts of such trade mark or of all or any portion of such matter to the exclusive use whereof they deem him not to be entitled, or make any other disclaimer which they consider needful to define his rights under the registration (s. 15). Marks calculated to deceive are not entitled to protection (*Eno* v. *Dunn*, 1890, 15 App. Cas. 250).

Applications as accepted are advertised; the advertisements state the conditions, if any, imposed on acceptance (s. 13). Notice of opposition to the registration of a trade mark may be given under s. 14 of the act of 1905 (which replaces s. 69 of the act of 1883). The registrar after consideration decides whether the opposition is well or ill founded. His decision is subject to appeal to the High Court or by consent of the parties to the board of trade [1905, s. 14 (5)]. In 1906 there were 251 notices of opposition, of which 51 were heard. There were 4 appeals to the board of trade, all referred by the board to the court under s. 59 of the act.

There may be added to any one or more of the "essential particulars" above enumerated any letters, words or figures, or a combination of these. But the right to the exclusive use of the added matter must be disclaimed. A man is not required, however, to disclaim his own name, or trade name, or that of his place of business, if the name appears in the mark. The number of applications to register trade marks in 1884 was 7104, and the number of marks registered 4523. In 1906 the corresponding figures were 11,414 and 4731. These figures included 153 applications made to the Cutlers' Company at Sheffield (*Parl. Pap.*, 1907, 164, 24th report).

Correction and Alteration of the Register.

The register may be corrected on the request of the registered owner of a trade mark as to errors or changes of address in the name of the registered owner, or by cancelling entries of marks or by striking out classes of goods for which a mark is registered or by entering disclaimers or memoranda as to a mark, provided that they do not extend the rights given by the existing registration (s. 33).

A registered trade mark may be altered or added to in matters not substantially affecting its identity (s. 34). Thus a firm on becoming a limited company has been allowed to add the word "limited" to its name upon a registered mark, but no alteration will be permitted in regard to any "essential particular." In the above cases the corrections or alterations are made by the registrar subject to appeal to the board of trade (ss. 32, 34). A registered trade mark may be taken off by order of the court on the application of a person aggrieved, on the ground that it was registered without a bona fide intention to use it in connexion with a particular class of goods, and that there has not been any such bona fide user, or that there has been no such bona fide user during the five years preceding the application. Non-user may be excused if proved to be owing to special circumstances and not to any intention not to use or to abandon the use of the mark (s. 37). (See *re Hare's Trade Mark*, 1907, 24 R.P.C. 263).

The register may be rectified by order of the court on the application of any person aggrieved, or in the case of fraud in registration or transmission of the mark on the application of the registrar. The powers of rectification include correcting or expunging wrong entries, supplying errors and omissions and defects (s. 35).

Effect of Registration.

Registration is effective for 14 years but is renewable (s. 28). The registration if valid gives the proprietor the exclusive right to the use of the mark on or in connexion with the goods in respect of which it is registered (1905, s. 39). This rule is subject to the following qualifications. (*a*) Where two or more persons are registered owners of the same or substantially the same mark in respect of the same goods, no one of them shall as against any other of them have any right of exclusive user except so far as their respective rights have been defined by the court. (*b*) Registration of a trade mark does not entitle the proprietor to interfere with or restrain the user by any person of a similar mark upon or in connexion with goods upon or in connexion with which such person has by himself or his predecessors in business continuously used such trade mark from a date anterior to the use of the mark by the registered proprietor, or to object to the registration of the other man's similar mark for concurrent user.

In all legal proceedings relating to a registered trade mark registration is prima facie evidence of validity, and after seven years from the original registration, or seven years from the passing of the act of 1905, whichever shall last happen, the original registration shall be taken to be valid in all respects unless it was obtained by fraud, or the mark offends against s. 11 of the act. This provision as to validity limits the power which formerly existed of getting rid of long registered marks by proceedings to rectify the register.

Registered trade marks are assignable and transmissible only with the goodwill of the business concerned in the goods for which they are registered, and are determinable with the goodwill (s. 22). Associated marks are assignable and transmissible only as a whole and not separately (s. 27). The owner of a registered mark may assign the right to use his registered mark in any British possession or protectorate or foreign country in connexion with any goods for which it is registered, together with the goodwill of the business therein of such goods (s. 22). Provision is made for apportioning marks where the goodwill of a business by dissolution of partnership or otherwise does not pass to a single successor (s. 23).

The assignments, &c., on proof of title, are recorded on the register (s. 33). It is a condition precedent to an action for the infringement of a new trade mark that the plaintiff should be the registered proprietor of the mark at the time when the action comes on for hearing. This last provision does not apply to an action for "passing-off" (*vide infra*). In actions for infringement, evidence of passing off, or that the infringing mark is calculated to deceive, is not necessary. The court decides on the probability of deception by inspecting and comparing the marks (*Hennessy* v. *Keating*, 1907, 24 R.P.C. 485).

In the case of an old mark in use before the 14th of August 1875 proceedings may be taken if registration under the act of 1907 has been refused (s. 42).

The right to a trade mark lapses if the mark ceases to be distinctive and becomes *publici juris*; if it is separated from the goodwill (a trade mark can only be assigned with the goodwill); if the mark is applied by the trader to spurious goods (as where boxes of cigarettes were so labelled, in conformity with an alleged custom of the trade, as to indicate that they were of Russian manufacture, which was not the fact; or when the mark is abandoned); (temporary disuse, however, is not abandonment unless the mark has in the meantime become associated with the goods of another trader); or where, as in the "linoleum" case (7 Ch. D. 834) it has become the name of the goods, and so merely descriptive; or after fourteen years where registration is not renewed. In dealing with a claim for infringement the court must admit evidence of the usages of trade as to the get-up of the goods for which the mark is registered, and of any trade marks or get-up legitimately used with such goods by other persons (s. 43).

Appeals, &c.

The registrar has an uncontrolled discretion in the administration of the act, except in those cases in which an appeal is given from his acts or refusals to the court or the board of trade (ss. 53, 54). In cases of difficulty he consults the law officers (s. 56).

Actions or other proceedings with relation to trade marks, so far as they are for the court, may be brought in the High Court of Justice in England or Ireland and in the Court of Session in Scotland (ss. 3, 69). In the case of marks registered on application at the Manchester branch, the chancery court of Lancaster has concurrent jurisdiction with the High Court (s. 71). Actions for infringement of a trade mark are not within the jurisdiction of the county court (*Bow* v. *Hart*, 1905, 1 K.B. 592). An annual report is made by the comptroller-general of patents, &c., as to proceedings with reference to trade marks.

III. "*Passing-off*" *and Trade Name.*—A trader has generally, besides his trade mark, numerous other symbols, which he uses as *indicia* of his goods, *e.g.* the name of title under which he himself trades, the name under which his goods are known and sold, badges of property which are termed "trade name," and the distinctive "get-up" of the goods as they appear in the market. These symbols enjoy the protection of the law, under certain conditions, equally with trade marks. No trader is entitled to "pass off" his goods as those of another, and if he infringes this rule he is liable to an action for an injunction and damages, and these rights are preserved by the Trade Marks Act 1905 (s. 45). The right to be protected against "passing-off" is restricted to goods of the same description as those upon which the trader uses the "get-up," &c., imitated. Even if the "passing-off" is done innocently it will be restrained (*Millington* v. *Fox*, 1838, 3 Mylne and Craig, 338). This case is described as not one of the use of a properly descriptive name, but rather a case of the same class as those in which a fancy or invented name is used (*Cellular Clothing Co.* v. *Maxton*, 1899, App. Cas. 326, 341). Although the first purchaser is not deceived, still if the article delivered to him bears words or marks such that it is "calculated to deceive" a purchaser from him, the use of them is illegal.

To this general rule there are several exceptions:—

1. No monopoly is allowed in names that are merely descriptive. But words which prima facie are descriptive, such as "camel-hair belting," for belting made of camel-hair (*Reddaway* v. *Banham*,

1896, App. Cas. 199), or "Stone Ales" for ales brewed at Stone (*Montgomery* v. *Thompson*, 1891, App. Cas. 217), may be shown to have acquired by long use a "secondary distinctive meaning," and, in fact, to mean the goods of a particular trader. And where a defendant is not selling the genuine goods indicated by the name, as where the composition of the goods is a secret, even if the name might otherwise be taken as merely that of the goods, he cannot rely on the defence that the name is descriptive (*Birmingham Vinegar Co.* v. *Powell*, 1897, App. Cas. 710; the "Yorkshire Relish Case"). If, however, the primary meaning of the word is simple and well known, it is extremely difficult to establish a secondary meaning exclusive of the primary one (*Hommel* v. *Bauer & Co.*, 1905, 22 R.P.C. 43; "Haematogen," a preparation for forming blood, secondary meaning not established; cf. *Fells* v. *Hedley & Co.*, 1904, 21 R.P.C. 91; "Naphtha soap," secondary meaning not established; *Wurm* v. *Webster & Girling*, 1904, 21 R.P.C. 373; "White Viennese Band," secondary meaning not established; *Cellular Clothing Co.* v. *Maxton*, 1899, A.C. 326, "cellular" as applied to cloth, secondary meaning not established). But although a name may not, owing to the fact that it consists of well-known or descriptive words, be inherently entitled to protection, a distinctive scroll or device, in which it is embodied, may be so. Thus, in a case (*Weingarten Brothers* v. *Bayer & Co.*, 1905, 21 Times L.R. 418; and see 19 Times L.R. 604) which sharply divided judicial opinion in England, the defendants were restrained from selling corsets in boxes bearing the name "Erect Form Corsets" scrolled thereon by the plaintiffs in a distinctive manner. No monopoly, of course, could be claimed in the words, but it was otherwise with the scroll. The use of a fancy name "iron oxide tablets" has been restrained where it was found likely to cause deception as being used to supersede in the market certain well-known "Iron Ox" tablets (*Iron Ox Remedy Co.* v. *Co-operative Wholesale Society Ltd.*, 1907, 24 R.P.C. 425). (2) A trader cannot be prevented from trading under his own name, if he is using it honestly (bona fide); even though from its similarity to the name of another trader—even one previously well-established—it may injure the business of the latter (*Burgess* v. *Burgess*, 1853, 3 De Gex, M. & G. 896; *Turton* v. *Turton*, 1889, 42 Ch. D. 128; *Dunlop Pneumatic Tyre Co.* v. *Dunlop Motor Co.*, 1907, App. Cas. 430). This right is recognized by the Trade Marks Act 1905, s. 44, which provides that registration of a trade mark under the act shall not interfere with any bona fide use by any person of his own name or place of business or that of any of his predecessors in business. But if a trader has never carried on such a business on his own account or in partnership with others, he cannot, by promoting and registering a joint-stock company with a title of which his name forms part, confer on the company the rights which he as an individual possesses in the use of his name (*Fine Cotton Spinners, &c., Association Ltd. and John Cash & Sons Ltd.* v. *Harwood Cash & Co. Ltd.*, 1907, 2 Ch. 184). If a trader's own name has, before he entered the trade, become the trade name of some other person's goods, he would probably not be allowed to use it without taking steps to prevent deception. This rule does not debar him from using "any bona fide description of the character or quality of his goods" (1905, s. 44). A name can become universally known as referring to the goods of a particular maker, *i.e.* as having a secondary meaning. This does not give exclusive rights to use of the name, but only to prevent other firms from using the goods so as to pass off their goods as those of the person whose name is in question (*Joseph Rodgers & Sons Ltd.* v. *Hearnshaw*, 1906, 23 R.P.C. 348).

It is provided by the Companies Act 1862 (s. 20), that no company shall be registered under a name identical with that by which a subsisting company is already registered, or so nearly resembling it as to be calculated to deceive, unless the subsisting company is in process of being wound up and consents to such registration; and provision is also made for a change of the name of any company which, through inadvertence or otherwise, is registered under a name coming within the statutory prohibition. It is to be observed (cf. Buckley, *Companies Acts*, 8th ed. p. 27) that (*a*) the Companies Act 1862 applies only to the case of taking the name of a subsisting company already registered, and not to a case where a new company proposes to register in the name of, or in a name closely resembling, the name of an old-established company which is not registered, or of a firm or individual trader; (*b*) that as soon as the new company is registered the act ceases to apply; and (*c*) that the act forbids registration irrespectively of the question whether the business proposed to be carried on by the new company is the same as that of the subsisting company or not. But the provisions of the Companies Act on this subject are merely supplemental to the common law, and any company trading in the United Kingdom may restrain persons from registering a new company to carry on a rival business under a name identical with or so similar as to be calculated to deceive, and a company already registered under such a name may be restrained from carrying on a rival business under it. The right to interfere depends not upon fraud but upon the tendency of the similarity to cause confusion, deception or mistake (Fine Cotton Spinners case above cited; *Birmingham Small Arms Co.* v. *Webb*, 1907, 24 R.P.C. 27; *Star Cycle Co.* v. *Frankenburgs*, 1907, 24 R.P.C. 405; *re Reddaway & Co.*, 1907, 24 R.P.C. 203). In such proceedings evidence is admissible to show how the existing company has used the name, and what, by reason of its connecting that name with its goods, the public have come to attribute to it (*Daimler Motor Car Co.* v. *London Daimler Co.*, 1907, 24 R.P.C. 379). A new company will not be allowed to take the whole name of a subsisting company, even although that name is of a descriptive character (*Manchester Brewery Co. Ltd.* v. *North Cheshire and Manchester Brewery Co. Ltd.*, 1899, App. Cas. 83).

Rights of Assignees.

The purchaser of the goodwill of a business has the right to use the trade name under which the business is known, and to restrain others from using it or such imitations of it as may mislead the public. But he is not entitled by the use of the trade name to make the vendor liable, under the doctrine of "holding out," for debts of the business incurred after the sale. And if the vendor of the goodwill gave his name to the business, he cannot (in the absence of any restrictive condition in the agreement for sale) be prevented from beginning to trade in his own name again, unless it be shown that in so doing he is attempting to deceive the public into the belief that he is still the owner of the old business. In construing the words "calculated to deceive" (s. 20) the courts will adopt principles closely analogous to those applicable in "passing off" cases in which the question is raised whether a trade name or the description or get-up of a particular class of goods is or is not likely to deceive (*British Vacuum Cleaner Co.* v. *New Vacuum Cleaner Co.*, 1907, 2 Ch. 312; *Aerators Ltd.* v. *Tollett*, 1902, 2 Ch. 319, 324). When the names of the two companies contain terms of common ordinary meaning descriptive of an article, s. 20 will be applied less readily than where the words said to create the confusion are of the character of fancy words relating rather to the maker than the article (Vacuum Cleaner Case).

IV. *Merchandise Marks.*—The first attempt to make the falsification of trade marks a criminal offence was in the Merchandise Marks Act 1862 (25 & 26 Vict. c. 88). That statute provided that the forgery of a trade mark with intent to defraud, and the false application of a trade mark to goods with the like intent, should be misdemeanours, but left upon the prosecutor the burden of establishing the fraudulent intent. The act contained no provision for summary prosecutions, and did not provide for the seizure of falsely-marked goods on importation from abroad. The international convention for the protection of industrial property, made at Paris in 1883, to which Great Britain acceded in 1884, contains a provision that all goods illegally bearing a trade mark or trade name may be seized on importation into those states of the union where the mark or name has a right to legal protection, and that the seizure shall be effected at the request of either the proper public department or of the interested party, pursuant to the internal legislation of each country. The law had to be amended in order to carry out this article in the convention, and the Merchandise Marks Act 1887 was passed to effectuate this object and generally to make better provision for the protection of merchandise. It was subsequently amended in 1891 and 1894. The effect of the provisions of these statutes may be briefly stated. Any person is guilty of an offence, punishable on indictment or summary conviction by fine or imprisonment, who does any of the five following acts, unless he proves as regards the first four of them that he acted without intent to defraud (there is a special defence to No. v. which is noted below): (i). forges any trade mark, or makes, disposes of, or has in his possession for such purpose any die or instrument; (ii.) falsely applies any trade mark or a colourable imitation of any trade mark to goods; (iii.) applies any false trade description to goods; (iv.) causes any of the above offences to be committed; (v.) sells or exposes for sale, or has in his possession for sale, trade or manufacture, any goods or things to which any forged trade mark or false trade description is applied, or any trade mark or colourable imitation of a trade mark is falsely applied, unless *the defendant* proves that, having taken all reasonable precautions, he had no ground to suspect the genuineness of the mark, &c., and also that on demand he gave to the prosecutor all the information in his power as to the person from whom he obtained the goods, &c., or proves that he otherwise acted "innocently." (See *Thwaites & Co.* v. *McEvilly*, 1903, 20 R.P.C. 663).

"Trade description" is defined as any descriptive statement or other indication as to the measurement, quantity (not *quality*, it should be observed), or weight, place or mode of production, or

Trade Description.

the material of the goods, or as to their being subject to an existing patent, privilege or copyright; conventional or customary descriptions lawfully in use in August 1887 to indicate that the goods are of a particular class or method of manufacture are allowed to be continued; but if they contain the name of a place and are calculated to mislead as to the real place of production, the name of the latter must be added. The test of what is a trade description depends upon the understanding of the trade and not on scientific correctness (*Fowler* v. *Cripps*, 1906, 1 K.B. 16).

On a prosecution for any of these offences, there is a power to forfeit the things found although no one is convicted. If the offender is indicted (it is in his option to be tried in this way) the punishment is fine and imprisonment, the latter not to exceed two years. On summary conviction the punishment is not to exceed, for a first offence, four months' imprisonment, with or without hard labour, and a fine of £20; and for any subsequent offence six months' imprisonment and a fine of £50. The importation is forbidden of goods by means of or in relation to which an offence against the acts has been committed, and also of all goods of foreign manufacture bearing any name or trade name being or purporting to be that of a manufacturer or trader within the country, unless it be accompanied by a definite indication of the country where the goods were made or produced. There are also special provisions with regard to the marking of catch-cases. The commissioners of customs have power to make general orders for carrying out the Merchandise Marks Acts. (See Regulations of the 1st of December 1887, Stat. R. & O. Revised, 1904, vol. viii. tit. Merchandise Marks.) Prosecutions may be undertaken by the board of trade in cases appearing to affect the general interests of the country or of a section of the community, or of a trade, subject to regulations made on the 21st of May 1892; and the board of agriculture and fisheries has a like power in the case of the produce of agriculture, horticulture and fisheries [act of 1894, s. 1; Board of Agriculture and Fisheries Act 1903, s. 1 (8); see the regulations of the 27th of October 1894, Stat. R. & O. Revised, vol. viii. tit. Merchandise Marks.]. Under the Sale of Food and Drugs Act 1899, and the Butter and Margarine Act 1907, the importation, except in containers showing their character, of margarine, margarine cheese, adulterated or impoverished butter, milk-blended butter or condensed, separated or skimmed milk, is penalized, and it is provided that the commissioners of customs, in accordance with directions given by the treasury after consultation with the board of agriculture, shall take such samples of consignments of imported articles of food as may be necessary for the enforcement of the law.

V. International Arrangements.—(The Trade Marks Act 1905 applies to the British Islands.) By the international convention for the protection of industrial property (see PATENTS), which was signed at Paris in 1883, the signatory states (others have since acceded) agreed that the subjects or citizens of each state should, in all the other states, enjoy as regards trade marks and trade names the advantages that their respective laws then granted, or should thereafter grant, to their own subjects or citizens. So far as Great Britain is concerned the provisions made for carrying out this convention are contained in s. 65 of the Trade Marks Act 1905 and in s. 91 of the Patents and Designs Act 1907.[1] The effect of that section is to confer on an applicant for the protection of a trade mark in one of the other contracting states a priority over other applicants for registration in the United Kingdom during the space of four months. The section does not, however, exempt the applicant from the conditions and formalities incumbent on ordinary applicants for registration in Great Britain; nor does the fact that the foreign application has been successful of itself give the applicant a right to have his mark accepted for registration. Under the Convention of Madrid of the 14th of April 1891 (to which Great Britain is not a party) a trade mark may be registered as the result of a single application in the countries of all the signatory powers. Besides the general international conventions there are also particular arrangements between many states, *e.g.* Germany and Italy (Italian law of the 24th of December 1903). Guatemala and Salvador, also signatory parties, have withdrawn from the convention.

The following is a list of the British orders in council that have been issued, applying to foreign countries, s. 103 of the Patents, &c., Act 1883:—

Foreign State.	Date of Order in Council.
Belgium	June 26, 1884.
Brazil	June 26, 1884.
Cuba	January 12, 1905.
Denmark (including the Faroe Islands)	November 20, 1894.
Dominican Republic	October 21, 1890.
Ecuador	May 16, 1893.
France	June 26, 1884.
Germany	October 9, 1903.
Greece	October 15, 1894.
Honduras	September 26, 1901.
Italy	June 26, 1884.
Japan	October 7, 1899.
Mexico	May 28, 1889.
Netherlands	June 26, 1884.
" (East Indian Colonies)	November 17, 1888.
" (Curaçoa and Surinam)	May 17, 1890.
Norway (and Sweden)	July 9, 1885.
Paraguay	September 24, 1886.
Portugal	June 26, 1884.
Rumania	August 5, 1892.
Servia	June 26, 1884.
Spain	June 26, 1884.
Sweden (and Norway)	July 9, 1885.
Switzerland	June 26, 1884.
Tunis	June 26, 1884.
United States	July 12, 1887.[2]
Uruguay	September 24, 1886.

All these orders in council are printed in the Statutory Rules and Orders Revised (ed. 1904), vol. ix., under the title "Patents, &c." By orders in council, made under the provisions of the Foreign Jurisdiction Acts, penalties have been imposed on British subjects committing offences against the Patents, &c., Act 1883–1888 (now represented by the Trade Marks Act 1905, and the Patents and Designs Act 1907) and the orders in council issued thereunder, and the Merchandise Marks Act 1887: China and Corea (1904), Egypt (1899), Morocco (1889), Muscat (1904), Ottoman Empire (1899), Persia, Persian coast and islands (1889–1901), Siam (1906) and Zanzibar (1906).

By s. 91 of the Patents and Designs Act 1907,[3] and s. 65 of the Trade Marks Act 1905, the king is empowered by order in council to apply the provisions of s. 91 above-mentioned, with such variations or additions as may seem fit, to any British possession. The following is a list of the orders in council that have been issued:—

British Possessions.	Date of Order in Council.
Ceylon	August 7, 1905.
New Zealand	February 8, 1890.
Trinidad and Tobago	August 12, 1907.
Australia (Commonwealth)	August 12, 1907.

The orders in council up to 1903 are printed in the Statutory Rules and Orders Revised (ed. 1904), vol. ix., under the title "Patents, &c."

It should be added that the protection of the Merchandise Marks Act 1887, extends to any trade mark which, either with or without registration, is protected by law in any British possession or foreign state to which the provisions of s. 103 of the act of 1883 or s. 91 of the act of 1907 are, under order in council, for the time being applicable.

A foreigner suing in the United Kingdom for infringement of a trade mark, or for "passing off," is in the same position as a subject.

VI. *Colonial and Foreign Trade Mark Laws.*—The British colonies generally follow the model of the English Trade Marks Acts (1883–1888).

Australia.—Legislation on trade marks is one of the subjects which the Commonwealth of Australia Constitution Act 1900 (s. 9, pt. v. 51, xviii.) places within the exclusive competence of the Federal Parliament. By the Commonwealth Trade Marks Act 1905, s. 20, provision is made for registration of trade marks throughout the Commonwealth, and subject to this act and other Commonwealth legislation the common law of England as to trade marks is applied throughout the Commonwealth. Prior to this act most of the states had their own trade mark law (New South Wales, No. 19 of 1900; Tasmania, No. 9 of 1893; Victoria, No. 1146, 1890; Western Australia, Nos. 7

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[1] This section supersedes ss. 103, 104 of the Patents, &c., Act 1883. The references to these sections in the Trade Marks Act 1905 must now be read as applying to s. 91 of the Patents, &c., Act 1907.

[2] A treaty was also concluded between Great Britain and the United States on the 24th of October 1877, for the protection of trade marks.

[3] This section re-enacts the provisions of ss. 103, 104 of the Patents, &c., Act 1883.

of 1884, 5 of 1886, 4 of 1894). But the state Trade Marks Acts, with certain savings, cease to apply to trade marks (1905, s. 6).

The Commonwealth act contains certain novel provisions:—

1. As to a Commonwealth trade mark to be applied to all goods included in or specified by a resolution passed by both houses, that in their opinion the conditions as to the remuneration of labour in connexion with their manufacture are fair and reasonable (s. 78). The mark consists in a device or label bearing the words "Australian Labour Conditions."

2. As to workers' trade marks intended to protect the products of any individual Australian worker or association of such workers other than primary products of agricultural or pastoral industries (s. 74). Sections 115, 116 of the act contain provisions for international and intercolonial arrangements as to protection of trade marks based on ss. 103, 104 of the act of 1883. By the Commerce Trade Descriptions Act, No. 16 of 1905, the import into and export from Australia of falsely marked goods is prohibited.

In *Canada* the law as to trade marks (*Rev. Stats.* c. 63) and merchandise marks (c. 41 of 1888) has been regulated by Dominion acts, similar to English statute law. *New Zealand* has an act of 1889. The *Hong-Kong* ordinance, No. 18 of 1898, is a typical instance of an ordinance in a Crown colony [see also Ceylon, No. 9 of 1906, Jamaica (laws 17 of 1888 and 6 of 1889)]. In the *Bahamas* a trade marks law was passed on the 29th of May 1906, based on the imperial act of 1905. In the *Straits Settlements* there is no registration of trade marks, but the common law as to "passing off" is applied.

United States.—Provision for the registration of trade marks in the United States was first made by an act of Congress of 1870; but that enactment was subsequently declared invalid by the Supreme Court (*U.S.* v. *Steffens*, 1879, 100 U.S. 82), on the ground that the constitution of the United States did not authorize legislation by Congress on the subject of trade marks, except such as had been actually used in commerce with foreign nations or with the Indian tribes. Congress legislated again on the subject in 1881 (act of the 3rd of March 1881, Revised Stats. U.S. ss. 4937–4947). The act of 1881 was repealed by an act of the 20th of February 1905 (s. 592), which, as modified by an act of the 4th of May 1906, now regulates the subject. A trade mark may be registered by the owner if he is domiciled within the United States, including all territory under the jurisdiction and control of the United States (s. 29), or resides or is located in any foreign country which by treaty, convention or law affords similar privileges to citizens of the United States (s. 1).

The right of persons domiciled in the United States was in 1906 extended to owners of trade marks who have a factory in the United States, so far as concerns the registration, &c., of trade marks used in the products of the factory (1906, s. 3). To obtain registration the owner of the mark (whether firm, corporation, association or natural person) must file in the patent office an application (*a*) specifying the name, domicile, location and citizenship of the applicant; (*b*) stating the class of merchandise and the particular description of goods in the class to which the mark is appropriated;[1] (*c*) annexing a drawing of the trade mark and as many specimens as may be required by the commissioner of patents; (*d*) giving a description of the trade mark (only when needed to express colours not shown in the drawing); and (*e*) specifying the mode in which the mark is applied and affixed to goods; (*f*) stating the time during which the mark has been used (1906, c. 2081, s. 1).

The application must be accompanied by a fee of $10, and be supported by a sworn declaration verifying the ownership and the drawing and description and stating that no one else has a right to use the mark, nor one so like it as might be calculated to deceive, and that the mark is in use in commerce among the several states or with foreign countries or with Indian tribes (1905 c. 592, s. 2).

Where the applicant resides or is located in a foreign country he must also show that the mark is registered in the foreign country, or that application has been made to register it there. Registration on behalf of foreign registrants is not made until foreign registration is proved nor unless application for United States registration is made within four months of the application abroad (1905, *c.* 592, ss. 2, 4).

The United States policy is to require registration of all trade marks unless they (*a*) consist of or comprise scandalous or immoral matter; (*b*) consist of or comprise the flag or insignia of the United States, or of any state or municipality, or of any foreign nation; (*c*) are identical with another known or registered trade mark owned and used by another and appropriated to merchandise of the same description, or so nearly resemble such other marks as to be likely to cause confusion or mistake in the mind of the public or to deceive purchasers; (*d*) consist merely in the name of an individual, firm, corporation or association, unless it is written, printed, impressed or woven in a particular or distinctive manner, or is associated with a portrait of the individual; (*e*) consist merely in words or devices descriptive of the goods with which they are used, or of the character or quality of such goods, or merely of a geographical name or term; (*f*) contain the portrait of a living individual unless his consent is evidenced by an instrument in writing.

Old marks may be registered irrespective of the above rules, no proof that they have been actually and exclusively used as a trade mark of the applicant or his predecessors from whom he derived title in such commerce as aforesaid for ten years before the 20th of April 1905. Applications made in proper form with the prescribed fee are at once examined in the patent office and if in order are gazetted to give opportunity for "interference."

Decisions of the examiners on applications or oppositions are subject to appeal to the commissioner of patents, and from him to the court of appeals for the District of Columbia (ss. 8, 9). The general jurisdiction in trade mark cases is given to the Federal courts below the Supreme Court, which has power by certiorari to review the decisions of circuit courts of appeal upon such cases (ss. 17, 18). The maximum protection given by registration is twenty years. The protection given to marks already registered in a foreign country lapses when the mark ceases to be protected in the foreign country (s. 12). Certificates of registration are issued under the seal of the patent office.

Provision is made to prevent importation of merchandise which copies or simulates the name of any domestic manufacture, manufacturer or trader, or of a manufacturer or trader located in a country affording like privileges to the United States, or which copies or simulates the trade mark registered in the United States, or which bears names or marks calculated to create the belief that it is made in the United States, or in any country other than the true country of origin. United States traders who seek protection can have their names and marks recorded and communicated to the customs department (s. 27). At any time during the six months prior to the expiry of the term of twenty years the registration may be renewed on the same terms and for a like period. The right to the use of any registered trade mark is assignable (with the goodwill of the business in which it is used) by an instrument in writing; and provision is made for recording such instruments in the patent office (s. 10).

France.—In France (laws of the 23rd of June 1857, and the 3rd of March 1890) trade marks are optional, but may be declared compulsory for certain specified articles by decrees in the form of administrative orders. The decrees regulating registration are of the 27th of February 1891 and the 17th of December 1892. The following are considered trade marks: names of a distinctive character, appellations, emblems, imprints, stamps, seals, vignettes, reliefs, letters, numbers, wrappers and every other sign serving to distinguish the products of a manufacture or the articles of a trade. A fixed fee of one franc is charged for entering the minute by registration (dépôt) of each mark, and making a copy thereof, exclusive of stamp and registration fees. By legislation of the 1st of August 1905 and the 11th of July 1906 provision is made for marking certain classes of commodities, mainly food products, to prevent falsification and the sale of foreign products as French.

Germany.—Under the German trade mark law of the 12th of May 1894 any person whatsoever can acquire protection for a trade mark, and all foreigners in Germany are placed on an exactly equal footing with Germans in the eyes of the law, so long as they have a domicile (*Niederlassung*) within the empire, *i.e.* a place of business or a residence which involves the payment of German taxes. The registration of a trade mark expires *ipso facto* after ten years from its date, but may be renewed for a similar period. Germany acceded to the international convention on the 1st of May 1903.

In the *Netherlands* (law of the 30th of September 1893) two distinct forms of registration are in force: (*a*) registration merely for the Netherlands; (*b*) international registration, available for the states of the international union.

The following other foreign trade mark laws may also be noted: *Austria-Hungary*, law of 1890 (published in Vienna on the 6th of January and in Budapest on the 6th of April 1890), and amending law of the 30th of July 1895, which enactment protects additions to trade marks. *Denmark* (law of the 11th of April 1890, and an amending law of the 19th of December 1898, which enables traders to register words or figures, provided that these are not indicative of the origin, kind, use, quality or price of the goods). *Japan* (law of the 1st of July, and regulations of the 20th of July 1899). *Russia* (law of the 26th of February [9th of March] 1896). *Switzerland* (law of the 26th of September 1890).

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[1] By the law of 1906 (s. 21) the commissioner of patents is directed to establish classes of merchandise.

AUTHORITIES.—Sebastian, *Trade Marks* (4th ed., London, 1899; in this work the American cases are fully dealt with); Kerly, *Trade Marks* (London, 3rd ed., 1908); Kerly and Underhay, *Trade Marks Act 1905* (London, 1906); Cartmell's *Digest* (London, 1876–1892); Sebastian, *Digest* (London; cases down to 1879); Gray, *Merchandise Marks Act* (London, 1888); Safford, *Merchandise Marks* (London, 1893). The reports of the Departmental Committee of 1887, and of the Select Committees of the House of Commons appointed in 1887 and 1890 to consider the law with regard to merchandise marks and false marks, and the annual Reports of the Comptroller-General, throw great light on both the history and the practical working of the law. For American law, see Browne, *Treatise on Trade Marks* (Boston, 1873); Cox, *American Trade Mark Cases* (Cincinnati, 1871); *Manual of Trade Mark Cases* (Boston, 1881); Greeley, *Foreign Patents and Trade Marks* (Washington, 1899); Paul, *Law of Trade Marks* (St. Paul, Minn., 1903); and the reports of the commissioner of patents. As to foreign trade mark laws generally, see the following: *British Parl. Papers; Reports relative to Legislation in Foreign Countries* (1879; Cd. 2284, 2420); *Reports from H.M.'s Representatives Abroad, on Trade Marks, Laws and Regulations* (1900; Cd. 104); *Summaries of Foreign and Colonial Laws as to Merchandise Marks* (1900; Cd. 358, p. 850 seq.).

(A. W. R.; W. F. C.)

TRADE ORGANIZATION. The development of commercial organization which attended the growth of trade and industry during the 19th century assumed two distinct phases. In the first we see the creation of associations of persons engaged in trade and industry for the purpose of protecting their interests and of facilitating and fostering commercial relations. In the second, governments elaborate departmental organizations for the supervision of commerial matters, and utilize their consular services as means of commercial intelligence and influence.

The associations belonging to the first category comprise three classes:—

a. Those which are themselves engaged in trade, like ordinary joint-stock companies, or which result from the combination of firms or individuals in the same or connected trades, for the purpose of facilitating or restricting production, limiting competition, regulating prices, &c.

b. Those which, without engaging in trade, aim at providing facilities for the transaction of commercial or financial operations. They chiefly take the form of exchanges, bourses, public sale rooms, &c., such as the Baltic, Lloyd's, the Stock Exchange, the Corn and Coal Exchanges, the Commercial Sale Rooms.

c. Non-trading bodies, in the nature of public institutions, whose objects are to protect the interests of trade.

British and French Systems.

When, at the close of the 18th century and early in the 19th, the power of the old trade gilds and corporations of merchants had been broken, both governments and commercial men soon realized that the ancient societies would not follow the commercial evolution, and that new organizations must be created to meet new requirements. Two systems were evolved, which, from their prototypes, are known as the British and the French systems. In the former, trade organizations were left to develop themselves in their own way, and in whatever direction they might think fit, without any official interference. In the latter, on the contrary, the government constituted itself the creator of trade organizations, which it incorporated into the administrative system of the country, and to which it gave an official status as an integral part of the machinery of the state. The former have grown chiefly into associations for the promotion and defence of commercial interests, whilst the latter have mainly become sources of commercial information and means of action at the disposal of the government. While organizations on the British system are, as regards the government, purely advisory bodies whose opinion might or might not be asked in connexion with commercial matters, and whose duties are limited to the services which they are in a position to render to their members and to commerce generally, organizations on the French system not only must be consulted, in certain specified cases, by the government, especially in connexion with the drafting of commercial legislation and of regulations affecting trade, but they have also administrative duties to perform, such as the control of public commercial institutions, of testing, standardizing and conditioning establishments, port and dock works, &c. The British system obtains in the United Kingdom and the British colonies, in the United States and in Belgium, while the French has been adopted in most European countries, and in Japan.

I.—GREAT BRITAIN AND COLONIES

A.—*Commercial Associations.*

In the United Kingdom commercial associations arose with the growth of trade, without any assistance from the state and free from all government restriction or control. The first in point of date were the "commercial societies" which were formed, chiefly during the last quarter of the 18th century, in Birmingham, Exeter, Halifax, Leeds, Liverpool and Manchester, and which exercised a not unimportant influence upon commercial developments at the close of the 18th and in the early years of the 19th centuries. The modern associations which superseded them divided themselves into four classes, viz:—

a. Chambers of commerce and associations which aim at becoming representative of general commercial interests;

b. Associations or institutes which represent particular trades or branches of trades;

c. Trade protection societies, which look after the interests of retail as well as wholesale traders, and undertake to supply them with information as to the standing and credit of firms, expose swindlers, collect debts, &c.; and

d. Non-representative associations rendering general commercial services.

a. Chambers of Commerce and General Associations.—Most of the chambers of commerce in the United Kingdom were formed during the latter half of the 19th century, although a few were in existence much earlier. The oldest British chamber is the Jersey chamber, which dates from 1768. The Glasgow chamber was founded in 1783. Dublin followed in 1785, Edinburgh in 1786, Manchester in 1794, Belfast in 1796, Birmingham in 1813, Newcastle-upon-Tyne in 1818, Liverpool in 1851, Sheffield in 1857, &c. The London chamber was the last of the chambers of importance to be established; it dates only from 1881.

The London Chamber.

The London Chamber of Commerce, which has over 3000 members, is one of the most representative associations of its kind, and the organization adopted has been very effective in securing this. The chamber has been divided into trade sections, of which there are at present forty-four, and members specify the sections to which they desire to belong. Each section has a separate organization, and is presided over by a chairman elected by itself, who may be helped by an elected committee if found advisable. The general council of the chamber confirms the election of chairmen of sections, and no action can be taken by the chamber on the recommendation of a section without authorization of the council. The chamber has placed itself in connexion with a number of mercantile associations which, whilst preserving their separate organizations and their independence of action, have found it advantageous to work in conjunction with it, either for general or for particular purposes, and to have a voice in its council. The more important of these are the Institute of Bankers, the Institute of Chartered Accountants, the Society of Accountants and Auditors, the General Ship Owners' Society, the General Produce Brokers' Association, the Federation of Grocers' Associations of the United Kingdom, the West India Committee, the Corn Trade Association, the United Planters' Association of Southern India, &c.

The Liverpool Chamber.

Particular reference should also be made to the Liverpool chamber, which, as regards division into trade sections and co-operation with independent associations, works on similar lines to those of the London chamber. The African trade section of the Liverpool chamber has been prominent in connexion with African questions, and since its foundation in 1884 has been the leading voice in all matters relating to West Africa.

Association of Chambers of Commerce.

The Association of Chambers of Commerce of the United Kingdom, which was formed in 1860, contributed much to give chambers of commerce as a whole a national importance. This association, like the chambers themselves, was of course purely voluntary, and at its foundation only sixteen chambers decided to join it. The association is maintained by an annual subscription from the constituent chambers. It has been instrumental in passing many useful acts of parliament, and in otherwise influencing legislation upon commercial topics. The general meetings, which are held annually in March, in London, and at which delegates are present from all parts of the country, have come to be considered as a kind of parliament of trade, and representatives of the Board of Trade, the general post office, and the foreign and colonial offices are generally in attendance. Special meetings take place in September, and are held in provincial towns on the invitation of the local chamber.

The association has limited its work to the United Kingdom, and has not taken advantage of the commercial development of the colonies to afford colonial interests an opportunity of voicing their needs in the metropolis. To supply this need the London Chamber of Commerce has, from time to time, organized congresses of chambers of commerce of the empire. Some of these congresses have been held in the colonies, the first being at Montreal in 1903.

British Chambers Abroad.

The home organization of chambers of commerce is supplemented by a few British chambers which have been established in foreign countries. These institutions are self-supporting, and not, as seems often to be thought, branches of, or subsidized or controlled by home chambers. The British Chamber of Commerce in Paris, which is the oldest of them, dates from 1873, and was originally established by British merchants in Paris for the defence of their own trade interests. Its scope soon extended, however, and it admitted to membership British firms trading with France although not resident in France, and in course of time became representative of general British commercial interests in the French markets. Other British chambers are to be found in Genoa, Alexandria, Barcelona, Constantinople and St Petersburg. In Brussels an Anglo-American chamber jointly represents British and American interests.

Foreign Chambers in England.

Several countries are represented in London by chambers of commerce, while the American Chamber (Liverpool), the Anglo-Belgian, the Anglo-Portuguese, the Australasian, the Italian, the Norwegian and the Swedish chambers are members of the Association of Chambers of Commerce of the United Kingdom. The United States are represented in England by the American Chamber of Commerce in Liverpool.

Colonial Chambers.

Commercial organization in the colonies is very much on the same footing as it is in the United Kingdom. The most representative associations are the chambers of commerce, whose constitution and functions are similar to those of the British chambers. In *Canada* the chambers, which are also sometimes called Boards of Trade, after the American custom, number over sixty, the most important being the Montreal and Toronto Boards of Trade and the Quebec Chamber of Commerce. The Canadian chambers have no association, but hold periodical conferences. There is, in addition, the Canadian Manufacturers' Association, with headquarters in Toronto and branches in all the provinces, which incorporates all the associations of manufacturers in the Dominion. The *Australian* chambers of commerce, which number some thirty, have joined into an association called the General Council of the Chambers of Commerce of the Commonwealth of Australia. In New Zealand, South Africa, India and many British colonies there are chambers of commerce in all the more important towns.

b. Associations Representing Particular Trades.—Associations representative of particular trades are almost innumerable. The London General Shipowners' Society, the Liverpool Shipowners' Association, the North of England Shipowners' and Steamship Owners' Associations may be mentioned as representative. The chambers of shipping and shipowners' associations joined forces in 1878 in order to establish the Chamber of Shipping of the United Kingdom, which does for them what the Association of Chambers of Commerce does for chambers of commerce. The Iron and Steel Institute affords a means of communication between members of the iron and steel trades, while the British Iron Trade Association is one of the most powerful. The nature of other associations is sufficiently indicated by their titles. In addition there are the Cotton Association, the Drapers' Chamber of Trade, the Fish Trade Association, the Sugar Refiners' Committee, various tea planters' associations, the Oil Seed Association, the Petroleum Defence Committee, the Mansion House Association on Railway and Canal Traffic, &c.

c. Trade Protection Societies.—These seem to be, on the whole, more ancient bodies than chambers of commerce. In the early part of the 19th century they were already strongly organized, especially in the West Riding of Yorkshire. Outside of that district the Dublin Society was the most important. They number more than 100 throughout the United Kingdom.

The Manchester Guardian Society, which dates from 1826, occupies a position of special prominence in the Midlands, and may be taken as the model of such associations. Its objects are—the making of private inquiries as to the respectability and credit of traders, the detection and exposure of swindlers; the collection of debts; the winding-up of insolvent estates; the issue of notices of bills of sale, judgments, bankruptcies, &c.; and generally the improvement of laws and regulations affecting trade. The society has over 6000 members, and its usefulness may be gauged by the fact that it answers an average of 40,000 credit inquiries every year.

Trade protection societies formed themselves, as early as 1848, into an association, which was at first an association of secretaries, but in 1865 was transformed into an association of societies. The association issues a quarterly journal called the *Trade Protection Journal*.

B.—*State Departmental Organizations.*

Although the British government allowed commercial organizations within its jurisdiction to grow independently of official control, it does not follow that it took no interest in the protection and promotion of British trade and the dissemination of commercial intelligence. As long ago as the reign of Charles II. the body which is now the British equivalent of what is known in most countries as the ministry of commerce, viz. the board of trade, was established. The commercial jurisdiction of the Board of Trade does not extend beyond the limits of the United Kingdom, but the Foreign Office, through the negotiation of commercial treaties and by means of the consular body, came into touch with international trade. With the development of the colonies, the colonial and India offices also found themselves called upon to act, to a certain extent, as guardians of commercial rights and channels for the dissemination of commercial intelligence. But when competition began to displace British goods from foreign markets, and when the British trader noticed the efforts which were being made by foreign governments for the promotion of trade, he came to the conclusion that the British government was not doing anything for him.

Consular Service.

Complaints were especially loud against the consuls, who were accused of systematically disregarding commercial interests, whilst their American, German, French and Belgian colleagues did not consider it below their dignity to take advantage of their position, in order to promote the trade of the country they represented. British Consular Reports were also unfavourably compared with those issued by foreign consuls, notably the American. The result was that, in 1886, instructions were issued to the consular service which, for the completeness and fairness with which they deal with the subject, have frequently been quoted as models which might advantageously be followed (see Parliamentary Paper, Commercial, No. 16, 1886). The preparation of consular reports, however, continued to be most unfavourably criticised, and frequent instructions were issued by the foreign office in regard to them. The whole question was raised again in 1896, when, as the result of lengthy communications between the Foreign Office on the one hand, and the Association of Chambers of Commerce and the London chamber on the other, fresh instructions were sent to British consuls, reiterating the instructions of 1886.

The consular service has of late years been supplemented by the appointment of commercial attachés.

Commercial Intelligence Branch of the Board of Trade.

The pressure exercised by the chambers of commerce upon the government led to the appointment in 1897 of a departmental committee on the dissemination of commercial intelligence, which was charged with considering means of more adequately supplying traders with commercial information, of improving consular and colonial reports, and with reporting on the advisability of appointing commercial agents to the colonies and establishing a commercial intelligence office. The chief result of the committee's recommendations was the establishment of the commercial intelligence branch of the Board of Trade. It publishes the *Board of Trade Journal* weekly. Attached to the branch is an advisory committee, composed of representatives of the various government departments and of the Association of Chambers of Commerce.

The scope of the commercial intelligence branch was further increased, and its means of action strengthened, by the transfer of the Imperial Institute to the Board of Trade, which was effected in 1902 by the passing of a private act of parliament.

The self-governing colonies are represented in London by agents-general (*q.v.*), while the commercial interests of the crown colonies are in the hands of the crown agents for the colonies.

II.—UNITED STATES OF AMERICA

A.—*Commercial Associations.*

American trade organizations have been developed mainly on the lines of the British system. Of the associations which come within the scope of this article, the most important are the chambers of commerce, which in certain cases are called boards of trade. Theoretically there is a distinction between the two, chambers of commerce being entrusted with the protection of general commercial interests, especially in connexion with foreign trade, whilst boards of trade look after local commercial questions. But in practice the difference is of no importance, as chambers of commerce take cognisance of local as well as international trade matters, and the boards of trade in no way limit the sphere of their activity to purely American questions.

The oldest American commercial organization is the New York Chamber of Commerce, which was founded in 1768, and incorporated by royal charter in 1770. In the words of its charter, its object was "to carry into execution, encourage and promote by just and lawful ways and means such measures as will tend to promote and extend just and lawful commerce." It was the prototype of all the other chambers of commerce and boards of trade which have since been established in the United States, and which are said to exceed 1000 in number. American trade organizations are associated in a National Board of Trade, which corresponds to the Association of Chambers of Commerce of the United Kingdom. The objects of this institution are to secure unity and harmony of action in reference to commercial questions, and to obtain, through its representative character, more satisfactory consideration of the matters which it brings under the notice either of the Federal government or of the local state administrations. The expenses of the National Board of Trade are defrayed out of a fund formed by the subscriptions of the various associations belonging to it. The United States has a number of chambers of commerce established in foreign countries. The first institution of this kind was started so long ago as 1801, when the American Chamber of Commerce in Liverpool was established. This chamber is the only one representing American commercial interests in the United Kingdom, there being no association of this nature in London. The American Chamber of Commerce in Paris is one of the most active, important and representative foreign associations on the continent of Europe. In some places where neither the American nor the British element is strong enough to maintain separate associations (notably in Brussels), they have joined hands to support an Anglo-American Chamber of Commerce, which is found to work fairly satisfactorily The American commercial museums, although of recent foundation, have attracted much notice owing to the practical and business-like manner in which they are conducted, and are considered to be among the best equipped institutions of this nature. Those in Philadelphia and at San Francisco are the best known. The Philadelphia museum, which came first and is better known, was established by an ordinance of the municipality in 1894, and is supported by subscriptions and by municipal subsidies, administered by a board of trustees, who are appointed for life and serve without remuneration. The work of the museum is supervised by an advisory board, composed of representatives of the principal commercial organizations in the United States. Its objects are to assist American manufacturers and merchants in securing wider foreign markets for their products, to aid them in forming connexions abroad, and to bring foreign buyers in touch with them. One of the chief ways in which this is done is by means of an index file of foreign customers supplied to American manufacturers, and vice versa. In addition to the regular service to members, the museum also maintains abroad, in various cities, index files covering some sixty American trades or trade divisions, containing the names of American manufacturers of standing, with full particulars of their various lines of manufacture. These files are generally entrusted to chambers of commerce, or similar commercial institutions, and are placed gratuitously at the disposal of foreign manufacturers and merchants. The Philadelphia museum has also a most valuable library and a museum of samples.

B.—*State Departmental Organization.*

The American state organization for dealing with commercial matters lacks the theoretical completeness of the organization of most European states, but is nevertheless found to give satisfaction. Official control is exercised through various bureaus placed, for the most part, under the treasury department. The most important of these are: the interstate commerce commission, which deals with matters affecting the inland trade; the industrial commission, which looks chiefly after manufacturing; and the fishery bureau. Foreign commercial matters come within the cognisance of the bureau of foreign commerce, a section of the state department which also controls the consular body, and sees to the publication of their reports and to the dissemination of foreign commercial intelligence. The state department corresponds to the British foreign office.

The Pan-American Union, until 1910 called the Bureau of American Republics, was established in 1889, as a result of the Pan-American Conference called together in that year by the late James G. Blaine, secretary of state at that time. This bureau, which had its offices in Washington, is supported by a contribution from all the republics of North, Central and South America, which is fixed at the rate of 1000 dollars a year per million inhabitants. Its object is the dissemination of trustworthy commercial information concerning the republics of the American continent, and in pursuance of this object it has issued a large variety of publications.

Consular Service.

The American consular service has been frequently pointed out as a model to be followed in connexion with commercial matters. America, contrary to the European practice, has no *consuls de carrière*. Her consular representatives are appointed for a period of, as a rule, four years, and are selected in preference from commercial circles. Their work, as compared with that of British consuls, is rather limited, and they have nothing to monopolize their time like the shipping interests with which the British consular body is entrusted in most countries. Since 1898 the bureau of foreign commerce issues consular reports daily, as fast as they are received, and circulates them in advance sheets, printed on one side of the paper only, like printers' proofs. They are afterwards republished in permanent form.

The American consular body, which numbers some 400 members, and is exclusively composed of American citizens, is distributed according to the commercial importance of towns.

III.—France

A.—*Commercial Associations.*

The French government was the first to elaborate a regular system of trade organizations, which it endeavoured to make as complete as possible. This system comprises:—

a. Chambers of commerce;

b. Consultative chambers of arts and manufactures; and

c. Syndical chambers of trade and industry.

Origin.

a. Chambers of Commerce.—Chambers of commerce owe their origin to the city of Marseilles, where, in 1599, the town council, which had hitherto looked after the commercial interests of the city, found it no longer possible to combine commercial with municipal functions, and established an association which it called the "Chamber of Commerce" to take up the commercial part of its duties. This seems to be the first time that the title was used. The new chamber soon became a most important body, and in 1650, during the minority of Louis XIV., *lettres patentes* were granted to it. It settled the law merchant and the customs of the port, was entrusted with the appointment of consuls and the control of French consulates in the Levant, fitted out expeditions against corsairs, owned fleets, sent embassies to the Barbaresque countries, organized commercial missions, &c. Its ordinary budget, at one time, amounted to over one million livres. Louis XIV. conceived the idea of a system of organizations which, whilst not being allowed to become so dangerously powerful as that of Marseilles, would nevertheless be useful in other towns, and in 1700 he caused an *arrêté* to be published, ordering the creation of chambers of commerce, which were entrusted with the nomination of deputies to the Royal Council of Commerce which had just been created in Paris. Chambers were consequently established in Lyons, Rouen, Toulouse, Montpellier, Bordeaux, La Rochelle, Lille, Bayonne, Amiens, &c. These bodies, however, did not exercise much influence under the monarchy. Including the Marseilles chamber, they were suppressed, with all trade gilds and other trade associations, in 1789. Napoleon re-established the chambers by decree of the 24th of December 1802, and endowed them with a constitution similar, in essential particulars, to the one they have at present, which has served as a model for chambers of commerce on the Continent, but he submitted them to a uniform and narrow administrative jurisdiction which practically deprived them of all initiative.

Constitution.

They are now regulated by the law of the 9th of April 1898, which codified, altered and completed previous legislation on the subject. Under this law, chambers of commerce can only be established by a decree countersigned by the minister of commerce, upon the advice of the municipal council of the place where the chamber is to be, of the general council of the department, and of the existing chambers of commerce of the district. The members of chambers of commerce used to be elected by the "Notables Commerçants," who were a body of commercial electors selected by the prefects in accordance with the provisions of the Code of Commerce. They were abolished by law in 1871, but those who were then entitled to the designation still continue to use it, which explains the words "Notable Commerçant," so puzzling to foreigners in French commercial directories and on French business cards. At present, commercial houses paying *patente*—which is a special tax upon people engaged in trade—elect the members of the chamber, the number of whom is fixed for each chamber by the minister of commerce.

Functions.

Their functions, which are consultative and administrative, are set out in part ii. of the law of 1898. The government is bound to take their opinion regarding the regulation of commercial usages, the establishment of public institutions of a commercial or financial nature, and of tribunals of commerce, the improvement of transport and communications, the application of laws of a local character, the sale price of prison-made goods and the tariff for prison labour, and local public works, and loans or taxation in connexion therewith. On the other hand, they are allowed to submit observations to the government, without being asked, on proposed changes in the commercial or economic legislation of the country; on customs tariffs and regulations; on railway, canal and river rates; and on transport regulations. As regards their administrative functions, they may be authorized to establish and administer such institutions as bonded warehouses, public sale-rooms, fire-arm testing establishments, conditioning rooms for wool, silk, textiles, paper, &c., commercial, professional, or technical schools and museums, &c. They may be granted concessions for public works, and may undertake the carrying out of public services, especially in regard to the ports, docks, canals and navigable rivers in their district, and be authorized to issue loans for the purpose.

Previous to 1898 it was illegal for chambers of commerce to hold joint meetings for the discussion of matters of public interest, and they were not even allowed to correspond or consult in any way, except through the medium of the minister of commerce. The new law relaxed to a certain extent this prohibition, by authorizing direct correspondence and permitting chambers in a district to meet for the joint consideration of questions affecting their district, but for no other purpose. Such a thing as an association of chambers of commerce is still illegal in France.

French Chambers of Commerce Abroad.

When, in 1873, British merchants in Paris started a British chamber of commerce in the French capital, the French government looked rather askance at the new venture, and M. Léon Say, when minister of commerce, even threatened it with forcible dissolution unless the title "Chamber of Commerce" was dropped. This demand was not ultimately pressed, and the services rendered by the British chamber soon opened the eyes of the French government to the advantages which they might derive from the formation of similar institutions to represent French commercial interests abroad. In 1883 the minister of commerce started the organization of such chambers, which endeavoured to combine to a certain extent the French and the British systems.

Foreign Chambers of Commerce in Paris.

Foreign commercial interests are represented in Paris by seven foreign chambers of commerce, of which the British Chamber is the oldest. The others are the American, Austro-Hungarian, Belgian, Italian, Spanish and Russian chambers. In 1896 these chambers formed themselves into an Association of Foreign Chambers of Commerce, but the French government gave it to be understood that, as they did not allow associations of French chambers, they could not treat foreign bodies more favourably, and the association had to be dissolved.

Constitution.

b. Consultative Chambers of Arts and Manufactures.—These institutions, organized somewhat after the model of chambers of commerce, represent manufacturing and industrial interests. They were established by Napoleon I. in 1803, and formed part of the complete system of commercial organizations which he intended to give France. They are now regulated by decrees of 1852 and 1863, and are composed of twelve members elected for six years by merchants and manufacturers inscribed upon an electoral list specially drawn up by the prefects. These chambers, of which there are some fifty in existence, are placed under the control of the minister of commerce, but instead of being kept out of the *patentes*, like chambers of commerce, they are supported by the municipality of the town where they are situated, which has also to provide them with offices rent free, and with clerical assistance. **Functions.** In addition to giving advice in connexion with manufacturing and industrial matters, they have to look after and report upon improvements in manufactures and machinery, new industrial processes, &c. They are especially useful in the preparation of local and international exhibitions. They are also entrusted with the nomination of the Consultative Committee of Arts and Manufactures, a body whose functions are to advise the ministers of commerce and finance, as well as those of the interior and of public works, as regards the regulation of dangerous trades and industries, patents and trade marks legislation, and the interpretation of customs regulations.

c. Syndical Chambers of Trade and Industry.—By the side of the official trade organizations other associations have grown up, which, although regulated by law, are in the nature of voluntary and self-supporting bodies, viz. the syndical chambers of trade and industry. The repeal in 1884 of the law of 1791, which prohibited the formation of trade or professional association, was the signal for the formation of those chambers, which soon acquired great influence. A few syndical chambers existed before that date, the oldest, the Chamber of Master Builders, dating back as far as 1809, but they were only tolerated, and their existence, being illegal, was most precarious.

Constitution.

The syndical chambers, which are divided into chambers of employers and chambers of employed, are the official organs and representatives of the trade and professional syndicates authorized by the law of the 31st of March 1884, which was the work of M. Waldeck-Rousseau. Each syndicate has its separate chamber. They may be established without government authorization, but a copy of their rules and a list of their officials must be sent to the prefect. Membership is strictly limited to persons of French nationality. The only way in which the government can dissolve them is by application to the courts of justice for an order of dissolution on the ground of infringement of the provisions of the law. In Paris, most of the syndical chambers have formed an association called the Union Nationale du Commerce et de l'Industrie—Alliance des Chambres Syndicales. Another association, intended to take up the defence of the interests and rights of syndical chambers, has been formed under the title of Syndicat du Commerce et de l'Industrie—Syndicat des Chambres Syndicales. The syndical chambers are kept up by the subscriptions of their members, and have the right to hold real property, as have also the associations of chambers, which are kept up by subscriptions from the constituent chambers.

Functions.

According to the law which authorized their formation, the objects of the syndical chambers are exclusively "the study and defence of economic, industrial, commercial and agricultural interests," and for this purpose they have complete freedom of intercommunication and can hold congresses. They are authorized to establish for their members mutual benefit societies and pension and relief funds, to open employment agencies, to give legal advice to, and in certain cases to bring actions on behalf of their members, and to organize the settlement of disputes by arbitration. They take part in the election of judges of the tribunals of commerce and of the Conseils de Prud'hommes.

B.—*State Departmental Organization.*

Ministry of Commerce.

The state commercial departments and offices are chiefly centred round the ministry of commerce, to which is assigned the commercial part of the duties fulfilled in England by the board of trade. A ministry of commerce existed for short periods in 1811 and in 1828, but it was ultimately suppressed in 1829, and from that date until 1886, when the department received its present form and separate existence, commerce was only represented in the French government by a subsidiary bureau attached sometimes to one ministry, sometimes to another. The ministry is divided into three main bureaus—the first entrusted with all matters connected with the home trade and industry, the second with foreign and colonial relations, and the third with the compilation of statistics.

Attached to the ministry of commerce is a body called the Conseil Supérieur du Commerce et de l'Industrie, which acts as an advisory council to the minister. Its origin goes back to the council of commerce established by Louis XIV., but it is now regulated by a decree of 1882.

National Office for Foreign Trade.

The Office National du Commerce Extérieur was established by a law of the 4th of March 1898, and is carried on jointly by the ministry of commerce and the chamber of commerce of Paris, the latter having provided it with an installation at a cost of over 1,200,000 francs. The office, which has been founded for the promotion of French trade with foreign countries and the dissemination of commercial intelligence, fulfils duties similar to those of the commercial intelligence branch of the board of trade. It also publishes the weekly *Moniteur officiel du commerce*.

Office Colonial.

The Office Colonial, whose duties are especially to furnish information concerning the French colonies, to promote emigration thither, and to foster a demand in France for the produce of her colonies, was established by a decree of the 14th of March 1899. It is entrusted, in addition, with a permanent exhibition of colonial produce and a museum of samples of goods supplied by or required in the colonies. The office is also in charge of a colonial garden at Vincennes, where experiments are made for the acclimatization of colonial plants and produce in France, and the cultivation of French produce in the colonies. The office publishes a monthly bulletin of miscellaneous colonial information, and issues yearly commercial and other reports dealing with the colonies. It is a dependency of the ministry of the colonies.

Consular Service.

French consuls are instructed to transmit to their government all information which they may consider useful for the prosperity of French trade. It is also their duty to spread, in the country where they reside, a knowledge of such French commercial and financial matters as they may consider most useful in the interests of their own country. The close relations which they are recommended to cultivate with the French commercial community within their jurisdiction through the local French chamber of commerce and the councillors of foreign trade are intended to enable them to keep in better touch with commercial questions. They have had, however, to be frequently reminded of their commercial duties, and the French chambers of commerce have criticized them almost as much as the British chambers have British consuls. The most important instructions issued to consuls were contained in circulars from the minister for foreign affairs dated the 15th of March and the 24th of April 1883. French consuls have to make a return to their government every fortnight—every month if the district is not of great commercial importance—showing, upon forms specially provided, the nature, quantity, origin or destination, prices wholesale and retail, and chief trade marks of the goods imported into and exported from the district, the results of public sales of produce, the conditions of transport, contemplated public works and tenders advertised, state of the labour market, artistic enterprises, commercial failures and rumours concerning important local firms, effect of foreign competition, imitation of French trade marks, &c. These returns are mostly of a confidential nature, and are not intended for publication, but whenever the minister considers it advisable he causes information to be conveyed through the chambers of commerce, or other channels, to the parties chiefly interested. The ordinary consular reports are published in weekly instalments in the *Moniteur officiel du commerce*.

IV. Germany

A.—*Commercial Associations.*

German trade organizations are of three kinds, viz.:—

a. Official organizations established by law, and called Handelskammern, or chamber of commerce;

b. Semi-official associations; and

c. Voluntary or "free" associations.

a. Chambers of Commerce.—Contrary to the idea prevalent in England, official trade organizations in Germany are in a somewhat chaotic state. They have been established under more or less different conditions and systems in each state of the empire, and in certain districts still bear the imprint of foreign origin. They are under the control of the local state governments and lack the homogeneity and unity of direction of the French official system.

Hanseatic Organization.

Before proceeding to a general examination of the German régime, special mention must be made of the chambers of commerce of the old Hanseatic Confederacy which stand apart, and whose duties, as well as constitution, differ from those of trade organizations in the rest of Germany. The chambers of commerce in Hamburg, Bremen and Lübeck are not only the successors of, but (contrary to what happened in Germany as well as in other countries) have been evolved out of the old corporations which looked after the interests of the Hans traders in the olden days, and which, in the case of the Hamburg "Commerz-Deputation," for instance, dated as far back as 1665.

The Hamburg Chamber of Commerce, whose present constitution dates from 1860, is composed of twenty-four members elected for six years by the ancient "Versammlung eines ehrbaren Kaufmannes," that is to say, the merchants and commercial men whose names appear on the register of the "Honest Merchants" of the city. Its income is chiefly derived from special taxation, to which are added the proceeds of the sale of contract and transfer stamps, and also the amount paid every year for the re-registration of each "Honest Merchant." This latter source of income amounts to about 70,000 marks per annum. The chamber has to submit its accounts for approval to the Senate of the Republic.

In addition to the general duties of chambers of commerce in connexion with trade matters, the Hamburg chamber—the same may also be said of the other Hanseatic chambers—fulfils the combined functions of a chamber of shipping and of a port and docks board. It has the right of proposing judges and of nominating experts attached to the courts. The exchanges and public sale rooms of the city are under its control, and it publishes the official quotations, as well as a weekly price list of goods and produce at the port of Hamburg. It is entitled to elect members to the "Bürgerschaft" or lower house of representatives, who are especially competent to deal with trade and shipping questions, customs duties and emigration. The chamber must be consulted by the "Bürgerschaft" with reference to all proposals affecting trade and navigation.

In Bremen the chamber is composed of twenty-four members elected by the "Ausschuss des Kaufmanns-Konvents," which comprises all the important commercial houses of the city. Two members go out every year, and no one can remain a member for more than eighteen years. The Bremen chamber is intimately connected with the Senate of the Republic, a standing committee of both being in existence to settle questions affecting trade and navigation.

The Lübeck chamber is composed of twenty members elected for six years by the associations representing the wholesale and retail trades. The president must be approved by the senate, and is sworn in as a state official. He holds office for two years, and is not paid for his services, but when he goes out of office is presented with a sum of money subscribed by the townspeople. The Lübeck chamber is probably the wealthiest organization of its kind in Germany, and is entrusted with the administration of the property of the old corporation of the "Vorstand der Kaufmannschaft," which is very important. The senate must consult it not only in trade and navigation matters, but also with reference to all contracts entered into on behalf of the state.

Chambers of Commerce.

Chambers of commerce in other parts of the German Empire are not so important, nor are their duties so varied, as in the Hanseatic towns. The oldest ones were established by Napoleon in 1802 in Cologne, Crefeld, Aachen, Stolberg and other towns which were then under the control of France, and they were submitted to the legislation which regulated the chambers organized in France at the same time. The model set up by the French was more or less closely followed in the subsequent establishment of institutions of this nature in other German states. The Berlin chamber was only constituted on the 1st of April 1902. A trade corporation called the "Aelteste der Kaufmannschaft" previously fulfilled, to a certain extent, the duties of a chamber of commerce. The new chamber rests on a broader basis than the old corporation, which, however, remains intact, though the sphere of its action has been restricted.

Broadly speaking, the German chambers are elected by the registered tradespeople and the merchants. Throughout the whole of Germany chambers are under the strict supervision of the state minister of commerce, and cannot be established except with his permission. He fixes the number of members as well as the amount of the state allocation to the chamber. In Prussia and Bavaria the government is entitled to dissolve chambers whenever it considers it advisable to do so, and there is always a government commissioner in attendance at all meetings. In most cases the local government allows a fixed sum for the expenses of chambers of commerce, and if this amount is exceeded the electors who are on the commercial register have to make good the excess by the striking of a special rate. In some states, *e.g.* Brunswick, Württemberg and Baden, the electors cannot be called upon to pay for deficiencies more than an amount fixed by law. In Bavaria chambers get a subvention from the district and central funds.

The duties and powers of the German chambers are practically the same as those of the French chambers.

The German government did not, like the French, interfere with the liberty of association of chambers of commerce, and as a result German chambers have united, together with other trade corporations, in an association called the "Deutsche Handelstag," founded in 1861, and carried on in its present form since 1886.

German Chambers Abroad and Foreign Chambers in Germany.

The German government is understood to be opposed to the formation of German chambers of commerce abroad, and as a matter of fact there are no German chambers in Europe outside of Germany. A few have been established in South America, but they are purely voluntary associations. No foreign chambers of commerce exist in Germany.

b. Semi-Official Corporations.—Besides the chambers of commerce, there exist, chiefly in Prussia, various old-established and quasi-official corporations, whose views receive as careful consideration from the government as do those of chambers of commerce. The Berliner Aelteste der Kaufmannschaft is one of the most important of these corporations, but the Gewerbekammer of Memel, the Kaufmännische Verein of Breslau, the Vorsteher Amt der Kaufmannschaft of Koenigsberg also deserve mention. Others exist in Elbing, Stettin, Danzig, Tilsit and Magdeburg. They originated for the most part in ancient gilds or associations of commercial firms, and were organized in their present form between 1820 and 1825.

c. Voluntary Associations.—Germany possesses also a large number of influential commercial associations of a voluntary character called the "Freie Vereine," which, especially in recent years, have greatly contributed to the commercial development of the empire.

B.—*State Departmental Organization.*

The German Empire has no ministry of commerce. As in the United States, commercial matters form only a department of the ministry of state. Most of the states of the empire have, however, their own ministries of commerce, the oldest being the Prussian ministry of commerce and industry, which dates from 1848.

Prussian Council of National Economy.

In Prussia, the minister of commerce is advised by the Volkswirthschaftsrath, or council of national economy, an official body constituted in 1880 by the Emperor William I. The functions of this council, which assembles periodically under the presidency of the minister of commerce, are also similar to those fulfilled in France by the Conseil Supérieur du Commerce et de l'Industrie.

Commercial Museums.

The German government has taken steps to facilitate the dissemination of commercial intelligence by the establishment of commercial museums, which are variously called "Handelsmuseen," "Ausfuhrmusterlager" or "Exportmusterlager." The first of these, which are on the model of the Vienna Handelsmuseum, was opened in Berlin in 1883. Others followed in Munich, Karlsruhe, Frankfort, Cologne, Dresden, Leipzig, Weimar, &c. They perform, to a certain extent, much the same functions as those performed in England by the commercial intelligence branch of the board of trade.

Consular Service.

A perusal of the instructions given to German consuls with regard to commercial matters shows that the German consular body is in this respect very much in the same position as the British consular body. If German consuls as a whole have been especially active and successful in promoting German commercial interests, it is not on account of the nature of the instructions received from their government, these instructions being to all intents and purposes similar to those issued to British consuls, but because particular care was taken to select consuls from a class of men imbued with the desire of increasing the greatness of their country by the promotion of German trade.

Agricultural Attachés.

Of distinctly commercial attachés, like those of Great Britain and Russia, Germany has none; but in addition to the consular body she is represented in foreign countries by five attachés or experts, whose duties are to study the movements of agricultural produce, and interest themselves in agricultural matters generally. They cover Great Britain, France, Russia, the Danube district and the United States.

V.—Belgium

A.—*Commercial Associations.*

The important place which Belgium has taken in international trade has directed much attention to her commercial organization, which comes nearer to the British model than that of any other European country. Belgian chambers of commerce were on the French system until 1875, when all official ties between them and the government were broken, and full liberty was given to commercial associations to establish and govern themselves in their own way. The Belgian chambers have now no administrative functions of any kind, but the Belgian government never fails to consult them in matters likely to interest the commercial community. The most important chambers are those of Antwerp, Brussels, Ghent, Liége, Charleroi, Verviers and Namur. Mention should also be made of the federations of industrial and commercial associations at Antwerp and at Brussels, and of the syndical union of Brussels. In some places there are Liberal and Conservative chambers of commerce.

In addition to institutions representative of the general interests of commerce and industry, the principal trades have also in the larger cities separate associations or syndicates. There are a large number of associations for the promotion of colonial trade, which have grown up since the establishment of the Congo Free State. A number of Belgian chambers of commerce also exist abroad, the first of which was established in New York in 1867.

B.—*State Departmental Organization.*

The Belgian ministry of commerce, under whose control commercial matters are placed, dates only from 1895, previous to which time the department of commerce at the ministry for foreign affairs fulfilled the same functions. The ministry has established in Brussels a Commercial Museum, similar to those of Germany and Austria, to centralize commercial intelligence and facilitate its dissemination.

VI.—Other Countries

Austria-Hungary.—The control exercised by the government over commercial organizations in Austria and in Hungary is very close. The only institutions of this kind of any importance within the dual monarchy are the chambers of commerce. They are official bodies, regulated by the law of the 29th of June 1868, which is, as regards the functions of chambers, almost similar to the French law. But the Austrian chambers, in certain cases, have the right to elect members of parliament, which right depends upon taxation. Within the Trieste district one-third of the members of chambers of commerce may be foreigners.

Austria and Hungary have each a ministry of commerce, the former since 1853 and the latter since 1867, whose jurisdiction is strictly confined to internal trade matters in each country. Whenever important questions arise affecting common interests the Gemeinsame Zoll-Conferenz, or Common Customs Conference, is summoned. This conference is made up of representatives of the various ministries of both countries. Matters arising out of commercial relations with foreign countries are under the control of the commercial department of the imperial foreign office.

The Vienna commercial museum was the prototype of similar institutions. It was established in 1875, as a consequence of the Vienna International Exhibition of 1873, and was followed shortly afterwards by the establishment of a similar one in Budapest.

Italy.—The chambers of commerce and arts, which are regulated by the law of 1862, are official bodies. They are instituted, and may be dissolved, by royal decree, and their functions are almost similar to those performed by the French chambers. They are, however, at liberty to unite for the consideration of commercial and industrial questions of common interest, and are entitled to own property and to levy taxes for their maintenance.

An advisory council is attached to the ministry of commerce, which dates from 1878. This council is called upon to give an opinion with reference to all matters connected with trade and industry. There are also two commercial museums, one in Rome and one in Milan.

Spain.—Spanish chambers of commerce were organized by a royal decree of 1886, which places them under the control of the Ministro de Fomento. They are self-supporting bodies with unlimited membership, but have also an official standing. In order to belong to them one must be of Spanish nationality, be engaged in trade, have paid direct taxes to the state for at least five years for the business in connexion with which membership of the chamber is sought, and pay annually the amount of the subscription provided by the regulations. The government must consult chambers of commerce upon treaties of commerce and navigation, tariff changes, the creation of commercial exchanges and the organization of commercial education. Owing to the peculiarity of their constitution the Spanish chambers are much more representative of the feelings of the commercial community, and much less under the strict control of the government, than similar institutions in other continental countries. Spain has no ministry of commerce proper, the duties of this office being performed by the commercial sub-department of the Ministro de Fomento, which dates from 1847.

Portugal.—In Portugal the organizations corresponding to chambers of commerce, which are called "commercial associations," are voluntary associations kept up by the subscriptions of their members. The associations at Lisbon and Oporto are the only ones of importance.

Russia.—Attached to the department of trade and manufactures of the ministry of Finance, which in Russia does duty for the ministry of commerce, there is an official council of trade and manufactures which sits in St Petersburg, and is presided over by a representative of the ministry. A similar council is also in existence at Moscow. In addition to these there are six local bodies, called the "local committees of trade and manufactures," entrusted with the care of commercial interests in Archangel, Odessa, Rostov-on-the-Don, Tver, Tikhvin and Ivanovo-Voznesensk. At Warsaw there is a "committee of manufactures." The committees are purely consultative bodies.

Closer to what we know as chambers of commerce are the institutions called "exchange committees." They are voluntary associations, chosen by a council elected for the purpose by the commercial community; they generally consist of twelve members elected for five years, and the president is appointed by the minister of finance. Two important commercial societies, although unofficial, are recognized and frequently consulted by the government, viz. the Society for the Encouragement of Russian Trade and Industry, of St Petersburg, and the Society for the Encouragement of Navigation, of Moscow.

The Russian government is represented abroad by commercial attachés, who are known as "agents of the Russian ministry of finance." The duties of these attachés are almost similar to those of the British commercial attachés, but they are entrusted with the promotion of Russian financial as well as commercial interests.

Japan.—Commercial matters in Japan come within the cognizance of the minister of state for agriculture and commerce. The chief commercial associations are the chambers of commerce, which are under the direct control of the minister. They are official bodies, with a constitution somewhat resembling that of the French chambers. The members must be Japanese subjects.

Authorities.—Correspondence respecting diplomatic and consular assistance to British trade abroad. *Parliamentary Papers*, No. 16, 1886, and No. 5, 1897; *Report of the Departmental Committee on the Dissemination of Commercial Intelligence* (2 vols., c. 8962, 8963, 1898); Reports on the constitution and functions of ministries of commerce and analogous branches of foreign administrations. *Parliamentary Paper*, No. 12 (1889). Reports, rules, by-laws and articles of association of the various chambers mentioned. W. H. Schoff, *American Commercial Institutions* (New York, 1900); *Foreign Trade Policies*; American Consular Report, No. 307 (Dec. 24, 1898). *The Bureau of American Republics Annual Reports* (Washington). *The Chambers of Commerce Year Book* (York, 1909).

TRADE UNIONS, combinations for regulating the relations between workmen and masters, workmen and workmen, or masters and masters, or for imposing restrictive conditions on the conduct of any industry or business.

I.—The United Kingdom

History of British Legislation.

By the English common law such combinations were, with certain unimportant exceptions, regarded as illegal. They were considered to be contrary to public policy, and were treated as conspiracies in restraint of trade. Those who were concerned in them were liable to be criminally prosecuted by indictment or information, and to be punished on conviction by fine and imprisonment. The offence was the same whether it was committed by masters or by workmen. But although the common law applied *mutatis mutandis* to both of them alike, it was, practically speaking, in reference rather to the latter than to the former that its effects were developed and ascertained. Although workmen, as individuals, might lawfully consent or refuse to labour for any remuneration or for any time they pleased, the hostility of the common law to combinations effected the result that when two or more of them joined together, and agreed to labour only on certain stipulated terms, their agreements were not only null and void, but were criminal offences subject to punishment. It was immaterial whether the end they had in view was to determine wages or to limit work; or whether the means they adopted for promoting its attainment was a simultaneous withdrawal from employment, an endeavour to prevent other workmen from resuming or taking employment, or an attempt to control the masters in the management of their trade, the engagement of journeymen or apprentices, or the use of machinery or industrial processes; or whether in seeking to enforce their demands they relied merely on advice and solicitation, or resorted to reproach and menace, or proceeded to actual violence. In any event their combination in itself constituted a criminal conspiracy, and rendered them amenable to prosecution and punishment.

Act of 1800.

From the reign of Edward I. to the reign of George IV. the operation of the common law was enforced and enlarged by between thirty and forty acts of parliament, all of which were more or less explicitly designed to prohibit and prevent the organization of labour. But the rise of the manufacturing system towards the end of the 18th century, and the revolution which accompanied it in the industrial arrangements of the country, were attended by a vast and unexpected extension of the movement which the legislature had for so long essayed to suppress. Among the multitudes of workmen who then began to be employed in factories, trade unions in the form of secret societies speedily became numerous and active, and to meet the situation a more summary procedure than that which had hitherto been available was provided by an act passed in 1800. By this statute it was enacted that all persons combining with others to advance their wages or decrease the quantity of their work, or in any way to affect or control those who carried on any manufacture or trade in the conduct and management thereof, might be convicted before one justice of the peace, and might be committed to the common gaol for any time not exceeding three calendar months, or be kept to hard labour in the house of correction for a term of two calendar months.

Act of 1824.

Act of 1825.

The discontent and disorder consequent upon the introduction of steam and improved appliances into British manufactures in the first quarter of the 19th century, in conjunction with a state of commercial depression and national distress, led to the nomination of a select committee by the House of Commons, to inquire into the whole question of what were comprehensively designated the "combination laws," in the session of 1824. The committee reported to the House that "those laws had not only not been efficient to prevent combinations either of masters or workmen, but on the contrary had, in the opinion of many of both parties, had a tendency to produce mutual irritation and distrust and to give a violent character to the combinations, and to render them highly dangerous to the peace of the community." They further reported that in their judgment "masters and workmen should be freed from such restrictions as regards the rate of wages and the hours of working, and be left at perfect liberty to make such agreements as they mutually think proper." They therefore recommended that "the statute laws which interfered in these particulars between masters and workmen should be repealed," and also that "the common law under which a peaceable meeting of masters or workmen might be prosecuted should be altered." In pursuance of their report, an act, 5 Geo. IV. c. 95, was at once brought in and passed. But the immediate results of the change which it effected were regarded as so inconvenient, formidable and alarming, that in the session of 1825 the House of Commons appointed another select committee to re-examine the various problems, and review and reconsider the evidence submitted to their predecessors. They reported without delay in favour of the total repeal of the act of 1824, and the restoration of those provisions of the combination laws, whether statutory or customary, which it had been more particularly intended to abrogate. The consequence was an act passed in 1825 of which the preamble declares that the act of 1824 had not been found effectual, and that combinations such as it had legalized were "injurious to trade and commerce, dangerous to the tranquillity of the country, and especially prejudicial to the interests of all who were concerned in them." The effect of this act was to leave the common law of conspiracy in full force against all combinations in restraint of trade, except such as it expressly exempted from its operation, as it had been before the act of 1824 was passed. It comprised, however, within itself the whole of the statute law relating to the subject, and under it no persons were liable to punishment for meeting together for the sole purpose of consulting upon and determining the rate of wages or prices which they, being present, would require for their work or pay to their workmen, or the hours for which they would work or require work in any trade or business, or for entering into any agreement, verbal or written, for the purpose of fixing the rate of wages or prices which the parties to it should so receive or pay. But all persons were subjected to a maximum punishment of three months' imprisonment with hard labour who should by violence, threats or intimidation, molestation, or obstruction, do, or endeavour to do, or aid, abet or assist in doing or endeavouring to do, any of a series of things inconsistent with freedom of contract which the act enumerated and defined.

Act of 1859.

In 1859, in order to remove certain doubts which had arisen as to the true import and meaning of the undefined words "molestation" and "obstruction," it was provided by an amending act that "no person, by reason merely of his endeavouring peaceably and in a reasonable manner, and without threat or intimidation, direct or indirect, to persuade others to cease or abstain from work, in order to obtain the rate of wages or the altered hours of labour agreed to by him and others, should be deemed to have been guilty of 'molestation' or 'obstruction.'"

Acts of 1869-1876.

In spite of the partial recognition which trade unions had thus received, they continued to be unlawful, although not necessarily criminal, associations. In certain cases, they were by statute exempted from penal consequences, and their members were empowered to combine for specified purposes, and to collect funds by voluntary contributions for carrying them into effect. But in the estimation of the common law the special privileges which had been accorded to them under particular circumstances did not confer any general character of legality upon them, and where their rules were held to be in restraint of trade, as in the prohibition of piece-work or the limitation of the number of apprentices, they were still regarded as conspiracies. In this condition the law was when what became notorious as the "Sheffield and Manchester outrages" suggested the appointment of the royal commission on trade unions, which investigated the subject from 1867 to 1869. The outcome was, first, a temporary measure for the more effectual protection of the funds of trade unions, passed in 1869, and, secondly, the two measures which, as amended and amending, are cited together as the "Trade Union Acts 1871 and 1876."

General Effects.

Under these statutes, construed with the Conspiracy and Protection of Property Act 1875, the law relating to combinations, whether of workmen or of masters, entered upon a new phase. In connexion with trade disputes no person can be prosecuted for conspiracy to commit an act which would not be criminal if committed by him singly. The purposes of a trade union are not to be deemed illegal merely because they are in restraint of trade, and the circumstance that they are in restraint of trade is not to render any member of it liable to prosecution, nor is it to avoid or make voidable any agreement or trust relating to it. No court, however, can entertain legal proceedings with the object of directly enforcing or recovering damages for the breach of an agreement between the members of a trade union as such, concerning the conditions on which the members for the time being shall or shall not sell their goods, transact their business, employ or be employed, or the payment by any person of any subscription or penalty to a trade union, or for the application of the funds of a trade union to provide benefits or to furnish contributions to any employer or workman not a member of such trade union in consideration of such employer or workman acting in conformity with the rules or resolutions of such trade union, or to discharge any fine imposed upon any person by any court of justice or any agreement made between one trade union and another, or any bond to secure such agreement. But such incapacity to sue on such agreements is not to be taken as constituting any of them illegal. Every person, however, commits a misdemeanour, and on conviction is liable to a maximum fine of £20, or to a maximum imprisonment of three months with hard labour, who wilfully and maliciously breaks a contract of service or hiring, knowing or having reasonable cause to believe that the probable consequence of his so doing, either alone or in combination with others, will be to endanger human life or cause serious bodily injury, or to expose valuable property, whether real or personal, to destruction or serious injury; or, who, being employed by a municipal authority or by any company or contractor on whom is imposed by act of parliament, or who have otherwise assumed, the duty of supplying any place with gas or water, wilfully and maliciously breaks a contract of service or hiring, knowing, or having reasonable cause to believe, that the probable consequence of his so doing, alone or in combination with others, will be to deprive the inhabitants of that place, wholly or in part, of their supply of gas or water; or who, with a view to compel any other person to do or to abstain from doing any act which such other person has a right to abstain from doing or to do, wrongfully and without legal authority uses violence to or intimidates such other person or his wife or children, or injures his property, or who persistently follows such person about from place to place, or who hides any tools, clothes or other property owned or used by such other person, or deprives him of or hinders him in the use thereof, or who watches or besets the house or other place where such person resides or works or carries on business or happens to be, or the approach to such house or place, or who follows such other person with two or more other persons in a disorderly manner in or through any street or road. Attending at or near the house or place where a person resides or works or carries on business, in order merely to obtain or communicate information was not watching or besetting within the statute, but this proviso has since been repealed. In regard to registration, trade unions are placed on a similar footing with friendly and provident and industrial societies, and they enjoy all the privileges, advantages and facilities which those associations possess and command, except in so far as they differ by the fact that there is no legally enforceable contract between a trade union and its members, and that the right of a registered trade union to invest funds with the National Debt Commissioners is limited, and in a few other matters. On their side, however, they have to comply with the same conditions, are subject to the same liabilities, and are compelled to make the same periodical returns.

Later Legislation.

During the years following 1876 several important amendments of the law, other than special trade union legislation, and the decisions of the courts in various cases, led up to the important act of 1906. These affected principally the liability of trade union funds to be taken in execution for the wrongful acts of agents of the union, the statute law relating to picketing and other incidents of strikes, and the law of conspiracy as affecting trade unions.

The two latter points are dealt with in the article on STRIKES AND LOCK-OUTS, and it may suffice here to say that the clauses in the act of 1875 prescribing punishment for watching and besetting a house, &c., with the view of compelling any other person in the manner set forth, have been amended by the repeal of the proviso that "Attending at or near the house or place where a person resides, or works, or carries on business, or happens to be, or the approach to such house or place, in order merely to obtain or communicate information, shall not be deemed a watching or besetting within the meaning of this section" by the enactment in the act of 1906 that; "It shall be lawful for one or more persons, acting on their own behalf or on behalf of a trade union or of an individual employer or firm in contemplation or furtherance of a trade dispute, to attend at or near a house or place where a person resides or works or carries on business or happens to be, if they so attend merely for the purpose of peacefully obtaining or communicating information, or of peacefully persuading any person to work or abstain from working."

The object was to include the right of peaceful persuasion which had been supposed by parliament to be implied in the terms of the act of 1875. Further, the law of conspiracy has been amended by enactments in the act of 1906 that: "An act done in pursuance of an agreement or combination by two or more persons shall, if done in contemplation or furtherance of a trade dispute, not be actionable unless the act if done without any such agreement or combination would be actionable," and "An act done by a person in contemplation or furtherance of a trade dispute shall not be actionable on the ground only that it induces some other person to break a contract of employment or that it is an interference with the trade, business or employment of some other person, or with the right of some other person to dispose of his capital or his labour as he wills."

Leading Cases in the Law-courts.

The act of 1875, in the words of Lord Cairns, was framed on the principle that "the offences in relation to trade disputes should be thoroughly known and understood, and that persons should not be subjected to the indirect and deluding action of the old law of conspiracy," but no one during the discussion of the bill was thinking of the civil action. This matter became important when the dicta of various judges in the House of Lords in the case of *Quinn* v. *Leathem* showed that there might be an action for damages based on any conspiracy to injure or do harm, particularly when it is considered that the very essence of a strike is in one sense injury to those against whom it is directed, and these opinions became of the utmost import to trade unions when the Taff Vale case showed that the fact of procuring to strike might also involve trade union funds in liability, even where there had been no procuring to break contracts. This important decision arose through the amendment of general procedure under the Judicature Acts in 1881. The distinction was abolished between legal and equitable rules as regards parties to sue and be sued, and in 1883 there was issued a General Order No. xvi. of the supreme court, rule 9 of which prescribed that where there are numerous parties having the same interest in one cause or matter, one or more of such persons may sue or be sued, or may be authorized by a court or judge to defend in such cause or matter, on behalf or for the benefit of all persons so interested. It was decided in *Temperton* v. *Russell* in 1893 where three trade unions were made defendants to represent all the members, and the order did not apply in the case of a trade union, because the words of the order "numerous parties having the same interest in one cause or matter" could only be satisfied by parties who had, or claimed to have, a beneficial proprietary right which they were asserting or defending, from which it was inferred that they could not be sued at all, and in the report of the Royal Commission on Labour in 1894 the opinion was either assumed or expressly stated that they could not be sued in tort. In 1901 the House of Lords overruled *Temperton* v. *Russell* in the case of the *Duke of Bedford* v. *Ellis*, holding that the General Order No. xvi. rule 9, was universal in its application. In the same year the Taff Vale case came before the House of Lords. In the first place, expounding the Trade Union Act 1871, they held unanimously that from the provisions in that act concerning registered trade unions there is to be legally inferred an intention of parliament that a trade union might be sued in tort in its registered name, with the consequence that trade union funds would be liable for any damages that might be awarded. Secondly—apart from the Trade Union Act—Lord Macnaghten and Lord Lindley expressed an unhesitating opinion that under the General Order No. xvi, as interpreted in *Duke of Bedford* v. *Ellis*, any trade union, whether registered or not, could be sued in tort by means of a representative action. Trade unionists protested against the result as a decision of judges making a practically new law against trade unions and nullifying the settlement of their status made by the legislature in 1871, and in June 1903 a royal commission was again appointed to inquire into the subject of trade disputes and trade

Taff Vale Case.

combinations and as to the law affecting them, and to report on the law applicable to the same and the effect of any modifications thereof.

Act of 1906.

The majority of the commission reported in January 1906 in favour of an alteration in the law relating to picketing and conspiracy, but against any alteration of the law as laid down in the Taff Vale judgment. A different view was, however, expressed in the Trade Disputes Act passed in the same year, whereby it was enacted with reference to trades union funds that "an action against a trade union, whether of workmen or masters, or against any members or officials thereof on behalf of themselves and all other members of the trade union in respect of any tortious act alleged to have been committed by or on behalf of the trade union, shall not be entertained by any court," although "nothing in this section shall affect the liability of the trustees of a trade union to be sued in the events provided for by the Trades Union Act 1871, section 9, except in respect of any tortious act committed by or on behalf of the union in contemplation or in furtherance of a trade dispute." This act and the two previous acts are cited together as the Trade Union Acts 1871 to 1906, and form the present statutory enactments upon the subject.

The Osborne Judgment.

In December 1909 one of the most important judgments in connexion with trade unions was delivered in the case of *Osborne* v. *Amalgamated Society of Railway Servants*. The litigation had extended over two years, ending in the House of Lords (December 21, 1909) upholding the decision of the court of appeal (L.R. 1909, ch. 163). The plaintiff, who had been a member of the Amalgamated Society of Railway Servants since 1892, sued his trade union to have it declared that one of its current rules, which provided, amongst other things, for parliamentary representation and the enforced levy of contributions from him and other members of the society, towards the payment of salaries or maintenance allowance to members of parliament pledged to observe and fulfil the conditions imposed by the Labour Party, was *ultra vires* and void. It was decided in the King's Bench against the plaintiff, but the judgment was reversed by the court of appeal, whose decision was upheld by the House of Lords. This meant that the Labour Party in the House of Commons would have to find other ways and means than contributions from trade unionists to maintain their members in parliament. A voluntary levy was attempted, but did not meet with any success, and in 1910 agitation was set on foot by the Labour Party for the reversal of the "Osborne judgment." They also announced in September their intention of making a change in the constitution of their party by eliminating the necessity of each member signing an acceptance of certain conditions, on the ground that the party had arrived at a state when it could trust to ordinary party loyalty to keep their members' action in accordance with the policy of the party. It was also hoped that it would meet many objections raised against their agitation for the reversal of the Osborne judgment. The agitation had the result of increasing the force of the movement for payment of members, not only in the Liberal party but also among the more progressive Conservatives.

History of Organization.

Trade unions, in the sense in which the term is now understood, appear to be almost exclusively of modern growth. Though combinations among various classes of workmen to improve their position have doubtless been formed from time to time from an early period, such combinations, up to comparatively recent years, were mostly ephemeral, almost the only class among whom permanent associations of journeymen are known to have existed in the middle ages being the masons, whose confederacies were prohibited by law in 1425. With this doubtful exception, there is little or no trace of permanent combinations corresponding to the modern trade union before the 18th century. During the period when wages and conditions of employment were the subject of State regulation (*e.g.* under the Statute of Apprentices of Elizabeth), combinations to exact higher rates or other conditions than those so fixed were naturally regarded as illegal conspiracies.

The craft gilds of the middle ages have sometimes been regarded as the true predecessors of trade unions, but the analogy must not be pressed too far. The structure, constitution and functions of a gild of craftsmen, aiming at the protection and regulation of the craft as a whole, were essentially different from those of a trade union, formed to protect one class of persons engaged in an industry against another. Nor is there any trace of direct continuity between gilds and trade unions, for the claim of certain Irish trade unions to be descended from gilds will not bear scrutiny (see Webb, *History of Trade Unionism*, appendix). The only true sense in which it can be said that there is a certain indirect historical filiation between gilds and trade unions is that, as pointed out by Brentano, some of the earliest trade unions had for their original object the enforcement of the decaying Elizabethan legislation, which in its turn had taken the place of the obsolete regulation of industry by the craft gilds, so that among the rules and objects of such unions would naturally be some bearing a likeness to gild regulations.

The actual way in which trade unions first came into being probably varied very greatly. In some cases, as stated above, their origin can be definitely traced to associations for enforcing the legal regulation of industry against the opposition of employers; in others, the meetings of journeymen belonging to the same trade for such purposes as sick or burial clubs became naturally the nucleus of secret combinations to raise wages. The growth of the "capitalistic" system of industry, under which the workman no longer owned the materials or instruments with which he worked, was one of the most potent causes of the development of workmen's combinations. The efforts of trade unions to revive the enforcement of the Elizabethan legislation not only failed, but led to its repeal (1813–1814); but the laws against combinations, which had been made more stringent and more general by the acts of 1799–1800, remained unaltered until 1824. In spite of these acts, which made all combinations illegal, there is evidence that trade clubs of journeymen existed and were tolerated in many trades and districts during the first quarter of the 19th century, though they were always subject to the fear of prosecution if they took hostile action against employers; and in many cases strikes were suppressed by the conviction of their leaders under these acts or under the common law of conspiracy. The partial protection accorded to societies for the purpose of regulating wages and hours of labour by the law of 1825 led to a rapid multiplication and expansion of trade unions, and to an outburst of strikes, in which, however, partly owing to the widespread commercial depression, the workmen were mostly unsuccessful. Thus the first impetus given to trade unions by the modification of the combination laws was followed by a collapse, which in its turn was followed (in the third decade of the century) by a succession of attempts on the part of workmen to establish a federal or universal combination, to embrace members not of one but of several trades. To this new form of combination, which excited a good deal of alarm among employers, the term "trades union," as distinct from trade union, was applied. All these general movements, however, proved short-lived, and the most extensive of them, the "Grand National Consolidated Trades Union," which was formed in 1834 and claimed half a million adherents, only had an active existence for a few months, its break-up being hastened by the conviction and transportation of six Dorchester labourers for the administration of unlawful oaths. In the years of depressed trade which followed, trade unionism once more declined, and the interest of workmen was largely diverted from trade combinations to more general political movements, *e.g.* Chartism, the Anti-Corn-Law agitation and Robert Owen's schemes of co-operation.

From 1845 we trace another revival of trade unions, the characteristic tendency of this period being the amalgamation of local trade clubs to form societies, national in scope, but confined to single or kindred trades. High rates of contribution, and the provision of friendly as well as trade benefits, were among the features of the new type of union, of which the Amalgamated Society of Engineers, formed in 1851, was the most important example. The growth of unions of the new type was followed by a development of employers' associations in the 'sixties, and by a number of widespread strikes and lock-outs, and also by various efforts to promote arbitration and conciliation by the establishment of joint boards of employers and employed. (See ARBITRATION AND CONCILIATION and STRIKES AND LOCK-OUTS.)

A series of outrages at Sheffield and Manchester in 1865–1866, in which officials of some local trade societies were implicated, led to the appointment in 1867 of a Royal Commission on Trade Unions, whose report was followed by the passage of the Trade Union Act of 1871, which as amended in 1876 and 1906 now governs the legal position of trade unions. Conferences of trade union representatives held in 1866 and 1867 to determine their policy with respect to the royal commission of inquiry, led to the gatherings of the trade union congress which are still held annually.

The period of inflated trade which began in 1871 caused, as usual, another rapid growth of trade combinations, of which the most characteristic feature was their extension to agricultural and general labourers. To meet this new development of combination, the National Federation of Associated Employers of Labour was formed in 1873. The years of depression, 1875–1880, were marked by a series of unsuccessful strikes against reductions of wages, and by a general decline of trade unions, which did not again revive until nearly ten years later, when the new wave of prosperous trade brought with it an outburst of strikes, chiefly among unskilled labourers, for improved conditions, of which the most notable was the strike of the London dock labourers in 1889. These trade movements were accompanied by the formation of a large number of unions of a type more akin to those of 1830–1834 than to the more modern trade-friendly society with its high contributions and benefits. The "new unions" were chiefly among unskilled labourers; their rates of contributions were from 1d. to 3d. a week, and as a rule they only offered strike benefit. Another characteristic was the extent to which their leaders were permeated with the Socialistic doctrines which had then recently taken root in Great Britain, and which led them to advocate positive state interference with industry in the interests of the labourers (*e.g.* the legal limitation of hours of labour).

The reports of the Royal Commission on Labour, which sat from 1891 to 1894, contain much valuable information on the state of facts and on the opinions of employers and workmen at this period.

From 1892 onwards the progress of trade unionism can be traced statistically. The depression of trade, 1892–1895, brought with it, as usual, some decline in trade unionism; but though many of the "new unions" collapsed, some of the more important have survived to the present time. The revival of trade which began in 1896 was naturally accompanied by an increase in the strength of trade unions; but the most marked characteristic of this period was the extension and consolidation of employers' associations, of which perhaps the most notable is the Engineering Employers' Federation, which was originally formed on the Clyde, but gradually extended to other districts and became a national organization of great strength during its successful struggle with the Amalgamated Society of Engineers in 1897–1898. Among the other more important employers' associations and federations of a national character may be mentioned the Shipping Federation, the Federated Coal Owners, the Ship-building Federation, the Federation of Master Cotton-Spinners' Associations, the National Federation of Building Trade Employers, and the Incorporated Federated Associations of Boot and Shoe Manufacturers.

Constitution.

In 1899 a general federation of trade unions was established which had in 1907 a membership of 650,000 in 117 affiliated societies. This federation links the trade unions of the United Kingdom with those of other countries by its affiliation with the international federation of trade unions, which embraces the national federations of the principal European countries. During recent years there has been a noticeable tendency towards the creation of federations of trade unions, and the absorption of the smaller by the larger societies. Trade unions, both in their historical development and their present organization, present a very great variety of constitutions. The oldest type is that of the local trade club, consisting of a comparatively small number of men following the same occupation in the same locality. A large number of unions have never progressed beyond this primitive form of organization. The government is of the simplest kind, by a general assembly of all the members, while such officers as are required to carry on the necessary routine business of the society are chosen by rotation or even by lot.

Indisposition to concentrate power in the hands of permanent officers and a tendency to divide the business of management equally among all the members, instead of delegating authority to a few chosen representatives, are leading characteristics of trade unions in this primitive form. The organization here described, even if adequate for ordinary current requirements, is ill suited for conducting a contest with employers, and accordingly in times of strife an improvised "strike committee" often comes into existence and practically governs the conduct of the dispute. No doubt this double constitution of the old trade club as a loosely organized friendly society, converting itself at times into a more or less secret strike combination ruled by an irresponsible committee, is to be traced to the time when trade unions as such were illegal combinations and had to carry out their objects under the guise of friendly societies. The Friendly Society of Ironfounders (established in 1809), though it has to a great extent outgrown its primitive constitution, retains in its name the mark of its origin, while the government of the London Society of Bookbinders, by mass meeting of its members, offers an example of the persistence of traditional methods under wholly changed conditions. The Sheffield trade clubs, responsible for the outrages which led to the appointment of the Trade Union Commission in 1867, and subsequently to the passage of the Trade Union Acts, conformed as a rule to the primitive type. At the present time over 750 trade unions are known to exist which are purely local in character, with no branches. The next step in trade union evolution seems to have generally been an alliance or federation of two or more local clubs belonging to the same trade. This federation would make it necessary to provide some machinery for common management, the simplest and crudest expedient being for each of the allied clubs to act in rotation as the governing branch. Thus the government of the federation or "amalgamated society" was at any given time confided to the members of a single locality, and the seat of government was periodically shifted. Some federal societies (*e.g.* the Mutual Association of Journeymen Coopers) still retain this primitive form of government.

As the tendency developed for local clubs to unite, the necessity of permanent officials to cope with the growing business of the amalgamation caused the institution of a paid secretary (usually elected by the whole body of members), and this led naturally to the fixing of the seat of administration at a particular centre instead of rotating among the branches. Some continuity of policy and of office tradition was thus made possible, but the executive committee almost invariably continued to consist of the local committee of the district where the seat of government happened to be. Thus up to 1892 the business of the Amalgamated Society of Engineers, a society with hundreds of branches all over the United Kingdom and even abroad, was conducted by a committee elected by the London branches. The Boilermakers continued a somewhat similar form of government up to 1895; and many great societies, *e.g.* the Amalgamated Society of

Carpenters and Joiners, continue a somewhat similar system to the present day.

The plan of entrusting the government of a national society to a local executive has obvious conveniences, where the society consists of a body of working men scattered over a large area and with no leisure for travelling. But the control exercised by a locally-elected committee over a general secretary deriving his authority not from them but from the vote of a much wider constituency, could hardly be expected to be very effective; while the expedients of referring all important questions to a vote of the whole body of members, and of summoning at periodical intervals special delegate meetings to revise the rules, have proved in practice but clumsy substitutes for the permanent control and direction of the executive officers by a representative council. Quite as ineffective in some cases has been the authority of a mere local executive over the committees of other districts. Accordingly, some of the largest "amalgamated" unions have now adopted a representative system of government. Thus in 1892 the Engineers revised their rules so as to provide for the election of the executive council by vote of all the members divided into eight equal electoral districts. The members of council so elected are permanent paid officials, devoting all their time to the work of the society. The general secretary, however, continues to be chosen by the whole body of members, while the responsibility of the council is also weakened by the institution of "district delegates" nominally responsible to them, but chosen by direct election in the various districts. (This division of authority and consequent weakness of responsibility was one of the causes of the state of things which led to the great engineering dispute of 1897, and it also led to a deadlock in negotiations on the north-east coast in 1908, the executive being powerless to enforce its views.) The Boilermakers adopted the system of a permanent executive in 1895.

In the case of certain highly-localized industries, such as cotton and coal, the conditions have admitted of a somewhat different form of constitution from that described above. Thus the Amalgamated Association of Operative Cotton-Spinners is a federal organization, consisting of a number of local associations, all, however, situated within a comparatively small area. The governing bodies of the association are—(1) a quarterly meeting of about a hundred representatives of the districts; (2) an executive committee of thirteen chosen by the above representative meeting, of whom seven must be working spinners and the other six are usually permanent district officials; (3) a sub-council to transact the ordinary daily work of the association, consisting of the six official members referred to above. The secretary is chosen by the representative meeting, and engages his own office assistants. Here we have the familiar features of representative institutions—a large legislative body, a small executive chosen by and responsible to this body, and a still smaller group of permanent officials to transact ordinary business.

Lastly, there are some large societies constituted not by the aggregation of local clubs or the federation of neighbouring associations, but originally founded as "national societies" divided into districts and branches for administrative convenience. An example is the Amalgamated Society of Railway Servants, founded in 1872.

Besides the tendency of the national society with branches to swallow up the local trade club, there is a further tendency among the larger societies to form federations for certain common purposes. Such federations are to be distinguished from national trade unions, inasmuch as their members are societies and not individuals, and as a rule their powers over their constituent organizations are limited to certain specific objects. On the other hand, they are more than merely consultative bodies (such as local trades councils).

Some federations consist of unions in the same industry in different districts (*e.g.* the Miners' Federation). "Single trade" federations like this have usually considerable powers, including that of imposing levies.

In the cotton-spinning trade, the trade union organization has a federal character, and the Amalgamated Association of Operative Cotton-Spinners, in spite of its name, is, strictly speaking, a federation.

Other federations (*e.g.* in the building trade) are formed of allied trades in the same locality, and usually have little executive power. The Federation of Engineering and Shipbuilding Trades has among its objects the settlement of disputes between members of its constituent societies as to the limits of their work. Some federations aim at embracing societies in all kinds of industries, but as a rule such organizations have not proved long-lived. The most recent example is the "General Federation of Trade Unions," formed in 1899, referred to above.

Since 1866 a congress of delegates from trade unions has met annually for discussion, and a parliamentary committee elected by this congress watches over matters in which trade unions are interested during the ensuing year.

Objects and Methods.

The principal object of every trade union is to protect the trade interests of its members, and to strengthen their position in bargaining with their employers with regard to the conditions under which they work. The chief means by which they seek to attain these objects (apart from political methods such as the promotion of legislation or of administrative action by public authorities) are twofold: viz. the support of members when engaged in a collective dispute with employers by the payment of "dispute" benefit, and the insurance of members against loss from want of work by the payment of "unemployed" benefit, so as to enable them to refuse any terms of employment inferior to those recognized by the trade union. All trade unions in one form or another provide "dispute" benefit, but a separate "unemployed" benefit is by no means universal, though, except in certain groups of trades, it is usual among more powerful and well established societies. Thus in the mining, clothing, and even many branches of the building trade, comparatively little is spent by trade unions on "unemployed" benefit, while, on the other hand, in the metal, engineering, shipbuilding, printing and other trades a large proportion of the total expenditure is devoted to this object (see *Statistics* below). In some important societies, such as the Amalgamated Society of Engineers, "unemployed" and "dispute" benefits are mixed up together, members engaged in a dispute receiving an addition of 5s. per week (known as "contingent" benefit) to the ordinary out-of-work pay (known as "donation").

Unemployed benefit may, of course, be regarded as a "friendly" benefit, *i.e.* a provision against one class of the casualties to which a workman is exposed—the loss of employment through slackness of trade. But in practice it also operates as a method of maintaining the "standard" rate of wages, members being entitled to it who could obtain employment, but only on conditions disapproved by the society or branch.

The conditions under which the members of a union are entitled to financial support in a strike vary in different societies, and are prescribed in the rules. Usually, though the initiative may come from the localities, the central executive must approve of the strike before it takes place, and may at any time declare it to be closed, though in some societies the central authority is often unwilling to take the responsibility of curbing its members by exercising its powers in this respect.

"Dispute" and "unemployed" benefits are the only ones which are specially characteristic of trade unions, and as regards the latter benefit, it may be said that trade unions have hitherto been the only form of organization capable of meeting the difficulties arising from "malingering." Most of the more firmly established unions, however, add to their trade functions those of friendly societies, providing sick, accident, superannuation, and funeral benefits, or some of these. The position of a trade union, however, with regard to these benefits differs very materially from that of a friendly society. The trade union is under no legally enforceable contract with its members to provide the stipulated benefits: it can change their scale, or even abolish them, by vote of its members, and a member who has contributed for years in hope of receiving them has no legal redress. Again, a member excluded from the society for some "trade" reason incidentally loses all claim to friendly benefits. The funds of a trade union applicable to trade and friendly purposes are never kept distinct (in the few cases in which some distinction is attempted, the society may "borrow" from the one fund in aid of the other in case of emergency); and a prolonged strike or depression of trade may so deplete the funds as to make it impossible for the society to meet its engagements as regards sickness or superannuation. Thus the friendly society operations of trade unions have strictly no actuarial basis, and in some cases the scale of contribution and benefit have been fixed with little regard to ultimate solvency.

On the other hand, the power of levying and varying the scale of contributions adds to some extent to the financial stability of the funds, and the provision of "friendly" as well as "trade" benefits by a trade union undoubtedly gives strength and continuity to the society, and increases its power of discipline over its members. Societies that only provide "dispute" pay are exposed to violent oscillations of membership, and also to a dangerous temptation to rush into an ill-considered strike owing to the mere accumulation of funds which can be used for no other purpose.

The statistics of trade union expenditure on benefits of various classes are given below. Of the 100 principal unions, all provide dispute benefit; 79 in the year 1905 provided unemployed benefit (including in some cases travelling pay); 79, sick or accident benefit; 37, superannuation benefit; and 87, funeral benefit; 32 unions providing all four classes of benefit.

One of the most important functions of trade unions in many industries is the negotiation of agreements with employers and employers' associations for the regulation of the conditions of employment in those industries. While undoubtedly the power of withdrawing its members from employment in the last resort adds to the power of a trade union in such negotiations, many of the most important agreements by which the conditions of labour of large bodies of workmen are governed are habitually concluded, and from time to time revised, by conferences of representatives of the trade union and employers without any strike taking place. To the functions of trade unions as fighting organizations and as friendly benefit societies should therefore be added that of providing the necessary machinery and basis for the conclusion of industrial agreements between bodies of workpeople and their employers (see ARBITRATION AND CONCILIATION, and STRIKES AND LOCK-OUTS).

While the broad objects of trade union policy are generally similar, their methods and features vary greatly in detail. Among the objects most frequently met with (besides those of raising wages and shortening hours, which may be said to be universal) are the enforcement of a "minimum" wage; the limitation of overtime; the restriction of numbers in the trade through the limitation of apprentices, or the regulation of the age of entrance; the restriction or regulation of piecework (in trades accustomed to "time" work); the preservation for members of the trade of the exclusive right to perform certain classes of work claimed by other trades (leading to so-called "demarcation" disputes); resistance to the encroachment of labourers on work considered to be "skilled" (leading to disputes as to the class of persons to be employed on machines, &c.); and the securing of a monopoly of employment for members of the union by a refusal to work with non-unionists.

Year.	Number of Unions.	Membership of Unions.[1]
1897	1292	1,622,713
1898	1261	1,659,480
1899	1255	1,820,755
1900	1244	1,928,035
1901	1238	1,939,585
1902	1203	1,925,800
1903	1187	1,903,596
1904	1153	1,864,374
1905	1136	1,887,823
1906	1161	2,106,283

[1] Includes a small number of members abroad.

Statistics.

The statistics of trade unions are very complete for recent years, but for earlier years the records are so fragmentary that it is impossible to give exact figures showing the total growth of trade unions over a long period. The table at foot of preceding column, based on the statistics published by the board of trade, shows the number and membership of all trade unions in the United Kingdom making continuous returns for each of the ten years 1897 to 1906.

The fluctuations in membership correspond in the main to the oscillations of trade, membership declining in the years of depression and increasing with the revival of trade. The decline in the number of separate unions is chiefly due to the growing tendency to amalgamate into large societies.

The following table shows the distribution of trade unions among the various groups of trades in 1905:—

Groups of Unions.	Number of Unions.	Membership in 1905.	
		Number.	Percentage of Total.
Mining and quarrying	68	495,968	26
Metal engineering and shipbuilding	222	339,282	18
Textile	253	239,539	13
Building	101	205,383	11
Railway, dock and other transport	55	162,563	9
Public employment	48	72,182	4
Printing, bookbinding and paper	40	62,368	3
Clothing	35	60,407	3
Wood-working and furnishing	100	40,115	2
General labour	18	96,094	5
All other unions	196	113,922	6
Total	1136	1,887,823	100

This table shows that the strength of trade unionism lies in the five first-named groups of trades—mining; metal engineering and shipbuilding; textile; building; and railway, dock and other transport—which among them account for over three-quarters of the total membership.

In agriculture, trade unionism is at present practically non-existent, but in 1875 there were important unions of agricultural labourers, though at no time did they include any considerable proportion of the total agricultural population.

Taking the men belonging to all trade unions together, we find that their number does not amount to more than about one in five of the adult men who belong to the classes from which trade unionists are drawn. Only in a few groups do trade unionists form a high percentage of the total working population, *e.g.* coal-mining and cotton manufacture. The number of women belonging to trade unions at the end of 1906 was 162,453, distributed among 156 unions, of which, however, only 28 consisted exclusively of women. The great bulk of women trade unionists are found in the cotton trade, in which they actually outnumber the male members. Of all the women employed in factories and workshops, about one in twelve belongs to a trade union.

The available statistics with regard to the financial resources of trade unions, and their expenditure on various objects, are not so complete as those of membership, as the board of trade figures only relate to 100 of the principal unions. As, however, these unions include nearly two-thirds of the total membership, the figures showing their financial position may be accepted as being representative of the whole number of societies. In 1906 the income of these 100 societies was £2,344,157 or 36s. 9½d. per head; and their expenditure £1,958,676 or 30s. 9d. per head; and at the end of the year the funds in hand amounted to £5,198,536 or 81s. 7¼d. per head.

The actual rates of contribution per member vary greatly among the unions—from 7s. up to £4 per annum. Generally speaking, the highest income per member is found among the unions in the metal, engineering and shipbuilding group, where in 1905 it averaged £3, 5s. 7¼d., while the average in the mining unions was only £1, 4s. 1½d., and among dock labourers still lower. The metal trades and the textile unions appear to hold the highest amount of funds compared with their membership, the amounts at the end of 1905 being £6, 3s. 8¼d. and £6, 0s. 3d. per head respectively in these groups, while in the building trade unions it was only 18s. 8½d. and in some societies of unskilled labourers far less than this.

The main items of expenditure of trade unions are "dispute" benefit, "unemployed" benefit, various friendly benefits (including sick and accident, superannuation and funeral), and working expenses. The proportions of expenditure on these various objects naturally vary greatly in different groups of unions, and also in different years, some of the items being affected largely by the general state of employment, and the occurrence or absence of important disputes. On the basis, however, of an average of the ten years 1897–1906, the following analysis of the proportionate expenditure of the 100 principal unions on various classes of objects has been made: on disputes, 13·4%; on unemployed 22·1%; on friendly benefits (other than "unemployed"), 42·5%; on working expenses 22%. The 42·5% of expenditure on friendly benefits is made up of 19·1% on sick and accident, 12·4% on superannuation and 11% on funeral and other benefits.

The mining unions devoted 28·6% of their expenditure to the support of disputes (friendly benefits in this industry being largely provided by other agencies), while the unions in the printing and bookbinding trades only used 3·9% for this object, over three-quarters of their expenditure going to unemployed or friendly benefits. As illustrations of the variation in the expenditure by the same group of unions on a particular object from year to year, it may be stated that within the ten years' period referred to the annual expenditure of the metal, engineering and shipbuilding group on disputes varied from £514,637 in 1897, the year of the great engineering dispute, to £13,266 in 1899. Again, the expenditure of the same group of unions on unemployed benefit varied from £80,512 in 1899 to £303,749 in 1904. The burden of superannuation payments by the 100 unions has steadily increased during the ten years from £137,813 in 1896 to £306,089 in 1906.

At the end of 1906 there were 89 federations, including societies with a gross membership of over a million and three-quarters, but a considerable deduction must be made from this total on account of duplication. In the same year 231 "trades councils" were known to exist, with an affiliated membership of over 895,000.

The number of employers' associations and federations known to exist in the United Kingdom in 1906 was 953, including 60 federations and national associations. Of the total number of associations 398 are in the building trades.

II.—Foreign and Colonial

Modern trade unionism has had its chief development in English-speaking countries, and especially in the United Kingdom, where the conditions necessary for its growth have been present to the fullest extent. With some exceptions, such unions as are found elsewhere are either derived or copied from English organizations, or are associations with political objects. It is therefore unnecessary to give more than a brief summary of the position of trade unions in some of the principal countries and colonies outside the United Kingdom (for *United States* see IV. below).

Germany.—In Germany the majority of trade unions are of a political character, being closely connected with the Social Democratic party. These Socialist trade unions, termed "Gewerkschaften," were started by a congress held at Berlin in 1868, under the auspices of Fritscher and Schweitzer, two followers of Lassalle. In 1878 many of them were dissolved under the law prohibiting socialistic organizations, but shortly after their place was taken by local unions termed "Fachvereine," which ostensibly abstained from politics, but which in various ways succeeded in evading the law and carrying on the work of the Gewerkschaften. In 1887 a general committee of the German Gewerkschaften was formed, and in 1890 the General Commission of Trade Unions in Germany was established. Later years of prosperous trade have been marked by a rapid growth in the strength of trade unions in Germany.

The Social Democratic (Gewerkschaften) trade unions included in 1907 a membership of 1,886,147 as compared with 743,296 in 1902 and 419,162 in 1897. Of the total number of members in 1907, 1,865,506 belonged to branches affiliated to central federations; the membership of non-federated local unions being returned as only 20,641. The income of the federated trade unions in 1907 was £2,569,839, or over 27s. per member as compared with £554,887 (or about 15s. per member) in 1902 and £204,185 (or about 10s. per member) in 1897, and the expenditure in the same years to £2,156,126, £500,276 and £177,140 respectively. Of the 61 federations in existence in 1907, 43 paid travelling benefit, 42 paid unemployed benefit, 47 paid sick benefit and 57 paid funeral, removal and special allowance.

Another group of trade unions in Germany, less important as regards number and membership than the above, are the "Gewerkvereine," or non-political trade unions, sometimes known as "Hirsch-Duncker" unions, from the names of their founders. These unions were first formed in 1868, immediately after the Berlin congress referred to above. They were directly modelled on British trade unions. Since 1876 Social Democrats have been excluded. In their earlier years these unions suffered in membership from a series of unsuccessful strikes, and of late years they have been mostly benefit societies. In 1907 the Gewerkvereine embraced 108,889 members. Their income amounted to £77,068 in 1907 and their expenditure to £71,717.

Another group of unions, the Christian trade unions (Christliche Gewerkvereine), was formed in 1894. In 1907 the membership of this group was 354,760. The income of these unions in 1907 was £225,821, and the expenditure £167,867. Besides these groups of unions there were a number of independent societies with a membership of 96,684 in 1907.

It will be seen that German trade unions of one type or another included a membership of nearly two and a half millions in 1907, their membership having more than doubled in the last five years.

France.—In France combinations of workmen as well as of employers were prohibited by the laws of the 14th of June and the 28th of September 1792, which overthrew the old gild or corporation system. They were also penalized under various articles of the Penal Code, and it was not till 1864 that the prohibition was modified by law. At present the status of trade unions in France is regulated by the law of 1884, which repealed that of 1791 and modified the articles of the Penal Code so far as regards professional syndicates of employers or workmen. Since then there has been a considerable growth of workmen's unions, which in 1906 numbered 5322 with a membership of 896,012. Of the unions in existence in 1906, 3675 with a membership of 752,362 belonged to 187 federations. There is, however, some duplication owing to the fact that some unions belong to more than one federation. In 1906 there were 260,869 members of unions in the transport, warehousing, &c., groups of trades, 103,835 in the metal, 73,126 in the mining and quarrying, 78,854 in the textile, 66,678 in the building, 51,407 in the agricultural, forestry, fishing and cattle breeding, 48,353 in the food preparation trades and the remainder in various other trades.

Austria.—Apart from the Austrian gilds, membership of which is compulsory for persons engaged in non-factory handicrafts and trades (under a law of 1883) and in mining (under a law of 1896), there are a certain number of trade unions in Austria, though freedom of combined action among workmen is less complete than in many other European countries. Such right of combination as exists rests on the law of 1870, which removed the restrictions imposed by the Penal Code on combinations for influencing the conditions of labour. The impulse given to the formation of unions by this law, and by the advantages gained for the workmen during the years of prosperous trade that immediately followed, received a severe check during the succeeding depression of trade, when these advantages were mostly lost. Trade unionism did not revive until 1888, from which time the unions formed have mostly been on a Social Democratic basis, the majority being affiliated to a central organization in Vienna.

Since 1901 statistics relating to the trade unions of Austria have been published annually by the Central Trade Union Commission (Gewerkschafts-Kommission) at Vienna. In 1907 there were 5156 trade unions in particular trades, with a membership of 501,094, affiliated to the Social Democratic trade unions (Gewerkschaften). Of the total number of unions, 49 were central unions, 77 were district unions and 5030 were local unions. Of the total number of members 454,693 were males and 46,401 were females. The greatest membership, 84,085 in 1907, is shown to have been in the metal engineering and shipbuilding group of industries, the building trades coming next with 68,543 members. The transport trades showed a membership of 61,744, and the textile trades, 51,632. The chemical, glass and pottery trades included 54,469 members and the wood-working and furnishing group included 36,502 members. Food and tobacco trades accounted for 32,679, and mining and quarrying for 30,715 members.

The total receipts of the trade unions in 1907 amounted to £338,365 and the total expenditure to £297,822, excluding receipts and expenditure for disputes. The expenditure on account of disputes, for which £136,822 was collected by special free organizations of the branch unions, amounted to £76,066 in 1907.

There are besides these unions a number of general unions not confined to one trade, and trade-clubs—educational associations discharging to a greater or less extent trade union functions. These associations have, however, been excluded from the statistics published by the Gewerkschafts Kommission as not being trade unions proper.

Hungary.—The trade union movement in Hungary is of very recent growth. The membership of unions affiliated to the Central Federation at the end of 1907 is given in the *Volkwirtschaftliche Mitteilungen aus Ungarn* as 130,192, compared with 129,332 at the end of 1906. Independent local unions had a membership of 11,838 at the end of 1907. The largest groups of organized workers are in the building trade (35,630), metal workers (27,732), railway employees (17,192) and wood-workers (14,665).

Italy.—The *Bolletino* of the bureau of labour for August 1908 states that the membership of trade unions at the beginning of 1908 numbered 191,599 (in 2550 local unions). Included in the membership of 1908 are 48,877 building trades-workers, 40,000 railway employés and 17,110 metal-trade workers. The agricultural labourers' trade unions were stated to have a membership of 425,983 at the beginning of 1908 as compared with 273,698 at the beginning of 1907.

Denmark.—In 1907 there were 99,052 members of 1249 trade unions in Denmark, and of these 78,081 were in unions affiliated to the National Federation. The largest unions in the Federation are those of the general labourers with 22,660 members; blacksmiths and machinists with 8000 members; masons, 5300 members; railway employés, 4990 members; carpenters, 3855 members; textile workers, 3700 members; and cabinet-makers, 3590 members.

Sweden.—In Sweden there were, in 1906, 126,272 members of 1596 trade unions, and of these 30,645 were factory workers (trades not specified), 24,485 were in unions connected with the metal trades, 10,706 were in the transport trades, 17,862 were in the wood-working trades, 7132 were in the food, &c., trades, 6602 were in the building trades, and 6005 were in the clothing trades.

Norway.—The trade union movement in Norway dates practically from 1884. At the end of 1906 there were 25,339 members of trade unions, as compared with 16,087 at the end of 1905. Of the membership in 1905, 5277 were iron and metal workers, 4910 journeymen (factory workers), and 1117 printers.

Holland.—In 1893 a National Labour Secretariat was formed, to which, in 1899, 45 societies with 13,050 members were said to be affiliated. After a general strike in April 1903 the membership of trade unions in Holland decreased considerably, the Secretariat losing half its members and several trade unions dissolving. In 1906 it was stated in the *International Report of the Trade Union Movement* that a new national centre of unions had been formed with trade unions affiliated to it, having a membership of 26,227, while the old centre still continued with a membership of 5000. The Diamond Workers' Federation, with a membership of over 8000, was affiliated with the new national centre.

The total number of members of trade unions at the end of 1906 is given as 128,845, 33,125 of these belonging to Christian organizations, while 95,720 belonged to other organizations.

Belgium.—The status of trade unions in Belgium is regulated by the law of 1898, under which they can be incorporated, provided that their objects are non-political and are confined to the furtherance of the interests of particular trades. Belgian trade unions, nevertheless, are mostly political in character, the majority being connected either with the Socialist-Labour, Catholic or Liberal parties. The membership of the Socialist-Labour group of unions in 1905 was 94,151, of the Catholic unions 17,814, of the free trade unions 34,833 and of the Liberal unions 1685, making a grand total of 148,483.

Of the 94,000 members of the Socialist-Labour unions, 60,000 are employed in mining, 11,500 in the textile industry and 7800 in the metal industry. Of the 17,800 in the Catholic trade unions, 5300 are in the textile trades, and 3200 in the building trades. Of the 35,000 in the free trade unions, 11,000 are in the textile industry, 6000 in the glass industry, 3600 in the applied art trades and 3300 in the printing and bookbinding trades.

Several organizations, *e.g.* the diamond workers, the printers' federation of Brussels, &c., are affiliated with the trade union committee without, however, joining the political organization. The Catholic and Liberal associations also do not affiliate with the other organizations.

British Dominions and Colonies.—Trade unionism has only developed to any considerable extent in a few of the industrial centres of the self-governing dominions. A great number of the unions in Canada are branches of organizations having their headquarters in the United States or in England. In July 1907 the *Canadian Labour Gazette* stated that of the 1593 local trade unions known to be in existence, 1346 were affiliated with central organizations of an international character. Besides these 1593 local trade unions, there were 8 congresses and national associations of labour, 49 trade and labour councils and 31 federations of trade unions known to be in existence.

Between 1876 and 1890 all the principal Australian states passed statutes more or less resembling the Trade Union Acts of the United Kingdom. A similar law was passed in New Zealand in 1878, but in this dominion and in some of the Australian states trade unions can now become incorporated and acquire a special legal status by registration as industrial unions under the laws relating to industrial conciliation and arbitration. In New Zealand there were, in 1906, 261 unions of workers with a membership of 29,869 and 133 unions of employers with a membership of 3276. In the years immediately preceding 1890 certain Australian unions, especially among the shearers and the seamen and wharf labourers, acquired great strength, and their determined attempts to secure a monopoly of employment for members of their organizations led to prolonged labour disputes in 1890 and 1891 (see Strikes and Lock-Outs), which resulted in the defeat of the unions and a consequent diminution of their membership and influence. More recently the unions have revived. They are encouraged by the laws relating to arbitration and conciliation, which (*inter alia*) permit preference for employment to be awarded to members of trade unions in certain circumstances.

Authorities.—For statistics of recent progress of trade unions, see reports on trade unions published by the board of trade (from 1887 onwards). Much information respecting trade unions is contained in the reports of the royal commission on trade unions (1867) and of the royal commission on labour (1891–1894). See also report of royal commission on trade disputes and trade combinations (1903–1906). The reports of the chief registrar of friendly societies give information with regard to trade unions registered under the Trade Union Acts. On the history and constitution of trade unions the fullest information is given in Webb's *History of Trade Unionism* and *Industrial Democracy*, both of which contain valuable bibliographical appendices which may be consulted as regards other sources of information respecting British trade unions. On trade unions abroad (besides the reports on foreign countries and the colonies of the royal commission on labour), see Kulemann's *Die Gewerkschaftsbewegung* (Jena, 1900), dealing with trade unions in all countries, and the board of trade "Abstract of Foreign Labour Statistics" and *Labour Gazette*, both of which give numerous references to the foreign official sources of information on trade unions, together with a summary of the statistics which they contain.

III.—Economic Effects of Trade Unionism

There is no general consensus of opinion as to the extent to which trade unions can attain success in achieving the objects which they set before themselves, or as to how far their action is beneficial or otherwise to the general community. One of the principal objects of trade unions being to maintain and increase the rates of wages paid to their members, the first question would be practically solved if statistical evidence were available to connect the course of wages with the action of combinations. Such evidence, however, is inconclusive. The period of growth of trade unionism in Great Britain has certainly been on the whole a period of rising wages. But many other causes tending to raise wages have been operative over the same period, and some of the facts might be explained as much by the tendency of rising wages to strengthen combinations as by that of combinations to raise wages.

Again, the observed fact that the rise has not been confined to industries in which organizations are strong might be explained either by the supposition that the rise brought about by trade unions has benefited a wider circle than their membership, or that the rise both within and outside the ranks of trade unions is due to causes other than their action. Perhaps the strongest statistical evidence of the power of trade unions to affect wages in particular districts is afforded by the local differences of wages in the same trade, which, it is contended, cannot be wholly explained by local differences of cost of living or industrial conditions, but which often correspond closely to differences of strength of trade union organization. This argument, however, does not touch the question of the effect of combination on the *general* level of wages.

Hardly more conclusive than the reasoning founded on statistics have been the attempts to solve the question by pure economic theory. During the prevalence of the old view of wages known as the "wage-fund" theory, combinations were usually held to be powerless to affect the general rate of wages, because they could not alter the proportion between capital and population, on which wages were thought to depend. The question however, was reopened by the change in theory which led economists to regard wages as depending primarily on the productivity of industry, and secondarily (and within comparatively narrow limits) on the relative power of bargaining as between the labourers or groups of labourers and the organizers of labour. According to this view, the effect of combinations on the rate of wages will ultimately depend, so far as the first and most important factor in the problem is concerned, on their effect on the general productiveness of industry. Prima facie, we might expect that trade unionism would, on the whole, restrict productiveness, and this is undoubtedly a view widely held among employers. Strictly professional associations tend generally to become conservative so far as methods of work are concerned; and even trade unions which may not "officially" oppose the introduction of new processes and the use of machinery may nevertheless serve to focus and make effective the hostility felt by the artisan towards methods of business organization which seem to him likely to decrease the demand for his services or to alter the conditions of work to his detriment. In some trades also trade unions are charged with encouraging or permitting their members to restrict the amount of work performed by them in a given time, with the short-sighted object of making more work for others. Many unions have attempted also with varying degrees of success to keep up the value of their labour by creating an artificial scarcity by restricting the numbers entering the trade, and have in various ways sought to control the management of business to a degree which must restrict the freedom of experiment on which the attainment of the maximum productiveness of industry must depend. By the resort to strikes—an essentially wasteful method of settling differences with employers—they have also to some extent restricted production, though the loss directly due to this cause is often exaggerated (see STRIKES AND LOCK-OUTS). Moreover, by their insistence on the payment to all workmen of a fixed "minimum" wage they have diminished the field for the profitable employment of the old and less capable, and may to some extent have discouraged the expert workman from earning and receiving the full reward of his extra ability.

On the other hand, it is claimed that trade unions have in many cases acted in the interests of industrial peace by restraining their members from ill-considered strikes, and that, by providing a recognized channel through which the workmen's grievances may find expression, they have often assisted in adjusting differences which would otherwise have led to the interruption of production. In particular they have frequently formed a convenient basis on which to build a system of conciliation or arbitration boards by which strikes are prevented (see ARBITRATION). It is also claimed that by protecting the "standard of life" of their members through the policy of securing a "minimum" rate of wages, trade unions may tend in the long run to build up a physically and industrially superior class of workmen, and thus ultimately increase the efficiency of industry.

The comparative weight of the above considerations differs according to the point of view from which the question is regarded. At any given time an individual employer may tend to feel most strongly the disadvantages of the restrictions under which he is placed by the action of a particular trade union, and may attach but little importance to the general effects, in the long run, on the national output of the pressure which such combinations exercise—which from the point of view of the general well-being of the community is by far the most important consideration. Generally speaking, any action of trade unions tending to diminish the efficiency and industry of the individual workman is as injurious to the community as to the individual employer, except in so far as such restriction may conceivably affect the health of the working community from over-strain. But the policy of "levelling up" the standard rate of wages, which may mean loss or ruin to a particular employer, may nevertheless act quite otherwise with respect to the national well-being, in so far as it tends to eliminate the "unfit" employer and to concentrate the industry in the hands of the more capable and more enterprising of the employing class, and in the localities most suited for the purpose. The pressure of rising wages has undoubtedly acted as a stimulus to the invention of labour-saving devices and the adoption of economical methods, as is shown in America, where the highest wages are often seen concurrently with the lowest labour cost. Advocates of trade unionism sometimes lay much stress on this aspect of their operation. On the other hand, it must not be forgotten that competition, both as between different grades of employing ability and of local advantages, is now international, and that the concentration of an industry in the most suitable localities and in the hands of the most capable organizers, which is claimed as a beneficial result of trade union action, may for any particular country mean the transference of the industry abroad; and this transference, especially in the case of industries dependent on export to neutral markets, may involve a considerable national loss.

Apart from the effect of trade unions on the total amount of the "national dividend," their supporters claim that they are able to alter the mode of distribution of this dividend. It is not usually claimed that they are able to affect the proportion of the total product which is paid as rent or interest for the use of the instruments of production, but that they can alter the proportions in which the residue is shared between the organizers of labour and the manual labouring class, to the advantage of the latter. The methods by which trade unions seek to achieve this result require separate examination.

The first group of methods are those which aim at creating a scarcity of some particular kind of labour so as to alter the relation of demand and supply. The particular methods employed for this purpose have been already sufficiently described. With regard to all of them it may be remarked that they are ineffective as regards the raising of the general rate of wages throughout the country (*i.e.* the average income per head of the manual labour classes), seeing that an artificial scarcity of one sort of labour implies a redundancy of some other kind. As regards the rate of wages in particular occupations there is no doubt but that at least for a time such methods may cause a considerable rise of wages, only limited at first by the imperfection of the control exercised by the union over the number competing in the labour market and by the extent to which the rise in the cost of production so caused is checked by the competition of goods imported from abroad, or of alternative commodities, or by the loss of foreign markets, or the diminution of home demand. But as time goes on other forces of a more subtle kind tend to come into play which further limit the power of the combination to keep up wages through restricting the supply of labour. Besides the substitution of alternative commodities, alternative processes of production may be invented, diminishing the demand for the services of the members of the exclusive trade union, while the artificial rise of wages is also likely to attract labour into the trade.

Generally speaking, it may be said that while the artificial restriction of the supply of workmen in a trade may raise wages for a time, it calls into play forces tending to restore the equilibrium of demand and supply by diminishing demand, and that these forces grow progressively stronger as time goes on, while the restrictive capacity of the combination usually tends to diminish. This is apart from the fact that restriction of the supply of labour entering a trade almost always involves the narrowing of the field of ability from which the trade can be recruited, and thus a lowering of the general standard of efficiency.

The other group of trade union methods which requires examination is that which aims at strengthening the economic position of the labourer by substituting collective for individual negotiations as regards wages, supported by a common reserve fund out of which the labourer may be maintained while waiting for his terms to be accepted. Undoubtedly these methods of mutual insurance and collective bargaining afford a powerful instrument for preventing "sweating" and for enabling the whole body of workmen to exact at the earliest moment and retain to the latest moment the full amount of the wages which a given state of trade and prices will enable the industry to support. The establishment of general working rules and standards of time or piece wages throughout a trade or district may also serve to protect the better and more capable employers against their more inefficient or unscrupulous competitors, and thus tend towards the survival of the "fittest" among the employing class. It is always to be remembered that the effect of collective bargaining is not in the long run one-sided. Combinations of workmen beget counter-combinations of employers, and the conditions of important industries tend to be settled more and more by "treaties" concluded between powerful bodies of employers and employed.

Were the combinations on both sides which enter into these agreements conterminous with the entire trades which they represent, and especially if the trades were protected from foreign competition, the interests of the general unorganized mass of consumers might conceivably suffer from these agreements.

As regards the future prospects of trade unions in Great Britain it is difficult to prophesy. The hopes of those who look for a universal expansion of these organizations so as to include the whole or the majority of the members of the manual-labour classes are probably extravagant. Not less chimerical is the expectation of the opponents of trade unions that a few defeats at the hands of determined employers or employers' organizations will permanently cripple them and lead to their decay and extinction. Probably for many years trade unions will include, as now, in their membership a powerful minority of the working classes, wielding an influence out of all proportion to their actual numbers. It is to be expected that experience and the spread of education may cause them gradually to abandon the rules and methods which interfere most with the economical application of labour and capital to industry.

Lastly, it may be pointed out that trade unionism has been the result of the growth of a class of manual workmen working for wages for employers who provide the materials and instruments of industry, and into whose ranks it is relatively difficult for the average workman to rise. It remains to be proved whether the class feeling which enables powerful trade unions to flourish can permanently be fostered and maintained except among workmen who expect to remain workmen most of their lives. If these conditions should be materially altered, trade unionism in its present form must decay or undergo a profound alteration. (X.)

IV.—UNITED STATES

Labour Organizations.

Trade unions in the United States are best treated from the broad standpoint of labour organizations generally, *i.e.* associations of wage-earners having for their general purpose the improvement of their members, either through a lessened working day, increased wages, or more satisfactory rules and conditions of employment. They may or may not admit employers, but as a rule they do not admit them. Sometimes they are formed for a specific purpose, like the Eight-Hours League, but generally they have platforms comprehending all the demands which labour usually makes. Labour organizations in the United States cannot be given a definite birthday. Prior to 1825 there were very few of them. In colonial days we have hints of their existence, but their purpose was partly political, and their membership often consisted of politicians. The purpose of the Caulkers' Club, in the early days of Massachusetts, was "to lay plans for introducing certain persons into places of trust and power." Tradition has it that the word "caucus" was derived from this club. It is also said that Samuel Adams's father, as early as 1724, was active in the club's work. There was probably a union of journeymen bakers in the city of New York in 1741 and of shoemakers in Philadelphia in 1792. The shipwrights of New York City were incorporated on the 3rd of April 1803, and the tailors and carpenters of that city were organized in 1806. The New York Typographical Society was in existence in 1817, and was probably organized in the early years of the 19th century. Peter Force was its president for a time, and Thurlow Weed was a member. A strike occurred in Mr Weed's office in 1821 on account of the employment of a non-union man, who was then designated a "rat." In 1823 was organized the Columbian Charitable Society of Shipwrights and Caulkers of Boston and Charlestown.

Formative Period.

The period from 1825 to 1860 may be called the formative period. About 1825, and for some years afterwards, there was a general discussion of socialistic theories, growing out of Robert Owen's experiments at New Lanark, in Scotland, and out of his communistic attempt at New Harmony, Indiana, in 1825. The wave of philosophic transcendentalism also, which swept over the country between 1825 and 1840, affected not only social but industrial life. Labour papers began to be established. The *Working Man's Advocate*, published in New York City in 1825, was probably the very first American labour journal. Soon afterwards there appeared the *Daily Sentinel* and *Young America*, projected by two Englishmen, George Henry Evans and Frederick W. Evans. The chief demands advocated by these journals were the freedom of public lands, the breaking up of monopolies, the adoption of a general bankruptcy law, a lien for the labourer upon his work for his wages, the abolition of imprisonment for debt, equal rights for women with men, and the abolition of chattel and wage slavery. These demands were endorsed by over 600 newspapers. In 1830 a Working-man's Convention was held in Syracuse, New York, the outcome of which was the nomination of Ezekiel Williams for governor. In 1832 a delegated convention which met in the state house at Boston initiated the 10-hours movement. The *Tribune* (New York), under the leadership of Horace Greeley, was opened to the advocacy of Fourierism, and so on all hands the movement towards organization was helped. In 1845 the New England Working Man's Association was organized, and such men as Charles A. Dana, George Ripley, Albert Brisbane, Wendell Phillips, William Lloyd Garrison, Theodore Parker, and others participated in its meetings. The first industrial congress of the United States was convened in the city of New York on the 12th of October 1845, but little came of it. Other and more important labour congresses were held in that city and in Chicago in 1847 and 1850 respectively. During the latter part of the formative period, that is, from 1825 to 1860, most of the great national trade unions that are now influential were projected and organized, though their great and rapid growth has been since the Civil War. The National Typographical Union was organized in 1852, its name being changed to International in 1862 in order to admit Canadian members; the National Union of Hat Finishers in 1854; the Iron Moulders' Union of North America on the 5th of July 1859; and in the same year the Machinists' and Blacksmiths' Union of North America. By 1860 the national unions already formed numbered 26.

Railway Brotherhoods.

During the next few years, among other important organizations, were instituted what are known as the group of railway brotherhoods, the oldest and largest of which is the International Brotherhood of Locomotive Engineers. The grand division was founded at Detroit, Michigan, on the 17th of August 1863, under the name of the Brotherhood of the Footboard. The society was reorganized under its present title at Indianapolis, Ind., on the 17th of August 1864. The second national association of railway employés that was organized was the Conductors' Brotherhood, formed at Mendota, Illinois, on the 6th of July 1868, by the conductors from various railways in the United States. This brotherhood was recognized, and a general governing board established, on the 15th of December of the same year. Ten years later the name of the organization was changed from the Conductors' Brotherhood to the Order of Railroad Conductors of America. The Brotherhood of Locomotive Firemen was organized at Port Jervis, N.Y., on the 1st of December 1873. The Brotherhood of Railroad Trainmen was organized at Oneonta, N.Y., on the 23rd of September 1883. It was called the Brotherhood of Railroad Brakemen until the 1st of January 1890, when the present name was adopted. The Brotherhood of Railroad Trackmen is one of the younger and smaller organizations. The first efforts to found it were made in the spring of 1887, but its permanent organization took place a year later. The Brotherhood of Railroad Carmen of America was founded on the 9th of September 1890, by the consolidation of the Carmen's Mutual Aid Association, the Brotherhood of Railroad Car Repairers, the Car Inspectors, Repairers and Oilers' Protective Association and the Brotherhood of Railroad Carmen of Canada. The Switchmen's Union of North America is the outgrowth of the Switchmen's Mutual Aid Association, the present organization dating from 1897. Several of these railway brotherhoods suffered materially in their membership and influence through the organization of the American Railway Union in 1893.

The Cigar-Makers' National Union dates from 1864, the Bricklayers' and Masons' International Union from the 17th of

National Unions.

October 1865, the United States Wool Hat Finishers' Association from 1869 and the National Union of Horseshoers of the United States from 1875. The Amalgamated Association of Iron and Steel Workers resulted, as its name signifies, from the consolidation of various other orders and societies, the present order being organized at Pittsburg in August 1876. The consolidated societies were known previously to the new order of things as the United Sons of Vulcan, the Associated Brotherhood of Iron and Steel Heaters, Rollers and Roughers of the United States, and the Iron and Steel Roll Hands' Union. The oldest was the United Sons of Vulcan, originating in Pittsburg on the 17th of April 1858, and afterwards called the Iron City Forge. The organization is now known as the Amalgamated Association of Iron, Steel and Tin Workers. The Granite Cutters' National Union was organized in 1877, the Brotherhood of Carpenters and Joiners in 1881 and the Journeymen Bakers' National Union in 1886.

The International.

There have also been attempts to organize labour on a general or universal plan. The first of these was the International Association of Working-men, known as the "International," which was organized in London in the autumn of 1864. This society sought to associate working-men wherever manufacturing has been extended. The International grew for a while, but never at any time had a membership exceeding 100,000 and probably never over 50,000. It did not extend to the United States with much force; certainly no large number of the working-men of the country were involved in it, and branches were not organized in the union until 1870 or 1871.

Knights of Labour.

The second attempt was the Noble Order of Knights of Labour of America, which was founded in Philadelphia on Thanksgiving Day 1869, through the efforts of Uriah S. Stephens and six associates, all garment-cutters. For several years the garment-cutters of Philadelphia had been organized as a trade union, but failed to maintain satisfactory rates of wages. Dissatisfaction prevailed, and resulted in the autumn of 1869 in the disbandment of the union. Stephens, who was a far-seeing man, and anticipated the disruption of his union, had prepared the outlines of a plan for an organization embracing, as he said, "all branches of honourable toil." He advocated education, co-operation and an intelligent use of the ballot as the proper means for gradually abolishing the present wage-system. The order had a varied career. Mr Stephens, himself a Mason, brought into the ritual of the new order many of the features of speculative Masonry. The obligations were in the nature of oaths, taken with much solemnity upon the Bible, and the members were sworn to the strictest secrecy. The order was known for a long time as "Five Stars," that designation being used in printing and writing. Many expressions taken from Greek literature were introduced into the ceremonies. The instructions given to every person admitted into the order are perhaps the best exponent of the nature of the ritual:—

> Labour is noble and holy. To defend it from degradation; to divest it of the evils to body, mind and estate which ignorance and greed have imposed; to rescue the toiler from the grasp of the selfish—is a work worthy of the noblest and best of our race. In all the multifarious branches of trade capital has its combinations; and, whether intended or not, they crush the manly hopes of labour and trample poor humanity in the dust. We mean no conflict with legitimate enterprise, no antagonism to necessary capital, but men, in their haste and greed, blinded by self-interests, overlook the interests of others and sometimes violate the rights of those they deem helpless. We mean to uphold the dignity of labour, to affirm the nobility of all who earn their bread by the sweat of their brows. We mean to create a healthy public opinion on the subject of labour (the only creator of values), and the justice of its receiving a full, just share of the values or capital it has created. We shall, with all our strength, support laws made to harmonize the interests of labour and capital, and also those laws which tend to lighten the exhaustiveness of toil. To pause in his toil, to devote to his own interests [*sic*], to gather a knowledge of the world's commerce, to unite, combine and co-operate in the great army of peace and industry, to nourish and cherish, build and develop, the temple he lives in, is the highest and noblest duty of man to himself, to his fellow men and to his Creator.

The ritual was neither printed nor written, and in all probability there is not now in existence a copy of it. So long as the utmost secrecy was retained the order did not grow rapidly; gradually it lost its secrecy and worked on more general plans. From the best evidence that can be secured it is probable that the first local assembly of the Knights of Labour was organized as early as 1873 in Philadelphia. Attempts at outside organization had been unsuccessful. The second assembly consisted of ship carpenters and caulkers employed in Cramp's shipyard. After this the order spread quite rapidly, 20 assemblies being organized in Philadelphia during 1873. A district assembly, consisting of delegates from local assemblies in Philadelphia, met in that city on Christmas Day 1873 and organized District Assembly No. 1. The order increased during the years following this action, and in 1877 delegates were chosen to organize a general assembly. These delegates met at Reading, Pennsylvania, on the 1st of January 1878, and organized the first general assembly, Mr Stephens, the founder, presiding as temporary chairman. Seven states were represented. General assemblies have been held each year since that time, and changes in the constitution or work of the order have been the subject of warm discussion. At the meeting of the first general assembly the membership must have been small, probably only a few thousand. It did not reach 50,000 till five years later. The general assembly of 1880, at Pittsburg, denounced strikes as injurious and not worthy of support except in extreme cases. At the fifth session, at Detroit, in 1881, the most important actions in the history of the order were taken, and from this session the rapid growth of the order may be dated. The assembly then declared that on and after the 1st of January 1882 the name and objects of the order should be made public. It also declared that women should be admitted upon an equal footing with men, and a strong committee was appointed to revise the constitution and the ritual. At the next general assembly, September 1882, in New York, the revised constitution was adopted, as well as laws and regulations for supporting strikes. After this the order began to grow rapidly. It antagonized the trade unions, the contention being that the order embraced higher and grander principles than those underlying the organization of the former. The trade unions in existence at that time struggled to preserve their organizations against what they considered the encroachment of the Knights of Labour. The high-water mark of the order was probably during 1883, 1884, 1885 and 1886, when, according to the very best information, it numbered not less than 1,000,000 members. In 1900 its membership was estimated at about 130,000.

Organization.

The order of the Knights of Labour is based on the federal plan, and has a hierarchy of assemblies—the local assembly, the district assembly, the state and the general assembly. The officers of the local assembly consist of a master workman, worthy foreman, venerable sage, recording secretary, financial secretary, treasurer, worthy inspector, almoner, statistician and some minor officers. These are elected semi-annually by ballot or by acclamation. The district assembly is composed of duly accredited delegates from at least five local assemblies, and is the highest tribunal of the Knights of Labour within its jurisdiction under the general laws of the order. It has the power to levy assessments for its maintenance upon all locals, and has also the power to establish locals in the territory governed by it. The officers and their duties are similar to those of the local assembly, except that the master workman is called the district master workman. The constitution of the general assembly is a very imposing document, containing twenty articles. The assembly consists of representatives chosen by the district assemblies, and has full and final jurisdiction, being the highest tribunal of the order. It alone possesses the power and authority to make, amend or repeal the fundamental and general laws of the order, to decide finally all controversies arising, and to issue charters to state, district and local assemblies. The officers are elected at each annual session, and their titles correspond almost completely with those of the local and district assemblies, with the exception that the word "general" takes the place of "district," as "general master workman," &c. The general master workmen have been Uriah S. Stephens (the founder of the order), Terence V. Powderly, James R. Sovereign, John N. Parsons and Henry A. Hicks. The order has a publication known as the *Journal of the Knights of Labour*, published at Washington, D.C.

American Railway Union.

The third attempt to bring into one order men employed in different vocations was the American Railway Union, organized in Chicago on the 20th of June 1893. It included all railway employés born of white parents. It was organized for the protection of members in all matters relating to wages and their rights as employés, and affirmed that such employés were entitled to a voice in fixing wages and in determining conditions of employment. The union won a great victory on the North-Western railway in April 1894, but its action in the great strikes in Chicago in 1894 cost it its life. Its membership reached at one time 150,000.

Federations of Labour.

The separate unions found that the co-operation of other unions was needed to perfect and extend their work, and attempts were made from time to time to organize a federated body. The initial steps were taken in 1866, when the trades assemblies of New York City and Baltimore called a national labour congress, the 100 delegates sent by 60 secret and open organizations from different trade unions meeting on the 20th of August. In 1867 a second convention was called to meet in Chicago, the aim being to form a Trades Union Congress like that existing in Great Britain. The National Labour Union held two conventions in 1868, the first in May and the other in September; it met again in Chicago in 1869, in Boston in 1870, in Philadelphia in 1871 and in Columbus, Ohio, in 1872. This closed the experience of the National Labour Union. During 1873, owing to the industrial depression, many of the trade unions were suspended. An industrial congress met in Rochester, N.Y., in April 1874, consisting of some of the leading trade unionists of the United States, and on the 14th of that month a convention was held representing the Sovereigns of Industry. The expectation was that the old National Labour Union should be taken up. The Industrial Brotherhood of the United States, another secret order, partaking largely of the character of the Knights of Labour, was represented in that convention. As might have been expected, the two ideas—that on which the Knights of Labour was organized and the trade union idea—immediately became antagonistic, yet a platform containing most of the principles of the Knights of Labour was adopted. The movement ended with the Rochester meeting. The years 1875 and 1876 saw other attempts; but they were chiefly political in their character and the temporary orders then organized were disbanded. Between 1876 and 1881 other attempts were made at federation. A call issued jointly by the Knights of Industry and a body known as the Amalgamated Labour Union, consisting of some dissatisfied members of the Knights of Labour, resulted in a convention held at Terre Haute, Ind., on the 2nd of August 1881. The chief purpose was to supplant the Knights of Labour by the creation of a new secret order. The membership of the convention, however, had trade union proclivities and did not believe in multiplying labour societies. The secret organization was not effected. Another convention was held in Pittsburg, on the 19th of November 1881, as the result of the following statement:—

> We have numberless trades unions, trades assemblies or councils, Knights of Labour, and various other local, national and international labour unions, all engaged in the noble task of elevating and improving the condition of the working classes. But great as has been the work done by these bodies, there is vastly more that can be done by a combination of all these organizations in a federation of trades and labour unions.

It is claimed that the 107 delegates represented 262,000 workmen. Their deliberations resulted in the Federation of Organized Trades and Labour Unions of the United States and Canada. Its platform differed but very little from that of the Knights of Labour, although it was in some respects more comprehensive. It demanded eight hours as a day's work; called for national and state incorporation of trade unions; favoured obligatory education of all children, and the prohibition of their employment under the age of fourteen; favoured the enactment of uniform apprentice laws; opposed bitterly all contract convict labour and the truck system for payment of wages; demanded laws giving to working men a first lien on property upon which their labour had been expended; insisted upon the abrogation of all so-called conspiracy laws, advocated the establishment of a national bureau of labour statistics; urged the prohibition of the importation of foreign labour; opposed government contracts on public work; favoured the adoption by states of an employers' liability act; and urged all other labour bodies to vote only for labour legislators. The second convention was held at Cleveland, O., on the 21st of November 1882.

The American Federation of Labour is the largest labour organization in the United States. It was organized at Columbus, O., on the 8th of December 1886, under the name it now bears. In 1888 it was declared that it owed its existence to the Federation of Organized Trades. &c., founded in 1881 at Pittsburg, and that the American Federation meetings or conventions should date from that year; hence it is generally stated that the Federation was founded in 1881. From the start in 1881 the Federation had a constitution, but it revised it at the convention held in Baltimore on the 16th of December 1887, under the name of the American Federation of Labour. The order is not secret, nor do individual members, through local trades unions or otherwise, owe any allegiance to it. Its object is the encouragement and formation of local trades and labour unions and the closer federation of such societies through the organization of central trades and labour unions in every state, and the combination of such bodies into state, territorial or provincial organizations for the purpose of securing general harmony not only in the interests of the working masses, but of legislation. While it is a federation, it cannot be called a federal body, like the Knights of Labour, although there are local trade unions, trade assemblies in cities and state federations; nevertheless, there is not the hierarchical character of the other body. Most of the trade unions in the United States are affiliated with the American Federation. The great railway brotherhoods are not so affiliated, except the Amalgamated Association of Railroad Employés of America, the Order of Railroad Telegraphers and the Brotherhood of Railroad Trackmen.

The federation has affiliated with it 117 international unions, 37 state federations, 574 city central bodies and 661 local trade and federal labour unions. The international unions are made up of approximately 28,500 local unions. The average membership on which dues have been paid was 264,825 in 1897, and ten years later the number was 1,538,970.

The chief officers of the federation are a president, first, second, third, fourth, fifth and sixth vice-presidents, treasurer and secretary. Samuel Gompers of New York was the first president, holding that position till 1894, when he was defeated through the endeavours of the Socialist Labour Party, and John M'Bride elected. At the next session, however, he was re-elected. The numerical strength of the American Federation of Labour is probably not far from 1,600,000. It maintains a journal called the *American Federationist*, published at Washington, D.C. The doctrine of the federation relative to strikes is that each affiliated society has its own government, distinct from the government of the national convention, which has no power to order strikes, such matters being left to the affiliated societies, but is advisory and not conclusive in its action.

Estimated Strength.

Unions are often organized for temporary purposes, their existence ceasing as soon as the purposes succeed or fail. The total number of members of all kinds of labour organizations cannot be stated. There are many local societies and associations other than those belonging to the Knights of Labour or those affiliated with the American Federation of Labour, but which are distinctly labour bodies. According to the best possible classification there are 20,000,000 wage-earners in the United States, including men, women and children. The most liberal estimate of the membership of all labour organizations places the total at 2,000,000. This would be about 10% of the whole body of wage-workers; but in some occupations, like that of the printing trade, the organization probably includes from 75 to 90%.

The law relating to trade unions varies somewhat in the different states. Both the federal legislature and several of the states (Massachusetts, New York, Pennsylvania, Michigan, Maryland, Iowa, Kansas and Louisiana) have passed laws permitting the incorporation of unions. Michigan, Wyoming and Nebraska have specially provided for incorporating assemblies of the Knights of Labour. Hardly any advantage, however, has been taken of these statutes. Some states have passed laws excepting trade unions from restrictions on combinations and conspiracies imposed by other statutes or the common law (*e.g.* New York), and especially from the operation of anti-trust laws (Michigan, Wisconsin, Nebraska, Montana, North Carolina and Texas). The Texas law, however, has been held unconstitutional. A number of states have passed laws, some of doubtful validity, prohibiting employers from making it a condition of employment that labourers should not belong to a union. Most states have adopted statutes legalizing union labels to indicate the products of members of trade unions.

By act of Congress, associations of the nature of labour organizations, having branches in several states or territories, may, on filing articles of association for record in Washington, become corporations. American legislation generally is friendly to trade unions. Their purposes are regarded as lawful by the courts, but if they use unlawful means for their accomplishments, a remedy will be applied. Injury to property, intimidation by threats, personal violence, or boycotts enforced by terrorism, are such unlawful means. The liberty of action thus secured to organizations of labour is equally the right of the employer. Therefore, a statute making it an offence for one to require those whom he employs to withdraw from a trade union is unconstitutional and void (see *Reports of American Bar Association*, xxi. 367, 372). The courts recognize that membership in trade unions is a species of property, of which no one can be deprived except through a formal procedure in conformity with the rules of the organization. Some of the states, notably New York, have a statute prohibiting trade unions from making any discrimination in connexion with their admission requirements on account of membership in the state militia or national guard.

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TRADE WINDS, the name given to the winds which blow from the tropical belts of high pressure towards the equatorial belt of low pressure, from the north-east in the northern hemisphere and from the south-east in the southern. They are exceedingly regular, especially over the oceans, where there is no disturbing influence from the great land masses. They receive their name from this feature, the term "trade" being used in the otherwise obsolete sense of "direction" or "course" (cf. "tread"). The area of their greatest influence may be taken to extend from about 3° to 35° N., and from the equator to 28° S., though these belts are actually somewhat narrower at any given season, as the whole system of surface winds over the globe moves north and south following the sun. The westerly winds prevalent in the belts respectively north of the northern tropical belt of high pressure, and south of the southern, are sometimes known as anti-trades, their direction being opposite to that of the trade winds.

TRAFALGAR, BATTLE OF. The British victory over the French off Cape Trafalgar, fought on the 21st of October 1805, was a sequel of the breakdown of Napoleon's great scheme for the invasion of the British Isles (See NAPOLEONIC CAMPAIGNS: *Naval*). When Villeneuve gave up in despair the attempt to enter the Channel, he steered for Cadiz, and anchored in that port on the 20th of August 1805. He found three British ships of the line, under the command of Vice-Admiral Cuthbert Collingwood, on the watch. Collingwood, resolved that the allies should not drive him through the Straits of Gibraltar without being compelled to follow, retired slowly, and at a short distance ahead of the ships sent to pursue him. They, not being willing to be drawn into the Mediterranean, gave up the pursuit. The British officer then resumed his watch off Cadiz. On the 22nd of August he was joined by Rear-Admiral Sir Richard Bickerton with four ships of the line, and on the 30th by Vice-Admiral Sir Robert Calder with 18. The allied fleet, consisting of 29 sail of the line which had come with Villeneuve, and five already at Cadiz, 34 in all, remained quiescent. The use to be made of it, or the measures to be taken for its destruction, were matters of urgent consideration to Napoleon and to the British government. On the 14th of September Napoleon gave orders that the French and Spanish ships at Cadiz should put to sea at the first favourable opportunity, join seven Spanish ships of the line then at Cartagena, go to Naples, and land the soldiers they carried to reinforce his troops then in that kingdom, and should fight a decisive action if they met a British fleet of inferior numbers. Two Spanish ships of the line were to be counted as equal to one French. Their final destination was to be Toulon. On the 15th he decided that Villeneuve, whose "excessive pusillanimity" rendered him incapable of vigorous action, must be replaced by Admiral Rosily. Rosily received his orders on the 17th and left for Cadiz. The British government, determined to confine the allies to Cadiz, or beat them if they came out, sent Nelson to take command and prepared to despatch reinforcements. Nelson left Portsmouth on the 15th of September, and reached Cadiz on the 28th, bringing three ships of the line with him. He gave orders that no salute should be fired for him lest the enemy should learn that reinforcements had arrived. The bulk of the fleet—23 sail—was kept well out at sea, and five ships of the line under Rear-Admiral Louis were appointed to cruise close to Cadiz as an inshore squadron. On the 5th of October Louis was sent to Gibraltar to renew his provisions and water, and the watch was left to two frigates. Between the 7th and the 13th of October Nelson was joined by six ships of the line, making a total of 34. But Admiral Calder, having been summoned home to stand a court-martial, took his flagship with him on the 14th, and on the 17th another line-of-battle ship had to be detached to renew her stores. As Admiral Louis could not return before the battle of the 21st, Nelson had at his disposal 27 ships of the line in all. Napoleon's order of the 14th of September reached Villeneuve on the 28th. He learnt also that Rosily was coming, but not that he himself was to be superseded. On the 5th of October he held a council of war of French and Spanish officers. They decided that the condition of their ships did not justify them in hoping for victory over the British fleet, but Napoleon's orders were peremptory, and they agreed that a sortie must be made. Easterly winds were needed to facilitate the sailing of a large and awkward fleet from Cadiz, and till the 14th the wind was hard from the west. Even when it fell the allies lingered. On the 18th of October Villeneuve heard that Rosily had reached Madrid, and of his own supersession. Stung by the prospect of being disgraced before the fleet, he resolved to go to sea before his successor could reach Cadiz.

The allies, aided by a light land breeze which blew from the east, though the wind at sea was westerly, began to leave Cadiz Bay on the 19th. Their movements were at once known to the British look-out frigates, and were transmitted by signal to Nelson, who was cruising some thirty miles to the west. During the period of blockade he had instructed his captains as to how he meant to fight the approaching battle. The memorandum in which his instructions were embodied was dated the 9th of October. It was drawn up in view of the circumstances which did not arise—that the enemy would come to sea with a strong easterly wind which would give him the weather gage; that he might be reinforced to a strength of over 50 ships of the line from Brest, Rochefort and Cartagena; that the British fleet might be raised by reinforcements to 40 ships. But the governing principles of the memorandum were independent of such details. They were that the order of sailing in which the fleet was when the enemy was seen was to be the order of battle; that no time was to be wasted in forming a precise line; that the attack was to be made in two bodies, of which one, to be led by the second in command, Collingwood, was to be thrown on the rear of the enemy, while the other, led by Nelson himself, was to take care that the centre and van should not come to the assistance of the ships cut off. Nelson was careful to point out that "Something must be left to chance. Nothing is sure in a sea fight beyond all others"; and he left his captains free from all hampering rules by telling them that "No captain can do very wrong if he places his ship alongside that of the enemy." In short the execution was to be as circumstances should dictate, subject to the guiding rule that the enemy's rear was to be cut off and a concentration of superior force on an inferior sought for.

The uncertainties of naval warfare in the days of sailing ships were fully shown at Trafalgar. The allies, having left Cadiz on the 20th of October, were 33 sail of the line strong, one of the fleet having been left behind. They sailed in five squadrons. Three were nearer the land than the other two. The leading squadron of the three was commanded by the Spanish admiral, Álava; Villeneuve followed; and the French admiral, Dumanoir, commanded the rear. The other two squadrons of six ships of the line each, commanded by the Spanish admiral, Gravina, and the French admiral, Magon, were parallel with, and outside of the three. All headed for the Straits of Gibraltar in the westerly breezes, which had become very light. The British fleet of 27 sail in two divisions also headed for the Mediterranean. During the night of the 20th–21st of October several movements were made to gain position, and there was an inevitable tendency to straggle among vessels which did not all sail equally well and were moving in light winds. On the early morning of the 21st the allies were some twelve miles off Cape Trafalgar. The British fleet was some ten or twelve miles out at sea to the west of them. Seeing that a battle would now be forced on him, Villeneuve ordered his whole fleet to turn so as to bring their heads on Cadiz. He was painfully aware that the incomparably more expert British fleet would not be content to attack him in the old-fashioned way, coming down in a parallel line and engaging from van to rear. He knew that they would endeavour to concentrate on a part of his line. But Villeneuve was too conscious of the inexperience of his officers and men to think it possible to make counter movements with them. It has been said that the French and Spanish ships which had taken part in the late cruise to the West Indies and back must be considered as trained in the same sense as the British. But apart from the fact that these vessels formed little more than a half of the allied fleet, the comparison is childish. It could only have occurred to writers who, wishing to exalt the glory of Trafalgar, forget that the superior quality of the British fleet, the fruit of foresight, of good sense, and the strenuous work of a people, was itself the best of all claims to honour. A hasty cruise across the Atlantic and back was no equivalent for years of training. The blockades maintained by the British fleet had made it difficult for the allies to obtain stores and their ships were ill fitted. Their crews contained a minute proportion of men bred to the sea, and as they had to be taught the elements of seamanship on the few occasions when they got to sea, their gunnery was neglected. There was valour in the allied fleet, but there was neither skill nor confidence. Moreover the very light wind then blowing rendered manœuvring all but impossible for the most expert crews. Villeneuve could do nothing more than order his fleet to turn so as to bring the ships' heads on Cadiz, to form the line, and await the enemy's attack. He, however, left his captains free to act for the best when the battle had begun, by telling them that whoever was not under fire was not at his post. The movement of conversion ordered at 6 o'clock a.m. was not executed till about 10 o'clock, and it was ill done. The three squadrons nearest the shore turned first, the rear beginning, to leave room for the others. Thus Dumanoir now led the van and Álava followed Villeneuve. The two squadrons of Gravina and Magon, which had been outside, fell in behind Álava. No accurate line was formed. The allies drifted rather than sailed into a curve of some five miles long, stretching from north to south, concave on the west side, and more pronounced at the southern than at the northern end. Their ships did not follow one another, but were in many cases two, and in some cases three, abreast in groups. To some extent this was to their advantage, as the effective range of fire of the artillery of the day was barely 1200 yds., and as the power of concentrating the fire of guns out of ports was limited, the danger to an assailant bearing down was not great during his approach. The peril was that he would be engaged with two or three enemies when he had broken into the line, and this risk was increased by the accidental group formation of the allies.

The confidence and promptitude of the British fleet presented a marked contrast to the passivity of the allies. When in the early morning the enemy was seen to the east, Nelson's fleet was in two divisions, somewhat scattered—his own of 12 sail of the line being to the westward and windward in the light breeze from W.N.W.; Collingwood's of 15 sail being to leeward and east. At 6.40 the signal was made to form the order of sailing and prepare for battle. The enemy's movement of conversion was already seen, and it was obvious that unless he were rapidly stopped he might reach Cadiz Bay in safety. A few minutes before 7 o'clock the signal to bear up, No. 76, was made by Nelson. Much discussion has arisen as to whether this was an order to bear up together, or in succession; the first if exactly executed would have caused the British ships to approach the enemy in a line abreast (side by side) since all would have turned at once; the second would have caused them to approach in a line ahead (one after the other) since they would have turned successively. The discussion is in reality futile, because the want of wind rendered it impossible to arrange exact formations, because it had been decided that no time should be wasted in dressing the line, and because Nelson's flagship, the "Victory" (100), and Collingwood's flagship, the "Royal Sovereign" (100), were quick-sailing vessels, and both admirals moved at the best attainable speed. The slow ships could not keep up with them. The two squadrons went down heading to north of east, Collingwood to the right and leeward, Nelson to the north and windward, in two bodies without exact formation, according to the speed of the ships. Collingwood headed for the centre, and the pronounced curve at the south end of the allied line caused the ships of his division to come into action in a close approach to a parallel with the enemy. The "Royal Sovereign" was the first British ship to break into the enemy's line, which she did about midday and astern of Álava's flagship the "Santa Ana." She was alone for a few minutes, but the ships of Collingwood's division, as they sailed into the curve, were mostly able, by steering to the right, to get into action very soon after their admiral. Nelson's division was headed by himself to cut through the enemy between his van and centre, and to bar his road to Cadiz. It was certainly in a nearer approach to a line ahead than Collingwood's. After making a demonstration at the allied van, he broke into their line astern of the "Bucentaure" (100), the flagship of Villeneuve.

The exact movements of all the ships engaged could only be given in a very detailed account of the battle, but the main lines of the action are already indicated. To the allies it appeared that the British fleet assailed them in two lines converging on their centre, and that it then carried out a concentration on this part of their line. Though this is too simple—or too bald—a statement of the case, it does not go far from the truth. The allied formation was broken in two, and though the rear part was kept well in play by Collingwood's division, the severest blows fell on the central sections.

The battle, which began at midday, was terminated about five. Eighteen of the allies were taken. Their van, after long remaining quiescent, made a futile demonstration, and then sailed away. The four van ships which escaped with

Admiral Dumanoir were met and captured off Cape Ortegal on the 4th of November by a British squadron of five ships under Sir Richard Strachan. The stormy weather which followed the battle gave the enemy an opportunity to retake some of the prizes, and others were lost. Four only were carried into Gibraltar by the British fleet—three French and one Spanish. Only eleven of the allied fleet succeeded in finding safety in Cadiz. The fragment of the French squadron remained there under Admiral Rosily till he was forced to surrender to the Spaniards in 1808 on the breaking out of the Peninsular War. The loss of life of the allies cannot be stated with precision. In the British fleet the reported loss in killed and wounded was 1690, of whom 1452 belonged to 14 out of the 27 ships of the line present—the inequality of loss being mainly due to the fact that it was as a rule these vessels which came earliest into action. For the circumstances of Nelson's death see the article NELSON.

AUTHORITIES.—Accounts of the battle of Trafalgar are to be found in all the naval, and most of the general, histories of the time. The most essential of the original authorities are collected by Sir N. Harris Nicolas in his *Despatches and Letters of Vice-Admiral Lord Viscount Nelson*, vol. vii. (London 1844–1846). The controversy as to the exact method on which the battle was fought, and the significance of the signal to bear down, is fully worked out with many references to authorities in *The Times* from the 14th of July to the 21st of October 1905, both in a general correspondence and in a series of articles on "Trafalgar and the Nelson Touch," 16th, 19th, 22nd, 26th, 28th and 30th of September 1905; see also J. S. Corbett, *The Campaign of Trafalgar* (1910). (D. H.)

TRAFFIC, properly the interchange or passing of goods or merchandise between persons, communities or countries, commerce or trade. The term in current usage is chiefly applied collectively to the goods, passengers, vehicles and vessels passing to and fro over the streets, roads, sea, rivers, canals, railways, &c.

The origin of the word is obscure. It occurs in Fr. *trafique*, and *trafiquer*, Ital. *traffico, trafficare*, Sp. *trafago, trafagar*. Du Cange (*Gloss. Med. et Inf. Lat.*) quotes the use of *traffigare* from a treaty between Milan and Venice of 1380, and gives other variants of the word in medieval Latin. There is a medieval Latin word *transfegator*, an explorer, spy, investigator (see Du Cange, *op. cit.*, *s.v.*) which occurs as early as 1243, and is stated to be from *transfegare*, a corruption of *transfretare*, to cross over the sea (*trans*, across, *fretum*, gulf, strait, channel). Diez (*Etymologisches Wörterbuch der romanischen Sprachen*) connects the word with Port. *trasfegar*, to decant, which he traces to Late Lat. *vicare*, to exchange, Lat. *vicis*, change, turn. A suggestion (*Athenaeum*, app. 7, 1900) has been made that it is to be referred to a late Hebrew corruption (*traffik*) of Gr. *τροπαϊκός*, pertaining to a trophy, applied to a silver coin with the figure of victory upon it and termed in Latin *victoriatus*.

TRAHERNE, THOMAS (1637?–1674), English writer, was, according to Anthony à Wood, a "shoemaker's son of Hereford." He entered Brasenose College, Oxford, in 1652, and after receiving his degree in 1656 took holy orders. In the following year he was appointed rector of Credenhill, near Hereford, and in 1661 received his M.A. degree. He found a good patron in Sir Orlando Bridgeman, lord keeper of the seals from 1667 to 1672. Traherne became his domestic chaplain and also "minister" of Teddington. He died at Bridgeman's house at Teddington on or about the 27th of September 1674. He led, we are told, a simple and devout life, and was well read in primitive antiquity and the fathers. His prose works are *Roman Forgeries* (1673), *Christian Ethics* (1675), and *A Serious and Patheticall Contemplation of the Mercies of God* (1699). His poems have a curious history. They were left in MS. and presumably passed with the rest of his library into the hands of his brother Philip. They then became apparently the possession of the Skipps of Ledbury, Herefordshire. When the property of this family was dispersed in 1888 the value of the MSS. was unrecognised, for in 1896 or 1897 they were discovered by Mr W. T. Brooke on a street bookstall. Dr Grosart bought them, and proposed to include them in his edition of the works of Henry Vaughan, to whom he was disposed to assign them. He left this task uncompleted, and Mr Bertram Dobell, who eventually secured the MSS., was able to establish the authorship of Thomas Traherne. The discovery included, beside the poems, four complete "Centuries of Meditation," short paragraphs embodying reflexions on religion and morals. Some of these, evidently autobiographical in character, describe a childhood from which the "glory and the dream" was slow to depart. Of the power of nature to inform the mind with beauty, and the ecstatic harmony of a child with the natural world, the earlier poems, which contain his best work, are full. In their manner, as in their matter, they remind the reader of Blake and Wordsworth. Traherne has at his best an excellence all his own, but there can be no reasonable doubt that he was familiar both with the poems of Herbert and of Vaughan. The poems on childhood may well have been inspired by Vaughan's lines entitled *The Retreat*. His poetry is essentially metaphysical and his workmanship is uneven, but the collection contains passages of great beauty.

See Bertram Dobell's editions of the *Poetical Works* (1906) and *Centuries of Meditation* (1908).

TRAILL, HENRY DUFF (1842–1900), British author and journalist, was born at Blackheath on the 14th of August 1842. He belonged to an old Caithness family, the Traills of Rattar, and his father, James Traill, was stipendiary magistrate of Greenwich and Woolwich. H. D. Traill was sent to the Merchant Taylors' School. He rose to be head of the school and obtained a scholarship at St John's College, Oxford. He was destined for the profession of medicine and took his degree in natural sciences in 1865, but then read for the bar, being called in 1869. In 1871 he received an appointment in the education office which left him leisure to cultivate his gift for literature. In 1873 he became a contributor to the *Pall Mall Gazette*, then under the editorship of Frederick Greenwood. He followed Greenwood to the *St James's Gazette* when in 1880 the *Pall Mall Gazette* took for a time the Liberal side, and he continued to contribute to that paper up to 1895. In the meantime he had also joined the staff of the *Saturday Review*, to which he sent, amongst other writings, weekly verses upon subjects of the hour. Some of the best of these he republished in 1882 in a volume called *Recaptured Rhymes*, and others in a later collection of *Saturday Songs* (1890). He was also a leader-writer on the *Daily Telegraph*, and acted for a time as editor of the (Sunday) *Observer*. In 1897 he became first editor of *Literature*, when that weekly paper (afterwards sold and incorporated with the *Academy*) was established by the proprietors of *The Times*, and directed its fortunes until his death. Traill's long connexion with journalism must not obscure the fact that he was a man of letters rather than a journalist. He wrote best when he wrote with least sense of the burden of responsibility. His playful humour and his ready wit were only given full scope when he was writing to please himself. One of his most brilliant *jeux d'esprit* was a pamphlet which was published without his name soon after he had begun to write for the newspapers. It was called *The Israelitish Question and the Comments of the Canaan Journals thereon* (1876). This told the story of the Exodus in articles which parodied very cleverly the style of all the leading journals of the day, and was at once recognized as the work of a born humorist. Traill sustained this reputation with *The New Lucian*, which appeared in 1884 (2nd ed., with several new dialogues, 1900); but for the rest his labours were upon more serious lines. He directed the production of a vast work on *Social England* in 1893–1898; he wrote, for several series of biographies, studies of Coleridge (1884), Sterne (1882), William III. (1888), Shaftesbury (1886), Strafford (1889), and Lord Salisbury (1891); he compiled a biography of Sir John Franklin, the Arctic explorer (1896); and after a visit to Egypt he published a volume on the country, and in 1897 appeared his book on Lord Cromer, the man who had done so much to bring it back to prosperity. Of these the literary studies are the best, for Traill possessed great critical insight. He published two collections of essays: *Number Twenty* (1892), and *The New Fiction* (1897). In 1865 his *Glaucus; a tale of a Fish*, was produced at the Olympic Theatre with Miss Nellie Farren in the part of Glaucus. In conjunction with Mr Robert Hichens he wrote *The Medicine Man*, produced at the Lyceum in 1898. He died in London on the 21st of February 1900.

TRAIN (M. Eng. *trayn* or *trayne*, derived through Fr. from Late Lat. *trahinare*, to drag, draw, Lat. *trahere*, cf. trail, trace, ultimately from the same source), a general term applied to that which is drawn or trailed behind or after anything else, the hind part or rear of anything. It is thus used of the portion of a skirt, robe or cloak which is lengthened behind so that when allowed to fall it trails along the ground. In ceremonial processions and other state functions the duty of keeping raised the train of the sovereign's robes, or of the robes of great officials and dignitaries, is assigned to pages or to official train-bearers. The length of the train which ladies must wear at royal courts, drawing-rooms or other state functions is fixed by regulations from the lord chamberlain's office. The chief specific uses of the term are for the trail of a gun, that portion of the carriage which rests upon the ground when it is unlimbered, the line of gunpowder or other combustible material which is used to ignite a charge of explosives, and, figuratively, to an ordered series or sequence of events, thoughts, &c. The most familiar application is to a number of carriages, wagons or trucks coupled together and drawn by a locomotive engine on a railway (see RAILWAYS). A special use of the verb "to train," in the sense of to educate, to instruct, to bring into fit and proper condition, mental, moral or physical, is developed, as in "educate" (Lat. *educare*, literally, to draw out), from the sense of drawing or bringing out the good qualities aimed at in a course of instruction; a specific use is that of training for a race or other form of athletics, *i.e.* getting into fit physical condition.

TRAJAN [MARCUS ULPIUS TRAJANUS] (A.D. 53–117), Roman emperor, was born at Italica, in Spain, on the 18th of September 52 (or 53). The family to which he belonged was probably Italian and not Iberian by blood. His father began as a common legionary soldier, and fought his way up to the consulship and the governorship of Asia. The younger Trajan was rigorously trained by him, and imbued with the same principles and tastes. He was a soldier born and bred. No better representative of the true old hardy Roman type, little softened by either luxury or education, had come to the head of affairs since the days of Marius. His training was almost exclusively military, but his experience as an officer gave him an acquaintance with almost every important province of the empire, which was of priceless value to him when he came to the throne. For ten years he held a commission as military tribune, which took him to many lands far asunder; then he filled important posts in Syria and Spain. By the year 89 he had achieved a considerable military reputation. At that time L. Antonius Saturninus headed a rebellion in Germany, which threatened seriously to bring Domitian's rule to an end. Trajan was ordered in hot haste from Further Spain to the Rhine. Although he carried his troops over that long and arduous march with almost unexampled rapidity, he only arrived after the insurrection had been put down. But his promptitude raised him higher in the favour of Domitian, and he was advanced to the consulship in 91. Of the next five years of his life we know nothing definite. It is not unlikely that they were spent at Rome or in Italy in the fulfilment of some official duties. When the revolution of 96 came, and Nerva replaced the murdered Domitian, one of the most important posts in the empire, that of consular legate of Upper Germany, was conferred upon Trajan. An officer whose nature, as the event showed, was interpenetrated with the spirit of legality was a fitting servant of a revolution whose aim it was to substitute legality for personal caprice as the dominant principle of affairs. The short reign of Nerva really did start the empire on a new career, which lasted more than three-quarters of a century. But it also demonstrated how impossible it was for any one to govern at all who had no claim, either personal or inherited, to the respect of the legions. Nerva saw that if he could not find an Augustus to control the army, the army would find another Domitian to trample the senate under foot. In his difficulties he took counsel with L. Licinius Sura, a lifelong friend of Trajan, and on the 27th of October in the year 97 he ascended the Capitol and proclaimed that he adopted Trajan as his son. The senate confirmed the choice and acknowledged the emperor's adopted son as his successor. After a little hesitation Trajan accepted the position, which was marked by the titles of imperator, Caesar and Germanicus, and by the tribunician authority. He immediately proceeded to Lower Germany, to assure himself of the fidelity of the troops in that province, and while at Cologne he received news of Nerva's death (Jan. 25, 98). The authority of the new emperor was recognized at once all over the empire. The novel fact that a master of the Romans should have been born on Spanish soil seems to have passed with little remark, and this absence of notice is significant. Trajan's first care as emperor was to write to the senate an assurance like that which had been given by Nerva, that he would neither kill nor degrade any senator. He ordered the establishment of a temple and cult in honour of his adoptive father, but he did not come to Rome. In his dealings with the mutinous praetorians the strength of the new emperor's hand was shown at once. He ordered a portion of the force to Germany. They did not venture to disobey, and were distributed among the legions there. Those who remained at Rome were easily overawed and reformed. It is still more surprising that the soldiers should have quietly submitted to a reduction in the amount of the donative or gift which it was customary for them to receive from a new emperor, though the civil population of the capital were paid their largess (*congiarium*) in full. By politic management Trajan was able to represent the diminution as a sort of discount for immediate payment, while the civilians had to wait a considerable time before their full due was handed to them.

The secret of Trajan's power lay in his close personal relations with the officers and men of the army and in the soldierly qualities which commanded their esteem. He possessed courage, justice and frankness. Having a good title to military distinction himself, he could afford, as the unwarlike emperors could not, to be generous to his officers. The common soldiers, on the other hand, were fascinated by his personal prowess and his camaraderie. His features were firm and clearly cut; his figure was tall and soldierly. His hair was already grey before he came to the throne, though he was not more than forty-five years old. When on service he used the mean fare of the common private, dining on salt pork, cheese and sour wine. Nothing pleased him better than to take part with the centurion or the soldier in fencing or other military exercise, and he would applaud any shrewd blow which fell upon his own helmet. He loved to display his acquaintance with the career of distinguished veterans, and to talk with them of their battles and their wounds. Probably he lost nothing of his popularity with the army by occasional indulgence in sensual pleasures. Yet every man felt and knew that no detail of military duty, however minute, escaped the emperor's eye, and that any relaxation of discipline would be punished rigorously, yet with unwavering justice. Trajan emphasized at once his personal control and the constitutionality of his sway by bearing on his campaigns the actual title of "proconsul," which no other emperor had done. All things considered, it is not surprising that he was able, without serious opposition from the army, entirely to remodel the military institutions of the empire, and to bring them into a shape from which there was comparatively little departure so long as the army lasted. In disciplinary matters no emperor since Augustus had been able to keep so strong a control over the troops. Pliny rightly praises Trajan as the lawgiver and the founder of discipline, and Vegetius classes Augustus, Trajan and Hadrian together as restorers of the morale of the army. The confidence which existed between Trajan and his army finds expression in some of the coins of his reign.

For nearly two years after his election Trajan did not appear in Rome. He had decided already what the great task of his reign should be—the establishment of security upon the dangerous north-eastern frontier. Before visiting the capital he determined to put affairs in train for the attainment of this object. He made a thorough inspection of the great lines of defence between the Danube and the Rhine, and framed and partly carried out a vast scheme for strengthening and securing them.

The policy of opposing uncivilized tribes by the construction of the *limes*, a raised embankment of earth or other material, intersected here and there by fortifications, was not his invention, but it owed in great measure its development to him. It is probable that the northernmost part of the great *limes Germaniae*, from the Rhine at Rheinbrohl, nearly midway between Coblenz and Bonn, to a point on the Main east of Frankfort, where that river suddenly changes its course from north to west, was begun by Domitian. The extension of this great barrier southwards to the point at which it met the *limes Raetiae* was undertaken by Trajan, though we cannot say how far he carried the work, which was not entirely completed till long after his time. We may without hesitation follow the opinion of Mommsen, who maintains that the *limes* was not intended, like Hadrian's Wall between the Tyne and the Solway, and like the great wall of China, to oppose an absolute barrier against incursions from the outside. It was useful as marking definitely the boundary of the Roman sway, and as assuring the Romans that no inroad could be made without intelligence being had of it beforehand, while the *limes* itself and the system of roads behind it enabled troops to be directed rapidly to any threatened point, and the fortified positions could be held against large numbers till reinforcements arrived. Great importance was no doubt attached to the perfection of the lines of communication bearing on the *limes*. Among a people of roadmakers, Trajan was one of the greatest, and we have definite evidence from inscriptions that some of the military roads in this region were constructed by him. The more secure control which the Romans now maintained over the territory within the *limes* tended to its rapid civilization, and the Roman influence, if not the Roman arms, soon began to affect powerfully the regions beyond.

After his careful survey of the Rhine end of the frontier defences, Trajan proceeded to strengthen them in the direction of the Danube. From the age of Tiberius onwards the Romans possessed the whole southern bank of the river from its source to the Euxine. But the precarious tenure of their possession had been deeply impressed on them by the disasters and humiliations they had undergone in these districts during the reign of Domitian. A prince had arisen among the Dacians, Decebalus by name, worthy to be placed at the head of all the great barbarian antagonists of Rome. Like Maroboduus, he was able to combine the forces of tribes commonly hostile to each other, and his military ability almost went the length of genius. Domitian attacked him but was compelled to make an ignominious peace. He agreed to pay to Decebalus an annual subsidy, and to supply him with engineers and craftsmen skilled in all kinds of construction, but particularly in the erection of fortifications and defensive works. During the nine or ten years which had elapsed since the conclusion of this remarkable treaty the Dacian prince had immensely strengthened the approaches to his kingdom from the Roman side. He had also equipped and drilled his formidable army after the Roman fashion. It was impossible for a soldier like Trajan to endure the conditions accepted by Domitian; but the conquest of Dacia had become one of the most formidable tasks that had ever confronted the empire. Trajan no doubt planned a war before he left the Danube for Rome late in 99.

The arrival of the emperor had been awaited in the capital with an impatience which is expressed by Pliny and by Martial.[1] As he entered the city and went on foot to the Capitol the plaudits of the people were unmistakably genuine. During his stay in the city he riveted more firmly still the affections both of the senate and of the people. The reconciliation of the empire with liberty, inaugurated, as Tacitus says, by Nerva, seemed now to be securely achieved. Trajan was absolutely open and simple, and lived with men at Rome as he had lived with his soldiers while on service. He realized the senate's ideal of the citizen ruler. The assurance that no senator should suffer was renewed by oath. All the old republican formalities were most punctiliously observed—even those attendant on the emperor's election to the consulate, so far as they did not involve a restoration of the old order of voting at the comitia. The veneration for republican tradition is curiously attested by the reproduction of many republican types of coin struck by senatorial officers. Trajan seized every opportunity for emphasizing his view that the *princeps* was merely the greatest of the magistrates, and so was not above but under the laws. He was determined, he said, to be to his subjects such a ruler as he had desired for himself when a subject. Real power and influence were accorded to the senate, which had now, by the incorporation of members whose origin was provincial, become in a manner representative of the whole empire. Trajan associated with the senators on equal terms, and enjoyed in their company every kind of recreation. All pomp was distasteful to him and discarded by him. There was practically no court, and no intrigues of any kind were possible. The approach to his house was free, and he loved to pass through the city unattended and to pay unexpected visits to his friends. He thirsted for no senator's blood, and used severity against the *delatores* alone. There was but one insignificant conspiracy against him during his whole reign. Though not literary himself, Trajan conciliated the literary men, who at all times had close relations with the senate. His intimate, M. Licinius, played an excellent Maecenas to his Augustus. In his efforts to win the affections of Roman society Trajan was aided by his wife Plotina, who was as simple as her husband, benevolent, pure in character, and entirely unambitious. The hold which Trajan acquired over the people was no less firm than that which he maintained upon the army and the senate. His largesses, his distributions of food, his public works, and his spectacles were all on a generous scale. The exhibitions in the arena were perhaps at their zenith during his tenure of power. Though, for some unexplained reason, he abolished the mimes, so beloved of the populace, at the outset of his reign, he availed himself of the occasion of his first triumph to restore them again. The people were delighted by the removal of the imperial *exedra* (a large chamber with open front) in the circus, whereby five thousand additional places were provided. Taxation was in many directions reduced, and the financial exactions of the imperial officers controlled by the erection of a special court. Elaborate precautions were taken to save Italy from famine; it is said that corn for seven years' consumption at the capital was retained in the granaries. Special encouragement was given to merchants to import articles of food. The corporation of bakers was organized and made more effective for the service of the public. The internal trade of Italy was powerfully stimulated by the careful maintenance and extension of the different lines of road. But the most striking evidence of Trajan's solicitude for his people's welfare is found in his institution of the *alimenta*, whereby means were provided for the rearing of poor and orphan children in Italy. The method had been sketched out by Nerva, but its great development was due to Trajan. The moneys allotted by the emperor were in many cases supplemented by private benevolence. As a soldier, Trajan realized the need of men for the maintenance of the empire against the outer barbarians, and he preferred that these men should be of Italian birth. He was only carrying a step farther the policy of Augustus, who by a system of rewards and penalties had tried to encourage marriage and the nurture of children. The actual effect of Trajan's regulations is hard to measure; they were probably more effectual for their object than those of Augustus. The foundations were confiscated by Pertinax, after they had existed less than a century.

On the 1st of September in the year 100, when Trajan was consul for the third time, Pliny, who had been designated consul for a part of the year, was appointed to deliver the "Panegyric" which has come down to us, and forms a most important source of our knowledge concerning this emperor. Pliny's eulogy of Trajan and his denunciation of Domitian are alike couched in extravagant phrases, but the former perhaps rests more uniformly on a basis of truth and justice than the latter. The tone of the "Panegyric" certainly lends itself to the supposition of some historians that Trajan was inordinately vain. That the emperor had an honest and soldierly satisfaction in his own well-doing is clear; but if he had had anything like the vanity of a Domitian, the senate, ever eager to outrun a ruler's taste for flattery, would never have kept within such moderate bounds.

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[1] It has been conjectured, not improbably, that the *Germania* of Tacitus, written at this period, had for one of its aims the enlightenment of the Romans concerning the formidable character of the Germans, so that they might at once bear more readily with the emperor's prolonged absence and be prepared for the necessity of decisive action on the frontier.

On the 25th of March in the year 101 Trajan left Rome for the Danube. Pretexts for a Dacian war were not difficult to find. Although there was no lack of hard fighting, victory in this war depended largely on the work of the engineer. The great military road connecting the posts in Upper Germany with those on the Danube, which had been begun by Tiberius, was now extended along the right bank of the river as far as the modern Orsova. The campaign of 101 was devoted mainly to road-making and fortification. In the following campaign, after desperate fighting to the north of the Danube in the mountainous region of Transylvania, Sarmizegethusa, the capital of Decebalus, was taken, and he was forced to terms. He agreed to raze all fortresses, to surrender all weapons, prisoners and Roman deserters, and to become a dependent prince under the suzerainty of Rome. Trajan came back to Italy with Dacian envoys, who in ancient style begged the senate to confirm the conditions granted by the commander in the field. The emperor now enjoyed his first Dacian triumph, and assumed the title of Dacicus. At the same time he royally entertained the people and no less royally rewarded his brave officers. But the Dacian chief could not school his high spirit to endure the conditions of the treaty, and Trajan soon found it necessary to prepare for another war. A massive stone bridge was built across the Danube, near the modern Turn Severin, by Apollodorus, the gifted architect who afterwards designed the forum of Trajan. In 105 began the new struggle, which on the side of Decebalus could now only lead to victory or to destruction. The Dacians fought their ground inch by inch, and their army as a whole may be said to have bled to death. The prince put an end to his own life. His kingdom became an imperial province; in it many colonies were founded and peopled by settlers drawn from different parts of the empire. The work done by Trajan in the Danubian regions left a lasting mark upon their history. The emperor returned to the capital in 106, laden with captured treasure. His triumph outdid in splendour all those that went before it. Games are said to have been held continuously for four months. Ten thousand gladiators are said to have perished in the arena, and eleven thousand beasts were killed in the contests. Congratulatory embassies came from all lands, even from India. The grand and enduring monument of the Dacian wars is the noble pillar which still stands on the site of Trajan's forum at Rome.

The end of the Dacian wars was followed by seven years of peace. During part of that time Pliny was imperial legate in the provinces of Bithynia and Pontus, and in constant communication with Trajan. The correspondence is extant and gives us the means of observing the principles and tendencies of the emperor as a civil governor.

The provinces (hitherto senatorial) were in considerable disorder, which Pliny was sent to cure. It is clear from the emperor's letters that in regard to nine out of ten of the matters which his anxious and deferential legate referred to him for his decision he would have been better pleased if the legate had decided them for himself. Trajan's notions of civil government were, like those of the duke of Wellington, strongly tinged with military prepossessions. He regarded the provincial ruler as a kind of officer in command, who ought to be able to discipline his province for himself and only to appeal to the commander-in-chief in a difficult case. In advising Pliny about the different free communities in the provinces, Trajan showed the same regard for traditional rights and privileges which he had exhibited in face of the senate at Rome. At the same time, these letters bring home to us his conviction that, particularly in financial affairs, it was necessary that local self-government should be carried on under the vigilant supervision of imperial officers. The control which he began in this way to exercise, both in Italy and in the provinces, over the "municipia" and "liberae civitates," by means of agents entitled (then or later) "correctores civitatium liberarum," was carried continually farther and farther by his successors, and at last ended in the complete centralization of the government. On this account the reign of Trajan constitutes a turning-point in civil as in military history. In other directions, though we find many salutary civil measures, yet there were no far-reaching schemes of reform. Many details in the administration of the law, and particularly of the criminal law, were improved. To cure corruption in the senate the ballot was introduced at elections to magistracies. The finances of the state were economically managed, and taxpayers were most carefully guarded from oppression. Trajan never lacked money to expend on great works of public utility; as a builder, he may fairly be compared with Augustus. His forum and its numerous appendages were constructed on a magnificent scale. Many regions of Italy and the provinces besides the city itself benefited by the care and munificence which the emperor bestowed on such public improvements. His attitude towards religion was, like that of Augustus, moderate and conservative. The famous letter to Pliny about the Christians is, according to Roman ideas, merciful and considerate. It was impossible, however, for a Roman magistrate of the time to rid himself of the idea that all forms of religion must do homage to the civil power. Hence the conflict which made Trajan appear in the eyes of Christians like Tertullian the most infamous of monsters. On the whole, Trajan's civil administration was sound, careful and sensible, rather than brilliant.

Late in 113 Trajan left Italy to make war in the East. The never-ending Parthian problem confronted him, and with it were more or less connected a number of minor difficulties. Already by 106 the position of Rome in the East had been materially improved by the peaceful annexation of districts bordering on the province of Syria. The region of Damascus, hitherto a dependency, and the last remaining fragment of the Jewish kingdom, were incorporated with Syria; Bostra and Petra were permanently occupied, and a great portion of the Nabataean kingdom was organized as the Roman province of Arabia. Rome thus obtained mastery of the most important positions lying on the great trade routes between East and West. These changes could not but affect the relations of the Roman with the Parthian Empire, and the affairs of Armenia became in 114 the occasion of a war. Trajan's campaigns in the East ended in complete though brilliant failure. In the retreat from Ctesiphon (117) the old emperor tasted for almost the first time the bitterness of defeat in the field. He attacked the desert city of Hatra, westward of the Tigris, whose importance is still attested by grand ruins. The want of water made it impossible to maintain a large force near the city, and the brave Arabs routed the Roman cavalry. Trajan, who narrowly escaped being killed, was forced to withdraw. A more alarming difficulty lay before him. Taking advantage of the absence of the emperor in the Far East, and possibly by an understanding with the leaders of the rising in Armenia and the annexed portions of Parthia, the Jews all over the East had taken up arms at the same moment and at a given signal. The massacres they committed were portentous. In Cyprus 240,000 men are said to have been put to death, and at Cyrene 220,000. At Alexandria, on the other hand, many Jews were killed. The Romans punished massacre by massacre, and the complete suppression of the insurrection was long delayed, but the Jews made no great stand against disciplined troops. Trajan still thought of returning to Mesopotamia and of avenging his defeat at Hatra, but he was stricken with sickness and compelled to take ship for Italy. His illness increasing, he landed in Cilicia, and died at Selinus early in August 117.

Trajan, who had no children, had continually delayed to settle the succession to the throne, though Pliny in the "Panegyric" had pointedly drawn his attention to the matter, and it must have caused the senate much anxiety. Whether Hadrian, the relative of Trajan (cousin's son), was actually adopted by him or not is impossible to determine; certainly Hadrian had not been advanced to any great honours by Trajan. Even his military service had not been distinguished. Plotina asserted the adoption, and it was readily and most fortunately accepted, if not believed, as a fact.

The senate had decreed to Trajan as many triumphs as he chose to celebrate. For the first time a dead general triumphed. When Trajan was deified, he appropriately retained, alone among the emperors, a title he had won for himself in the field, that of "Parthicus." He was a patient organizer of victory rather than a strategic genius. He laboriously perfected the military machine, which when once set in motion went on to victory. Much of the work he did was great and enduring, but the last year of his life forbade the Romans to attribute to him that *felicitas* which they regarded as an inborn quality of the highest generals. Each succeeding emperor was saluted with the wish that he might be "better than Trajan and more fortunate than Augustus." Yet the breach made in Trajan's *felicitas* by the failure in the East was no greater than that made in the *felicitas* of Augustus by his retirement from the right bank of the Rhine. The question whether Trajan's Oriental policy was wise is answered emphatically by Mommsen in the affirmative.

It was certainly wise if the means existed which were necessary to carry it out and sustain it. But succeeding history proved that those means did not exist. The assertion of Mommsen that the Tigris was a more defensible frontier than the desert line which separated the Parthian from the Roman Empire can hardly be accepted. The change would certainly have created a demand for more legions, which the resources of the Romans were not sufficient to meet without danger to their possessions on other frontiers.

The records of Trajan's reign are miserably deficient. Our best authority is the 68th book of Dio Cassius; then comes the "Panegyric" of Pliny, with his correspondence. The facts to be gathered from other ancient writers are scattered and scanty. Fortunately the inscriptions of the time are abundant and important. Of modern histories which comprise the reign of Trajan the best in English is that of Merivale; but that in German by H. Schiller (*Geschichte der römischen Kaiserzeit*, Gotha, 1883) is more on a level with recent inquiries. There are special works on Trajan by H. Francke (Güstrow, 1837), De la Berge (Paris, 1877), and Dierauer in M. Büdinger's *Untersuchungen zur römischen Kaisergeschichte*, (Leipzig, 1868). A paper by Mommsen in *Hermes*, iii. pp. 30 seq., entitled "Zur Lebensgeschichte des jüngeren Plinius," is important for the chronology of Trajan's reign. The inscriptions of the reign, and the Dacian campaigns, have been much studied in recent years, in scattered articles and monographs. (J. S. R.)

TRALEE, a market town and seaport, and the county town of Co. Kerry, Ireland, on the Ballymullen or Leigh River, about a mile from its mouth in Tralee Bay, and on the Great Southern & Western railway. Pop. (1901), 9687. A ship canal, permitting the passage of ships of 200 tons burden, connects it with Tralee Bay. Large vessels discharge at Fenit, 8 m. westward, where there is a pier connected with Tralee by rail. Coal, iron and timber are imported, and there is a considerable export of grain. There is a large trade in butter. Railways serve the neighbouring seaside watering-places of Ballybunnion and Castlegregory, and the coast scenery of this part is grand and varied. Four miles north-west of Tralee is Ardfert, with its cathedral, one of the oldest foundations in Ireland, now united to the see of Limerick. St Brendan was its original founder, and it had once a university. A neighbouring round tower fell in 1870. Seven miles north of this again is the fine round tower of Rattoo.

Tralee, anciently Traleigh, the "strand of the Leigh," owes its origin to the foundation of a Dominican monastery in 1213 by John Fitz-Thomas, of the Geraldine family. During the reign of Elizabeth it was in the possession of Earl Desmond, on whose forfeiture it came into possession of the Dennys. At the time of the rebellion in 1641 the English families in the neighbourhood asked to be placed in the castle under the charge of Sir Edward Denny, but during his absence a surrender was made. The town was incorporated by James I., and returned two members to the Irish parliament. Though disfranchised at the Union in 1800, it obtained the privilege of returning one member in 1832, but in 1885 it was merged in the county division. It is governed by an urban district council.

TRALLES (mod. *Güzel Hissar*), an ancient town of Caria, Asia Minor, situated on the Eudon, a tributary of the Maeander. It was reputed an Argive and Thracian colony, and was long under Persian rule, of which we hear in the history of Dercyllidas' raid from Ephesus in 397 B.C. Fortified and increased by the Seleucids and Pergamenians, who renamed it successively Seleucia and Antiochia, it passed to Rome in 133. Though satirized in a famous line (Juv. *Sat.* iii. 70) as a remote provincial place, it had many wealthy inhabitants in the Roman period and, to judge by objects discovered there, contained many notable works of art. Two of the best marble heads in the Constantinople museum came from Tralles; and both in the excavations conducted for that museum by Edhem Bey (1904), and by chance discoveries, fine-art products have come to light on the site. Rebuilt by Andronicus II. about 1280, it was superseded a few years later, after the Seljuk conquest, by a new town, founded by the amir Aidin in a lower situation (see Aidin). (D. G. H.)

TRAMORE, a market village and seaside resort of Co. Waterford, Ireland, on the bay of the same name, 7 m. S. of the city of Waterford, and the terminus of the Waterford & Tramore railway. The situation is pleasant, and the neighbouring coast exhibits bold cliff scenery. The bay is open to the south, and is dangerous to navigators, as in foggy weather it has been frequently mistaken for the entrance to Waterford Harbour. On the cliffs to the west are three towers, one having a curious iron figure known as the "metal man," erected as a warning to sailors. The bay is divided into an outer part and an inner lagoon (the Back Strand) by a spit of sand, with a strait, crossed by a ferry at its eastern extremity. A monument commemorates the wreck of the troopship "Seahorse" in 1816. Four miles west is Dunhill Castle, well situated on a precipitous rock.

TRAMP, a vagrant, one who "tramps" or walks the roads begging from house to house or ostensibly looking for work, but with no home and habitually sleeping out or moving on from the casual ward of one workhouse to that of another (see Vagrancy). The word is the shortened form of "tramper," one who tramps or walks with heavy tread. The term "tramp" is also used of a cargo steamer not running on a regular line but passing from port to port where freight may be picked up.

TRAMWAY, a track or line of rails laid down in the public roads or streets (hence the American equivalent "street railway"), along which wheeled vehicles are run for the conveyance of passengers (and occasionally of goods) by animal or mechanical power; also a light roughly laid railway used for transporting coals, both underground and on the surface, and for other similar purposes. The word has been connected with the name of Benjamin Outram, an engineer who, at the beginning of the 19th century, was concerned in the construction of tram roads, and has been explained as an abbreviation for "Outram way." But this is clearly wrong, since the word is found much earlier. It appears to be of Scandinavian origin and primarily to mean a beam of wood, cf. Old Swedish *trām*, *trum*, which have that sense. In a will dated 1555 reference is made to amending a "higheway or tram" in Bernard Castle, where a log road seems to be in question. In Lowland Scottish "tram" was used both of a beam of wood and specifically of such a beam employed as the shaft of a cart, and the name is still often given in England to the wheeled vehicles used for carrying coal in mining. "Tramway," therefore, is primarily either a way made with beams of wood or one intended for the use of "trams" containing coal (see Railway).

Construction.—The first tramway or street railway designed for passenger cars with flanged wheels was built in New York in 1832. The construction of this tramway does not appear to have been a success, and it was soon discontinued. In 1852 tramways were revived in New York by a French engineer named Loubat, who constructed the track of flat wrought-iron rails with a wide, deep groove in the upper surface, laid on longitudinal timbers. The groove, which was designed for wheel flanges similar to those employed on railways, proved dangerous to the light, narrow-tired vehicles of the American type. To meet this difficulty a step-rail consisting of a flat plate with a step at one side raised about ¾ in. above the surface was designed and laid at Philadelphia in 1855. When tramways were first introduced into England by G. F. Train in 1860 a rail similar to that laid at Philadelphia was adopted. This rail (fig. 1) was made of wrought-iron and weighed 50 lb per yard. It was 6 in. wide and had a step ¾ in. above the sole. The rails were spiked to longitudinal timbers, which rested on transverse sleepers, and they were laid to a gauge of 4 ft. 8½ in. Tramways of this type were laid at Birkenhead in 1860, at London in 1861, and in the Potteries (North Staffordshire) in 1863. The English public, however, would not tolerate the danger and obstruction caused by the step-rail, with its large area of slippery iron surface, and the tramway laid in London had to be removed, while those at Birkenhead and the Potteries were only saved by being relaid with grooved rails. Thus, while the step-rail became the standard form used in the United States, the grooved-rail became generally adopted in Europe. From the tramway point of view the step-rail has many advantages. A groove collects ice and dirt, and on curves binds the wheel flanges, increasing the resistance to traction. A grooved rail is, however, far less of a nuisance to the ordinary vehicular traffic, and it has come to be largely used in the principal cities of America.

After the passing of the Tramways Act of 1870 the construction of tramways proceeded rapidly in England. A flat grooved rail supported on a longitudinal timber and laid on a concrete bed was generally adopted. The paving consisted of stone setts from 4 to 6 in. in depth, laid on a thin bed of sand and grouted with cement, mortar or a bituminous mixture. With the exception of the design of the rail and the manner of supporting it on the concrete foundation, which has continually changed, this method of constructing the track has varied but little to the present day.

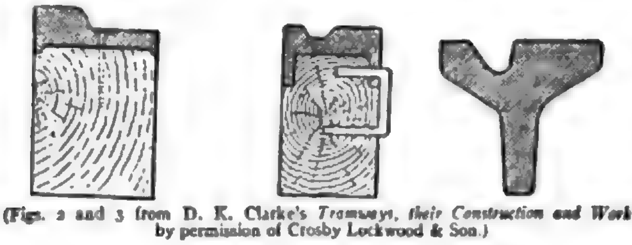

(Figs. 2 and 3 from D. K. Clarke's *Tramways, their Construction and Working*, by permission of Crosby Lockwood & Son.)

FIG. 1. FIG. 2. FIG. 3.

Early Tramway Rails.

The flat section of rail which was wanting in vertical stiffness soon proved unsatisfactory. A fillet or flange was then added to each side, which, bedding into the supporting timber, not only increased the vertical strength but also prevented horizontal displacement of the rail. With the addition of the side flanges a greatly improved method of fixing the rail to the sleepers was adopted. The old vertical spike, which was a crude fastening, was replaced by a "dog" or double-ended side spike, one end of which was driven through a hole in the flange of the rail (fig. 2). This fastening was very strong and proved a great improvement.

The next change was the use of cast-iron chairs to support the rails, which were introduced by Kincaid in 1872. These led to a modification of the rail section, and instead of the two side flanges a rail with a central flange (fig. 3) which fitted into the cast-iron chairs was used. The chairs weighed about 75 lb each, and were spaced at intervals of about 3 ft. The Barker rail laid in Manchester in 1877 was somewhat similar to that shown in fig. 3, but a continuous cast-iron chair was used to support it.

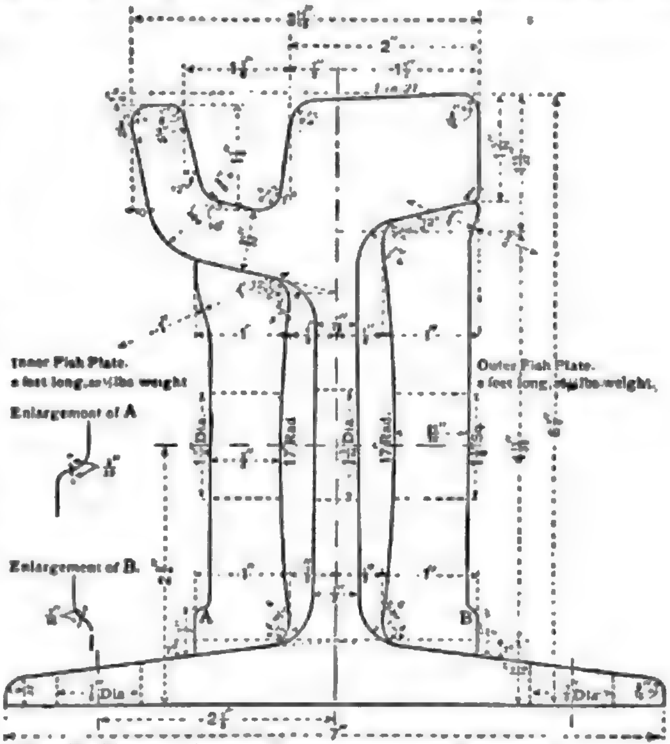
The introduction of steam traction about 1880, with its heavier axle loads and higher speeds, was a severe test of the permanent way. The flat section laid on timber sleepers and the built-up rails of the Kincaid and Barker types began to be discarded in favour of the solid girder rail rolled in one piece. The solidity and depth of this section gave it great vertical stiffness, and its introduction materially assisted in solving the problem of providing a smooth and serviceable joint.

The merits of the girder rail soon caused it to be generally adopted, and although the design has been greatly improved it remains to-day the standard form of tramway rail used throughout the world. At first difficulty was experienced in rolling the heavier sections with thin webs and wide bases, but the introduction of steel and improvements in the rolling mills overcame these troubles. The early girder rails laid about 1880 usually weighed from 70 to 80 lb per lineal yard, and were 6 or 6½ in. deep. The groove varied from 1 to 1¼ in., and the tread was about 1¾ in. in width. The fish-plates were not designed to give any vertical support, and were merely used to keep the rail ends in line. The girder rails were either bedded directly on the foundation or spiked to timber sleepers which were buried in the concrete.

The form of head adopted for tramway rails in Europe has almost universally been one with the groove on one side. With this section the wheel flange forces out the dirt clear of the tread. In a few isolated cases a centre grooved rail has been used. As with railways, the adoption of many different gauges has led to much inconvenience. This want of uniformity in the gauge is in some parts of the country a great obstacle to the construction of inter-urban lines. London and the larger provincial towns adopted the standard gauge of 4 ft. 8½ in., but in many towns narrow gauges of 3 ft. or 3 ft. 6 in. were laid. Glasgow and a few other towns adopted the gauge of 4 ft. 7¾ in. with a view of making the narrow grooved rail of the tramways available for railway wagons, but without any real success.

With the introduction of electric traction the weight and speed of the cars greatly increased, and experience soon proved that only the most substantial form of permanent way was capable of withstanding the wear and tear of the traffic. The early electric lines were laid with girder rails weighing about 75 lb per lineal yard. These proved to be too light, and, at the present time, rails weighing from 95 to 110 lb per lineal yard are in general use. The large number of rail sections designed a few years ago gave considerable trouble to makers of rails. The issue in 1903 by the Engineering Standards Committee of a set of standard girder tramway rail sections was therefore generally welcomed. The sections comprise rails of five different weights. Modified sections for use on curves were also published, together with a standard form of specification. Fig. 4 shows the section of the 100 lb. B.S. rail (No. 3).

Tramway rails are generally ordered in 45 ft. lengths. Rails 60 ft. long are sometimes used, but they are difficult to handle, especially in narrow streets. The rail joints still prove the weakest part of the track. Numerous patents have been taken out for fish-plates and sole-plates of special design, but none has proved quite satisfactory. The "Dicker" joint, in which the head of the rail on the tread side is partly cut away and the fish-plate carried up so that the wheel runs on its top edge, and the "anchor" joint, in which a short piece of inverted rail is bolted or riveted to the undersides of the abutting rails, have been largely used. The latter makes a good stiff joint, but when buried in concrete it interferes with the bedding of the rail as a whole, often causing it to work loose in the centre. Various processes have also been introduced for uniting the ends of the rails by welding. Electric welding was first tried in the United States about 1893, and has since been considerably used in that country. In this process two specially prepared fish-plates are applied, one to each side of the joint. Each fish-plate has three bosses or projections, one in the centre opposite the joint and one near each end. By passing a heavy alternating current of low voltage between the opposite bosses the fish-plates are welded to the rail. The current is obtained from the line by means of a motor-generator and static transformer. Another process which has been used considerably in the United States, and at Coventry and Norwich in England, is the cast-welded joint. To make this joint the rail ends are enclosed in an iron mould filled with molten cast-iron, which makes a more or less perfect union with the steel rails. The



(Reproduced by permission of the Engineering Standards Committee.)

FIG. 4.—British Standard Tramway Rail, No. 3.

great drawback to these two processes is the costly and cumbersome apparatus required. The "thermit" process (see WELDING) does not require any large initial outlay, and has been applied to welding the joints on both old and new tracks. The cost of making each joint is about £1.

Points and crossings are used on a tramway to deflect a car from one road to another. In the days of horse traction no movable switch was used, the car being guided by making the horses pull the leading wheels in the required direction. With the introduction of mechanical traction a movable switch was fitted in one of the castings to act as a guide to the wheel flanges. On modern tramways the points consist of a pair of steel castings, one being a fixed or dummy point, and the other containing a movable switch. On a single track at passing places the cars in Great Britain always take the left-hand road, and a spring is fitted to hold the movable switch to lead in that direction. The bottom of the grooves at open points and crossings are raised so that the car wheel runs on its flange over the break in the tread of the rail. Double switch points in which the two tongues are connected are sometimes laid. In recent years the size and weight of the castings and the length of the movable switches have considerably increased. Manganese steel is very generally used for the tongues and sometimes for the whole casting. Ordinary cast steel with manganese steel inset pieces at the parts which wear most quickly are a feature of the later designs. At some junctions the points are moved by electric power.

While the form of concrete foundation remains the same as that laid at Liverpool in 1868, far greater care is now given to the bedding of the rails. After the excavation has been completed the rails are set up in the trench and carefully packed up to the finished level. The concrete is then laid and packed under the rail, generally for a depth of 6 in. When the surface is to be paved with stone setts bedded on sand the concrete may be left rough, but where wood is to be laid the surface must be floated with fine mortar and finished to a smooth surface. Both hard and soft wood blocks are used for paving. Wood should not be used unless the whole width of the carriage-way is paved. Many different qualities of stone setts have been laid. Hard granite such as that supplied from the quarries near Aberdeen is the most suitable.

In urban districts the road authorities almost always require the tramway surface, *i.e.* between the rails and for 18 in. on either side, to be paved. In country districts many tramways have been laid with only a sett edging along each rail, the remainder of the surface being completed with either ordinary or tarred macadam. This construction, however, is only suitable on roads with very light traffic. After a tramway is laid, especially in a macadamized road, the heavy vehicular traffic use the track, and the wear is very much greater than on other parts of the carriage-way.

Steam and Cable Tramways.—Horse traction, especially in hilly districts, has many limitations, and early in the history of tramways experiments were made both with steam cars and cable haulage. Although experimental steam cars were tried in England in 1873 the first tramways which regularly employed steam engines were French, though the engines were supplied by an English firm. About 1880 many improvements were made in the design of the engines employed, and this form of traction was adopted on several tramways in England. Beyond requiring a better constructed track it does not necessitate any modifications in the general design of the permanent way. The first cable tramway was constructed at San Francisco in 1873. In England the first cable system was a short length at Highgate in 1884. Cable tramways were also laid down at Edinburgh, Birmingham, Matlock and Brixton (London). Cable traction, with the expensive track construction it necessitates, and the limited speed of haulage, belongs to the past. Only gradients too severe to be worked by ordinary adhesion will in the future justify its use. The construction of the conduit or tube in which the cable runs adds very considerably to the cost of the permanent way. On the Edinburgh system the conduit was formed of concrete, with cast-iron yokes spaced at intervals of 4 ft. to support the slot beams. The conduit was 19 in. deep by 9 in. wide. The slot was ¾ in. wide. The running rails were of the ordinary girder type bedded in concrete. Fig. 5 shows a cross-section of the track at a yoke. This form of construction is very similar to that employed in forming the tube on a modern electric conduit tramway. At Edinburgh and other places where a shallow conduit is used the supporting pulleys are placed in pits sunk below the general level of the tube. On the Birmingham cable tramway, where the tube is 2 ft. 8 in. deep, pits are not required at the supporting pulleys. This reduces the difficulty of draining the conduit. The yokes in this case are made of steel T-bars spaced 4 ft. apart.

Electric Tramways.—Electricity is now the standard motive power for tramway service, and is applied in three main ways: (1) the overhead or trolley system; (2) the open conduit system; and (3) the surface contact or closed conduit system. (See also TRACTION.)

Overhead Trolley.

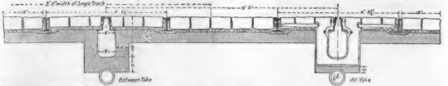
On a tramway worked on the overhead principle current is supplied to the cars by two overhead conductors or wires. Round copper wires varying in size from 0 (0·324 in.) to 0000 (0·40 in.) S.W. gauge are generally used. With feeding points at every mile, the 0 wire is electrically sufficient on most roads, but from a mechanical point of view 00 wire is the smallest it is desirable to erect. Wires having figure 8 or elliptical grooved sections have been employed, and have the advantage of allowing the use of a mechanical clip ear which is clear of the trolley wheel. The ordinary round wire is usually supported by a gun-metal or gun-metal and iron ear grooved to fit the wire, which is soldered or sweated to it. In Great Britain the overhead conductors are required by the board of trade to be divided into half-mile sections. The wires on adjoining sections are connected by section insulators. These consist of gun-metal castings in two parts, insulated from each other. The line wires are clamped to the metal ends. The continuity of the path of the trolley wheel is provided for on the underside of the insulator by fixing a hardwood strip between the ends or by the ribs on the castings with air gaps.

The trolley wires are supported by ears either from span wires which extend across the roadway between two poles or from bracket arms carried on a pole on one side only of the road. The span wires and short bracket suspension wires are also insulated, so that there is double insulation between the conductor and the pole. The overhead conductors are usually hung about 21 ft. above the rails. (For catenary suspensions see TRACTION.) The poles which carry the span wires and the bracket arms are placed not more than 40 yds. apart and are generally placed at the edge of the kerb. They are built up of three sections of steel tubes, one overlapping the other; the joints are shrunk together while hot. A cast-iron case is used to improve the appearance of the pole, and cast-iron collars hide the joints. Standard specifications for poles have been issued by the Engineering Standards Committee.

When permission can be obtained the span wires are sometimes supported by rosettes attached to the walls of the houses on either side of the street. This method has been largely adopted in Germany, and by dispensing with the poles in the roadway it improves the appearance of the street.

Open Conduit.

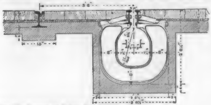
Overhead conductors will not be tolerated in some cities, and to avoid the use of them open conduit and surface contact tramways have been introduced. In the conduit system the conductors are carried in a conduit or tube beneath the surface of the track, and the electric current is picked up by means of a plough carried by the cars. Modern conduit tramways are divided into two kinds: those which have the conduit at the side under one running rail, and those which have it under the centre of the track. The only example of the former to be found in England is at Bournemouth, but it is used at Vienna, Brussels, Paris, Berlin and Budapest. Centre conduit construction has been adopted in London, Nice, Bordeaux, New York, Washington, &c. The advantages of the side slot system are the reduction in the amount of metal



(From T. Aitall's *Permanent Way for Tramways and Street Railways*, by permission of *The Railway Engineer*.)

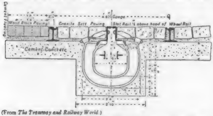
FIG. 5.—Section Edinburgh Cable Conduit.

in the roadway, less breaking up of the pavement, and slightly cheaper cost of construction. Its chief disadvantage is the difficulty it introduces in connexion with points and crossings. It is also objected that if the side slot is made the same width as the rail groove it becomes a danger to narrow-tired vehicles. The difficulty in regard to points and crossings is overcome by bringing the slot into the centre of the track at junctions and turn-outs. Fig. 6 shows a section of the side slot track laid at Bournemouth. The width of the slot is 1 in., which is the least width possible. In London ¾ in. was first adopted as the width of the centre slot, but later this was increased to 1 in., so that in this particular there is not much to choose between the two systems. Fig. 7 shows a section of the London County Council track at one of the cast-iron yokes. These are spaced 3 ft. 9 in. apart, every second yoke being now continued out under the running rail which is fastened to it. There is no doubt that the extended yoke greatly increases the strength of the track. The slot beams weigh 60 lb per yard. The conductor bars are of mild steel, T-shaped. They weigh 22 lb per yard and are supported on insulators at intervals of 15 ft. Each insulator is covered over in the roadway with a cast-iron frame and movable lid. There are two conductor rails—positive and negative—so that the whole circuit is insulated from earth. The conduit or tube is formed of cement concrete. The track between the rails is paved with granite setts in order that there may be no trouble with wood blocks swelling and closing the slot.



(From *The Tramway and Railway World.*)

FIG. 6.—Section of Side Conduit.



(From *The Tramway and Railway World.*)

FIG. 7.—Section of Centre Conduit (London County Council type).

American practice in conduit construction has become fairly well standardized (fig. 8). The conduit is oval in shape, its major axis being vertical, and is formed of concrete. An excavation about 30 in. deep and 5 ft. wide is made, and in this are laid cast-iron yokes weighing 410 lb each, and spaced 5 ft. apart centre to centre. Every third yoke contains bearings for a hand-hole plate, and weighs about 600 lb. These yokes surround the conduit proper and are provided with extensions on each side for the attachment of the rails. In the older construction the rails were laid directly upon the iron of the yokes, steel wedges and shims being used under them for the final alinement of the rails. In the more recent construction, on the Third Avenue railroad in New York City, a wooden stringer, 6 in. by 4½ in. in size, is laid along from yoke to yoke on the bearing surfaces, and the rail laid upon this. The rail is held down on the yoke by means of two bolts at each bearing-point, these bolts having turned-up heads which embrace the foot of the rail. The slot rails, or Z bars forming the two jaws of the ¾ in. slot, are bolted to the upper part of the yokes. The weights of the metal used per linear yard of construction of this type are: castiron, including both types of yokes, 500 lb; track rails, 214 lb; slot rails, 116 lb; conductor rails, 42 lb; and conduit plate, 16 lb—nearly 400 lb of rolled steel per yard. After the rails, which are of a high girder type, are fastened in place thin plates of sheet steel are bent into the oval holes in the yokes extending from yoke to yoke, and form the inner surface of the completed conduit. Around this is carefully laid a shell, 4 in. thick, of Portland cement concrete. The yokes are furnished with lugs which serve to retain, temporarily, wooden boards forming a mould in which the concrete is rammed. Sectional wooden shapes serve to hold the thin steel lining in place while the concrete is hardening. Around this concrete tube, and on each side of it, to form a basis for the street pavement, is laid a mass of coarser concrete. In each side of the special yokes is placed an insulator of porcelain, protected by a cast-iron shell and carrying a support for the conductor rail, which is of T-shaped steel, weighing 21 lb per yard. It is in 30 ft. lengths and is supported every 15 ft. by the insulators, the ends of separate rails being matched at and held by an insulator support. This rail is, of course, bonded with copper bonds. Two such conductor rails are installed in the conduit 6 in. apart, the flat faces corresponding to the upper surface of the T being placed towards each other. Elaborate provisions for drainage and inspection are also provided, depending upon the situation of the tracks and nature of the street. The current is fed to the conductor rails by heavy copper conductors of from 500,000 to 1,000,000 circular mils cross-section, insulated and lead-covered, laid in ducts alongside of or between the two tracks of double-track systems. Connexion is

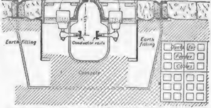
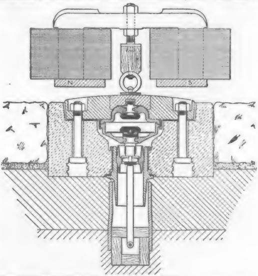


FIG. 8.—Cross-section of Open Conduit Road (American type).



(From J. H. Rider's *Electric Traction*, by permission of Whittaker & Co.)

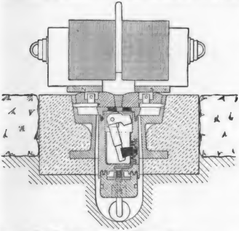
FIG. 9.—Cross-section of Stud, Skates and Magnets. Lorain System.

made between the cars and the conductor rails by means of a "plough," carried by a hard steel plate, which is channelled to receive the insulated wires leading up to the controller on the car. The plough carries two cast-iron rubbing-blocks, which are pressed outward into contact with the conductor rails by springs, the two being, of course, very carefully insulated from each other and from the other metal-work of the plough. It has been found expedient in practice to reverse the polarity of the current used on these conduit roads from time to time, since electrolytic deposits, formed by small leakage currents in the vicinity of insulators, &c., are thus dissolved before they become a source of trouble.

Great difficulty is experienced with all conduits in keeping them clean and free from water. On the London tramways a sump has been formed at intervals of about 60 yds. into which the conduit drains. These sumps are connected with the sewers. The principal objection to the conduit system is its heavy first cost. The tracks alone in London are estimated to cost about £13,000 per mile of single track against about £8000 per mile for a track to be worked on the overhead system.

Surface Contact.

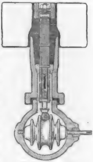
This high cost of construction has caused considerable attention to be directed by inventors to devising surface contact systems. Many of the designs which have been patented appear excellent in theory, but have been found untrustworthy under working conditions. Among those worked commercially in England are (1) the Lorain system in operation at Wolverhampton; (2) the Dolter system at Torquay, Hastings and Mexborough, and (3) the G.B. system at Lincoln. Of all these systems current is supplied from iron studs laid in the roadway between the rails of the track to a skate carried on the car. The studs are placed 10 ft. to 15 ft. apart and contain a movable switch or contact, which is operated by the influence of a magnet carried under the car. In the Lorain system (fig. 9) connexion is made to the source of power through two carbon contact pieces. The lower carbon contact is carried on a soft iron strip which is connected to the supply cable by means of a flat copper ribbon spring. When the magnet passes from over a stud the iron armature and the lower carbon contact, which has been magnetically attracted, falls vertically, assisted by the copper ribbon spring. In the Dolter system the contact box (fig. 10) contains a bell crank lever with a carbon contact at its lower end. The upper arm of this lever is of soft iron, which is attracted by the magnet carried under the car. When the lever is moved the carbon block at the lower end is brought into contact with the fixed carbon contact in the side of the box which is permanently connected to the supply cable. In the G.B. contact box (fig. 11) contact is made direct to a bare feeder cable carried in a pipe under the boxes. The switch, consisting of a piece of galvanized iron, is suspended freely by means of an insulated phosphor bronze spring. At the lower end of this moving piece a carbon contact piece is attached. When the magnet carried by the car passes over a stud, the moving piece is magnetically attracted to the cable against the pull of the spring. In the Lorain and the Dolter systems the studs are raised slightly above the road surface—which is an objectionable feature—and the current is collected by a skate, suspended under the car, touching the projecting surface. In the G.B. system the stud heads are kept flush with the pavement, and the collector consists of iron links spring suspended. As the collector passes over the box the links are magnetically attracted, and move down, making contact with the stud.



(From J. H. Rider's *Electric Traction*, by permission of Whittaker & Co.)

FIG. 10.—Cross-section of Stud, Skates and Magnets. Dolter System.

In all surface contact systems, short circuiting devices are provided to detect any studs which may remain live after the skate has passed, either by blowing a fuse or by ringing a bell, but it is questionable how much reliance can be placed on their efficiency under all conditions. The collecting skate and magnets carried by the cars on a surface contact tramway are of considerable weight, and the skate requires renewal at frequent intervals.



(From *The Tramway and Railway World.*)

FIG. 11.—G. B. Stud.

An efficient system of street traction may be defined as one which, while giving a reasonable return on the capital invested, provides the public, without disfigurement of the highway, with a quick and frequent service of comfortable cars.

Advantages of Different Systems.

When tramways were first introduced the surface of the streets was often exceedingly rough. The tramcar running on rails was therefore a great advance in comfort of travelling on the old stage carriage. Horse traction, however, limited the weight of the car and the speed of travelling. The substitution of steam traction for horse traction was a great advance. Higher speeds and quicker acceleration were obtained, and larger and more comfortable cars could be worked. The power, however, was limited, and the locomotives, built as light as possible, were expensive in first cost and maintenance. Cable traction, owing to the heavy first cost of the track, requires a great density of traffic to make it pay. The speed is limited both up and down hill to that of the cable. It has the advantage that it can be safely worked on severe gradients, and once installed the working costs are low.

Electric traction by accumulator cars was tried in Birmingham in 1890 and abandoned after some years of unsatisfactory working. The cars were costly to work and maintain. The storage batteries had to be recharged at frequent intervals, and they rapidly dropped in capacity. There was little reserve of power, and the cells added considerably to the weight of the car.

Those forms of electric traction in which the power is supplied to the cars from an outside source have many advantages. Only the weight of the motors has to be carried. These are efficient over a wide range of speed, accelerate quickly, have a large reserve of power and are clean and silent. The electric conduit and surface contact tramways do not require any disfiguring overhead wires. They have, however, troubles of their own. The construction of the electric conduit is so expensive that its choice must necessarily be limited to large cities. The conductors are easily short-circuited. Gaps in the conductors must be left at the points and crossings. The cost of keeping the conduit clean is considerable. It has the advantage, however, of having both the positive and negative conductors insulated. Surface contact systems require studs or contact boxes to be placed in the road. In most systems these project above the surface of the street. The switches which they contain are hidden away from inspection. A failure of insulation or the sticking of a switch may allow a live stud to be unprotected in the roadway. The weight of the car and consequently the power required to move it is considerably increased by the skate, magnet and battery which have to be carried.

For simplicity of working the overhead system easily comes first. The conductors are out of reach, they can easily be doubly or trebly insulated, and with their insulators are open to inspection. The poles and wiring can be erected without closing or obstructing the street. The supply of power is not interfered with by heavy rain, snow or other climatic causes. Duplicate conductors are used, and repairs can be rapidly executed. The only objection is that of unsightliness, which, however, can be greatly reduced by good design.

The cost of establishing tramways to be worked on the various systems of traction mentioned above has varied considerably. The locality and the amount of street widening have considerable influence on the total. Horse tramways in the larger cities cost in the past about £15,000[1] per track mile complete with horses, cars, &c., tramways worked by steam power about £18,000[2] per track mile including locomotives and cars. The Edinburgh Corporation cable tramways cost £23,316[3] to establish complete with power-house, cars, &c. Of this figure, the cost of the permanent way construction amounted to £14,431.[3] The construction and equipment of the South London conduit tramways cost £25,106[4] per mile of single line; the permanent way, its electrical equipment and the distributing cables cost £15,895[4] per track mile. More recent estimates appear to show that the average cost in London will be between £26,000 and £30,000 per track mile. In Glasgow the total cost of constructing and equipping the electric tramways on the overhead system, including the provision of a power station, cost £19,787[5] per track mile, and at Leeds £13,206. At Manchester, where current is provided by the lighting station, the complete cost works out at £12,498.[5] The cost of the permanent way, cables and electrical equipment per track mile varies from £6575 at Manchester to £9959 at Glasgow. The cost of laying down a surface contact electric tramway is about slightly more than that of constructing and equipping a track with overhead conductors. The cost of the permanent way and its electrical equipment together with the cables at Wolverhampton on the Lorain surface contact principle amounted to £8601 per track mile.

The working expenses of the various systems of traction are largely affected by the age of the tramway, the locality, and, in the case of electric lines, by the cost at which power is obtained. In Birmingham in 1890–1891[6] horse traction cost 9·79d. per car mile, steam traction 10·99d. per mile, cable traction 6·33d. and electric accumulator traction 9·90d. per car mile. Modern electric trolley lines generating their own current work at from 5d. to 6d. per car mile. Where current is purchased the costs vary from 6d. to 7½d. per car mile. The working costs of the London County Council conduit tramways worked on purchased current amounted to 8·02d. per car mile in the year 1905–1906.

Tramway Cars.—The modern tramway car is made up of two distinct parts, the body and the truck. The present type of double ended car with a platform at each end was first used on the American street railways about 1860. The car body was supported directly on axle-boxes through helical steel or rubber springs.

When the early pioneers were experimenting in the United States with electric traction they attached the motor to the car body. This proved unsatisfactory, and resulted in the development of the modern truck. The truck may be described as a carriage or frame supported on the axle-boxes by springs and supporting by another set of springs the car body. The truck carries the motors and in itself resists all the strains of the driving mechanism.

Modern car bodies are mounted either on a single four-wheeled truck, with a fixed or rigid wheel-base, or on two four-wheeled bogies or swivelling trucks. Four-wheeled radial trucks have been tried on several tramways, but they have not proved satisfactory. The wheel-base of the fixed or rigid truck usually varies from 6 to 7 ft. The length of the wheel-base should be determined by the radius of the sharpest curve. To obtain steady running it should be made as long as possible. Two motors are generally fitted on a car.

Of the bogie or swivelling trucks the greater number now in use are of the "maximum traction" type. This truck is used to obtain the greatest tractive effect from two motors when fitted to a car supported on eight wheels. Each bogie is a small four-wheeled truck in itself. It has one pair of its wheels driven by the single motor and of the standard size—about 30 in.—while the guiding or "pony" wheels are of small diameter. The weight of the car body is supported eccentrically on the truck, so that about 70% to 80% is available for adhesion under the driving-wheels. While this form of truck has many merits, it also has many disadvantages. The small wheels easily leave the rails, while the adhesion of the driving-wheels compared with a four-wheeled car is considerably reduced. Quick acceleration is difficult, and on a greasy rail much energy is lost in slipping. The use of equal-wheeled bogies with a motor on every axle gets over the difficulty of the loss of adhesion but at a greatly increased cost. The current consumption is increased, the first cost is greater, and there are four instead of two motors to be maintained. Steel-tired wheels have largely replaced the cast-iron chilled wheel for many years used on tramcars.

While the various forms of trucks are common both to British and American practice, car body construction differs in many points. The single-deck car is universal outside the United Kingdom, where, although many single-deck cars are worked, the greater number are of the double-deck type. It is claimed that with small single-deck cars a quicker service can be maintained, as they are easier to load and unload and generally handier. On the other hand, the double-deck car seats more than double the number of passengers, requires the same number of men to work it, and takes but little more power to drive it. Experience has proved that the 58-passenger—28 inside and 30 outside—double-deck car mounted on a four-wheeled truck is the type of rolling stock most suitable for British conditions. For heavy rush traffic or long distance travel the larger bogie cars are convenient. They are, however, slow to start and stop, and a 72-passenger car is too much for one conductor to work efficiently. Another difference is due to the width of the cars. In the United States car bodies vary from 8 ft. to 9 ft. 6 in. in width. In Great Britain the width is limited by the Tramways Act of 1870 to 11 in. beyond the outer edge of the wheels, which, on the standard gauge, allows the maximum width to be 6 ft. 10 in. This limit has governed the arrangement of the seating in the cars. Inside, the ordinary side seat is almost invariably adopted. Cross seats have been used, but they leave a very narrow gangway—a great disadvantage at times of overcrowding. On the top deck, where the available width is greater and standing is never permitted, cross seats are universally fitted.

On the old horse cars a straight type of stairway was used. The reserved stairway, brought in about 1902, gave greater protection from accident and increased the seating accommodation on the top deck. It had, however, two great disadvantages. The stairway shut out the motorman's view on the left-hand side, and the stream of passengers descending met the stream of passengers leaving the inside of the car, causing delay. The reversed type of stairway has now been abandoned and the straight type, well protected by railings, is usually fitted.

In addition to the ordinary single-deck and double-deck types of cars which are in general use many other designs are to be found. Single-deck open cars of the "toast-rack" type with transverse seats are popular on many holiday lines. They have the advantage of being quickly filled and emptied. Centre vestibule cars are now seldom seen. It is inconvenient not to have the conductor at the back of the car where he can look out for passengers, and, if necessary, "nurse" the trolley. There is also danger of a passenger being struck by the axle-boxes of the rear bogie truck when leaving the car. The Californian type of car body, with the central part closed in and one or two double-sided transverse seats at each end, has been used on routes where low bridges do not allow of the use of double-deck cars. The carrying capacity of this type in wet weather when the exposed seats cannot be used is small. A demi or one-man car has been worked in some towns. It saves the wages of one man, but the average speed of the service is reduced. Top deck covers have in recent years been largely fitted. Their use practically doubles the covered seating capacity of the car and provides accommodation for smokers, a difficult matter on a single-deck car.

In Great Britain the board of trade requires all cars to be fitted with an efficient form of lifeguard. The gate and tray pattern, in which anything striking the vertical gate drops the tray, is that principally employed. In addition to the ordinary hand-brake which operates shoes on all the wheels, and the electric reverse switch, a large number of cars are fitted with some form of electric brake (see TRACTION).

Legislative Conditions in Great Britain.—The first tramways constructed in Great Britain were promoted by private enterprise under powers conferred by private acts of parliament. Considerable opposition was offered to pioneer schemes, but after a few private acts had been passed, parliament, in 1870, passed a general act providing for the laying of rails upon roads, and specifying the procedure for tramway promotion and the main relations between tramway undertakers and local authorities. The Tramways Act 1870, which is still in force, enabled promoters to apply to the board of trade for a provisional order which, when confirmed by parliament, possesses all the force of an act of parliament. The procedure is therefore simpler and cheaper than private bill procedure. Under this act promoters are obliged to obtain, as a condition precedent to making application for a provisional order, the consent of local authorities in whose areas the proposed tramways are to run. This provision is referred to as the "veto clause." Where a line is laid in two or more districts and two-thirds of the line are in districts where the local authorities do consent, the board of trade may dispense with the consent of the remainder. When procedure by private bill is adopted a similar "veto" provision is made by Standing Order 22, which requires the consent of the local authority (and of the road authority where there is one distinct from the local authority) before the bill goes to first reading; in this case also the consent of authorities for two-thirds of a continuous line are deemed sufficient. The powers granted under the Tramways Act are in perpetuity, subject to the right of the local authorities (under the 43rd section) to purchase, at the end of twenty-one years or each septennial period following (or within three months after the promoters have discontinued working the tramway or have become insolvent), so much of the undertaking as lies within their areas, on paying the then value of the properties suitable to and used for the undertaking, exclusive of any allowance for past or future profits or compensation for compulsory sale or any other consideration whatsoever, such value to be determined by an arbitrator appointed by the board of trade. Another part of the arrangement specified between the local authorities and the undertakers is that the undertakers shall pave the tramway track between the outer rails and for 18 in. beyond each outer rail. Mr G. F. Shaw-Lefevre (afterwards Lord Eversley), when introducing the bill in 1870, said that it "would give powers to the local authorities to construct tramways, but not, of course, to work them." The idea apparently was that local authorities should retain full control of the roads by constructing the tramways, and would make arrangements with lessees on terms which would secure reasonable fares and other conditions for the benefit of the travelling public. It was not until 1896 that parliament permitted local authorities to work tramways as well as own them, except in cases where lessees could not be obtained. The precedents for municipal working were created by private acts at a time when public opinion was in favour of that policy; and after the first few bills for municipal tramway working had been successful, other municipalities found practically no difficulty in obtaining the desired powers, although parliament had never adequately discussed, as a specific reform, the departure from the principle laid down by Mr Shaw-Lefevre in 1870. The conditions in fact proved more favourable to municipal than company promoters, since the local authorities, as soon as they aspired to work tramways as well as own them, used the power of veto against the proposals of companies.

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[1] and [2] See *Tramways: Their Construction and Working*, by D. K. Clarke.

[3] *Proc. Inst. Civ. Eng.* 156, p. 179.

[4] Tramway Accounts, year ended March 31, 1906.

[5] Ibid., year ended March 31, 1905.

[6] See *Tramways: Their Construction and Working*, by D. K. Clarke.

The situation entered a more acute phase when electric traction was introduced on tramways. The Tramways Act provides, by section 34, that all carriages shall be moved by the power prescribed by the special acts or provisional order, and where no such power is prescribed, by animal power only. The mechanical power used must be by consent of the board of trade, and subject to board of trade regulations. Owing to the capital expenditure involved in electric traction, undertakings nearing the end of their twenty-one years' tenure found that it was not commercially feasible to carry out the change without an extension of tenure. The local authorities were reluctant to grant that extension, and they were also reluctant to give permission for the promotion of new lines.

The difficulties of the altered conditions created by the advent of electric traction were met to some extent by the Light Railways Act 1896. This act contains no definition of a light railway, and it has been used largely for electric tramway purposes. Lord Morley, when piloting the bill through the Lords, said that "light railway" includes "not merely all tramways but any railway which the board of trade thinks may justly be brought within the scope." It certainly includes tramways in towns, and it might include large trunk lines throughout the country." Accordingly it has been used for the construction of many miles of tram lines on the public streets and also in some cases for extensions where the track leaves the public road, and is laid on land purchased for the purpose. These tracks are generally constructed with grooved girder rails, having a wide groove and a high check, so that the shallow flanged tramcar wheels can run on them with safety at high speeds. The rails are laid on cross sleepers and ballasted in the ordinary railway fashion. Fencing is erected, but level-crossing gates are often omitted, and cattle guards only are used to prevent animals straying on the track. These sleeper tracks on private ground are cheap to maintain if well constructed in the first instance. Speeds of 20 to 25 m. an hour have been sanctioned on electric lines of this character, worked by ordinary tramway rolling stock. There is no purchase clause in the Light Railways Act, but arrangements for purchase of the undertaking were usually made with the local authorities and the terms embodied in the order. The act contains no veto clause, section 7 stating that the commissioners are to "satisfy themselves that all reasonable steps have been taken for consulting the local authorities, including road authorities, through whose areas the railway is intended to pass, and the owners and occupiers of the land it is proposed to take." The Light Railway Commissioners, however, have interpreted the act in the spirit of the Tramways Act, so that for all practical purposes the veto remains. The new act differed from the Tramways Act in providing for the compulsory purchase of land under the Lands Clauses Acts—the Tramways Act expressly stating that the promoters should not be empowered to acquire land otherwise than by agreement. The board of trade has held that the act does not apply to tramways wholly within one borough. County, borough and district councils as well as individuals and companies are empowered to promote and work light railways.

The passing of the act gave a great impetus to the construction of tramways worked by electric traction. But owing to the practical retention of the veto, there was not so much progress as was anticipated. Another cause of restriction was section 9, sub-section 3, which provides that if the board of trade considers that "by reason of the magnitude of the proposed undertaking, or of the effect thereof on the undertaking of any railway company existing at the time, or for any other special reason relating to the undertaking, the proposals of the promoters ought to be submitted to parliament," they should not confirm the order. In many cases railway companies, by pleading the competitive influence of proposed tramways promoted under the Light Railways Act, were able to force the promoters to apply to parliament or to drop the scheme. The latter alternative was frequently adopted, owing to the costs of parliamentary procedure being too heavy for the undertaking.

Commercial Results.—Interest in the commercial results of tramway enterprise is practically limited to electric traction, since other forms of traction have been almost entirely superseded owing to their economical inferiority. The main advantages of electric traction over horse traction lie in the higher speed, greater carrying capacity of cars, and the saving in power over a system in which only a small proportion of the power source is available at one time. Steam, compressed air and gas traction possess the disadvantages that each car has to carry the dead weight of power-producing machinery capable of maintaining speed up to the maximum grade. Cable traction has the disadvantages that the speed of the cars is limited by the speed of the cable, that the range and complexity of the system are restricted, and that construction is expensive. The electric system, in which power is generated at a central source and distributed to cars which take power in proportion to the work being done, possesses a higher degree of flexibility, convenience and economy than any other system. Electric tramways in Great Britain are mostly equipped on the overhead trolley system, though the conduit and the surface contact systems have been installed in a few instances. Roughly the capital expenditure required for the three systems is in proportion of 2, 1½ and 1, and both the conduit and the surface contact systems are more costly to maintain than the overhead system. A fourth system of electric traction, in which the cars are fitted with storage batteries charged at intervals, has been tried frequently and as frequently abandoned. The great weight of the batteries, the serious initial cost and high rate of deterioration prevented the attainment of financial success.

The earliest development of electric road traction on a large scale took place in America and on the continent of Europe, and the estimates for British tramways were therefore prepared from American and continental results. The following figures summarize a number of estimates made at this period; the first table gives the figures for capital cost, and the second for operating expenses. The receipts were estimated at 10d per car mile.

	Capital cost per mile of single track.
	£
Permanent way, including bonding	5050
Overhead equipment	750
Feeder cables	400
Cars at £700 each	2100
Car sheds, sundries and contingencies	1200
Total	£9500

Operating expenses per car mile.

Electrical energy	1·50d.
Wages of drivers and conductors	1·10
Car shed expenses, wages and stores	0·55
General expenses	0·90
Repairs and maintenance	1·25
Total	5·30d.

The estimates gave reason to expect that electric traction would mean cheaper fares and more frequent services at a higher speed, resulting in a considerable increase in traffic receipts per mile and a substantial reduction of working expenses. The result of pioneer undertakings in South Staffordshire, Bristol and Coventry supported this expectation. Later experience, however, showed that the estimates were too optimistic. Taking the actual figures realized for the undertakings included in the above tables, the capital expenditure per mile of single track was £12,000 and the working expenses per car mile 6·3d. The expectations as to gross revenue have been generally realized, but the increase in capital expenditure and working expenses over the estimates is typical of electric tramways in Great Britain. In the matter of wear and tear the estimates have also been too low. The reasons for the larger capital expenditure are (1) superior track construction, (2) more elaborate overhead equipment, (3) use of larger cars, (4) higher cost of road paving and other improvements imposed upon tramway undertakings.

According to the official returns of tramways and light railways for the year 1905–1906, there were 312 tramway undertakings in the United Kingdom, and 175 of these belonged to local authorities. Out of the total of 1491 m. of line owned by local authorities, 1276 m. are worked by these authorities themselves, and the remaining 215 m. by leasing companies. Local authorities working as well as owning their tramways made a net profit of £2,529,752, applying £663,336 to the reduction of tramway debt and £205,981 to the relief of rates, while carrying £623,617 to reserve and renewal funds. The following table summarizes the amounts expended by local authorities on electric traction:—

Year.	Municipalities.	£
1900	11	1,169,429
1901	18	2,748,873
1902	47	10,519,543
1903	61	14,644,126
1904	92	21,295,771
1905	115	27,876,320
1906	131	31,147,824
1907	131	35,965,920

The corresponding table for electric traction companies (including electric railways), detailing the amounts and proportions of ordinary preference and loan and debenture capital, is as follows:—

Year.	Number of under-takings.	Ordinary capital.	Percent. to total.	Preference capital.	Percent. to total.	Loan and Debenture capital.	Percent. to total.	Total.
		£		£		£		£
1896	17	5,041,375	83	412,776	7	630,521	10	6,084,672
1897	30	6,584,147	88	124,850	2	727,176	10	7,436,173
1898–1899	51	9,793,234	68	1,640,780	11	2,972,126	21	14,406,140
1899–1900	66	11,770,777	60	3,834,761	20	4,033,992	20	19,639,530
1900–1901	75	14,558,076	55	5,904,998	23	5,686,785	22	26,149,859
1901–1902	125	19,748,965	50	9,748,891	24	10,024,327	26	39,522,183
1903	126	21,600,056	49	11,170,319	25	11,296,714	26	44,067,089
1904	156	33,491,604	54	13,219,487	22	14,895,418	24	61,606,509
1905	159	36,949,069	47	22,853,948	29	19,410,384	24	79,213,401
1906	170	38,130,981	41	25,206,988	27	29,522,581	32	92,860,550
1907	173	53,034,778	45	30,642,266	26	34,372,411	29	118,049,455

The financial results achieved by electric traction companies are summarized in the next table:—

Year.	Number of companies.	Aggregate capital.	Average ordinary capital.	Average preference capital.	Average loan and debenture capital.	Total average.
		£	%	%	%	%
1899–1900	24	9,056,332	3·87	5·56	4·64	4·37
1900–1901	37	15,021,137	4·27	5·53	4·57	4·65
1901–1902	62	28,322,117	4·07	4·44	4·53	4·29
1903	64	35,479,296	4·31	5·11	4·47	4·57
1904	77	48,789,525	4·13	4·81	4·53	4·41
1905	99	61,273,986	3·79	4·92	4·39	4·33
1906	117	77,202,373	3·47	4·81	4·18	4·13
1907	118	99,315,028	2·87	4·25	4·38	3·78 [1]

The total expenditure on tramways and light railways (omitting railways—main, branch and suburban) was £15,195,993 in 1896 and £58,177,832 in 1906.

One effect of the increased cost of expenditure per mile of track is to discourage extensions of rural and inter-urban lines where the traffic is not heavy. Proposals have been made to adopt the "railless trolley" (used in some places on the continent of Europe) for such extensions. In this system the cars run on ordinary wheels and take power from overhead trolley wires. But so far no such arrangement has been put into practice in Great Britain, and outlying districts are generally dealt with by petrol or steam motor vehicles, running as feeders to the tramways and railways. The future commercial development of tramways lies more in the economics in working than in growth of track mileage. Owing to the enormous volume of traffic a very slight alteration in one of the items of expense or revenue produces a large result in the aggregate. The addition of ½d. per car mile to revenue or a corresponding reduction in expenses would, on the 240 millions of car miles run in 1905–1906, result in a gain of about £500,000 per annum, which is equal to nearly 1% on the entire capital expenditure in respect of tramways and light railways. The tables given above show that the yield upon the capital invested in electric traction is not high. The effect of increased capital expenditure has been accentuated by reductions in fares. In 1886 the average fare per passenger was 1·61d. and in 1896 it was 1·31d., falling in 1906 as low as 1·10d. Some systems carry passengers over 2½ m. for one penny, workmen being carried twice the distance for the same sum. Halfpenny fares are represented as a boon to the working man, but they have been abandoned as a failure after several years' trial on several systems, and in Glasgow it is found that halfpenny fares contribute only 20·4% of the early morning traffic, while the penny fare contributes 72·3% of that traffic. The general manager of the Birmingham Corporation tramways reported against halfpenny fares on the basis of his experience as general manager of the London County Council tramways that all the halfpenny passengers there are carried at a loss. The adjustment of fares and stages to their proper value is a question now carefully studied by tramway managers along with many problems of economy in working. The close adjustment of the service to the fluctuations in traffic is one source of economy which is being more seriously considered. Many systems have adopted top covers to cars in order to carry more passengers during wet weather. The adoption of these covers is not popular in fine weather; it adds to the weight and wind-resistance of the cars, thus increasing current consumption, and it adds to the cost of construction and maintenance. Economy in electrical energy is, in its broader aspects, secured by purchasing current from an outside source in preference to generating it at a special station. The average cost per unit of electricity for all tramway undertakings in the United Kingdom is 1·06d., but one tramway company which purchases its energy from a large power company pays only 0·85d. per unit. In its narrower aspects economy in current may be secured by reducing waste car mileage—that is to say, eliminating the running of cars at times and places where they are not required for an adequate service. Saving may also be effected by supervision of the driving of the cars, since the difference of as much as 20% has been noted between different drivers. One tramway manager secured substantial improvement by merely marking on the trolley standards the position which the controller handle should occupy in passing each point. The limitation of stops is another source of economy, the average cost per stop on a system having been found to be 0·17d. A slight increase in the maximum speed of tramcars would also improve the net results by reducing the proportion of standing charges (wages, &c.) to the traffic capacity of the system without making the cost of maintenance or current more than slightly greater. A 15% increase in average speed means a saving of ½d. per car mile. The development of parcels traffic is a source of revenue, and additional receipts can be earned by the hiring-out of cars for picnics and other special purposes. An important point is the proper selection of the size of car. A small four-wheeled car is suitable to continual traffic of comparatively small volume, but when the traffic is heavy cars of larger capacity are advisable. A serious burden on tramways is the cost of insurance against accidents, although the number of serious accidents on electric tramways is exceedingly small in proportion to the number of passengers carried, the ratio of tramway accidents of all kinds being about one accident to every 15,000 passengers.

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[1] Average reduced owing to inclusion of Metropolitan and Metropolitan District railways' capital.

There are many adjoining towns having separate tramway undertakings which do not provide intercommunication. Experience has shown that a break of tramway facilities reduces the receipts by 20 to 50% on the lines which have been severed; and the terminal half-mile, except in populous districts, is the least remunerative section of a tramway route.

Statistics.—Each year the British board of trade issues a return of street and road tramways and light railways authorized by act or order, showing the amount of capital authorized, paid up and expended; the length of line authorized and the length open for public traffic; the gross receipts, working expenditures, net receipts and appropriation of net receipts; the number of passengers conveyed; the number of miles run by cars and the quantity of electrical energy used; together with the number of horses, engines and cars in use. The return published in January 1909 deals with the figures for local authorities up to the 31st of March 1908 and for companies up to the 31st of December 1907. The following comparative table summarizes the most important general figures for the United Kingdom provided by this official return:—

	Years ended June 30.				Year ending Dec. 31 (companies) and March 31 (local authorities).
	1878.	1886.	1898.	1902.	1907–1908
Total capital authorized	£6,586,111	£17,640,488	£24,435,427	£51,677,471	£91,305,439
Total capital expended	£4,207,350	£12,573,041	£16,492,869	£31,562,267	£68,199,918
Length of route open (miles)	269	865	1,064	1,484	2,464
Number of horses	9,222	24,535	38,777	24,120	5,288
Number of locomotive engines	14	452	589	388	64
Number of cars	1,124	3,440	5,335	7,752	10,908
Total number of passengers carried	146,001,223	384,157,524	858,485,524	1,394,452,983	2,625,532,895
Quantity of electrical energy used, B.O.T. units	—	—	—	—	431,969,119
Gross receipts	£1,099,271	£2,630,338	£4,560,126	£6,679,291	£12,439,625
Working expenditure	£868,315	£2,021,556	£3,507,895	£4,817,873	£7,792,663
Net receipts	£230,956	£608,782	£1,052,231	£1,861,418	£4,646,962

The total figures at the date of the return are summarized in the following table, which is accompanied by one showing the lengths of line worked by various methods of traction:—

	Capital expenditure on lines and works open for traffic.	Total expenditure on capital account.	Length open for traffic.						No. of undertakings.
			Double.		Single.		Total.		
	£	£	M.	Ch.	M.	Ch.	M.	Ch.	
Tramways and light railways belonging to local authorities	32,978,579	44,920,317	1113	77	505	77	1619	74	177
Tramways and light railways belonging to companies and private individuals	18,641,279[1]	23,279,601	408	58	435	46	844	24	128
Total United Kingdom	51,619,858	68,199,918	1522	55	941	43	2464	18	305

Table showing lengths worked by various methods of traction:—

Method of traction.	England and Scotland.				Ireland.		Total.	
	M.	Ch.	M.	Ch.	M.	Ch.	M.	Ch.
Electric	1922	66	235	35	127	69	2286	10
Steam	22	67	—	—	29	45	52	32
Cable	4	49	22	72	—	—	27	41
Gas motors	4	2	—	—	—	—	4	2
Horse	82	60	4	28	7	5	94	13
Total.	2037	4	262	55	164	39	2461	18

The following table gives a few totals, ratios, and percentages for the last two years of what may be called a period of electric traction, in comparison with a typical "steam" period (*i.e.* a period in which the use of steam power in tramways was at its maximum) and a typical "horse" period:—

	Electric period, 1907–1908.	Steam period, 1896.	Horse period, 1879.
Length of route open	2,464·22	1009	321·27
Total number of passengers carried	2,625,532,895	759,466,047	150,881,515
Percentage of net receipts to total capital outlay	6·81	6·88	3·97
Percentage of working expenditure to gross receipts	62·64	74·79	83·81
Passengers carried per mile of route open	1,065,462	752,691	469,641
Average fare per passenger	1·09d.	1·61d.	1·84d.

From the above figures it will be noticed that the capital cost per mile has increased as a result of the adoption of electric traction, while at the same time the percentage of the return on the capital has been reduced notwithstanding that the rate of working expenditure has fallen and the number of passengers carried per mile has increased, the fares charged having been disproportionately reduced.

(E. Ga.)

TRANCE (through the French, from Lat. *transitus*, from *transire*, to cross, pass over), a term used very loosely in popular speech to denote any kind of sleeplike state that seems to present obvious differences from normal sleep; in medical and scientific literature the meaning is but little better defined. In its original usage the word no doubt implied that the soul of the entranced person was temporarily withdrawn or passed away from the body, in accordance with the belief almost universally held by uncultured peoples in the possibility of such withdrawal. But the word is now commonly applied to a variety of sleeplike states without the implication of this theory; ordinary sleep-walking, extreme cases of melancholic lethargy and of anergic stupor, the deeper stages of hypnosis (see Hypnotism), the cataleptic state, the ecstasy of religious enthusiasts, the self-induced dream-like condition of the medicine-men, wizards or priests of many savage and barbarous peoples, and the abnormal state into which many of the mediums of modern spiritualistic seances seem to fall almost at will; all these are commonly spoken of as trance, or trance-like, states. There are no well-marked and characteristic physical symptoms of the trance state, though in many cases the pulse and respiration are slowed, and the reflexes diminished or abolished. The common feature which more than any other determines the application of the name seems to be a relative or complete temporary indifference to impressions made on the sense-organs, while yet the entranced person gives evidence in one way or another, either by the expression of his features, his attitudes and movements, his speech, or by subsequent relation of his experiences, that his condition is not one of simple quiescence or arrest of mental life, such as characterizes the state of normal deep sleep and the coma produced by defective cerebral circulation by toxic substances in the blood or by mechanical violence done to the brain.

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[1] These figures include cost of buildings and equipment in respect of certain local authorities' lines worked in conjunction with other lines.

If we refuse the name trance to ordinary sleep-walking, to normal dreaming, to catalepsy, to the hypnotic state and to stupor, there remain two different states that seem to have equal claims to the name; these may be called the ecstatic trance and the trance of mediumship respectively.

The ecstatic trance is usually characterized by an outward appearance of rapt, generally joyful, contemplation, the subject seems to lose touch for the time being with the world of things and persons about him, owing to the extreme concentration of his attention upon some image or train of imagery, which in most cases seems to assume an hallucinatory character (see HALLUCINATION). In most cases, though not in all, the subject remembers in returning to his normal state the nature of his ecstatic vision or other experience, of which a curiously frequent character is the radiance or sense of brilliant luminosity.

In the mediumistic trance the subject generally seems to fall into a profound sleep and to retain, on returning to his normal condition, no memory of any experience during the period of the trance. But in spite of the seeming unconsciousness of the subject, his movements, generally of speech or writing, express, either spontaneously or in response to verbal interrogation, intelligence and sometimes even great intellectual and emotional activity. In many cases the parts of the body not directly concerned in these expressions remain in a completely lethargic condition, the eyes being closed, the muscles of neck, trunk and limbs relaxed, and the breathing stertorous.

Trances of these two types seem to have occurred sporadically (occasionally almost epidemically) amongst almost all peoples in all ages. And everywhere popular thought has interpreted them in the same ways. In the ecstatic trance the soul is held to have transcended the bounds of space or time, and to have enjoyed a vision of some earthly event distant in space or time, or of some supernatural sphere or being. The mediumistic trance, on the other hand, popular thought interprets as due to the withdrawal of the soul from the body and the taking of its place, the taking possession of the body, by some other soul or spirit; for not infrequently the speech or writing produced by the organs of the entranced subject seems to be, or actually claims to be, the expression of a personality quite other than that of the sleeper. It is noteworthy that in almost all past ages the possessing spirit has been regarded in the great majority of cases as an evil and non-human spirit; whereas in modern times the possessing spirit has usually been regarded as, and often claims to be, the soul or spirit of some deceased human being. Modern science, in accordance with its materialistic and positive tendencies, has rejected these popular interpretations. It inclines to see in the ecstatic trance a case of hallucination induced by prolonged and intense occupation with some emotionally exciting idea, the whole mind becoming so concentrated upon some image in which the idea is bodied forth as to bring all other mental functions into abeyance. The mediumistic trance it regards as a state similar to deep hypnosis, and seeks to explain it by the application of the notion of cerebral or mental dissociation in one or other of its many current forms; this assimilation finds strong support in the many points of resemblance between the deeper stages of hypnosis and the mediumistic trance, and in the fact that the artificially and deliberately induced state may be connected with the spontaneously occurring trance state by a series of states which form an insensible gradation between them. A striking feature of the mediumistic trance is the frequent occurrence of "automatic" speech and writing; and this feature especially may be regarded as warranting the application of the theory of mental dissociation for its explanation, for such automatic speech and writing are occasionally produced by a considerable number of apparently healthy persons while in a waking condition which presents little or no other symptom of abnormality. In these cases the subject hears his own words, or sees the movement of his hand and his own hand writing, as he hears or sees those of another person, having no sense of initiating or controlling the movements and no anticipatory awareness of the thoughts expressed by the movements. When, as in the majority of cases, such movements merely give fragmentary expression to ideas or facts that have been assimilated by the subject at some earlier date, though perhaps seemingly completely forgotten by him, the theory of mental dissociation affords a plausible and moderately satisfactory explanation of the movements; it regards them as due to the control of ideas or memories which somehow have become detached or loosened from the main system of ideas and tendencies that make up the normal personality, and which operate in more or less complete detachment; and the application of the theory is in many cases further justified by the fact that the "dissociated" ideas and memories seem in some cases to become taken up again by, or reincorporated with, the normal personality.

But in recent years a new interest has been given to the study of the mediumistic trance by careful investigations (made with a competence that commands respect) which tend to re-establish the old savage theory of possession, just when it seemed to have become merely an anthropological curiosity. These investigations have been conducted for the most part by members of the Society for Psychical Research, and their most striking results have been obtained by the prolonged study of the automatic speech and writing of the American medium, Mrs Piper. In this case the medium passes into a trance state apparently at will, and during the trance the organs of speech or the hand usually express what purport to be messages from the spirits of deceased relatives or friends of those who are present. A number of competent and highly critical observers have arrived at the conviction that these messages often comprise statements of facts that could not have come to the knowledge of the medium in any normal fashion; and those who are reluctant to accept the hypothesis of "possession" find that they can reject it only at the cost of assuming the operation of telepathy (*q.v.*) in an astonishing and unparalleled fashion. During 1907–1908 the investigation was directed to the obtaining of communications which should not be explicable by the most extended use of the hypothesis of telepathic communication from the minds of living persons. The plan adopted was to seek for "cross-correspondences" between the communications of the Piper "controls" and the automatic writings of several other persons which claimed to be directed by the same disembodied spirits; *i.e.* it was sought to find in the automatic writings of two or more individuals passages each of which in itself would be fragmentary and unintelligible, but which, taken in connexion with similar fragments contemporaneously produced by another and distant writer, should form a significant whole; for it is argued that such passages would constitute irrefutable evidence of the operation of a third intelligence or personality distinct from that of either medium. The results published up to 1909 seem to show that this attempt met with striking success; and they constitute a body of evidence in favour of the hypothesis of possession which no impartial and unprejudiced mind can lightly set aside. Nevertheless, so long as it is possible to believe, as so many of the most competent workers in this field believe, that dissociated fragments of a personality may become synthesized to form a secondary and as it were parasitic personality capable of assuming temporary control of the organs of expression, and so long as we can set no limits to the scope of telepathic communication between embodied minds, it would seem wellnigh impossible, even by the aid of this novel and ingenious plan of investigation, to achieve completely convincing evidence in favour of the hypothesis of "possession."

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TRANENT, a police burgh of Haddingtonshire, Scotland. Pop. (1901), 2584. It lies 9½ m. E. of Edinburgh by road and 1 m. S.E. of Prestonpans station on the North British railway. The town possesses the oldest coal-mining charter (1202–1218) in Great Britain, and the mines and quarries in the neighbourhood provide the staple industry. A fragment of a parish church, said to have been built in the 11th century, still stands. Of the palace of the Setons which stood in the parish there are no remains. It was demolished towards the close of the 18th century and a modern mansion was erected on its site.

In the neighbouring village of Ormiston, in 1885, a granite obelisk was erected in memory of Robert Moffat (1795–1883), a native, the South African missionary and father-in-law of Livingstone. At Ormiston Hall, a seat of the marquess of Linlithgow, there is a yew tree, beneath which the reformer George Wishart (1513–1546) used to preach. Hard by is the village of Pencaitland, divided into an eastern and a western portion by the Tyne. The parish church in Easter Pencaitland probably dates from the 13th century. The aisle may belong to the original building, but the rest is of the 16th century, excepting the small belfry of the 17th century. The old house of Pencaitland stands in the grounds of Winton Castle, which was erected by the 3rd earl of Winton in 1620 but forfeited by the 5th earl, who was involved in the Jacobite rising of 1715. Five miles south-east of Tranent is the village of Salton (or Saltown), where Gilbert Burnet, afterwards bishop of Salisbury, had his first charge (1665). At his death he bequeathed the parish 20,000 marks for the clothing and educating of poor children. He was tutor to Andrew Fletcher, who was born at Salton in 1655 and buried there in 1716. At Fletcher's instigation James Meikle, a neighbouring millwright, went to Holland to learn the construction of the iron-work of barley mills, and the mill which he erected at Salton after his return not only gave Salton barley a strong hold on the market, but was also for forty years the only mill of its kind in the British Isles. Meikle's son Andrew (1719–1811), inventor of the threshing machine, carried on his trade of millwright at Houston Mill near Dunbar. Andrew Fletcher, also of Salton (1692–1766), nephew of the elder Andrew, became lord justice clerk in 1735 under the style of Lord Milton. By his mother's energy the art of weaving and dressing holland linen was introduced into the village. She travelled in Holland with two skilled mechanics who contrived to learn the secrets of the craft. The British Linen Company laid down their first bleachfield at Salton under Lord Milton's patronage. Salton also lays claim to having been the birthplace of the poet William Dunbar.

TRANI, a seaport and episcopal see of Apulia, Italy, on the Adriatic, in the province of Bari, and 26 m. by rail W.N.W. of that town; 23 ft. above sea-level. Pop. (1901), 34,688. Trani has lost its old walls and bastions, but the 13th-century Gothic citadel is used as a prison. Some of the streets remain much as they were in the medieval period, and many of the houses display more or less of Norman decoration. The cathedral (dedicated to St Nicholas the Pilgrim, a Greek assassinated at Trani in 1094 and canonized by Urban II.), on a raised open site near the sea, was consecrated, before its completion, in 1143; it is a basilica with three apses, a large crypt and a lofty tower, the latter erected in 1230–1239 by the architect whose name appears on the ambo in the cathedral of Bitonto, Nicolaus Sacerdos. It has an arch under it, being supported partly on the side wall of the church, and partly on a massive pillar. The arches of the Romanesque portal are beautifully ornamented, in a manner suggestive of Arab influence; the bronze doors, executed by Barisanus of Trani in 1175, rank among the best of their period in southern Italy. The capitals of the pillars in the crypt are fine examples of the Romanesque. The interior of the cathedral has been barbarously modernized, but the crypt is fine. Near the harbour is the Gothic palace of the doges of Venice, which is now used as a seminary. The church of the Ognissanti has a Romanesque relief of the Annunciation over the door. S. Giacomo and S. Francesco also have Romanesque façades and the latter and S. Andrea have "Byzantine" domes. The vicinity of Trani produces an excellent wine (Moscato di Trani); and its figs, oil, almonds and grain are also profitable articles of trade.

Trani is the *Turenum* of the itineraries. It first became a flourishing place under the Normans and during the crusades, but attained the acme of its prosperity as a seat of trade with the East under the Angevin princes. The harbour, however, has lost its importance.

TRANQUEBAR, a town of British India, in the Tanjore district of Madras, on the sea-coast, 18 m. N. of Negapatam. Pop. (1901), 13,142. A Danish factory was opened here as early as 1620. It was taken by the British in 1801, but restored in 1814, and finally purchased, with the other Danish settlements in India, in 1845. In Danish times Tranquebar was a busy port, but it lost its importance when the railway was opened to Negapatam. It was the first settlement of Protestant missionaries in India, founded by Ziegenbalg and Plutschau (Lutherans) in 1706; and there is still a Lutheran mission high school and mission press.

TRANSBAIKALIA (sometimes also known as *Dauria*), a province of Eastern Siberia, lying E. of Lake Baikal, with the government of Irkutsk on the N.W. and N., the provinces of Amur and Manchuria on the E. and Mongolia on the S. Its area (232,846 sq. m.) is nearly as large as that of Austria-Hungary, but its population does not much exceed half a million.

Transbaikalia forms an intermediate link between Siberia, Mongolia and the northern Pacific littoral. The Yablonoi Mountains, which run north-east from the sources of the Kerulen̄ to the bend of the Olekma in 56° N., divide the province into two quite distinct parts; to the west, the upper terrace of the high east Asian plateau, continued from the upper Selenga and the Yenisei (4000 to 5000 ft. high) towards the plateau of the Vitim (3500 to 4000 ft.); and to the east the lower terrace of the same plateau (2800 ft.), forming a continuation of the eastern Gobi. Beginning at Lake Baikal, a valley, deep and broad, penetrates the north-western border-ridge of the plateau, and runs eastward up the river Uda, with an imperceptible gradient, like a gigantic railway cutting enclosed between two steep slopes, and it sends another branch south towards Kiakhta. After having served, through a succession of geological periods, as an outlet for the water and ice which accumulated on the plateau, it is now utilized for the two highways which lead from Lake Baikal across the plateau (3500-4000 ft.) to the Amur on the east and the Chinese depression on the south. Elsewhere the high and massive border-ridge on the north-western edge of the plateau can be crossed only by difficult footpaths. The border-ridge just mentioned, gapped by the wide opening of the Selenga, runs from south-west to north-east under different names, being known as Khamar-daban (6900 ft.) south of Lake Baikal, and as the Barguzin Mountains (7000 to 8000 ft.) along the east bank of the Barguzin river, while farther north-east it has been described under the names of the South Muya and the Chara Mountains (6000 to 7000 ft.). Resting its south-east base on the plateau, it descends steeply on the north-west to the lake and to the broad picturesque valleys of the Barguzin, Muya and Chara. Thick forests of larch, fir and cedar clothe the ridge, whose dome-shaped rounded summits (*goltsy*) rise above the limits of tree vegetation, but do not reach the snow-line (here above 10,000 ft.). The high plateau itself has the aspect of an undulating table-land, intersected by ranges, which rise some 1500 or 2000 ft. above its surface, and are separated by broad, flat, marshy valleys, traversed by sluggish meandering streams. The better drained valleys have fine meadow lands, while the hills are clothed with forests (almost exclusively of larch and birch). Numberless lakes and ponds occur along the river courses. Tunguses hunt in the forests and meadows, but permanent agricultural settlements are impossible, corn seldom ripening on account of the early frost. The lower parts of the broad, flat valley of the Jida have, however, a few Cossack settlements, and Mongolian shepherds inhabit the elevated grassy valleys about Lake Kosso-gol (5300 ft. above the sea). Quite different is the lower terrace of the plateau, occupied by the eastern Gobi and the Nerchinsk region, and separated from the upper terrace by the Yablonoi range. This last is the south-eastern border-ridge of the higher terrace. It rises to 8035 ft. in the Sokhondo peak, but elsewhere its dome-shaped summits do not exceed 5000 or 6000 ft. Numberless lakes, with flat undefined margins, feed streams which join the great north-going rivers or the Amur and the Pacific. Low hills rise above the edge of the plateau, but the slope is abrupt towards the south-east, where the foot-hills of the Yablonoi are nearly 1500 and 2000 ft. lower than on the north-west. Climate, flora and fauna change suddenly as soon as the Yablonoi has been crossed. The Siberian flora gives way to the Daurian flora, and this is in turn exchanged for the Pacific littoral flora on the Manchurian plains and lowlands.

The lower terrace has the character of a steppe, but is intersected by a number of ranges, plications of Silurian and Devonian rocks, all running south-west to north-east, and all containing silver, lead, copper and auriferous sands. Agriculture can be easily carried on in the broad prairies, the only drawbacks being droughts, and frosts in the higher closed valleys of the Nerchinsk or Gazimur Mountains. The lower terrace is in its turn fringed by a border-ridge—the Great Khingan—which occupies, with reference to the lower terrace, the same position that the Yablonoi does in relation to the upper, and separates Siberia from northern Manchuria. This important ridge does not run from south to north, as represented on the old maps, but from south-west to north-east; it is pierced by the Amur near Albazin, and joins the Okhotsk Mountains, which however do not join the Yoblonoi Mountains.

The rivers belong to three different systems—the affluents of Lake Baikal, of the Lena and of the Amur. Of the first the Selenga (800 m. long) rises in north-west Mongolia, one of its tributaries (the Egin-gol) being an emissary of Lake Kosso-gol. The Chikoi, Khilok and Uda are its chief tributaries in Transbaikalia. The Barguzin and the upper Angara enter Lake Baikal from the north-east. Of the tributaries of the Lena, the Vitim with its affluents (Karenga, Tsipa, and Muya) flows on the high plateau through uninhabited regions, as also does the Olekma. The tributaries of the Amur are much more important. The Arguñ, which at a quite recent epoch received the waters of the Dalai-nor, and thus had the Keruleñ for its source, is no longer in communication with the rapidly desiccating Mongolian lake, but has its sources in the Gan, which flows from the Great Khingan Mountains. It is not navigable, but receives the Gazimur and several other streams from the Nerchinsk mining district. The Shilka is formed by the union of the Onon and the Chita rivers, and is navigable from the town of Chita, thus being an important channel to the Amur.

Lake Baikal, with an area of 13,200 sq. m. (nearly equal to that of Switzerland), extends in a half crescent from south-west to north-east, with a length of nearly 400 m. and a width of 20 to 50 m. Its level is 1,500 ft. above the sea.[1] The wide delta of the Selenga narrows it in the middle, and renders it shallower in the east than in the west. The other lakes include the Gusinoye and Lake Ba-unt on the Vitim plateau. Many lakes yield common salt.

The high plateau is built up of granites, gneisses and syenites, overlain by Laurentian schists. Silurian and Devonian marine deposits occur only on the lower terrace. Since that epoch the region has not been under the sea, and only fresh-water Jurassic deposits and coal beds are met with in the depressions. During the Glacial period most of the high terrace and its border ridges were undoubtedly covered with vast glaciers. Volcanic rocks of more recent origin (Mesozoic?) are met with in the north-western border-ridge and on its slopes, as well as on the Vitim plateau. During the Glacial period the fauna of the lowest parts of Transbaikalia was decidedly arctic; while during the Lacustrine or post-Glacial periods this region was dotted over with numberless lakes, the shores of which were inhabited by Neolithic man. Only few traces of these survive, and they are rapidly drying up. Earthquakes are very frequent on the shores of Lake Baikal, especially at the mouth of the Selenga, and they extend as far as Irkutsk, Barguzin and Selenginsk; in 1862 an extensive area was submerged by the lake. Numerous mineral springs, some of them of high repute, exist all over Transbaikalia. The most important are the hot alkaline springs (130° F.) at Turka, at the mouth of the Barguzin, those of Pogromna on the Uda (very similar to the Seltzer springs), those of Molokova near Chita and those of Darasun in the Nerchinsk district.

The climate is, as a whole, exceedingly dry. The winter is cold and dry, the thermometer dropping as low as −58° F. But the snow is so trifling that the horses of the Buryats are able to procure food throughout the winter on the steppes, and in the very middle of the winter wheeled vehicles are used all over the west. To the east of the Yablonoi ridge the Nerchinsk district feels the influence of the North Pacific monsoons, and snow falls more thickly, especially in the valleys; but the summer is hot and dry. On the high plateau even the summer is cold, owing to the altitude and the humidity arising from the marshes, and the soil is frozen to a great depth. At Chita the daily range in summer and spring is sometimes as much as 33° to 46° In the vicinity of Lake Baikal there is a cooler summer; in winter exceedingly deep snow covers the mountains around the lake.[2]

The estimated population in 1906 was 742,200. The Russian population is gathered around the mines of the Nerchinsk district, while the steppes are occupied by the Buryats. A string of villages has been planted along the Shilka between Chita and Stryetensk. The valleys of the Uda, the lower Selenga, and especially the Chikoi and the Khilok have been occupied since the beginning of the 19th century by Raskolniks, some of whom, living in a condition of prosperity such as is unknown in Russia proper, rank amongst the finest representatives of the Russian race. The remainder of the steppe of the Uda is occupied by Buryats, while the forests and marshes of the plateau are the hunting grounds of the nomad Tunguses. South of the Khamar-daban the only settled region is the lower valley of the Jida. On the Upper Arguñ the Cossacks are in features, character, language and manners largely Mongolian. The Russians along the Chinese frontier constitute a separate *voisko* or division of the Transbaikal Cossacks. The Buryats number about 180,000, the Tunguses over 30,000. The province is divided into five districts, the chief towns of which are Chita, the capital, Barguzin, Nerchinsk, Selenginsk and Verkhneudinsk.

Although a good deal of land has been cleared by the settlers, nearly one-half of the entire area is still covered with forests. The principal varieties are fir, larch, aspen, poplar and birch, with *Abies pectinata* in the north and the cedar in the south. Only about one-third of the surface is adaptable for cultivation, and of that only about one-tenth is actually under tillage.

Agriculture is carried on to a limited extent by the Buryats and in all the Russian settlements; but it prospers only in the valleys of West Transbaikalia, and partly in the Nerchinsk region, while in the steppes of the Arguñ and Onon even the Russians resort to pastoral pursuits and trade, or to hunting. Livestock rearing is extensively carried on, especially by the Buryats, but their herds and flocks are often destroyed in great numbers by the snowstorms of spring. Hunting is an important occupation, even with the Russians, many of whom leave their homes in October to spend six weeks in the *taiga* (forest region). The fisheries of Lake Baikal and the lower parts of its affluents are important. Enormous quantities of *Salmo omul* are taken every year; and *S. thymalus*, *S. oxyrhynchus* and *S. fluviatilis* are also taken. Mining, and especially gold mining, is important, but the production of gold has fallen off. Silver mines have only a very small output. Iron mining is gradually developing, and good coal mines are now being worked. Salt is raised from several lakes, and the extraction of Epsom salts has considerably developed. Manufactures, though insignificant, have increased. The trade is chiefly concentrated at Kiakhta. The Cossacks on the frontier traffic in brick-tea, cattle and hides with Mongolia. The export of furs is of considerable value.

Transbaikalia is crossed by the Trans-siberian railway from Mysovaya on Lake Baikal, via Chita, to Stryetensk, and from Kaidalovo, near Chita, to the Mongolian frontier; the latter section is continued across Manchuria to Vladivostok and Port Arthur. Regular steamer communication has been established along Lake Baikal, not only for the transport of passengers and goods between the two railway stations of Listvinichnoye and Mysovaya, but also with the object of developing the fishing industry, which is of great importance. Steamers ply up the Selenga river as far as Selenginsk, considerable cargoes of tea being transported along this line.

(P. A. K.; J. T. Be.)

TRANSCASPIAN REGION, a Russian territory on the E. of the Caspian, bounded S. by Khorasan and Afghanistan, N. by the Russian province of Uralsk, N.E. by Khiva and Bokhara and S.E. by Afghan Turkestan. Area, 212,545 sq. m. Some of the most interesting problems of geography, such as those relating to the changes in the course of the Jaxartes (Syr-darya) and the Oxus (Amu-darya), and the supposed periodical disappearance of Lake Aral, are connected with the Transcaspian deserts; and it is here that we must look for a clue to the physical changes which transformed the Euro-Asiatic Mediterranean—the Aral-Caspian and Pontic basin—into a series of separate seas, and desiccated them, powerfully influencing the distribution of floras and faunas, and centuries ago compelling the inhabitants of Western and Central Asia to enter upon their great migrations. But down to a comparatively recent date the arid, barren deserts, peopled only by wandering Turkomans, were almost a *terra incognita*.

A mountain chain, comparable in length to the Alps, separates the deserts of the Transcaspian from the highlands of Khorasan. It begins in the Krasnovodsk peninsula of the Caspian, under the names of Kuryanyn-kary and Great Balkans, whose masses of granite and other crystalline rock reach an altitude of some 5350 ft. Farther south-east they are continued in the Little Balkans (2000 ft.) and the Kopepet-dagh or Kopet-dagh. The latter rises steep and rugged above the flat deserts over a stretch of 600 m. In structure it is homologous with the Caucasus chain; it appears as an outer wall of the Khorasan plateau, and is separated from it by a broad valley, which, like the Rion and Kura valley of Transcaucasia, is drained by two rivers flowing in opposite directions—the Atrek, which flows north-west into the Caspian, and the Keshef-rud, which flows to the south-east and is a tributary of the Murghab. On the other side of this valley the Alla-dagh (Aladagh) and the Binalund border-ranges (9000 to 11,000 ft.) fringe the edge of the Khorasan plateau. Descending towards the steppe with steep stony slopes, the mountain barrier of the Kopet-dagh rises to heights of 6000–9000 ft. to the east of Kyzyl-arvat, while the passes which lead from the Turkoman deserts to the valleys of Khorasan are seldom as low as 3500, and usually rise to 5000, 6000 and even 8500 ft., and in most cases are very difficult. It is pierced by only one wide opening, that between the Great and Little Balkans, through which the sea, which once covered the steppe, maintained connexion with the Caspian.

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[1] There is uncertainty as to the absolute altitude (see BAIKAL).

[2] See "Das Klima von Ost-Siberien," by A. Woyeikow, in *Meteorol. Zeitschrift* (1884).

While the Alla-dagh and Binalund border-ranges are chiefly composed of crystalline rocks and metamorphic slates, overlain by Devonian deposits, a series of more recent formations—Upper and Lower Cretaceous and Miocene—crops out in the outer wall of the Kopet-dagh. Here again we find that the mountains of Asia which stretch towards the north-west continued to be uplifted at a geologically recent epoch. Quarternary deposits have an extensive development on its slopes, and its foothills are bordered by a girdle of loess.

The loess terrace, called Atok ("mountain base"), 10 to 20 m. in width, is very fertile; but it will produce nothing without irrigation, and the streams flowing from the Kopet-dagh are few and scanty. The winds which impinge upon the northern slope of the mountains have been deprived of all their moisture in crossing the Kara-kum—the Black Sands of the Turkoman desert; and even such rain as falls on the Kopet-dagh (10½ in. at Kyzyl-arvat) too often reaches the soil in the shape of light showers which do not penetrate it, so that the average relative humidity is only 56 as compared with 62 at even so dry a place as Krasnovodsk. Still, at those places where the mountain streams run closer to one another, as at Geok-tepe, Askhabad, Lutfabad and Kaaka, the villages are more populous, and the houses are surrounded by gardens, every square yard and every tree of which is nourished by irrigation.

North of this narrow strip of irrigated land begins the desert—the Kara-kum—which extends from the mountains of Khorasan to Lake Aral and the plateau of Ust-Urt, and from the Caspian to the Amu-darya, interrupted only by the oases of Merv and Tejeñ. But the terrible shifting sands, blown into *barkhans*, or elongated hills, sometimes 50 and 60 ft. in height, are accumulated chiefly in the west, where the country has more recently emerged from the sea. Farther east the barkhans are more stable. Large areas amidst the sands are occupied by *takyrs*, or flat surfaces paved with clay, which, as a rule, is hard but becomes almost impassable after heavy rains. In these takyrs the Turkomans dig ditches, draining into a kind of cistern, where the water of the spring rains can be preserved for a few months. Wells also are sunk, and the water is found in them at depths of 10 to 50, or occasionally 100 ft. and more. All is not desert in the strict sense; in spring there is for the most part a carpet of grass.

The vegetation of the Kara-kum cannot be described as poor. The typical representative of the sandy deserts of Asia, the saksaul (*Anabasis ammodendron*), has been almost destroyed within the last hundred years, and occurs only sporadically, but the borders of the spaces covered with saline clay are brightened by forests of tamarisk, which are inhabited by great numbers of the desert warbler (*Atraphornis aralensis*)—a typical inhabitant of the sands—sparrows and ground-choughs (*Podoces*); the *Houbara macqueeni*, though not abundant, is characteristic of the region. Hares and foxes, jackals and wolves, marmots, moles, hedgehogs and one species of marten live in the steppe, especially in spring. As a whole, the fauna is richer than might be supposed, while in the Atok it contains representatives of all the species known in Turkestan, intermingled with Persian and Himalayan species.

The Uzboi.—A feature distinctive of the Turkoman desert is the very numerous *shors*, or elongated depressions, the lower portion of which are mostly occupied with moist sand. They are obviously the relics of brackish lakes, and, like the lakes of the Kirghiz steppes, they often follow one another in quick succession, thus closely resembling river-beds. As the direction of the *shors* is generally from the higher terraces drained by the Amu-darya towards the lowlands of the Caspian, they were usually regarded as old beds of the Amu-darya, and were held to support the idea of its once having flowed across the Turkoman desert towards what is now the Caspian Sea. It was formerly considered almost settled, not only that that river (see Oxus) flowed into the Caspian during historical times, but that after having ceased to do so in the 7th century, its waters were again diverted to the Caspian about 1221. A chain of elongated depressions, bearing a faint resemblance to old river-beds, was traced from Urgenj to the gap between the Great and the Little Balkans; this was marked on the maps as the Uzboi, or old bed of the Oxus.[1] The idea of again diverting the Amu into the Caspian was thus set afloat, but the investigations of Russian engineers, especially A. E. Hedroitz, A. M. Konshin, I. V. Mushketov, P. M. Lessar and Svintsov,[2] went to show that the Uzboi is no river-bed at all, and that no river has ever discharged its waters in that direction. The existence of an extensive lacustrine depression, now represented by the small Sary-kamysh lakes, was proved, and it was evident that this depression, having a length of more than 130 m., a width of 70 m., and a depth of 280 ft. below the present level of Lake Aral, would have to be filled by the Amu before its waters could advance farther to the south-west. The sill of this basin being only 28 ft. below the present level of Lake Aral, this latter could not be made to disappear, nor even be notably reduced in size, by the Amu flowing south-west from Urgenj. A more careful exploration of the Uzboi has shown that, while the deposits in the Sary-kamysh depression, and the Aral shells they contain, bear unmistakable testimony to the fact of the basin having once been fed by the Amu-darya, no such traces are found along the Uzboi below the Sary-kamysh depression;[3] on the contrary, shells of molluscs still inhabiting the Caspian are found in numbers all along it, and the supposed old bed has all the characteristics of a series of lakes which continued to subsist along the foothills of the Ust-Urt plateau, while the Caspian was slowly receding westwards during the post-Pliocene period. On rare occasions only did the waters of the Sary-kamysh, when raised by inundations above the sill just mentioned, send their surplus into the Uzboi. It appears most probable that in the 16th century the Sary-kamysh was confounded with a gulf of the Caspian;[4] and this gives much plausibility to Konshin's supposition that the changes in the lower course of the Amu (which no geologist would venture to ascribe to man, if they were to mean the alternative discharge of the Amu into the Caspian and Lake Aral) merely meant that by means of appropriate dams the Amu was made to flow in the 13th–16th centuries alternately into Lake Aral and into the Sary-kamysh.

The ancient texts (of Pliny, Strabo, Ptolemy) about the Jaxartes and Oxus only become intelligible when it is admitted that, since the epoch to which they relate, the outlines of the Caspian Sea and Lake Aral have undergone notable changes, commensurate with those which are supposed to have occurred in the courses of the Central Asian rivers. The desiccation of the Aral-Caspian basin proceeded with such rapidity that the shores of the Caspian cannot possibly have maintained for some twenty centuries the outlines which they exhibit at present. When studied in detail, the general configuration of the Transcaspian region leaves no doubt that both the Jaxartes and the Oxus, with its former tributaries, the Murghab and the Tejeñ, once flowed towards the west; but the Caspian of that time was not the sea of our days; its gulfs penetrated the Turkoman steppe, and washed the base of the Ust-Urt plateau. (See Caspian and Aral.)

Kelif-Uzboi.—There is also no doubt that, instead of flowing north-westward of Kelif (on the present Bokhara-Afghan frontier), the Amu once bent south to join the Murghab and Tejeñ; the chain of depressions described by the Russian engineers as the Kelif-Uzboi[5] supports this hypothesis, which a geographer cannot avoid making when studying a map of the Transcaspian region; but the date at which the Oxus followed such a course, and the extension which the Caspian basin then had towards the east, are uncertain.

In 1897 the population numbered 377,416, of whom only 42,431 lived in towns; but, besides those of whom the census took account, there were about 25,000 strangers and troops.

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[1] On the original Russian map of the Transcaspian, drawn immediately after the survey of the Uzboi had been completed, the Uzboi has not the continuity which is given to it on subsequent maps.

[2] Their original papers are printed in the *Isvestia* of the Russian Geographical Society, 1883 to 1887, also in the *Journal* of the Russian ministry of roads and communications.

[3] According to A. E. Hedroitz and A. M. Konshin the old Tonu-darya bed of the Amu contains shells of molluscs now living in the Amu (*Cyrena fluminalis*, *Dreissensia polymorpha* and *Anodonta*). The Sary-kamysh basin is characterized by deposits containing *Neritina liturata*, *Dreissensia polymorpha* and *Limnaeus*, characteristic of this basin. Below the Sary-kamysh there are no deposits containing shells characteristic of the Amu; *Anodontae* are found quite occasionally on the surface, not in beds, in company with the Caspian *Cardium* (*Didacna*) *trigonoides*, var. *crassum*, *Cardium piramidatum*. *Dreissensia polymorpha*, *D. rostriformis*, *Hydrobia caspia*, *Neritina liturata* and *Dreissensia beardii*; the red clays containing these fossils extend for 130 m. east of the Caspian (*Isvestia* of Russ. Geog. Soc., 1883 and 1886).

[4] As by Jenkinson, who mentions a freshwater gulf of the Caspian within six days' march from Khwarezm (or Khiva), by which gulf he could only mean the Sary-kamysh depression.

[5] The Turkomans call this southern "old bed" Unghyuz or Onguz ("dry old bed"), and there can be no doubt that when the *Bolshoi-Chertezh* of the 16th century (speaking from anterior information) mentions a river, Ughyuz or Ugus, flowing west from the Amu towards the Caspian, it is merely describing as a river what the very name shows to have been a dry bed, supposed to have been once occupied by a river. The similarity of the names Ongus and Ugus with Ogus and Ochus possibly helped to accentuate, if not to give rise to, the confusion. Cf. N. G. Petrusevich, "The South-east Shores of the Caspian," in *Zapiski* of the Caucasian Geographical Society (1880), vol. xi.

Included in the total were some 280,000 Turkomans, 60,000 Kirghiz, 12,000 Russians, 8000 Persians, 4250 Armenians, and some Tatars. The estimated population in 1906 was 397,100. The province is divided into five districts, the chief towns of which are Askhabad, the capital; Krasnovodsk; Fort Alexandrovskiy, in the district of Manghishlak, on the Caspian Sea; Merv and Tejeñ. Until a recent date the chief occupations of the Turkomans were cattle-rearing and robbery. Even those who had settled abodes on the oases of the Atok, Tejeñ and Merv were in the habit of encamping during the spring in the steppes, the khanates of Afghan Turkestan from Balkh to Meshhed being periodically devastated by them. The aspect of the steppe has, however, greatly changed since the Russian advance and the fall (1881) of the Turkoman stronghold of Geok-tepe. Their principal oases are situated along the Atok or loess terrace, the chief settlements being Askhabad, Kyzyl-arvat and Geok-tepe. The oasis of Merv is inhabited by Akhal-tekkes (about 240,000), mostly poor. In January 1887 they submitted to Russia. The oasis of Tejeñ has sprung up where the river Tejeñ (Heri-rud) terminates in the desert.

South-west Turcomania.—The region between the Heri-rud and the Murghab has the characteristics of a plateau, reaching about 2000 ft. above the sea, with hills 500 and 600 ft. high covered with sand, the spaces between being filled with loess. The Borkhut Mountains which connect the Kopet-dagh with the Sefid-kuh in Afghanistan reach 3000 to 4000 ft., and are cleft by the Heri-rud. Thickets of poplar and willow accompany both the Murghab and the Heri-rud. Pistachio and mulberry trees grow in isolated clumps on the hills; but there are few places available for cultivation, and the Saryk Turkomans (some 60,000 in number) congregate in only two oases—Yol-otan or Yelatan, and Penjdeh. The Sarakhs oasis is occupied by the Salor Turkomans, hereditary enemies of the Tekke Turkomans; they number about 3000 tents at Old Sarakhs, and 1700 more on the Murghab, at Chardjui, at Maimene (or Meimane), and close to Herat.

The Transcaspian Region is very rich in minerals. Rock-salt, petroleum, gypsum and sulphur are extracted. Nearly 300,000 acres are irrigated by the natives, and attempts are being made by the government to increase the irrigated area; it is considered that over 5,000,000 acres of land could be rendered suitable for agriculture. Several hundred thousand trees are planted every year, and a forest guard has been established to prevent useless destruction of the saksaul trees, which grow freely in the steppes. A model garden and a mulberry plantation have been established at Askhabad in connexion with the gardening school. The land in the oases, especially those of the Atrek River, is highly cultivated. Wheat and barley are grown, in addition to sorghum (a species of millet), maize, rice, millet and sesame for oil. Raw cotton is extensively grown in the Merv district. Gardening and fruit-growing are well developed, and attempts are being made to encourage the spread of viticulture. Livestock breeding is the chief occupation of the nomad Turkomans and Kirghiz. Considerable fishing is carried on in the Caspian Sea, and seals are killed off the Manghishlak peninsula. The natives excel in domestic industries, as the making of carpets, travelling bags, felt goods and embroidered leather. The Russian population is mostly limited to the military and the towns. Wheat, flour, wool, raw cotton and dried fruit are exported; while tea, manufactured goods, timber, sugar, iron and paraffin oil are imported, as also rice and fruit from Bokhara, Turkestan and Persia. The Transcaspian railway, constructed across the province from Krasnovodsk to Merv, with a branch to Kushk, and from Merv to Bokhara and Russian Turkestan, has effected quite a revolution in the trade of Central Asia. The old caravan routes via Orenburg have lost their importance, and goods coming from India, Persia, Bokhara and even China are now carried by rail. (For the history of the region see MERV.)

See the researches of Andrusov, Bogdanovich, Konshin, Mushketov and Obruchev in the *Memoirs*, the *Bulletin* (*Izvestia*) and the *Annuals* of the Russian Geographical Society (1890–1900); P. M. Lessar, *L'Ancienne jonction de l'Oxus avec la mer Caspienne* (1889); Zarudnoi (zoology) in *Bulletin de la société des naturalistes de Moscou* (1889 seq.). (P. A. K.; J. T. BE.)

TRANSCAUCASIA, a general name given to the governments and provinces of Russian Caucasia, excluding the steppe provinces of Kuban and Terek and the steppe government of Stavropol. It thus includes the governments of Baku, Elisavetpol, Erivan, Kutais and Tiflis; the provinces of Batum, Daghestan and Kars; and the military districts of the Black Sea (Chernomorsk) and Zakataly. Its area is 95,402 sq. m., and the estimated population in 1906 was 6,114,600. (See CAUCASIA and CAUCASUS.)

TRANSCENDENTALISM (Lat. *trans*, across, *scandere*, climb, whence *transcendere*, to pass a limit), in philosophy, any system which emphasizes the limited character of that which can be perceived by the senses and is based on the view that true knowledge is intuitive, or supernatural. The term is specially applied to Kant's philosophy and its successors which hold that knowledge of the a priori is possible. It is traceable as far back as the schoolmen of whom Duns Scotus describes as "transcendental" those conceptions which have a higher degree of universality than the Aristotelian categories. Thus *ens* (being) is more universal than God or the physical universe because it can be predicated of both. Kant distinguishes as "transcendent" the world of things-in-themselves as being without the limits of experience; while "transcendental" is his term for those elements which regulate human experience, though they are themselves beyond experience; such are the categories of space, time, causality.

In general use the term is applied rather promiscuously and frequently by way of criticism to an attitude of mind which is imaginative, aloof from mundane affairs and unmoved by practical considerations. The most famous example of the pseudo-philosophic use of the term is for a movement of thought which was prominent in the New England states from about 1830 to 1850. Its use originated in the Transcendental Club (1836) founded by Emerson, Frederic Henry Hedge (1805–1890), and others. This movement had several aspects: philosophical, theological, social, economic. Its main theme was regeneration, a revolt from the formalism of both Unitarian and Calvinist theology and a widening literary outlook. It took its rise to a large extent in the study of German (and to a less extent French) philosophy and spread widely among the cultured classes. In 1840 the club began to issue an official organ, *The Dial*, and the settlement of Brook Farm (*q.v.*) followed in 1841. These enterprises themselves did not receive general support even among the Transcendentalist leaders, and the real significance of the movement was the stimulus which it gave to philanthropy, to the Abolition movement, and to a new ideal of individual character. The chief names associated with it, besides those of Emerson and Hedge, are those of A. B. Alcott (*q.v.*), Margaret Fuller (*q.v.*), George Ripley (*q.v.*), W. E. Channing (*q.v.*), and H. D. Thoreau (*q.v.*).

TRANSEPT (from Lat. *trans*, across, and *septum*, enclosure; synonymous terms in other languages are Fr. *croisée*, *nef transversée*; Ital. *crociata*; Ger. *Querbau*, *Querschiff*), in architecture, the term given to the large and lofty structure which lies at right angles to the nave and aisles of a church. The first example is that which existed in the old St Peter's at Rome, but as a rule it is not found in the early basilicas. At the present day the transept might be better defined as that portion of a cruciform church which extends from north to south across the main body of the building and usually separates the choir from the nave; but to this there are some exceptions, as in Westminster Abbey, where the choir, with its rood screen, occupies the first four bays of the nave; in Norwich two bays; in Gloucester one bay; and Winchester one bay. In some of the English cathedrals there is an eastern transept, as in Canterbury, Lincoln, Salisbury and Worcester; at Durham that which might be regarded as an eastern transept is the chapel of the Nine Altars, and the same is found in Fountains Abbey. Four of the English cathedrals have aisles on east and west sides, viz. Ely, Wells, Winchester and York, while at Chester there are aisles to the south transept only, and at Lincoln, Peterborough and Salisbury on the east side only. In some cases the transept extends to the outer walls of the aisles only, but there are many instances in which it is carried beyond, as at Lincoln (225 ft. long), Ely (180 ft.), Peterborough (180 ft.), Durham (175 ft.) and Norwich (172 ft.); in all these cases the transept is carried three bays beyond; in York (220 ft.), St Albans (170 ft.), Lichfield (145 ft.) and Canterbury, east transept (165 ft.), two bays beyond; and in Canterbury, western transept (130 ft.), Chichester (160 ft.) and Worcester (130 ft.), only one bay on each side, the dimension in all cases being taken within the north and south walls of the transept.

TRANSFER (from Lat. *transferre*, to bear across, carry over), the handing over, removal or conveyance of anything from one person or place to another; also the subject of this transference or the form or method by which it is effected. The term is particularly used in law of the conveyance of property from one person to another, especially of the conveyance of real property (see CONVEYANCING). For the simplification of this process by means of registration of title, see LAND REGISTRATION. For the transference of designs, drawings, &c., by means of transfer-paper to the surface of pottery and porcelain, see CERAMICS; for their transfer to stones for printing, see LITHOGRAPHY.

TRANSFORMERS. An electrical transformer is the name given to any device for producing by means of one electric current another of a different character. The working of such an appliance is, of course, subject to the law of conservation of energy. The resulting current represents less power than the applied current, the difference being represented by the power dissipated in the translating process. Hence an electrical transformer corresponds to a simple machine in mechanics, both transforming power from one form into another with a certain energy-dissipation depending upon frictional losses, or something equivalent to them. Electrical transformers may be divided into several classes, according to the nature of the transformation effected. The first division comprises those which change the form of the power, but keep the type of the current the same; the second those that change the type of the current as well as the form of power. The power given up electrically to any circuit is measured by the product of the *effective value* of the current, the *effective value* of the difference of potential between the ends of the circuit and a factor called the *power factor*. In dealing with periodic currents, the effective value is that called the root-mean-square value (R.M.S.), that is to say, the square root of the mean of the squares of the time equidistant instantaneous values during one complete period (see ELECTROKINETICS). In the case of continuous current, the power factor is unity, and the effective value of the current or voltage is the true mean value. As the electrical measure of a power is always a product involving current and voltage, we may transform the character of the power by increasing or diminishing the current with a corresponding decrease or increase of the voltage. A transformer which raises voltage is generally called a *step-up* transformer, and one which lowers voltage a *step-down* transformer.

Again, electric currents may oe of various types, such as continuous, single-phase alternating, polyphase alternating, undirectional but pulsating, &c. Accordingly, transformers may be distinguished in another way, in accordance with the type of transformation they effect. (1) *An alternating current transformer* is an appliance for creating an alternating current of any required magnitude and electromotive force from another of different value and electromotive force, but of the same frequency. An alternating current transformer may be constructed to transform either single-phase or polyphase currents. (2) *A continuous current transformer* is an appliance which effects a similar transformation for continuous currents, with the difference that some part of the machine must revolve, whereas in the alternating current transformer all parts of the machine are stationary; hence the former is generally called a rotatory transformer, and the latter a static transformer. (3) *A rotatory or rotary transformer* may consist of one machine, or of two separate machines, adapted for converting a single-phase alternating current into a polyphase current, or a polyphase current into a continuous current, or a continuous current into an alternating current. If the portions receiving and putting out power are separate machines, the combination is called a *motor-generator*. (4) A transformer adapted for converting a single-phase alternating current into a unidirectional but pulsatory current is called a *rectifier*, and is much used in connexion with arc lighting in alternating current supply stations. (5) *A phase transformer* is an arrangement of static transformers for producing a polyphase alternating current from a single-phase alternating current. Alternating current transformers may be furthermore divided into (*a*) single-phase, (*b*) polyphase. Transformers of the first class change an alternating current of single-phase to one of single-phase identical frequency, but different power; and transformers of the second class operate in a similar manner on polyphase currents. (6) The ordinary induction or spark coil may be called an intermittent current transformer, since it transforms an intermittent low-tension primary current into an intermittent or alternating high-tension current.

Alternating Current Transformer.—The typical alternating current transformer consists essentially of two insulated electric circuits wound on an iron core constituting the magnetic circuit. They may be divided into (1) open magnetic circuit static transformers, and (2) closed magnetic circuit static transformers, according as the iron core takes the form of a terminated bar or a closed ring. A closed circuit alternating current transformer consists of an iron core built up of thin sheets of iron or steel, insulated from one another, and wound over with two insulated conducting circuits, called the primary and secondary circuits. The core must be laminated or built up of thin sheets of iron to prevent local electric currents, called eddy currents, from being established in it, which would waste energy. In practical construction, the core is either a simple ring, round or rectangular, or a double rectangular ring, that is, a core whose section is like the figure 8. To prepare the core, thin sheets of iron or very mild steel, not thicker than ·014 of an inch, are stamped out of special iron (see ELECTROMAGNETISM) and carefully annealed.

The preparation of the particular sheet steel or iron used for this purpose is now a speciality. It must possess extremely small hysteresis loss (see MAGNETISM), and various trade names, such as "stalloy," "lohys," are in use to describe certain brands. Barrett, Brown and Hadfield have shown (*Journ. Inst. Elec. Eng. Lond.*, 1902, 31, p. 713) that a silicon iron containing 2·87% of silicon has a hysteresis loss far less than that of the best Swedish soft iron. In any case the hysteresis loss should not exceed 3·0 watts per kilogram of iron measured at a frequency of 50 ~ and a flux-density of 10,000 lines per square centimetre. This is now called the "figure of merit" of the iron.

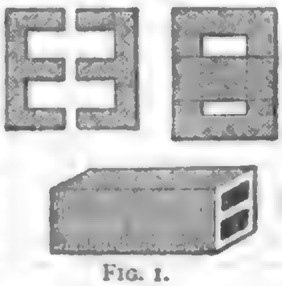

FIG. 1.

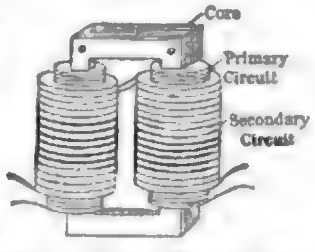

FIG. 2.—Closed Circuit Transformer.

Examples of the shapes in which these stampings are supplied are shown in fig. 1. The plates when annealed are varnished or covered with thin paper on one side, and then piled up so as to make an iron core, being kept together by bolts and nuts or by pressure plates. The designer of a transformer core has in view, first, economy in metal, so that there may be no waste fragments, and second, a mode of construction that facilitates the winding of the wire circuits. These consist of coils of cotton-covered copper wire which are wound on formers and baked after being well saturated with shellac varnish. The primary and secondary circuits are sometimes formed of separate bobbins which are sandwiched in between each other; in other cases they are wound one over the other (fig. 2). In any case the primary and secondary coils must be symmetrically distributed. If they were placed on opposite sides of the iron circuit the result would be considerable magnetic leakage. It is usual to insert sheets or cylinders of micanite between the primary and secondary windings. The transformer is then well baked and placed in a cast-iron case sometimes filled in with heavy insulating oil, the ends of the primary and secondary circuits being brought out through water-tight glands. The most ordinary type of alternating current transformer is one intended to transform a small electric current produced by a large electromotive force (2000 to 10,000 volts) into a larger current of low electromotive force (100 to 200 volts). Such a step-down transformer may be obviously employed in the reverse direction for raising pressure and reducing current, in which case it is a step-up transformer. A transformer when manufactured has to be carefully tested to ascertain, first, its power of resisting break-down, and, second, its energy-dissipating qualities. With the first object, the transformer is subjected to a series of pressure tests. If it is intended that the primary shall carry a current produced by an electromotive force of 2000 volts, an insulation test must be applied with double this voltage between the primary and the secondary, the primary and the case, and the primary and the core, to ascertain whether the insulation is sufficient. To prevent electric discharges from breaking down the machine in ordinary work, this extra pressure ought to be applied for at least a quarter of an hour. In some cases three or four times the working pressure is applied for one minute between the primary and secondary circuits. When such an alternating current transformer has an alternating current passed through its primary circuit, an alternating magnetization is produced in the core, and this again induces an alternating secondary current. The secondary current has a greater or less electromotive force than the primary current according as the number of windings or turns on the secondary circuit is greater or less than those on the primary. Of the power thus imparted to the primary circuit one portion is dissipated by the heat generated in the primary and secondary circuits by the currents, and another portion by *the iron core losses* due to the energy wasted in the cyclical magnetization of the core; the latter are partly eddy current losses and partly hysteresis losses.

In open magnetic circuit transformers the core takes the form of a laminated iron bar or a bundle of iron wire. An ordinary induction coil is an instrument of this description. It has been shown, however, by careful experiments, that for alternating current transformation there are very few cases in which the closed magnetic circuit transformer has not an advantage. An immense number of designs of closed circuit transformers have been elaborated since the year 1885. The principal modern types are the Ferranti, Kapp, Mordey, Brush, Westinghouse, Berry, Thomson-Houston and Ganz. Diagrammatic representations of the arrangements of the core and circuits in some of these transformers are given in fig. 3.

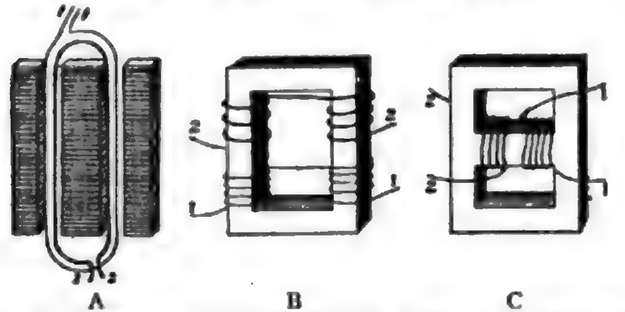

FIG. 3.—Diagrams of (A) Mordey (in section), (B) Kapp and (C) Ganz Transformers.

1, 1 Primary circuit; 2, 2 Secondary circuit.

Alternating current transformers are classified into (i.) *Core* and (ii.) *Shell* transformers, depending upon the arrangements of the iron and copper circuits. If the copper circuits are wound on the outside of what is virtually an iron ring, the transformer is a core transformer; if the iron encloses the copper circuits, it is a shell transformer. Shell transformers have the disadvantage generally of poor ventilaton for the copper circuits. Berry, however, has overcome this difficulty by making the iron circuit in the form of a number of bunches of rectangular frames which are set in radial fashion and the adjacent legs all embraced by the two copper circuits in the form of a pair of concentric cylinders. In this manner he secures good ventilation and a minimum expenditure in copper and iron, as well as the possibility of insulating the two copper circuits well from each other and from the core. An important matter is the cooling of the core. This may be effected either by ordinary radiation, or by a forced draught of air made by a fan or else by immersing the transformer in oil, the oil being kept cool by pipes through which cold water circulates immersed in it. This last method is adopted for large high-tension transformers.

Efficiency.

The ratio between the power given out by a transformer and the power taken up by it is called its *efficiency*, and is best represented by a curve, of which the ordinate is the efficiency expressed as a percentage, and the corresponding abscissae represent the fractions of the full load as decimal fractions. The output of the transformer is generally reckoned in kilowatts, and the load is conveniently expressed in decimal fractions of the full load taken as unity. The efficiency on one-tenth of full load is generally a fairly good criterion of the economy of the transformer as a transforming agency. In large transformers the one-tenth load efficiency will reach 90% or more, and in small transformers 75 to 80%. The general form of the efficiency curve for a closed circuit transformer is shown in fig. 4. The horizontal distances represent fractions of full secondary load (represented by unity), and the vertical distances efficiency in percentages. The efficiency curve has a maximum value corresponding to that degree of load at which the copper losses in the transformer are equal to the iron losses.

In the case of modern closed magnetic circuit transformers the copper losses are proportional to the square of the secondary current (I_2) or to qI_2^2, where $q=R_1a^2+R_2$; R_1 being the resistance of the primary and R_2 that of the secondary circuit, while a is the ratio of the number of secondary and primary windings of the transformer. Let C stand for the core loss, and V_2 for the secondary terminal potential difference (R.M.S. value). We can then write as an expression for the efficiency (η) of the transformer ($\eta=I_2V_2/(C+qI_2^2+I_2V_2)$). It is easy to show that if C_1, V_2 and q are constants, but I_2 is variable, the above expression for η has a maximum value when $C-qI_2^2=O$, that is, when the iron core loss $C=$ the total copper losses qI_2^2.

Iron and Copper Losses.

The iron core energy-waste, due to the hysteresis and eddy currents, may be stated in watts, or expressed as a fraction of the full load secondary output. In small transformers of 1 to 3 kilowatts output it may amount to 2 or 3%, and in large transformers of 10 to 50 kilowatts and upwards it should be 1 or less than 1%. Thus the core loss of a 30-kilowatt transformer (one having a secondary output of 30,000 watts) should not exceed 250 watts. It has been shown that for the constant potential transformer the iron core loss is constant at all loads, but diminishes slightly as the core temperature rises. On the other hand, the copper losses due to the resistance of the copper circuits increase about 0·4% per degree C. with rise of temperature. The current taken in at the primary side of the transformer, when the secondary circuit is unclosed, is called the *magnetizing current*, and the power then absorbed by the transformer is called the *open circuit loss* or magnetizing watts. The ratio of the terminal potential difference at the primary and secondary terminals is called the *transformation ratio* of the transformer. Every transformer is designed to give a certain transformation ratio, corresponding to some particular primary voltage. In some cases transformers are designed to transform, not potential difference, but current in a constant ratio. The product of the root-mean-square (R.M.S.), effective or virtual, values of the primary current, and the primary terminal potential difference, is called the *apparent power* or apparent watts given to the transformer. The true electrical power may be numerically equal to this product, but it is never greater, and is sometimes less. The ratio of the true power to the apparent power is called the *power factor* of the transformer. The power factor approaches unity in the case of a closed circuit transformer, which is loaded non-inductively on the secondary circuit to any considerable fraction of its full load, but in the case of an open circuit transformer the power factor is always much less than unity at all loads. Power factor curves show the variation of power factor with load. Examples of these curves were first given by J. A. Fleming, who suggested the term itself (see *Jour. Inst. Elec. Eng. Lond.*, 1892, 21, p. 606). A low power factor always implies a magnetic circuit of large reluctance.

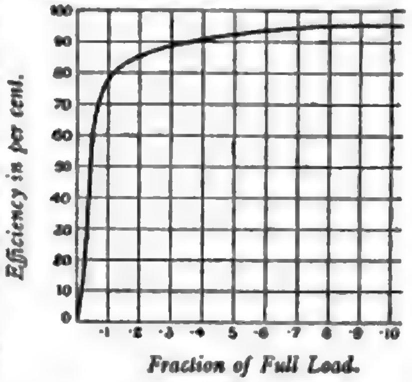

FIG. 4.—Typical Efficiency Curve of Closed Circuit Transformer.

The operation of the alternating current is then as follows: the periodic magnetizing force of the primary circuit creates a periodic magnetic flux in the core, and this being linked with the primary circuit creates by its variation what is called the back electromotive force in the primary circuit. The variation of the particular portion of this periodic flux, linked with the secondary circuit, originates in this last a periodic electromotive force. The whole of the flux linked with the primary circuit is not interlinked with the secondary circuit. The difference is called the *magnetic leakage* of the transformer. This leakage is increased with the secondary output of the transformer and with any disposition of the primary and secondary coils which tends to separate them. The leakage exhibits itself by increasing the *secondary drop*. If a transformer is worked at a constant primary potential difference, the secondary terminal potential difference at no load or on open secondary circuit is greater than it is when the secondary is closed and the transformer giving its full output. The difference between these last two differences of potential is called the secondary drop. This secondary drop should not exceed 2% of the open secondary circuit potential difference.

Appraisement.

The facts required to be known about an alternating current transformer to appraise its value are (1) its full load secondary output or the numerical value of the power it is designed to transform, on the assumption that it will not rise in temperature more than about 60° C. above the atmosphere when in normal use; (2) the primary and secondary terminal voltages and currents, accompanied by a statement whether the transformer is intended for producing a constant secondary voltage or a constant secondary current; (3) the efficiency at various fractions on secondary load from one-tenth to full load taken at a stated frequency; (4) the power factor at one-tenth of full load and at full load; (5) the secondary drop between full load and no load; (6) the iron core loss, also the magnetizing current, at the normal frequency; (7) the total copper losses at full load and at one-tenth of full load; (8) the final temperature of the transformer after being left on open secondary circuit but normal primary potential for twenty-four hours, and at full load for three hours.

The matters of most practical importance in connexion with an alternating current transformer are (1) the iron core loss, which affects the efficiency chiefly, and must be considered (*a*) as to its initial value, and (*b*) as affected by "ageing" or use; (2) the secondary drop or difference of secondary voltage between full and no load, primary voltage being constant, since this affects the service and power of the transformer to work in parallel with others; and (3) the temperature rise when in normal use, which affects the insulation and life of the transformer. The shellacked cotton, oil and other materials with which the transformer circuits are insulated suffer a deterioration in insulating power if continuously maintained at any temperature much above 80° C. to 100° C. In taking the tests for core loss and drop, the temperature of the transformer should therefore be stated. The iron losses are reduced in value as temperature rises and the copper losses are increased. The former may be 10 to 15% less and the latter 20% greater than when the transformer is cold. For the purpose of calculations we require to know the number of turns on the primary and secondary circuits, represented by N_1 and N_2; the resistances of the primary and secondary circuits, represented by R_1 and R_2; the volume (V) and weight (W) of the iron core; and the mean length (L) and section (S) of the magnetic section. The hysteresis loss of the iron reckoned in watts per lb per 100 cycles of magnetization per second and at a maximum flux density of 2500 C.G.S. units should also be determined.

Testing.

The experimental examination of a transformer involves the measurement of the efficiency, the iron core loss, and the secondary drop; also certain tests as to insulation and heating, and finally an examination of the relative phase position and graphic form of the various periodic quantities, currents and electromotive forces taking place in the transformer. The efficiency is best determined by the employment of a properly constructed wattmeter (see WATTMETER). The transformer T (fig. 5) should be so arranged that, if a constant potential transformer, it is supplied with its normal working pressure at the primary side and with a load which can be varied, and which is obtained either by incandescent lamps, L, or resistances in the secondary circuit. A wattmeter, W, should be placed with its series coil, Se, in the primary circuit of the transformer, and its shunt coil, Sh, either across the primary mains in series, with a suitable non-inductive resistance, or connected to the secondary circuit of another transformer, T^1, called an *auxiliary transformer*, having its primary terminals connected to those of the transformer under test. In the latter case one or more incandescent lamps, L, may be connected in series with the shunt coil of the wattmeter so as to regulate the current passing through it. The current through the series coil of the wattmeter is then the same as the current through the primary circuit of the transformer under test, and the current through the shunt coil of the wattmeter is in step with, and proportional to, the primary voltage of the transformer. Hence the wattmeter reading is proportional to the mean power given up to the transformer. The wattmeter can be standardized and its scale reading interpreted by replacing the transformer under test by a non-inductive resistance or series of lamps, the power absorption of which is measured by the product of the amperes and volts supplied to it. In the secondary circuit of the transformer is placed another wattmeter of a similar kind, or, if the load on the secondary circuit is non-inductive, the secondary voltage and the secondary current can be measured with a proper alternating current ammeter, A_2, and voltmeter, V_2, and the product of these readings taken as a measure of the power given out by the transformer. The ratio of the powers, namely, that given out in the external secondary circuit and that taken in by the primary circuit, is the efficiency of the transformer.

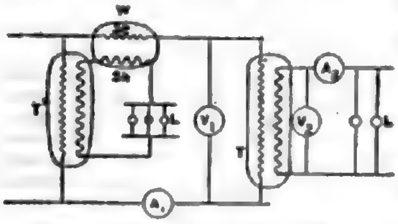

FIG. 5.—Arrangement for Testing Transformers.

In testing large transformers, when it is inconvenient to load up the secondary circuit to the full load, a close approximation to the power taken up at any assumed secondary load can be obtained by adding to the value of this secondary load, measured in watts, the iron core loss of the transformer, measured at no load, and the copper losses calculated from the measured copper resistances when the transformer is hot. Thus, if C is the iron core loss in watts, measured on open secondary circuit, that is to say, is the power given to the transformer at normal frequency and primary voltage, and if R_1 and R_2 are the primary and secondary circuit resistances when the transformer has the temperature it would have after running at full load for two or three hours, then the efficiency can be calculated as follows: Let O be the nominal value of the full secondary output of the transformer in watts, V_1 and V_2 the terminal voltages on the primary and secondary side, N_1 and N_2 the number of turns, and A_1 and A_2 the currents for the two circuits; then O/V_2 is the full load secondary current measured in amperes, and N_2N_1 multiplied by O/V_2 is to a sufficient approximation the value of the corresponding primary current. Hence O^2R_2/V_2^2 is the watts lost in the secondary circuit due to copper resistance, and $O^2R_1N_2^2/V_2^2N_1^2$ is the corresponding loss in the primary circuit. Hence the total power loss in the transformer (=L) is such that

$$L = C + \frac{O^2}{V_2^2}R_2 + \left(\frac{N_2}{N_1}\right)^2 \frac{O^2}{V_2^2}R_1 = C + (R_2 + R_1a^2)O^2/V_2^2.$$

Therefore the power given up to the transformer is O+L, and the efficiency is the fraction O/(O+L) expressed as a percentage. In this manner the efficiency can be determined with a considerable degree of accuracy in the case of large transformers without actually loading up the secondary circuit. The secondary drop, however, can only be measured by loading the transformer up to full load, and, while the primary voltage is kept constant, measuring the potential difference of the secondary terminals, and comparing it with the same difference when the transformer is not loaded. Another method of testing large transformers at full load without supplying the actual power is by W. E. Sumpner's differential method, which can be done when two equal transformers are available (see Fleming, *Handbook for the Electrical Laboratory and Testing Room*, ii. 602).

Ageing.

No test of a transformer is complete which does not comprise some investigation of the "ageing" of the core. The slow changes which take place in the hysteretic quality of iron when heated, in the case of certain brands, give rise to a time-increase in iron core loss. Hence a transformer which has a core loss, say, of 300 watts when new, may, unless the iron is well chosen, have its core loss increased from 50 to 300% by a few months' use. In some cases specifications for transformers include fines and deductions from price for any such increase; but there has in this respect been great improvement in the manufacture of iron for magnetic purposes, and makers are now able to obtain supplies of good magnetic iron or steel with non-ageing qualities. It is always desirable, however, that in the case of large sub-station transformers tests should be made at intervals to discover whether the core loss has increased by ageing. If so, it may mean a very considerable increase in the cost of magnetizing power. Consider the case of a 30-kilowatt transformer connected to the mains all the year round; the normal core loss of such a transformer should be about 300 watts, and therefore, since there are 8760 hours in the year, the total annual energy dissipated in the core should be 2628 kilowatt hours. Reckoning the value of this electric energy at only one penny per unit, the core loss costs £10, 19s. per annum. If the core loss becomes doubled, it means an additional annual expenditure of nearly £11. Since the cost of such a transformer would not exceed £100, it follows that it would be economical to replace it by a new one rather than continue to work it at its enhanced core loss.

In Great Britain the sheet steel or iron alloy used for the transformer cores is usually furnished to specifications which state the maximum hysteresis loss to be allowed in it in watts per lb (avoirdupois) at a frequency of 50, and at a maximum flux-density during the cycle of 4000 C.G.S. units. When plates having a thickness t mils are made up into a transformer core, the total energy loss in the core due to hysteresis and eddy current loss when worked at a frequency n and a maximum flux-density during the cycle B is given by the empirical formulae

$$T = \cdot 0032nB^{1\cdot 55}10^{-7} + (tnB)^2 10^{-15},$$

or

$$T^1 = 0\cdot 88nB_1^{1\cdot 55}10^{-9} + 1\cdot 4(t_1nB_1)^2 10^{-10},$$

where T stands for the loss per cubic centimetre, and T_1 for the same in watts per pound of iron core, B for the maximum flux-density in lines per square centimetre, and B_1 for the same in lines per square inch, t for the thickness of the plates in thousandths of an inch (mils), and t_1 for the same in inches. The hysteresis loss varies as some power near to 1·6 of the maximum flux-density during the cycle as shown by Steinmetz (see ELECTROMAGNETISM). Since the hysteresis loss varies as the 1·6th power of the maximum flux-density during the cycle (B max.), the advantages of a low flux-density are evident. An excessively low flux-density increases, however, the cost of the core and the copper by increasing the size of the transformer. If the form factor (f) of the primary voltage curve is known, then the maximum value of the flux-density in the core can always be calculated from the formula $B = E_1/4fnSN_1$, where E is the R.M.S. value of the primary voltage, N_1 the primary turns, S the section of the core, and n the frequency.

Curve Tracing.

The study of the processes taking place in the core and circuits of a transformer have been greatly facilitated in recent years by the improvements made in methods of observing and recording the variation of periodic currents and electromotive forces. The original method, due to Joubert, was greatly improved and employed by Ryan, Bell, Duncan and Hutchinson, Fleming, Hopkinson and Rosa, Callendar and Lyle; but the most important improvement was the introduction and invention of the oscillograph by Blondel, subsequently improved by Duddell, and also of the ondograph of Hospitalier (see OSCILLOGRAPH). This instrument enables us, as it were, to look inside a transformer, for which it, in fact, performs the same function that a steam engine indicator does for the steam cylinder.[1] Delineating in this way the curves of primary and secondary current and primary and secondary electromotive forces, we get the following result: Whatever may be the form of the curve of primary terminal potential difference, or primary voltage, that of the secondary voltage or terminal potential difference is an almost exact copy, but displaced 180° in phase. Hence the alternating current transformer reproduces on its secondary terminals all the variations of potential on the primary, but changed in scale. The curve of primary current when the transformer is an open secondary circuit is different in form and phase, lagging behind the primary voltage curve (fig. 6); but if the transformer is loaded up on its secondary side, then the primary current curve comes more into step with the primary voltage curve. The secondary current curve, if the secondary load is non-inductive, is in step with the secondary voltage curve (fig. 7). These transformer diagrams yield much information as to the nature of the operations proceeding in the transformer.

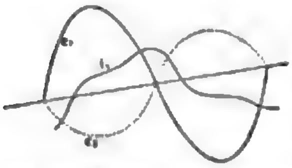

FIG. 6.—Transformer Curves at no load.

e_1, Primary voltage curve; i_1, Primary current curve; e_2, Secondary voltage curve.

The form of the curve of primary current at no secondary load is a consequence of the hysteresis of the iron, combined with the fact that the form of the core flux-density curves of the transformer is always not far removed from a simple sine curve. If e_1 is at any moment the electromotive force, i_1 the current on the primary circuit, and b_1 is the flux-density in the core, then we have the fundamental relation $e_1 = R_1i_1 + SN_1\ db_1/dt$, where R_1 is the resistance of the primary, and N_1 the number of turns, and S is the cross-section of the core. In all modern closed circuit transformers the quantity R_1i_1 is very small compared with the quantity $SNdb/dt$ except at one instant during the phase, and in taking the integral of the above equation, viz. in finding the value of $\int e_1dt$, the integral of the first term on the right-hand side may be neglected in comparison with the second. Hence we have approximately $b_1 = (SN_1)^{-1}\int e_1dt$. In other words, the value of the flux-density in the core is obtained by integrating the area of the primary voltage curve. In so doing the integration must be started from the time point through which passes the ordinate bisecting the area of the primary voltage curve. When any curve is formed such that its ordinate y is the integral of the area of another curve, viz. $y = \int y^1dx$, the first curve is always smoother and more regular in form than the second. Hence the process above described when applied to a complex periodic curve, which can by Fourier's theorem be resolved into a series of simple periodic curves, results in a relative reduction of the magnitude of the higher harmonics compared with the fundamental term, and hence a wiping out of the minor irregularities of the curve. In actual practice the curve of electromotive force of alternators can be quite sufficiently reproduced by employing three terms of the expansion, viz. the first three odd harmonics, and the resulting flux-density curve is always very nearly a simple sine curve.

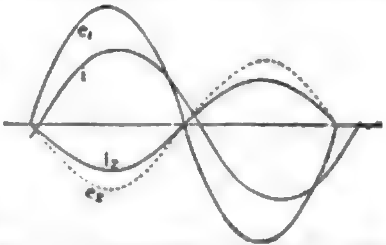

FIG. 7.—Transformer Curves at full load.

e_1, Primary voltage curve; i_1, Primary current curve; e_2, Secondary voltage curve; i_2, Secondary current curve.

We have then the following rules for predetermining the form of the current curve of the transformer at no load, assuming that the hysteresis curve of the iron is given, set out in terms of flux-density and ampere-turns per centimetre, and also the form of the curve of primary electromotive force. Let the time base line be divided up into equal small elements. Through any selected point draw a line perpendicular to the base line. Bisect the area enclosed by the curve representing the half wave of primary electromotive force and the base line by another perpendicular. Integrate the area enclosed between the electromotive force curve and these two perpendicular lines and the base. Lastly, set up a length on the last perpendicular equal to the value of this area divided by the product of the cross-section of the core and the number of primary turns. The resulting value will be the core flux-density b at the phase instant corresponding. Look out on the hysteresis loop the same flux-density value, and corresponding to it will be found two values of the magnetizing force in ampere-turns per centimetre, one the value for increasing flux-density and one for decreasing. An inspection of the position of the point of time selected on the time line will at once show which of these to select. Divide that value of the ampere-turns per centimetre by the product of the values of the primary turns and the mean length of the magnetic circuit of the core of the transformer, and the result gives the value of the primary current of the transformer. This can be set up to scale on the perpendicular through the time instant selected. Hence, given the form of the primary electromotive force curve and that of the hysteresis loop of the iron, we can draw the curves representing the changes of flux-density in the core and that of the corresponding primary current, and thus predict the root-mean-square value of the magnetizing current of the transformer. It is therefore possible, when given the primary electromotive force curve and the hysteresis curve of the iron, to predetermine the curves depicting all the other variables of the transformer, provided that the magnetic leakage is negligible.

Elementary Theory.

The elementary theory of the closed iron circuit transformer may be stated as follows: Let N_1, N_2 be the turns on the primary and secondary circuits, R_1 and R_2 the resistances, S the section of the core, and b_1 and b_2 the co-instantaneous values of the flux-density just inside the primary and secondary windings. Then, if i_1 and i_2 and e_1 and e_2 are the primary and secondary currents and potential differences at the same instant, these quantities are connected by the equations

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[1] For a useful list of references to published papers on alternating current curve tracing, see a paper by W. D. B. Duddell, read before the British Association, Toronto, 1897; also *Electrician* (1897), xxxix. 636; also *Handbook for the Electrical Laboratory and Testing Room* (J. A. Fleming), i. 4c7.

$$e_1 = R_1 i_1 + SN_1 \frac{db_1}{dt},\ e_2 = SN_2 \frac{db_2}{dt} - R_2 i_2.$$

Hence, if $b_1 = b_2$, and if $R_1 i_1$ is negligible in comparison with $SN_1 db/dt$, and $i = 0$, that is, if the secondary circuit is open, then $e_1/e_2 = N_1/N_2$, or the transformation ratio is simply the ratio of the windings. This, however, is not the case if b_1 and b_2 have not the same value; in other words, if there is magnetic leakage. If the magnetic leakage can be neglected, then the resultant magnetizing force, and therefore the iron core loss, is constant at all loads. Accordingly, the relation between the primary current (i_1), the secondary current (i_2), and the magnetizing current (i), or primary current at no load, is given by the equation $N_1 i_1 - N_2 i_2 = N_1 i$. Then, writing b for the instantaneous value of the flux-density in the core, everywhere supposed to be the same, we arrive at the identity

$$e_1 i_1 = e_2 i_2 + (R_1 i_1^2 + R_2 i^2) + S\frac{db}{dt}(N_1 i_1 - N_2 i_2).$$

This equation merely expresses the fact that the power put into the transformer at any instant is equal to the power given out on the secondary side together with the power dissipated by the copper losses and the constant iron core loss.

The efficiency of a transformer at any load is the ratio of the mean value, during the period, of the product $e_2 i_2$ to that of the product $e_1 i_1$. The efficiency of an alternating current transformer is a function of the form of the primary electromotive force curve. Experiment has shown[1] that if a transformer is tested for efficiency on various alternators having electromotive force curves of different forms, the efficiency values found at the same secondary load are not identical, those being highest which belong to the alternator with the most peaked curve of electromotive force, that is, the curve having the largest *form factor*. This is a consequence of the fact that the hysteresis loss in the iron depends upon the manner in which the magnetization (or what here comes to the same thing, the flux-density in the core) is allowed to change. If the primary electromotive force curve has the form of a high peak, or runs up suddenly to a large maximum value, the flux-density curve will be more square-shouldered than when the voltage curve has a lower form factor. The hysteresis loss in the iron is less when the magnetization changes its sign somewhat suddenly than when it does so more gradually. In other words, a diminution in the form factor of the core flux-density curve implies a diminished hysteresis loss. The variation in core loss in transformers when tested on various forms of commercial alternator may amount to as much as 10%. Hence, in recording the results of efficiency tests of alternating current transformers, it is always necessary to specify the form of the curve of primary electromotive force. The power factor of the transformer or ratio of the true power absorption at no load, to the product of the R.M.S. values of the primary current and voltage, and also the secondary drop of the transformer, vary with the form factor of the primary voltage curve, being also both increased by increasing the form factor. Hence there is a slight advantage in working alternating current transformers off an alternator giving a rather peaked or high maximum value electromotive force curve. This, however is disadvantageous in other ways, as it puts a greater strain upon the insulation of the transformer and cables. At one time a controversy arose as to the relative merits of closed and open magnetic circuit transformers. It was, however, shown by tests made by Fleming and by Ayrton on Swinburne's "Hedgehog" transformers, having a straight core of iron wires bristling out at each end, that for equal secondary outputs, as regards efficiency, open as compared with closed magnetic circuit transformers had no advantage, whilst, owing to the smaller power factor and consequent large R.M.S. value of the magnetizing current, the former type had many disadvantages (see Fleming, "Experimental Researches on Alternate Current Transformers," *Journ. Inst. Elec. Eng.*, 1892).

The discussion of the theory of the transformer is not quite so simple when magnetic leakage is taken into account. In all cases a certain proportion of the magnetic flux linked with the primary circuit is not linked with the secondary circuit, and the difference is called the magnetic leakage. This magnetic leakage constitutes a wasted flux which is non-effective in producing secondary electromotive force. It increases with the secondary current, and can be delineated by a curve on the transformer diagram in the following manner. The curves of primary and secondary electromotive force, or terminal potential difference and current, are determined experimentally, and then two curves are plotted on the same diagram which represent the variation of $(e_1 - R_1 i_1)/N_1$ and $(e_2 + R_2 i_2)/N_2$; these will represent the time differentials of the total magnetic fluxes Sb_1 and Sb_2 linked respectively with the primary and secondary circuits. The above curves are then progressively integrated, starting from the time point through which passes the ordinate bisecting the area of each half wave, and the resulting curves plotted to express by their ordinates Sb_1 and Sb_2. A curve is then plotted whose ordinates are the differences $Sb_1 - Sb_2$, and this is the curve of magnetic leakage.

Magnetic Leakage.

The existence of magnetic leakage can be proved experimentally by a method due to Mordey, by placing a pair of thermometers, one of mercury and the other of alcohol, in the centre of the core aperture. If there is a magnetic leakage, the mercury bulb is heated not only by radiant heat, but by eddy currents set up in the mercury, and its rise is therefore greater than that of the alcohol thermometer. The leakage is also determined by observing the secondary voltage drop between full load and no load, and deducting from it the part due to copper resistance; the remainder is the drop due to leakage. Thus if V_2 is the secondary voltage on open circuit, and V_2^1 that when a current A_2 is taken out of the transformer, the leakage drop v is given by the equation

$$v = (V_2 - V_2^1) - \{R_2 A_2 + R_1 A_2 (N_2/N_1)^2\}.$$

The term in the large bracket expresses the drop in secondary voltage due to the copper resistance of the primary and secondary circuits.

In drawing up a specification for an alternating current transformer, it is necessary to specify that the maximum secondary drop between full and no load to be allowed shall not exceed a certain value, say 2% of the no-load secondary voltage; also that the iron core loss as a percentage of the full secondary output shall not exceed a value, say, of 1% after six months' normal work.

Transformer Design.

In the design of large transformers one of the chief points for attention is the arrangement for dissipating the heat generated in their mass by the copper and iron losses. For every watt expended in the core and circuit, a surface of 3 to 4 sq. in. must be allowed, so that the heat may be dissipated. In large transformers it is usual to employ some means of producing a current of air through the core to ventilate it. In these, called *air-blast transformers*, apertures are left in the core by means of which the cooling air can reach the interior portions. This air is driven through the core by a fan actuated by an alternating current motor, which does not, however, take up power to a greater extent than about $\frac{1}{4}$ or $\frac{1}{16}$% of the full output of the transformer, and well repays the outlay.

In some cases transformers are *oil-insulated*, that is to say, included in a cast-iron box which is filled in with a heavy insulating oil. For this purpose an oil must be selected free from mineral acids and water: it should be heated to a high temperature before use, and tested for dielectric strength by observing the voltage required to create a spark between metal balls immersed in it at a distance of 1 millimetre apart. Oils, however, are inferior in dielectric strength or spark-resisting power to solid dielectrics, such as micanite, ebonite, &c., as shown by the above table of dielectric strengths (see T. Gray, *Phys. Rev.*, 1898, p. 199).

Material.	Dielectric strength in kilowatts per centimetre.	Material.	Dielectric strength in kilowatts per centimetre.
Glass	285	Lubricating oil	83
Ebonite	538	Linseed oil	67
Indiarubber	492	Cotton-seed oil	57
Mica	2000	Air film ·02 cm. thick	27
Micanite	4000	Air film 1·6 cm. thick	48
American linen paper paraffined	540		

Polyphase Transformers are appliances of similar construction to the single-phase transformers already described, but modified so as to enable them to transform two or more phase-related primary alternating currents into similar secondary currents. Thus, a three-phase transformer may be constructed with a core, as shown in fig. 8. Each core leg is surrounded with a primary coil, and these are joined up either in star or delta fashion, and connected to the three or four line wires. The secondary circuits are then connected in a similar fashion to three or four secondary lines. In the case of two-phase transmission with two separate pairs of leads, single-phase transformers may be

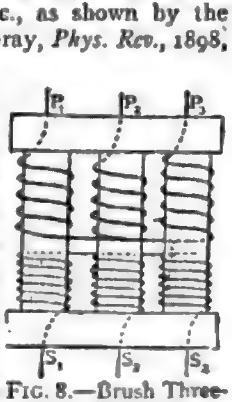

FIG. 8.—Brush Three-phase Transformer.

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[1] See Dr G. Roessler, *Electrician* (1895), xxxvi. 150; Beeton, Taylor and Barr, *Journ. Inst. Elec. Eng.* xxv. 474; also J. A. Fleming, *Electrician* (1894), xxxiii. 580.

employed in each branch, but with two-phase three-wire supply, two-phase transformers must be supplied.

Phase Transformers are arrangements of static or rotary transformers intended to transform single-phase alternating currents into polyphase currents. An important system of phase transformation has been described by C. F. Scott.[1] It is known that if two alternating electromotive forces differing in phase are connected in series, the resulting electromotive force will in general differ in phase and value from either of the components. Thus, if two alternating electromotive forces differing 90° in phase, and having magnitudes in the ratio of $1:\sqrt{3}$, are connected in series, the resulting electromotive force will have a magnitude represented by 2, and the three can be represented by the sides of a triangle which is half an equilateral triangle. If then a two-phase alternator, D (fig. 9), provides two-phase currents, and if the two circuits are connected, as shown, to a pair of single-phase transformers, T_1 and T_2, we can obtain three-phase alternating currents from the arrangement. The primaries of both transformers are the same. The secondary circuit of one transformer, T_2, has, say, 100 turns, and a connexion is made to its middle point O, and this is connected to the secondary of the other transformer which has 87 $(=50\sqrt{3})$ turns. From the points A, B, C we can then tap off three-phase alternating currents. The advantages of the Scott system are that we can transform two-phase alternating currents into three-phase for transmission, and then by a similar arrangement retransform back again into two-phase for use. In this manner an economy of 25% in copper is effected, for instead of four transmission lines we have only three. The system adapts itself for the transmission of currents both for power in driving three-phase motors and for working incandescent lamps. A somewhat similar system has been designed by C. P. Steinmetz for producing three-phase currents from single-phase (see *Electrician*, xliii. 236). When a number of alternating electromotive forces are maintained in a closed circuit, the sum of all must be zero, and may be represented by the sides of a closed polygon. The fundamental principle of Mr Steinmetz's invention consists in so choosing the number of these electromotive forces that the polygon must remain stable. Thus, if three single-phase alternators are driven independently at constant speed and excitation, and if they are joined in series, then three wires led away from the junction points will provide three-phase currents to a system from which lamps and motors may be worked.

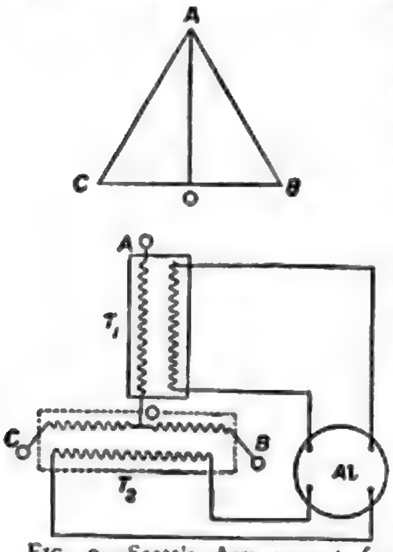

FIG. 9.—Scott's Arrangement for Transformation of Two-phase to Three-phase Currents.

Reference must be made to the continuous current transformer. The conversion of a continuous current supplied, say, at 100 volts, into one having an electromotive force of 10 volts, can of course be achieved by coupling together on the same bedplate a suitable electric motor and a dynamo. The combination is called a *motor-dynamo set*, and each machine preserves its own identity and peculiarity. The same result may, however, be accomplished by winding two separate armature circuits on one iron core, and furnishing each with its own commutator. The two circuits are interlaced or wound on together. An arrangement of this kind constitutes a *rotatory* or *rotary transformer*, or continuous current transformer. It has the advantage of greater cheapness and efficiency, because one field magnet serves for both armature windings, and there is only one armature core and one pair of bearings; moreover, no shift or lead of the brushes is required at various loads. The armature reactions of the two circuits annul each other. Machines of this description are self-starting, and can be constructed to take in primary current at high pressures, say 1000 to 2000 volts, and yield another larger current of much lower voltage, say 100 or 150 volts, for use with electric lamps. They are used in connexion with public electric supply by continuous current in many places.

Continuous Current Transformers.

Another important class of rotatory transformer is that also called a *rotatory converter*, by means of which continuous current is translated into alternating current of one-, two- or three-phase, or vice versa. The action of such an appliance may best be understood by considering the simple case of a Gramme ring armature (see DYNAMO) having, in addition to its commutator, a pair of insulated rings on its shaft connected with opposite ends of the armature winding (fig. 10). If such a ring is placed in a bipole field magnet, and if a pair of brushes make contact with the commutator C and another pair with the two rings called slip rings, S_1 S_2, and if continuous current at a constant voltage is supplied to the commutator side, then the armature will begin to revolve in the field, and from the brushes in contact with the slip rings we can draw off an alternating current. This reaches its maximum value when the points of contact of the rings with the armature circuit pass the axis of commutation, or line at right angles to the direction of the magnetic field, for it has at this moment a value which is double the steady value of the continuous current being poured into the armature. The maximum value of the electromotive force creating this alternating current is nearly equal to the electromotive force on the continuous current side. Hence if A is the maximum value of the continuous current put into the armature and V is the value of the brush potential difference on the continuous current side, then 2A is the maximum value of the outcoming alternating current and V is the maximum value of its voltage. Hence $2AV/2=AV$ is the maximum value of the outcoming alternating current power, and if we neglect the loss in the armature for the moment, the power given out is equal to the power put in. Hence, assuming a simple harmonic law of variation, the effective value of the alternating current voltage is $V/\sqrt{2}$, and that of the alternating current is $2A\sqrt{2}$. This conclusion follows at once from the fact that the mean value of the square of a sine function is half its maximum value, and hence the R.M.S. value is $1/\sqrt{2}$ times the maximum value. The outcoming alternating current has its zero value at the instant when the ends of the diameter of the axis to which the rings are connected are in the direction of the magnetic field of the transformer. Hence the power output on the alternating current side varies from a maximum value AV to zero. The rotatory transformer thus absorbs continuous current power and emits it in a periodic form; accordingly, there is a continual storage and emission of energy by the armature, and therefore its kinetic energy is periodically varying during the phase. The armature is also creating a back-electromotive force which acts at some instants against the voltage driving the current into the armature and at others is creating an electromotive force that assists the external impressed voltage in driving a current through the alternating current side. If we put on another pair of insulated rings and connect them to points of the insulated diameter at right angles to the points of connexion of the first pair of rings, we can draw off another alternating current, the phase of which differs 90° from that of the first. Similarly, if we provide three rings connected to points removed 120° apart on the armature circuit, we can tap off a three-phase alternating current.

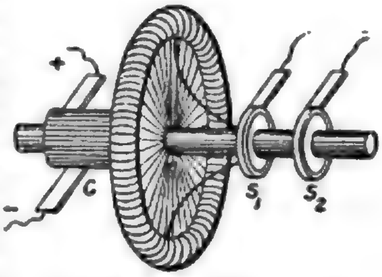

FIG. 10.—Rotary Converter, continuous to two-phase.

Returning to the case of the single-phase rotatory transformer, we may notice that at the instant when the outcoming alternating current is zero the armature is wholly engaged in absorbing power and is acting entirely as a motor. When the alternating current is a maximum, the armature on the other hand is acting as a generator and adds current to the current put into it. The ratio between the potential difference of the brushes on the continuous current side and the root-mean-square or effective value of the voltage between any pair of rings on the alternating current side is called the transformation ratio of the converter.

The following table, taken from a paper upon rotatory converters by S. P. Thompson (*Proc. Inst. Elec. Eng.*, November 1898), gives the voltage ratio or conversion ratio in the case of various forms of rotatory transformer:—

Number of slip rings.	Angle between points of connexions to armatures.	Type of current generated.	Voltage ratio.	Effective voltage on alternating current side as percentage of voltage on continuous current side.
2	180°	Single-phase	$\sqrt{2}:1$	70·71
3	120°	Three-phase	$2\sqrt{2}:\sqrt{3}$	61·23
4	90°	Two-phase	$\sqrt{2}:1$	70·71
4	90°	Four-phase	$2:1$	50
6	60°	Three-phase	$3\sqrt{3}:\sqrt{3}$	61·23
6	60°	Six-phase	$2\sqrt{2}:1$	35·35

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[1] *Proceedings of the National Electric Light Association* (Washington, U.S.A., 1894); also *Electrician* (1894), xxxii. 640.

Neglecting the energy losses in the armature, and assuming that the continuous current side of the transformer is supplied with 100 amperes, the following table, also taken from a paper by S. P. Thompson, shows the effective value of the current on the alternating side put out into each line:—

Number of slip rings.	Angle between points of connexion to armature.	Type of current generated.	Effective current put out on each line in amperes.
2	180°	Single-phase	141·4
3	120°	Three-phase	94·3
4	90°	Two-phase	70·7
6	60°	Six-phase	47·2

It is obvious that the same results of conversion can be obtained by coupling together two separate machines on the same shaft; thus we might obtain a single-phase alternating current from a continuous current by coupling together mechanically a continuous current motor and a single-phase alternator. Such a combination is generally called a *motor-dynamo.* In this case there are two field magnets and two separate armatures, and the hysteresis eddy current and copper losses are all in duplicate. If, however, the same armature winding is made to serve both purposes, the resulting machine is called a *rotatory* or *rotary converter.* In the former combination the brushes of the continuous current part require to be set with the usual lead or lag according as that part is generator or motor, but in the latter the armature reactions nearly annul each other, and lead or lag is no longer necessary.

Rectifiers.

Rectifiers are devices for transforming an alternating (generally single-phase) current into a continuous but pulsatory current. They may shortly be described as appliances for separating out each alternate current flux in an alternating current. An immense number of more or less imperfect methods of doing this have been proposed, and here we shall describe two which may be called respectively the mechanical and the electrolytic methods. Of the first class a good example is the Ferranti rectifier (fig. 11). This consists of a synchronous alternating current motor which is started up and driven in step with the alternator supplying the current. The motor drives a commutator of insulated segments, each alternate segment being connected to two insulated rings, against which press a pair of brushes. Another pair of brushes, so adjusted as to be in contact simultaneously with a pair of adjacent commutator segments, are in connexion with the alternator supplying the current to be commutated. The insulated rings are in connexion with the external circuit. It will easily be seen that when the commutator revolves at proper speed the currents delivered from the insulated rings are unidirectional. The Ferranti rectifier is much employed for rectifying alternating current for arc lighting purposes. With this object it is associated with a constant current transformer which converts alternating current supplied at constant potential to one supplied at constant current. This is achieved by taking advantage of the repulsive force existing between the primary and secondary circuits of a transformer. These are wound separately, and so balanced that any increase in the current presses them away from each other and so reduces the secondary current to normal value. Such an appliance is useful for rectifying currents up to 10 or 15 amperes.

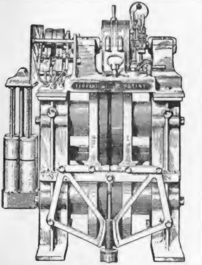


Fig. 11.—Ferranti Rectifier.

The electrolytic rectifier is based upon the fact that if plates of aluminium and carbon are placed in an electrolyte, say a solution of alum or dilute acids which yield oxygen on electrolysis, it is found that a current can be sent through the liquid from the carbon to the aluminium, but that great counter-electromotive force is created to a current in the opposite direction. Grätz and Pollak (*Elektrotechnische Zeitschrift*, 1897, 25, p. 359), taking advantage of this fact, have constructed a rectifying arrangement by arranging two series of carbon aluminium (CAl) cells with alum or hydro-potassic phosphate solution as electrolyte. In one set the order of the plates is (CAl), (CAl), &c., and in the other series (AlC), (AlC), counting from the same end. These series being connected in parallel, it follows that if an alternating current is sent through the parallel series all the currents in one direction pass through one battery and all those in the opposite direction through the other. Thus the constituents of the alternating current are separated out. By using very large cells so as to reduce the internal resistance, an efficiency of 95% is said to be obtained.

Theory of Electrolytic Rectifier.

There are many points in the operation of the electrolytic rectifier which have as yet been imperfectly explained. The action of the aluminium electrolytic rectifier, consisting as it does of an aluminium plate and a lead or carbon plate placed in an aqueous electrolyte, is to oppose a great obstruction to a current passing out of the aluminium plate, but little or no obstruction to the current passing into the aluminium plate, especially if the aluminium has been subjected to a previous treatment called *formation.* This unilateral conductivity is dependent on a certain voltage or potential difference between the plates not being exceeded, but within these limits a plate of carbon and aluminium placed in a solution, say of hydro-sodic phosphate, acts as an electrical *valve*, allowing current to pass in one direction but not in another. An examination of the aluminium plate after it has been so used shows that its appearance has changed and that its surface is covered by a thin film, the thickness of which varies with the electrolyte and the time of formation. After a certain period of use this film is seen as a grey, dull coating traversed by dark lines. It is impossible that the unilateral conductivity can be due to a true electrolytic polarization, because we know of no polarization of this latter kind which exceeds three volts, and the film can be made to resist the flow of a current under an electromotive force of 140 to 200 volts. The resistance of this film has been measured and found to be very high, so high as to be practically an insulation. Light was thrown upon the subject by F. Kohlrausch's discovery of the polarization capacity of metallic electrodes, and this discovery was applied to develop the theory of the aluminium cell by Streintz (1888), Scott (1899) and others.

This theory was expounded by K. Norden (*Electrician*, xlviii. 107). According to this view, the deposit covering the aluminium electrode forms the dielectric of a condenser. One plate of the condenser is formed by the aluminium plate and the other by an opposite layer of electrically-charged ions in the electrolyte. The dielectric film on the aluminium having been formed, the electromotive force of the circuit then charges the resulting condenser to the value of its own voltage, but immediately the impressed electromotive force is removed this condenser discharges itself. This condenser theory receives support from the behaviour of the aluminium cell when placed in the circuit of an alternating current dynamo, for it is found that in these circumstances the current through the cell is in advance in phase of the difference of potential. The question then arises, What is the nature of this insulating film? The first discoverer of the phenomenon (Buff) considered it to consist of silicon. Later Professor Beetz disproved this by experiment, and, with many others, assumed that a sub-oxide of aluminium was formed; but this has never been demonstrated in a satisfactory manner. By forming a sufficient quantity of the film Dr K. Norden was able to obtain sufficient of the material to make a chemical analysis, and this revealed the fact that it consists of normal aluminium hydroxide, $Al_2(OH)_6$.

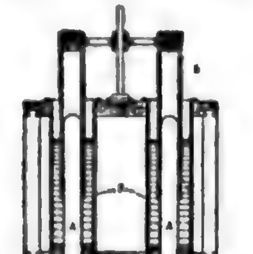
According to the facts above stated, one wave of the alternating current produces the insulating film by converting the surface of the aluminium into hydroxide, practically, therefore, blocking its own path very quickly by the creation of this film. If, then, the electromotive force reverses its direction the current immediately flows. According to Dr Norden, the rapid removal of the insulating film is due to the action of the electrolyte corroding or dissolving the weak points in the coating and thus breaking down its insulating power. The insulating film is therefore a conductor in one direction, but when the current is reversed and flows out of the aluminium plate the insulating film is renewed and is continually being repaired and kept in order. Thus different electrolytes yield aluminium valves having very different efficiencies.

Rectifying cells have been made by Pollak which will bear a voltage of over 140 volts, and which are said to have an efficiency of 75%. The plates, however, must be removed when not in use, otherwise the film of hydroxide is destroyed by the electrolyte. One great practical difficulty in connexion with the aluminium rectifier is the tendency to heat in working.

The historical development of the discovery of this unilateral conductivity of an electrolytic cell with an aluminium electrode is as follows. The effect was first noticed by Buff in 1857, but was not applied technically until 1874, when Ducretet employed it in telegraphy. Beret in 1877 and Streintz in 1887 discussed the theory of the cell and sought for an explanation. In 1891 Hutin and Leblanc, in their study of alternating current, showed its uses in rectifying an alternating current. Pollak and Grätz laboured to give it a practically useful form. Pollak took out patents in 1895, and made a communication to the Academy of Sciences in Paris in June 1897; and Grätz presented a memoir at a meeting of the German Association of Electrochemists in Munich in 1897. M. Blondin has summarized all the work so far done on the aluminium rectifier in two articles in *L'Éclairage électrique* (1898), xiv. 293, and xxviii. 117 (1901). The choice of an electrolyte is of great importance. Buff, Ducretet and Grätz employed dilute sulphuric acid, and the greatest difference of potential which could then be applied to the cell without breaking down its insulation in one direction was 20 volts. Pollak in 1896 found that when aqueous solutions of alkaline salts were used, and when the aluminium was subjected to a preliminary formation, the back electromotive force or what is equivalent to it could be raised to 140 or 200 volts. Pollak found that the best results were given by the use of phosphate of potassium or sodium. It appears, therefore, that the ions of K or Na effect the breaking down of the film of aluminium hydroxide more quickly than the ion of hydrogen. The practical form of aluminium rectifier, according to Pollak, consists of plates of thick aluminium and lead placed in a large deep glass vessel filled with a solution of potassium hydrogen phosphate.

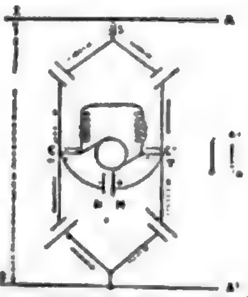
Nodon Valve.

In 1899 Albert Nodon of Paris began experimenting with an electric rectifier which is now on a commercial footing. It is known as the Nodon electric valve, and it is claimed that it will give an efficiency of 75 to 80% when used to transform single or polyphase currents into continuous currents. In the form used for transforming single-phase currents the valve is made up of 4 cells, each consisting of an iron cylinder with an insulating plug at the bottom through which is passed a cylinder formed of an alloy of zinc and aluminium. This cylinder is concentric with the iron tube and provided with a terminal at the lower end. The cell is filled with a saturated solution of ammonium phosphate, and a non-conducting shielding tube can be slid over the aluminium electrode to alter the exposed area.



(From the *Electrical Times*, by permission.)

Fig. 12.—Section through Nodon Valve.



(From the *Electrical Times*, by permission.)

Fig. 13.—Method of connecting the cells.

The valve is shown in section in fig. 12, and the 4 cells are arranged in a Wheatstone's Bridge fashion, as shown in fig. 13. A and A^1 are the terminals to which the alternating current is supplied, C and C^1 the terminals from which the continuous current is drawn off. The electrolytic actions which take place in the cells are as follows: When the alternating current passes in the positive direction from the zinc-aluminium cylinder to the iron cylinder there is formed instantly on the former a film of aluminium hydroxide; this film, presenting an enormous resistance, opposes the passage of the current. On the other hand, if the current passes in the opposite direction the film is reduced instantly and the current now flows. When used with polyphase currents the valve comprises as many times two cells as there are wires in the distribution. The cells must stand a pressure varying from 50 to 140 volts, and for higher pressures two or more valves in series are employed.

Vacuum or Vapour Rectifiers.

The aluminium-iron electrolytic rectifier is not suitable for the rectification of very high frequency currents, because the chemical actions on which it depends involve a time element. It was, however, discovered by J. A. Fleming that an oscillation valve could be constructed for rectifying electrical oscillations, as follows (see *Proc. Roy. Soc. Lond.*, 1905, 74, p. 476): In a glass bulb similar to that of an incandescent lamp a carbon filament is fixed. Around the carbon filament, but not touching it, is placed a cylinder of nickel connected to an external terminal by means of platinum wire sealed through the glass. If the carbon filament is made incandescent by an insulated battery (and for this purpose it is convenient to have the filament adjusted to be fully incandescent at a pressure of about 12 volts), then the space between the incandescent filament and the embracing cylinder possesses a unilateral conductivity such that negative electricity can pass from the incandescent filament to the cylinder but not in the opposite direction. Hence if the negative terminal of the filament and the terminal attached to the cylinder are connected to an oscillation transformer (see Induction Coil) which supplies a high frequency alternating oscillatory current, the flow of electricity in one direction is cut out and the oscillatory current is therefore converted into a continuous current. Such valves have been employed by Fleming in connexion with wireless telegraphy. Wehnelt discovered that if a platinum wire was covered with oxide of barium or any of the oxides of rare earth metals, it possessed in the same manner, when used in a valve of the above type, an even greater power than incandescent carbon. The explanation of this action is to be sought for in the fact that incandescent carbon in a vacuum or incandescent earthy oxides copiously emit negative electrons.

A rectifier dependent upon the peculiar qualities of mercury vapour has been devised by Cooper-Hewitt for the transformation of polyphase currents into continuous currents. The three-phase transformer is made as follows: A large glass bulb (see fig. 14) has four iron electrodes sealed through the walls as positive electrodes and a negative electrode consisting of a pool of mercury in the bottom of the bulb connected with platinum wires sealed through the glass; the bulb is highly exhausted and contains only mercury vapour. The three iron electrodes are connected to the terminals of a star-connected polyphase transformer and one of them to the positive pole of a continuous current starting current, the connexions being shown as in fig. 15. The mercury vapour is a non-conductor for low voltages, but if a sufficiently high voltage is placed on the mercury bulb by means of the continuous current it begins to conduct and if the three-phase current is then switched on the mercury vapour will allow the components of the three-phase current to pass when the mercury electrode is negative, not when it is positive. Hence for alternate current wave of the three-phase, supply is cut down and a continuous current can be drawn by the connexions as shown in fig. 15 for the purposes of supplying secondary batteries, arc lamps, &c.

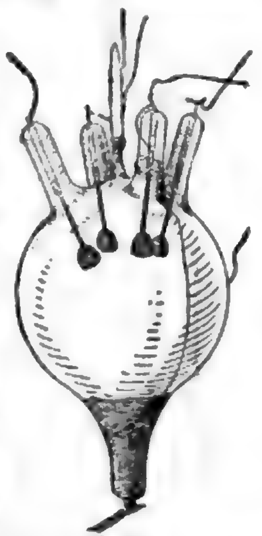


Fig. 14.
Cooper-Hewitt Rectifier.

Owing to the fact that the mercury vapour ceases to conduct when the electromotive force on it falls below a certain critical value the valve will not work with single-phase currents but will work with polyphase currents at all voltage from 100 to 1000 or more and can transform as much as 100 amperes. It is stated to have an efficiency of 88 to 89%. (See *The Electrician*, 1903, 50, p. 510.)

A mechanical polyphase rectifier or rotary devised by Bragstad and La Cour is described in *Der Kaskadenumformer*, by E. Arnold and J. L. La Cour, Stuttgart, 1904. It consists of a three-phase induction motor coupled direct to a continuous current dynamo, the armatures of the two machines being electrically connected so that the three-phase current created in the rotor of the induction motor enters the continuous current armature and creates around it a rotary field. The connexions are such that the rotating field turns in a direction opposite to that in which the armature is turning, so that the field is stationary in space. From the continuous current armature can therefore be drawn off a continuous current and the device acts as a transformer of three-phase alternating current to a continuous current.

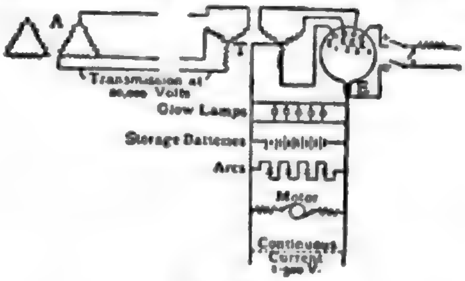


FIG. 15.

The ordinary induction coil (*q.v.*) may be regarded as the transformer for converting continuous current at low voltage into high voltage intermittent continuous current, but the difficulties of interrupting the primary current render it impossible to transform in this way more than a small amount of power. Where, however, high voltages are required, high potential transformers are used which are now built for the purpose of wireless telegraphy and the transformation of power to give secondary voltages up to 20,000, 30,000 or 60,000 volts. Transformers have even been built to give secondary voltages of half a million volts capable of giving a 14 in. spark in air. These machines, however, must be regarded as more physical laboratory instruments than appliances for technical work. For description of one such extra high potential transformer see H. B. Smith, on "Experiments on Transformers for Very High Potentials," *The Electrician* (1904), 54, p. 358. A transformer of this kind must invariably be an oil insulated transformer, as under extremely high voltage the air itself becomes a conductor and no solid insulator that can be put upon the wires is strong enough to stand the electric strain.

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TRANSIT CIRCLE, or MERIDIAN CIRCLE, an instrument for observing the time of a star's passing the meridian, at the same time measuring its angular distance from the zenith. The idea of having an instrument (quadrant) fixed in the plane of the meridian occurred even to the ancient astronomers, and is mentioned by Ptolemy, but it was not carried into practice until Tycho Brahe constructed a large meridian quadrant. This instrument enabled the observer to determine simultaneously right ascension and declination, but it does not appear to have been much used for right ascension during the 17th century, the method of equal altitudes by portable quadrants or measures of the angular distance between stars with a sextant being preferred. These methods were, however, very inconvenient, which induced Römer to invent the transit instrument about 1690. It consists of a horizontal axis in the direction east and west resting on firmly fixed supports, and having a telescope fixed at right angles to it, revolving freely in the plane of the meridian. At the same time Römer invented the altitude and azimuth instrument for measuring vertical and horizontal angles, and in 1704 he combined a vertical circle with his transit instrument, so as to determine both co-ordinates at the same time. This latter idea was, however, not adopted elsewhere, although the transit instrument soon came into universal use (the first one at Greenwich was mounted in 1721), and the mural quadrant continued till the end of the century to be employed for determining declinations. The advantage of using a whole circle, as less liable to change its figure, and not requiring reversal in order to observe stars north of the zenith, was then again recognized by Ramsden, who also improved the method of reading off angles by means of a micrometer microscope as described below. The making of circles was shortly afterwards taken up by Troughton, who in 1806 constructed the first modern transit circle for Groombridge's observatory at Blackheath, but he afterwards abandoned the idea, and designed the mural circle to take the place of the mural quadrant. In the United Kingdom the transit instrument and mural circle continued till the middle of the 19th century to be the principal instrument in observatories, the first transit circle constructed there being that at Greenwich (mounted in 1850) but on the continent the transit circle superseded them from the years 1818–1819, when two circles by Repsold and by Reichenbach were mounted at Göttingen, and one by Reichenbach at Königsberg.[1] The firm of Repsold was for a number of years eclipsed by that of Pistor and Martins in Berlin, who furnished various observatories with first-class instruments, but since the death of Martins the Repsolds have again taken the lead, and have of late years made many transit circles. The observatories of Harvard College (United States), Cambridge and Edinburgh have large circles by Troughton and Simms, who also made the Greenwich circle from the design of Airy.[2]

In the earliest transit instrument the telescope was not placed in the middle of the axis, but much nearer to one end, in order to prevent the axis from bending under the weight of the telescope. It is now always placed in the centre of the axis. The latter consists of one piece of brass or gun-metal with carefully turned cylindrical steel pivots at each end. Several recent instruments have been made entirely of steel, which is much more rigid than brass. The centre of the axis is shaped like a cube, the sides of which form the basis of two cones which end in cylindrical parts. The pivots rest on V-shaped bearings, either let into the massive stone or brick piers which support the instrument or attached to metal frameworks bolted on the tops of the piers. In order to relieve the pivots from the weight of the instrument, which would soon destroy their figure, the cylindrical part of each end of the axis is supported by a hook supplied with friction rollers, and suspended from a lever supported by the pier and counterbalanced so as to leave only about 10 lb pressure on each bearing. Near each end of the axis is attached a circle or wheel (generally of 3 or 3½ ft. diameter) finely divided to 2′ or 5′ on a slip of silver let into the face of the circle near the circumference. The graduation is read off by means of microscopes, generally four for each circle at 90° from each other, as by taking the mean of the four readings the eccentricity and the accidental errors of graduation are to a great extent eliminated.[3] In the earlier instruments by Pistor and Martins the microscopes were fixed in holes drilled through the pier, but afterwards they let the piers be made narrower, so that the microscopes could be at the sides of them, attached to radial arms starting from near the bearings of the axis. This is preferable, as it allows of the temporary attachment of auxiliary microscopes for the purpose of investigating the errors of graduation of the circle, but the plan of the Repsolds and of Simms, to make the piers short and to let the microscopes and supports of the axis be carried by an iron framework, is better still, as no part of the circle is exposed to radiation from the pier, which may cause strain and thereby change the angular distance between various parts of the circle. Each microscope is furnished with a micrometer screw, which moves a frame carrying a cross, or better two close parallel threads of spider's web, with which the distance of a division line from the centre of the field can be measured, the drum of the screw being divided to single seconds of arc (0·1″ being estimated), while the number of revolutions are counted by a kind of comb in the field of view. The periodic errors of the screw must be investigated and taken into account, and care must be taken that the microscopes are placed and kept at such a distance from the circle that one revolution will correspond to 1′, the excess or defect (error of run) being determined from time to time by measuring standard intervals of 2′ or 5′ on the circle.

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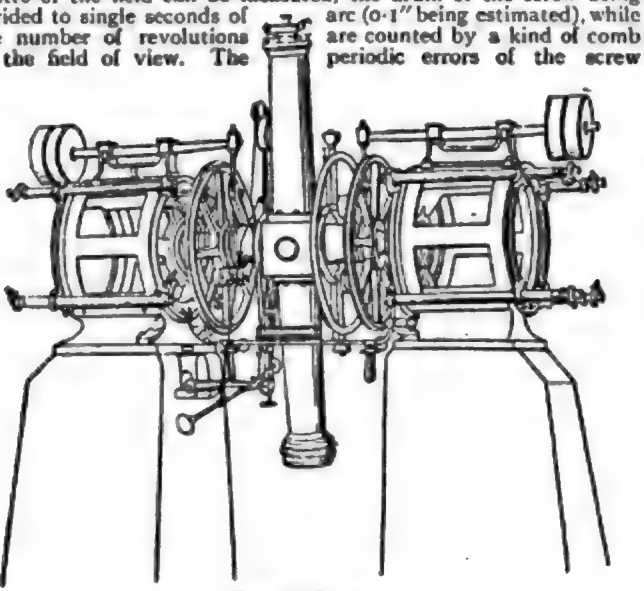
[1] The most notable exception was the transit instrument and vertical circle of the Pulkovo observatory, specially designed by the elder Struve for fundamental determinations.

[2] This instrument differs in many particulars from others: the important principle of symmetry in all the parts (scrupulously followed in all others) is quite discarded; there is only one circle; and the instrument cannot be reversed. There is a similar instrument at the Cape observatory.

[3] On Reichenbach's circles there were verniers instead of microscopes, and they were attached to an alidade circle, the immovability of which was tested by a level.



Transit Circle.

The telescope consists of two slightly conical tubes screwed to the central cube of the axis. It is of great importance that this connexion should be as firm and the tube as stiff as possible,[1] as the flexure of the tube will affect the declinations deduced from the observations. The flexure in the horizontal position of the tube may be determined by means of two collimators or telescopes placed horizontally in the meridian, north and south of the transit circle, with their object glasses towards it. If these are pointed on one another (through holes in the central tube of the telescope), so that the wire-crosses in their foci coincide, then the telescope, if pointed first to one and then to the other, will have described exactly 180°, and by reading off the circle each time the amount of flexure will be found. M. Loewy has constructed a very ingenious apparatus[2] for determining the flexure in any zenith distance, but generally the observer of standard stars endeavours to eliminate the effect of flexure in one of the following ways: either the tube is so arranged that eyepiece and object-glass can be interchanged, whereby the mean of two observations of the same star in the two positions of the object-glass will be free from the effect of flexure, or a star is not only observed directly (in zenith distance Z), but also by reflection from a mercury trough (in zenith distance $180^\circ-Z$), as the mean result of the Z.D. of the direct and reflection observations, before and after reversing the instrument east and west, will only contain the terms of the flexure depending on $\sin 2Z$, $\sin 4Z$, &c. In order to raise the instrument a reversing carriage is provided which runs on rails between the piers, and on which the axis with circles and telescope can be raised by a kind of screw-jack, wheeled out from between the piers, turned exactly 180°, wheeled back, and gently lowered on its bearings.

The eye end of the telescope has in a plane through the focus a number of vertical and one or two horizontal wires (spider lines). The former are used for observing the transits of the stars, each wire furnishing a separate result for the time of transit over the middle wire by adding or subtracting the known interval between the latter and the wire in question. The intervals are determined by observing the time taken by a star of known declination to pass from one wire to the other, the pole star being best on account of its slow motion.[3] Instead of vertical wires, the eye end may be fitted with Repsold's self-registering micrometer with one movable wire to follow the star (see MICROMETER). The instrument is provided with a clamping apparatus, by which the observer, after having beforehand set to the approximate declination of a star, can clamp the axis so that the telescope cannot be moved except very slowly by a handle pushing the end of a fine screw against the clamp arm, which at the other side is pressed by a strong spring. By this slow motion, the star is made to run along one of the horizontal wires (or if there are two close ones, in the middle between them), after which the microscopes are read off. A movable horizontal wire or declination-micrometer is also often used. The field or the wires can be illuminated at the observer's pleasure; the lamps are placed at some distance from the piers in order not to heat the instrument, and the light passes through holes in the piers and through the hollow axis to the cube, whence it is directed to the eye-end by a system of prisms.[4]

The time of the star's transit over the middle wire is never exactly equal to the actual time of its meridian passage, as the plane in which the telescope turns never absolutely coincides with the meridian. Let the production of the west end of the axis meet the celestial sphere in a point of which the altitude above the horizon is b (the error of inclination), and of which the azimuth is $90^\circ-a$ (the azimuth being counted from south through west), while the optical axis of the telescope makes the angle $90^\circ + c$ with the west end of the axis of the instrument, then the correction to the observed time of transit will be $\{a \sin(\phi-\delta) + b \cos(\phi-\delta) + c\} / \cos\delta$, where ϕ is the latitude of the station and δ the declination of the star. This is called Tobias Mayer's formula, and is very convenient if only a few observations have to be reduced. Putting $b \sin\phi - a \cos\phi = n$, we get Hansen's formula, which gives the correction $= b \sec\phi + n (\tan\delta - \tan\phi) + c \sec\delta$, which is more convenient for a greater number of observations. The daily aberration is always deducted from c, as it is also multiplied by $\sec\delta$ (being $0{\cdot}31^s \cos\phi \sec\delta$). The above corrections are for upper culmination; below the pole $180^\circ - \delta$ has to be substituted for δ. The constant c is determined by pointing the instrument on one of the collimators, measuring the distance of its wire-cross from the centre wire of the transit circle by a vertical wire movable by a micrometer screw, reversing the instrument and repeating the operation, or (without reversing) by pointing the two collimators on one another and measuring the distance of first one and then the other wire-cross from the centre wire. The inclination b is measured directly by a level which can be suspended on the pivots.[5] Having thus found b and c, the observation of two stars of known right ascension will furnish two equations from which the clock error and the azimuth can be found. For finding the azimuth it is most advantageous to use two stars differing as nearly 90° in declination as possible, such as a star near the pole and one near the equator, or better still (if the weather permits it) two successive meridian transits of a close circumpolar star (one above and one below the pole), as in this case errors in the assumed right ascension will not influence the result.

The interval of time between the culminations or meridian transits of two stars is their difference of right ascension, 24 hours corresponding to 360° or 1 hour to 15°. If once the *absolute right ascensions* of a number of *standard stars* are known, it is very simple by means of these to determine the R.A. of any number of stars. The absolute R.A. of a star is found by observing the interval of time between its culmination and that of the sun. If the inclination of the ecliptic (ϵ) is known, and the declination of the sun (δ) is observed at the time of transit, we have $\sin\alpha \tan\epsilon = \tan\delta$, which gives the R.A. of the sun, from which, together with the observed interval of time corrected for the rate of the clock, we get the R.A. of the star. Differentiation of the formula shows that observations near the equinoxes are most advantageous, and that errors in the assumed ϵ and the observed δ will have no influence if the $\Delta\alpha$ is observed at two epochs when the sun's R.A. is A and $180^\circ-A$ or as near thereto as possible. A great number of observations of this kind will furnish materials for a standard catalogue; but the right ascensions of many important catalogues have been found by making use of the R.A.'s of a previous catalogue to determine the clock error and thus to improve the individual adopted R.A.'s of the former catalogue.

In order to determine absolute declinations or polar distances, it is first necessary to determine the co-latitude (or distance of the pole from the zenith) by observing the upper and lower culmination of a number of circumpolar stars. The difference between the circle reading after observing a star and the reading corresponding to the zenith is the zenith distance of the star, and this plus the co-latitude is the north polar distance or $90^\circ - \delta$. In order to determine the zenith point of the circle, the telescope is directed vertically downwards and a basin of mercury is placed under it, forming an absolutely horizontal mirror. Looking through the telescope the observer sees the horizontal wire and a reflected image of the same, and if the telescope is moved so as to make these coincide, its optical axis will be perpendicular to the plane of the horizon, and the circle reading will be 180° + zenith point. In observations of stars refraction has to be taken into account as well as the errors of graduation and flexure, and, if the bisection of the star on the horizontal wire was not made in the centre of the field, allowance must be made for curvature (or the deviation of the star's path from a great circle) and for the inclination of the horizontal wire to the horizon. The amount of this inclination is found by taking repeated observations of the zenith distance of a star during the one transit, the pole star being the most suitable owing to its slow motion.

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[1] Reichenbach supplied his tubes with counterpoising levers like those on the Dorpat refractor (see TELESCOPE).

[2] *Comptes rendus*, lxxxvii. 24.

[3] The transits are either observed by "eye and ear," counting the second beats of the clock and comparing the distance of the star from the wire at the last beat before the transit over the wire with the distance at the first beat after the transit, in this way estimating the time of transit to $0{\cdot}1^s$; or the observer employs a "chronograph," and by pressing an electric key causes a mark to be made on a paper stretched over a uniformly revolving drum, on which the clock beats are at the same time also marked electrically.

[4] The idea of illuminating through the axis is due to H. Ussher, professor of astronomy in Dublin (d. 1790).

[5] To avoid the use of a very large level, the pivots of the new transit circle at Kiel are supplied with small "riders" carrying a wire-cross; these can in turn be observed through a horizontal telescope with a hanging mirror in front of its object-glass, whereby the difference in height of the two pivots above a horizontal line may be measured.

Attempts have been made in various places to record the transits of a star photographically; with most success at the Georgetown College Observatory, Washington (since 1889). A sensitive plate is placed in the focus of a transit instrument and a number of short exposures made, their length and the time they are made being registered automatically by a clock. The exposing shutter is a thin strip of steel, fixed to the armature of an electromagnet. The plate thus gives a series of dots or short lines, and the vertical wires are photographed on the plate by throwing light through the object-glass for one or two seconds. This seems to give better results than the method adopted at the Paris observatory, where the plate is moved by clock-work and the exposure is comparatively long, while the image of a fixed slit is photographed at different recorded instants.

LITERATURE.—The methods of investigating the errors of a transit circle and correcting the results of observations for them are given in Brünnow's and Chauvenet's manuals of spherical astronomy. For detailed descriptions of modern transit circles, see particularly the *Washington Observations* for 1865, the *Publications* of the Washburn Observatory (vol. ii.) and *Astronomische Beobachtungen zu Kiel* (1905). The Greenwich circle is described in an appendix to the *Greenwich Observations* for 1852. Accounts of photographic transit instruments will be found in *The Photochronograph* (Washington, 1891), *Annales de l'observatoire de Tokyo*, tome iii. and *Comptes rendus* (July 16, 1906). (J. L. E. D.)

TRANSKEI, one of the divisions of the Cape province, South Africa, east of the Kei River, being part of the country known variously as Kaffraria ((*q.v.*), "the Native Territories" (of the Cape) and the Transkeian Territories. The majority of the inhabitants are Fingo (*q.v.*).

TRANSLATION (Lat. *trans*, across, and *latus*, the participle of *ferre*, to carry), literally a carrying over or transference from one to another, and so from one medium to another. Among the more literal usages is the translation of Enoch in the Bible (Heb. xi. 5), or the ecclesiastical removal of a bishop to another see. But the commonest sense of the word is in connexion with the rendering of one language into another.

The characteristics of a good translation in the literary sense, and the history of the influence, through translations, of one literature on another, are worth more detailed notice. Dryden has prescribed the course to be followed in the execution of the ideal translation: "A translator that would write with any force or spirit of an original must never dwell on the words of his author. He ought to possess himself entirely, and perfectly comprehend the genius and sense of his author, the nature of the subject, and the terms of the art or subject treated of; and then he will express himself as justly, and with as much life, as if he wrote an original; whereas, he who copies word for word loses all the spirit in the tedious transfusion." Comparatively few translators have satisfied this canon. A writer capable of attaining the standard set up by Dryden is naturally more disposed to use his powers to express his own views than those of his foreign predecessors. No doubt at all times, and in all countries, translations have usually been produced for utilitarian purposes, and not from artistic motives. In the first instance we may assume that translations were undertaken in a spirit of educational propaganda as a means of communicating new ideas and new facts to a somewhat uninstructed and uncritical public, indifferent as to matters of form. But, though the translator's primary motive is didactic, he is insensibly led to reproduce the manner as well as the matter of his original as closely as possible. Montaigne warns aspirants of the difficulty in dealing with authors remarkable for the finish of their execution. "Il faict bon," he writes in the *Apologie de Raimond Sebonde*, "traduire les aucteurs comme celuy-là ou il n'y a guères que la matière à représenter; mais ceux qui ont donné beaucoup à la grace et à l'élégance de langage ils sont dangereux à entreprendre nommément pour les rapporter à un idiome plus foible." As it happens, however the task of translating foreign masterpieces has frequently been undertaken by writers of undisputed literary accomplishment whose renderings have had a permanent effect on the literature of their native country.

It was certainly the case when Rome, having conquered Greece, was captured by her captive. There is much point and little exaggeration in the statement that "when the Greek nation became a province of Rome, the Latin literature became a province of the Greek"; and this peaceful victory was initiated by a series of translations made by writers of exceptional ability and, in some cases, of real genius. The first translator whose name is recorded in the history of European literature is L. Livius Andronicus, a manumitted Greek slave who about 240 B.C., rendered the *Odyssey* into Saturnian verse. This translation, of which some fragments are preserved, was long in use as a school text, for Horace studied it under the formidable Orbilius; but Andronicus appears to have recognized his mistake in using the native Latin measure as a vehicle of literary expression, and is said to have rendered Greek tragedies and comedies into metres corresponding to those of his Greek originals. The decision was momentous, for it influenced the whole metrical development of Latin poetry. The example set by Andronicus was followed by Naevius and Ennius, both of whom laid the foundations of the Latin theatre by translating Greek plays—especially those of Euripides—and naturalized in Rome the hexameter, which, as practised later by Lucretius and Virgil, was destined to become "the stateliest measure ever moulded by the lips of man." The tradition of translating more or less freely was continued by Pacuvius, the nephew of Ennius, as well as by Plautus and Terence, whose comedies are skilful renderings or adaptations from the New Attic Comedy of Philemon, Diphilus and Menander. A persistent translator from the Greek was Cicero, who interpolates in his prose writings versified renderings of passages from Homer, Aeschylus, Sophocles and Euripides which prove the injustice of the popular verdict on his merits as a poet. Cicero not only translated the oration of Demosthenes *On the Crown*, but also made Latin versions of Plato's *Timaeus* (part of which survives), of Xenophon's *Oeconomicus*, and of the *Phaenomena*, an astronomical poem by Aratus of Soli, an Alexandrian imitator of Hesiod. This last performance was a tribute to the prevailing fashion of the moment, for the Alexandrian poets had supplanted the early Greek school in favour among the literary circles of Rome. To the foregoing list may be added the great name of Catullus, whose *Como Berenices* is translated from Callimachus, and Cornelius Gallus is mentioned as a translator of Euphorion. Complete translations became less and less necessary as a knowledge of Greek spread among the educated class. But the practice of translating fragments of Greek verse continued throughout the classic period of Latin literature, and the translations of Greek originals incorporated by Virgil were duly pointed out by Octavius Avitus.

The knowledge of Greek declined with the empire, and translations were accordingly produced for the benefit of students who were curious concerning the philosophic doctrines of the Athenians and the Neoplatonists. Porphyry's introduction to Aristotle's *Categories* was translated by Victorinus about the reign of Julian the Apostate; at the end of the 5th century this introduction was once more translated by Boetius, whose translations of Aristotle's *Categories* and other logical treatises began the movement which ended in establishing the Greek philosopher as the most profound and authoritative exponent of intellectual problems during the middle ages. Plato was less fortunate, for he was known to students chiefly by the Latin version of the *Timaeus* made by Chalcidius (it is said) for Hosius, the bishop of Cordova. Cassiodorus, the contemporary of Boetius, went farther afield when he ordered a Latin translation of Josephus to be prepared; but the interest in Aristotle extended to the

East, and in the 6th century he was translated into Syriac by Sergius of Resaina. The Syrians acted as interpreters of Greek learning to the Arabs, and during the 8th and 9th centuries—chiefly through the staff of translators organized at Bagdad by Honein ibn Ishak—the works of Plato and Aristotle, as well as those of Hippocrates and Galen, were translated into Arabic. These translations are of capital importance in the history of European thought. Many of them were introduced into Spain by the Arabs, and were rendered—in some cases through the intermediary of a Castilian-speaking Jew—into Latin at the college of translators founded in 1130 (or shortly afterwards) at Toledo by Raymund, archbishop of that city. Circulating widely throughout western Europe, these Latin translations supplied the learned with a third- or fourth-hand knowledge of Greek philosophy. When Albertus Magnus, St Thomas Aquinas, or any other early light of the schools refers to Aristotle, it must be borne in mind that he often had no more exact acquaintance with the text which he expounds or confutes than could be gathered from an indirect Latin version of an Arabic rendering of a Syriac translation of a Greek original. This accounts for many misunderstandings and errors which would otherwise be incomprehensible. Among the earliest European translators who made their way to Toledo were Adelard of Bath, who rendered an Arabic version of Euclid into Latin; the Englishman known as Robert de Retines, afterwards archdeacon of Pamplona, the first translator of the Koran, which he did into Latin in 1141–1143 by order of Peter the Venerable; and Gerard of Cremona, who, towards the end of the 12th century, was responsible for over seventy translations from the Arabic, including Ptolemy's *Almagest* and many of Aristotle's treatises, as well as works by Galen, Hippocrates and Avicenna. Early in the 13th century Michael Scot, who had begun his Arabic studies at Palermo, visited Toledo and (perhaps with the help of the Jew Andreas, if we are to believe the statement of Hermann the German, repeated by Roger Bacon) translated into Latin various works of Aristotle, Avicenna, and—more especially—Averroes. These Latin translations by Michael Scot introduced Averroes to the notice of Western scholars, and the fact that they were used at the universities of Paris and Bologna gave the first impetus to the vogue of Averroistic doctrine which lasted from the time of St Thomas Aquinas to the rise of Martin Luther. At Toledo, between 1240 and 1256, Hermann the German translated into Latin the commentaries of Averroes on Aristotle's *Ethics*, together with abridgments of the *Poetic* and the *Rhetoric* made respectively by Averroes and Alfarabi. But, at the very period of Hermann the German's residence at Toledo, a more satisfactory method of translation was begun. Within half a century of the conquest of Constantinople in 1204 a visit to Spain was no longer indispensable for a would-be translator of Greek philosophical treatises. The original texts slowly became more available, and a Latin translation of Aristotle's *Ethics* seems to have been made from the Greek by order of Robert Grosseteste, bishop of Lincoln, between 1240–1244. Towards the end of the century the indefatigable William of Moerbeke (near Ghent)—mentioned as "William the Fleming" by Roger Bacon—produced, amongst numerous other Latin renderings from the Greek, versions of Aristotle's *Rhetoric* and *Politics* which have commended themselves to more exact scholars of the modern German type. The Latin renderings from the Arabic were current till a much later date; but it was henceforth accepted, at least in principle, that translations of the Greek classics should be made direct from the original text.

Meanwhile the work of translating foreign productions into the local vernacular had been begun in the north and west of Europe. Towards the end of the 9th century an illustrious English translator appeared in the person of King Alfred, who rendered St Gregory the Great's *Cura pastoralis* into West Saxon "sometimes word for word, sometimes sense for sense." Alfred is also regarded, though with less certainty, as the translator of Bede's *Historia ecclesiastica* and the *Historia adversus paganos* of Orosius. The version of St Gregory's treatise is the most literal of the three; omissions are frequent in the renderings of Bede and Orosius, and in all the diction is disfigured by latinisms. A larger conception of a translator's function is noticeable in Alfred's version of Boetius's *De consolatione philosophiae*, a famous Neoplatonic treatise which was the delight of the middle ages, and was translated later into German by Notker Labeo, into French by Jean de Meung, and twice again into English by Chaucer and by Queen Elizabeth respectively. In translating Boetius, Alfred deals more freely with his author, interpolates passages not to be found in the extant texts of the original, and yet succeeds in giving an adequate interpretation which is also an excellent specimen of English prose. If the alliterative verses found in one manuscript of Alfred's translation are accepted as his work, it is clear that he had no poetic faculty; but he has the credit of opening up a new path, of bringing England into contact with European thought, and of stimulating such writers as Werferth, bishop of Worcester—the translator of St Gregory's *Dialogues*—to proceed on the same line. Some forty years earlier John Scotus (Erigena) had won celebrity as a translator by his Latin renderings of works ascribed to the mysterious 5th century Neoplatonist who passes under the name of Dionysius the Areopagite. Towards the close of Alfred's reign some countrymen of Erigena bettered his example by producing Irish versions of Hippocrates and Galen at St Gallen. St Gallen became a centre of translation, and there, at the beginning of the 11th century, Notker Labeo presided over a committee of interpreters who issued German renderings of certain treatises by Aristotle, Terence's *Andria* and Virgil's *Eclogues*. Far greater literary importance attaches to *Syntipas*, the title given by Michael Andreopulos to a collection of ancient Oriental tales which he translated from an intermediate Syriac version into Greek at the request of the Armenian duke of Melitene about the end of the 11th century. These stories were retranslated into French verse and (by Jean de Haute-Seille) into Latin during the course of the 12th century under the respective titles of the *Sept sages de Rome* and *Dolopathos*; they were utilized in the *Cento novelle antiche*, in the *Libro dei sette savj*, and in the *Decamerone*, and were finally absorbed by every literature in Europe. Immense popularity was won by the *Liber gestorum Barlaam et Josaphat*, a Latin translation made in the 11th or 12th century from the Greek, and recast in many European languages during the 13th century. The book is in fact a legendary life of Buddha adapted to the purposes of Christianity by a monk; but it was accepted as an historical record, the undiscerning credulity of the faithful informally canonized Barlaam and Josaphat, and ultimately compelled the Latin Church to include these two fictitious beings as saints in the *Martyrologium romanum*. This is perhaps the most curious result attained by any translation. The interest in Eastern apologues and moralizing stories, which was early shown in Marie de France's translation of Aesopic fables, was further demonstrated by the Castilian translations of *Kalilah and Dimnah* and *Sindibad* made about the middle of the 13th century, by (or at the command of) Alphonso the Learned and his brother the Infante Fadrique respectively.

The enthusiasm for these Oriental stories was communicated to the rest of Europe by John of Capua's *Directorium humanae vitae* (1270), a Latin translation of *Kalilah and Dimnah*; but, in the meanwhile, as the younger European literatures grew in power and variety, the field of translation necessarily widened to such an extent that detailed description becomes impossible. Geoffrey of Monmouth's *Historia regum Britanniae*, which purports to be a free version of an unnamed Breton book, is the source of the Arthurian legends which reappeared transformed in elaborate French versions, and were transmitted to the rest of Europe during the 12th and 13th centuries. During this period of French literary supremacy instances of bilingual faculty are not wanting in the form of translations: shortly after the middle of the 13th century Brunetto Latini translated passages of Cicero into Italian, and selections from Sallust into French. A hundred years later there are unmistakable indications that the middle ages are departing, that the French suzerainty over literature is at an end, and that the advent of the New Humanism is an accomplished fact. The early Renaissance had already dawned in Italy: a renewed interest in the Latin classics (Greek was not yet generally cultivated by scholars) proved that there was a revival of learning in France. Livy was done into French by Bersuire, Seneca by Bauchant, Boccaccio by Laurent de Premier Fait, and a celebrated translator appeared in the person of Nicolas Oresme, who, however, rendered Aristotle from a Latin version. In England Chaucer executed translations of Boetius and part of the *Roman de la rose*, and succeeded equally in interpreting the philosophic treatise and the allegorical poem. A still further advance is discernible in the book of travels ascribed to Sir John Mandeville: this work, which seems to have been originally written in French, is rendered into English with an exceptional felicity which has won for the translator the loose-fitting but not altogether inappropriate title of "the father of English prose." The English version of Mandeville is assigned to the beginning of the 15th century. About 1470 Sir Thomas Malory produced from French originals his *Morte d'Arthur*, a pastiche of different texts translated with a consummate art which amounts to originality. Malory's inspired version, together with the numerous renderings from the French issued (and often made personally) by Caxton, stimulated the public taste for romantic narrative, raised the standard of execution, and invested the translator with a new air of dignity and importance.

Yet the 15th century has a fair claim to be regarded as the golden age of translation. The Gothic version of the Bible, made by Ulfilas during the 4th century almost simultaneously with St Jerome's Vulgate, is invaluable as the sole literary monument of a vanished language; the 14th century English version by Wycliffe and the 15th century English versions which bear the names of Tyndale and Coverdale are interesting in themselves, and are also interesting as having contributed to the actual Authorized Version of 1611. But they are incomparably less important than Luther's German translation of the Bible (1522–1534) which, apart from its significance as indicating the complete victory of the liberal middle class and the irremediable downfall of the feudal and ecclesiastical autocracy, supplanted minor dialects and fixed the norm of literary expression in German-speaking countries. Luther, it has been truly said, endowed Germany with a uniform literary language, a possession which she had lost for nearly three hundred years. The effect of profane literature was speedily visible in Fischart's translations of Rabelais's *Pantagruéline* (1572) and the first book of *Gargantua* (1575). But before this date France had produced a prince of translators in Jacques Amyot, bishop of Auxerre. In 1548 Nicolas de Herberay had published a French translation of *Amadis de Gaule* which enchanted the polite world at the court of Henry II., had its day, and is forgotten. But Amyot's translation of Plutarch (1559) remains an acknowledged masterpiece, surviving all changes of taste and all variations of the canon of translation. Montaigne writes: "Je donne la palme avecque raison, ce me semble, à Jacques Amyot, sur tous nos escripvains François." If "escripvain" be understood to mean "translator," this judgment is beyond appeal.

Lord Berners will not bear comparison with Amyot in achievement or influence; but, though less completely equipped and less uniformly happy in his choice of texts (for Amyot translated the *Aethiopian History* and *Daphnis and Chloe* as well as Plutarch), Lord Berners holds a distinguished place in the ranks of English translators. His renderings of Fernández de San Pedro's *Cárcel de amor* and of Guevara's *Libro aureo* are now read solely by specialists engaged in tracing English euphuism to its remoter sources, and some of his other translations—the *Boke of Duke Huon of Burdeux* and *Arthur of Little Britain*—are too poor in substance to be interesting nowadays. But Lord Berners is justly remembered by his notable translation of Froissart (1523–1525). Froissart offers fewer opportunities than Guevara for the display of that "fecundious art of rhetoric" in which the English translator thought himself deficient, and, with this temptation removed, Lord Berners is seen at his best. In his version of Froissart, apart from endless confusion of proper names, he makes few mistakes of any real importance, and, if he scarcely equals his original in *brio*, he is almost invariably adequate in reproducing the French blend of simplicity with stateliness. Such translations as Phaer's *Virgil* (1557) and Golding's *Ovid* (1561) have not the historical importance of William Painter's *Palace of Pleasure*, a miscellaneous collection of stories rendered from the Italian, nor of Jasper Heywood's version of Seneca (1581) whose plays had exercised immense influence upon the methods of Garnier and Montchrétien in France. Though Kyd translated Garnier's *Cornélie*, the Senecan system was destined to defeat in England, and Heywood's translation did not even postpone the catastrophe. On the other hand Marlowe found the subject of his *Tamburlaine* in Painter's collection, and thus began the systematic exploitation of the *Palace of Pleasure* which was continued by his successors on the stage. A translator of the rarest excellence was forthcoming in Sir Thomas North, who rendered Guevara (1557) from the French (revising his second edition from the Spanish), and *The Morall Philosophie of Doni*—"a worke first compiled in the Indian tongue"—from the Italian (1570). But, good as they are, both these versions are overshadowed by the famous translation of Plutarch which North published in 1579. He may have referred occasionally to the Greek, or perhaps to some intermediate Latin rendering; but the basis of his work is Amyot, and his English is not inferior to the French in sonority and cadence of phrase. This retranslation of a translation is a masterpiece of which fragments are incorporated with scarcely any change in *Coriolanus*, *Julius Caesar* and *Antony and Cleopatra*; and touches from North have been noted also in the *Midsummer Night's Dream* and in *Timon of Athens*. Amyot greatly influenced the development of French prose, and his translation was the source of Racine's *Mithridate*; but, if we reflect that Shakespeare not only took some of his subjects from the English Plutarch and found nothing to amend in the diction of many passages, North's triumph may be reckoned as even more signal than Amyot's. Very little below North's translation of Plutarch comes John Florio's translation of Montaigne (1603), a fantastically ingenious performance which contributed a celebrated passage to *The Tempest* and introduced the practice of the essay into England. It is impossible to cope with the activity of English translators during the last half of the 16th century and the first half of the 17th. To this period belongs Chapman's impressive and resounding translation (1598–1616) of Homer, which was to enrapture Keats two hundred years later. Adlington's version of Apuleius, Underdown's renderings of Heliodorus and Ovid, the translations of Livy, Pliny, Suetonius and Xenophon issued in quick succession by Philemon Holland are vivid and often extravagantly picturesque in their conveyance of classic authors into Elizabethan prose. With them must be named the translator of Tacitus (1591), Sir Henry Savile, who served later on the committee which prepared the Authorized Version of the Bible, and must therefore be counted amongst those who have exercised a permanent influence on English prose style. Thomas Shelton produced the earliest translation (1612) of *Don Quixote*, a version which, in spite of its inaccuracies and freakishness, preserves much of the tone and atmosphere of the original. Mabbe's translation (1622) of *Guzmán de Alfarache* was lauded by Ben Jonson, and widely read during the 17th century, and his version of the *Celestina* deserved a success which it failed to obtain. It compares most favourably with a version of Tasso (1600) by Edward Fairfax, who has been persistently overpraised. But the Puritanical instinct of the English people, powerful even when not in the ascendant, was an insuperable obstacle to the acclimatization of Spanish literature in England. The *Leviathan* has obscured Hobbes's fame as a translator, but he is known to scholars by his sound but crabbed rendering of Thucydides (1629), and by a wholly unnecessary version of Homer which he published at the very end of his career (1674). Sir Roger L'Estrange is responsible for translations of Seneca, Cicero and Josephus, which are usually lively enough to be readable and unfaithful enough to be misleading; the most popular of his renderings is a translation of Quevedo's *Sueños* (made through the French) which owes most of its vogue during the Restoration rather to its reckless indecency than to its intrinsic merit. Dryden's free translations of Juvenal (1693) and Virgil (1697) treat the original authors with a cavalier freedom, but at least they preserve the meaning, if not the conciseness and point, of the Latin.

Among the multitudinous English translations of the 18th century it is only necessary to mention Pope's versions of the *Iliad* (1715-1720) and the *Odyssey* (1725-1726), and Cowper's rendering of Homer, issued in 1791. These neat translations necessarily fail to convey any impression of Homer's epical grandeur, and they set a mischievous fashion of artificial "elegance" which has been too often adopted by their successors; but both Pope and Cowper conform faithfully to the mistaken canon of their age, and both have fugitive moments of felicity. A posthumous translation of *Don Quixote* bearing the name of Charles Jarvis appeared in 1742, has been reprinted times innumerable ever since, and has helped to make Cervantes's masterpiece known to generations of English-speaking people. Defective in point of exact scholarship, it has the merit of agreeable perspicuity, and there seems no reason to believe the remark, ascribed by Warburton to Pope, that Jarvis "translated *Don Quixote* without knowing Spanish": the available evidence is strongly against this malicious theory. The most remarkable translations of the 18th century, however, appeared in Germany: these are the versions of the *Odyssey* (1781) and *Iliad* (1793) by Voss, and A. W. von Schlegel's rendering of Shakespeare (1797-1810), which gave a powerful impulse to the romantic movement on the Continent.

Byron's version of a Spanish ballad and Shelley's renderings of Calderón are interesting exhibitions of original genius voluntarily accepting a subordinate rôle. More importance attaches to Carlyle's translation of *Wilhelm Meister* (1824), a faithful rendering free from the intolerable mannerisms and tricks which the translator developed subsequently in his original writings. William Taylor had long before translated Bürger's *Lenore*, Lessing's *Nathan* and Goethe's *Iphigenia*; but such interest as the English nation has been induced to take in German literature dates from the appearance of Carlyle's translation. If he did nothing more, he compelled recognition of the fact that Germany had at last produced an original genius of the highest class. Calderón found accomplished translators in Denis Florence MacCarthy (1848-1873) and in Edward FitzGerald (1853), who also attempted to render Sophocles into English; but these are on a much lower plane than the translation of the *Rubaiyát* (1859) of Omar Khayyam, in which, by a miracle of intrepid dexterity, a half-forgotten Persian poet is transfigured into a pessimistic English genius of the 19th century. Versions of Dante by Longfellow (whose translations of poems by minor authors are often admirable), of Latin or Greek classics by Conington, Munro, Jowett and Jebb, maintain the best traditions of the best translators. William Morris was less happy in his poetical versions of *Virgil* (1875) and the *Odyssey* (1887) than in his prose translations of *The Story of Grettir the Strong* (1869) and *The Volsunga Saga* (1870)—both made in collaboration with Magnússon—and in his rendering of *Beowulf* (1895). In his *Lays of France* (1872) Arthur O'Shaughnessy skirts the borders of translation without quite entering into the field; he elaborates, paraphrases and embroiders rather than translates the *lais* of Marie de France.

Most versions of modern foreign writers are mere hackwork carelessly executed by incompetent hands, and this is even more true of England than of France and Germany. But, with the development of literature in countries whose languages are unfamiliar, the function of the translator increases in importance, and in some few cases he has risen to his opportunity. Through translations the works of the great Russian novelists have become known to the rest of Europe, and through translations of Ibsen the dramatic methods of the modern stage have undergone a revolution. (J. F.-K.)

TRANSOM (probably a corruption of Lat. *transtrum*, a thwart, in a boat; equivalents are Fr. *traverse, croisillon*, Ger. *Losholz*), the architectural term given to the horizontal lintel or beam which is framed across a window, dividing it into stages or heights. In early Gothic ecclesiastical work transoms are only found in belfry unglazed windows or spire lights, where they were deemed necessary to strengthen the mullions in the absence of the iron stay bars, which in glazed windows served a similar purpose. In domestic work, on account of the opening casements, they are more frequently found. In the later Gothic, and more especially the Perpendicular period, the introduction of transoms became very general in windows of all kinds.

TRANSUBSTANTIATION, the term adopted by the Roman Catholic Church to express her teaching on the subject of the conversion of the Bread and Wine into the Body and Blood of Christ in the Eucharist. Its signification was authoritatively defined by the Council of Trent in the following words: "If any one shall say that, in the Holy Sacrament of the Eucharist there remains, together with the Body and Blood of Our Lord Jesus Christ, the substance of the Bread and Wine, and shall deny that wonderful and singular conversion of the whole substance of the Bread into (His) Body and of the Wine into (His) Blood, the species only of the Bread and Wine remaining—which conversion the Catholic Church most fittingly calls Transubstantiation—let him be anathema."[1] The word Transubstantiation is not found earlier than the 12th century. But in the Eucharistic controversies of the 9th, 10th and 11th centuries the views which the term embodies were clearly expressed; as, for example, by Radbertus Paschasius (d. 865), who wrote that "the substance of the Bread and Wine is efficaciously changed interiorly into the Flesh and Blood of Christ," and that after the consecration what is there is "nothing else but Christ the Bread of Heaven."[2] The words "substantially converted" appear in the formula which Berengarius was compelled to sign in 1079. Assuming that the *Expositio canonis missae* ascribed to St Pietro Damiani (d. 1072) is doubtful, we may take it that the first use of the word is in a passage of Hildebert de Savardin[3] (d. 1133), who brings it into an exhortation quite informally, as if it were in common use.[4] It is met with in a Decretal of Innocent III.[5] The fourth Council of Lateran fully adopted it (1215). It is clear from the treatise of Radbertus Paschasius already quoted that the word "substance" was used for *reality* as distinguished from *outward appearance*, and that the word "species" meant *outward appearance* as opposed to *reality*. The terms, therefore, were not invented by St Thomas Aquinas, and are not mere scholastic subtlety. The definition of the Council of Trent was intended both to enforce the accepted Catholic position and to exclude the teaching of Luther, who, whilst not professing to be certain whether the "substance" of the Bread and Wine could or could not be said to remain, exclaimed against the intolerance of the Roman Catholic Church in defining the question.[6]

For a full and recent exposition of the Catholic teaching on Transubstantiation the reader may consult *De ecclesiae sacramentis*, auctore Ludovico Billot, S.J. (Rome, Propaganda Press, 1896). The Abbé Pierre Batifol, in his *Études d'histoire et de théologie positive*, 2me série (*Elaboration de la notion de conversion*, and *Conversion et transubstantiation*) treats it from the point of view of development (V. Lecoffre, Paris, 1905). (✠ J. C. H.)

TRANSVAAL, an inland province of the Union of South Africa between the Vaal and Limpopo rivers. It lies, roughly, between 22½° and 27¼° S. and 25° and 32° E., and is bounded S. by the Orange Free State and Natal, W. by the Cape province and the Bechuanaland Protectorate, N. by Rhodesia, E. by Portuguese East Africa and Swaziland. Save on the south-west the frontiers, for the main part, are well defined natural features. From the south-west to the north-east corners of the colony is 570 m.; east to west its greatest extent is 397 m. The total area is 111,196 sq. m., a little less than the area of Great Britain and Ireland. The boundaries of the Transvaal have varied from time to time. The most important alteration was made in January 1903 when the districts of Utrecht and Vryheid, which then formed the south-eastern part of the country were annexed to Natal. The area thus lost to the Transvaal was 6970 sq. m. (For map see South Africa.)

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[1] *Concil trident.* Sess. XIII. Can. 2.

[2] P. L. Migne. CXX. *De corpore et sanguine Domini*, cap. viii. 2, cf. xv. 2.

[3] Sometimes called of Tours, or of Le Mans.

[4] See Batifol, *Études d'histoire et de théologie positive*, 2me série.

[5] Lib. III. *Decretalium*, tit. 41, n. 6.

[6] *De captivitate babylonica ecclesiae.* De coenâ Domini. But Luther elsewhere professed Consubstantiation; that is, in modern Lutheran phraseology, the "presence of our Lord's Body" in, with and under the bread.

Physical Features.—About five-sixths of the country lies west of the Drakensberg (*q.v.*), the mountain range which forms the inner rim of the great tableland of South Africa. For a few miles on the Natal-Transvaal frontier the Drakensberg run east and west and here is the pass of Laing's Nek. Thence the mountains sweep round to the north, with their precipitous outer slopes facing east. For some 250 m. within the province the mountains form a more or less continuous range, the highest point being the Mauchberg (8725 ft.) in 24° 20′ 10″ S. 30° 35′ E., while there are several heights of 7000 or more feet. Eastward from the foot of the Drakensberg stretches a broad belt of low land beyond which rise the Lebombo hills running north and south along the parallel of 32° E. and approaching within 35 m. of the sea at Delagoa Bay. The Lebombo hills are flat topped but with a well-defined break on their seaward side. This eastern edge forms the frontier between Transvaal and Portuguese territory.

The country west of the Drakensberg, though part of the main South African tableland, is not uniform in character, consisting of (1) elevated downs, (2) their slopes, (3) the flat "bottom" land. The downs or plateaus occupy all the southern part of the country, sloping gradually westward from the Drakensberg. That part of the plateau east of Johannesburg is from 5000 to 6400 ft. high; the western and somewhat larger half is generally below 5000 ft. and sinks to about 4000 ft. on the Bechuanaland border. This plateau land is called the high veld,[1] and covers about 34,000 sq. m. The northern edge of the plateau follows an irregular line from somewhat north of Mafeking on the west to the Mauchberg on the east. This edge is marked by ranges of hills such as the Witwatersrand, Witwatersberg and Magaliesberg; the Witwatersrand, which extends eastward to Johannesburg, forming the watershed between the rivers flowing to the Atlantic and Indian Ocean. Farther north, beyond the intervening slopes and low bush, are two elevated regions covering together over 4000 sq. m. They are the Waterberg, and, more to the east, separated from the Waterberg by the valley of the Magalakwane tributary of the Limpopo, the Zoutpansberg. The Zoutpansberg has steep slopes and is regarded as the northern termination of the Drakensberg. An eastern offshoot of the Zoutpansberg is known as the Murchison Range. The low land between the high veld and the Waterberg and Zoutpansberg is traversed by the Olifants River, an east flowing tributary of the Limpopo.

The true high veld, extending east to west 120 m. and north to south 100 m., consists of rolling grass covered downs, absolutely treeless, save where, as at Johannesburg, plantations have been made by man, the crest of the rolls being known as *builts* and the hollows as *laagtes* or *vleys*. The surface is occasionally broken by kopjes—either table-shaped or pointed—rising sometimes 100 ft. above the general level. Small springs of fresh water are frequent and there are several shallow lakes or pans—flat bottomed depressions with no outlet. The largest of these pans, Lake Chrissie, some 5 m. long by 1 m. broad, is in the south-eastern part of the high veld. The water in the pans is usually brackish. The middle veld is marked by long low stony ridges, known as rands, and these rands and the kopjes are often covered with scrub, while mimosa trees are found in the river valleys.

The banken veld, formed by the denudation of the plateau, is much broken up and is rich in romantic scenery. It covers about 27,000 sq. m., and has an average breadth of 40 m. In places, as between Mafeking and Johannesburg, the descent is in terrace-like steps, each step marked by a line of hills; in other places there is a gradual slope and elsewhere the descent is abrupt, with outlying hills and deep well-wooded valleys. The rocks at the base of the slopes are granite, the upper escarpments are of sedimentary rocks. Thence issue many streams which in their way to the ocean have forced their way through the ranges of hills which mark the steps in the plateau, forming the narrow passes or *poorts* characteristic of South African scenery.

As in the middle veld, rands and kopjes occur in the low or bush veld, but the general characteristic of this part of the country, which covers over 50,000 sq. m., is its uniformity. The low veld east of the Drakensberg begins at about 3000 ft. above the sea and slopes to 1000 ft. or less until it meets the ridge of the Lebombo hills. The lowest point is at Komati Poort, a gorge through the Lebombo hills only 476 ft. above the sea. West and north of the Drakensberg the general level of the low veld is not much below that of the lowest altitudes of the middle veld, though the climatic conditions greatly differ. North of the Zoutpansberg the ground falls rapidly, however, to the Limpopo flats which are little over 1200 ft. above the sea. Near the north-west foot of the Zoutpansberg is the large saltpan from which the mountains get their name. The low veld is everywhere covered with scrub, and water is scarce, the rivers being often dry in the winter season.

River Systems.—There are four separate river basins in the Transvaal. Of these the Komati (*q.v.*) and its affluents, and the Pongola and its affluents rise in the high veld and flowing eastward to the Indian Ocean drain but a comparatively small area of the province, of which the Pongola forms for some distance the south-eastern frontier. The rest of the country is divided between the drainage areas of the Vaal and Limpopo. The Vaal (*q.v.*) rises in the nigh veld in the Ermelo district not far from the source of the Komati and that of the Usuto tributary of the Pongola. The Vaal drains the greater part of the plateau, flowing westward towards the Atlantic. The waters of the northern escarpments of the plateau and of all the region farther north are carried to the Indian Ocean by the Limpopo (*q.v.*) and its tributaries the Olifants, Great Marico, Great Letaba, &c. Both the Vaal and the Limpopo in their main course have high steep banks. They carry an immense volume of water during the summer rains, but are very small streams in the winter, when several of their tributaries are completely dry.[1] None of the rivers is navigable within the limits of the province. The absence of alluvial deposits of any size is another characteristic of the Transvaal rivers. For a considerable distance the Vaal forms the frontier between the province and the Orange Free State and in similar manner the Limpopo separates the Transvaal from Bechuanaland and Rhodesia. Since the first advent of white colonists many springs and pans and small streams have dried up, this desiccation being attributed, not so much to decreased rainfall, as to the burning off of the grass every winter, so that the water, instead of soaking in, runs off the hard, baked ground into the larger rivers. (F. R. C.)

Geology.

A broad ring of crystalline rocks (Swaziland schists) encircles the Transvaal except on the south, where the Karroo formation extends over the Vaal River. Within this nearly complete circle of crystalline rocks several geological formations have been determined, of which the age cannot be more definitely fixed than that they are vastly older than the Karroo formation and newer than the Swaziland schists.

The following subdivisions have been recognized by Molengraaff: Karroo System, Transvaal System, Vaal River System, South African Primary System. Each of these systems is separated from the other by a strong unconformity.

South African Primary System.—The South African Primary System includes a complex of rocks as yet little understood. According to Molengraaff it includes the two following series:—

Witwatersrand Series.	An upper group including the auriferous conglomerates of the Rand: a lower group (Hospital Hill series) of quartzites, shales and conglomerates.
Barberton and Swaziland Series.	Crystalline schists, quartzites, conglomerates, intrusive granites.

Barberton Series.—Molengraaff considers the Barberton series to be the metamorphosed equivalent of the Hospital Hill series, while Hatch regards it to be older and to form a portion of his Archaean series (Swaziland schists) to which position it is here assigned. The chief outcrops are in the south-western Transvaal, around Zoutpansberg and in Swaziland. They show a great variety of type made up of slates, quartzites, occasional conglomerates, schists with large masses of intrusive granites and gneiss.

Witwatersrand Series.—It is now generally acknowledged that this important series consists of two main groups. Their chief occurrences are in the districts of Witwatersrand, Heidelberg, Klerksdorp and Venterskroon. The lower group (Hospital Hill slates) consists of quartzites and shales, resting on the eroded surface of the older granites and schists, and estimated to be from 10,000 to 12,000 ft. thick. There are occasional bands of conglomerates, sometimes auriferous. In the absence of fossils their age cannot be determined. The upper group consists of conglomerates, grits and quartzites with a few bands of shales. It has obtained notoriety from the conglomerates along certain bands containing gold, when they constitute the famous "banket." The thickness varies from 2300 to over 11,000 ft. The conglomerate beds occur in belts forming in descending order the Elsburg series, Kimberley series, Bird Reef series, Livingstone Reef series, Main Reef series. The richest in gold are to be found among the Main Reef series, which yields by far the greater part of the total output of gold from the Transvaal. The individual beds, seldom more than a few feet in thickness and sometimes only a few inches, are interstratified with an immense thickness of quartzites. The conglomerates consist almost entirely of pebbles of quartz set in a hard matrix consolidated by the deposition of secondary silica. The conglomerate bands and quartzites contain large quantities of iron pyrites deposited subsequent to their formation, that in the conglomerates containing the gold. Sericite in the form of scales and films characterizes those portions which have been faulted, squeezed or sheared. Sheets of diabase, apparently volcanic flows, and numerous dykes interfere with the regularity of the stratification. The theory of the subsequent infiltration of the gold is that generally accepted. No fossils have been discovered, and except that they represent some portion or portions of rocks of the Pre-Cape formation the age of the upper Witwatersrand beds, as well as that of the lower division, remains an open question. They may safely be considered to be among the oldest auriferous sediments of the world.

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[1] By the Boers the western and less elevated part of the plateau is known as the middle veld.

[1] At the Standerton gauge on the Vaal in 1905–1906, a year of extreme drought, the total flow was 8,017,000,000 cub. ft., of which 7,102,000,000 was storm water.

Vaal River System.—This consists largely of rocks of igneous origin, of which the amygdaloidal diabase of Klipriversberg forms the type. The other rocks include igneous breccias, shales, coarse conglomerates and grits. Near Reitzburg the coarse conglomerates reach a thickness of 400 ft. and about 500 ft. at Kroomdraai. This system rests unconformably on the Witwatersrand series and is unconformably overlain by the Transvaal system. It must, however, be acknowledged that these relationships are very imperfectly understood. Compared with other formations they occupy restricted areas, being only met with south of Johannesburg, around Wolmaransstad, Lichtenburg and east of Marico.

Transvaal System.—This is a very definite sequence of rocks covering immense areas in the centre of the country. The following groups are recognized: Waterberg Series, Pretoria Series, Dolomite Series, Black Reef Series.

The Black Reef Series is composed of quartzites, sandstone, slates and conglomerate. It varies in thickness from 100 ft. in the southern Transvaal to 1000 ft. at Lydenburg. Thin bands of conglomerate, sometimes auriferous, occur near the base.

The Dolomite Series, known to the Dutch as "Olifants Klip," consists of a bluish-grey magnesian limestone with bands of chert. The thickness varies from 2600 ft. in the Witwatersrand area to 5000 ft. around Pretoria; and is about 2600 ft. about Lydenburg. It is worn by solution into caves and swallow-holes (*Wondergarten*). Gold, lead, copper and iron ores occur as veins. So far it has proved to be unfossiliferous. Dykes and intrusive rocks are common.

The Pretoria Series, formerly known as the Gatsrand series, consists of repeated alternations of flagstones and quartzites, shales and sheets of diabase. These follow conformably on the Dolomite series. In the Marico district the shales become highly ferruginous and resemble the Hospital Hill slates of the Witwatersrand series. Near Pretoria duplications of the beds, due to overthrusting, are not uncommon.

The Waterberg Series lies unconformably on the Pretoria series. The colour is usually red, forcibly recalling the Old Red Sandstone and Trias of England. Sandstones, quartzites, conglomerates and breccia make up the formation. They occur to the north-east of Pretoria and occupy still wide areas in the Waterberg district.

A complex of igneous rocks of different ages covers immense areas in the central Transvaal. Various types of granite are the predominant variety. Syenites, gabbros, norites and volcanic rocks are also represented. The granite contains two varieties. One is a red granite intruded subsequently to the Waterberg sandstones; another is a grey variety considered to be older than the Black Reef series and possibly older than the Witwatersrand series.

The Karroo System attains its chief development in the south-eastern Transvaal in the districts of Ermelo, Standerton and Wakkerstroom.

The latest classification of Molengraaff subdivides the beds as follows:—

Hoogeveld Series	Beaufort beds of Cape Colony. Contains coal-seams.
Ecca shales.	Not present at Vereeniging.
Dwyka conglomerate.	Sandstones and conglomerates with coal-seams at Vereeniging.

The Dwyka conglomerate resembles the same bed in the Cape province. The boulders consist of very various rocks often of large size. Many of them show glacial striae. The direction of striae on the underlying quartzitic rocks, particularly well seen near the Douglas colliery, Balmoral, point to an ice movement from the north-north-west to south-south-east.

The Ecca series, as in the Cape, consists of sandstones and shales. Seams of coal lie near the base, some of them exceeding 20 ft. in thickness, but in this case layers of shaly coal are included. The overlying sandstones afford good building stones, and frequently, as at Vereeniging, yield many fossil plants. These include among others, *Glossopteris browniana*, *Gangamopteris cyclopteroides*, *Sigillaria Brardi*, *Bothrodendron Leslii*, *Noeggerathiopsis Hislopi*.

The Karroo beds lie almost horizontally, in marked contrast to the highly inclined older rocks. Their distribution, other than in the south-eastern districts, is imperfectly understood. Remnants have been found of their former existence in the neighbourhood of Pretoria; and portions of the Bushveld Sandstone have recently been relegated to the Karroo formation.

The diamond pipes probably represent some of the most recent rocks of the Transvaal. They may be of Cretaceous age or even later, and in any case belong to the same class as those of Kimberley. The recent deposits of the Transvaal may be considered to be insignificant. They include the gravels and alluviums of the present streams and the almost ubiquitous red sand of aeolian origin.[1] (W. G.*)

Climate.—Although lying on the border of and partly within the tropics, the Transvaal, owing to its high general elevation, and to the absence of extensive marshy tracts, enjoys on the whole a healthy invigorating climate, well suited to the European constitution. The climate of the high veld is indeed one of the finest in the world. The air is unusually dry, owing to the proximity of the Kalahari Desert on the west and to the interception on the east by the Drakensberg of the moisture bearing clouds from the Indian Ocean. The range of temperature is often considerable—in winter it varies from about 100° F. in the shade at 1 p.m. to freezing point at night. During summer (Oct.–April) the mean temperature is about 73°; during winter about 53°. Nov.–Jan. are the hottest and June–July the coldest months. The chief characteristic of the rainfall is its frequent intensity and short duration. During May to August there is practically no rain, and in early summer (Sept.–Dec.) the rainfall is often very light. The heaviest rain is experienced between January and April and is usually accompanied by severe thunderstorms. On the eastern escarpment of the Drakensberg the rainfall is heavy, 50 or 60 in. in the year, but it diminishes rapidly towards the centre of the plateau where it averages, at Johannesburg about 30 in.,[2] while in the extreme west as the Kalahari is approached it sinks to about 12 in. The winds in winter are uniformly dry while dust storms are frequent at all seasons—a fact which renders the country unsuitable for persons suffering from chest complaints. In the eastern part of the plateau snow occasionally falls, and frost at night is common during winter.

The banken veld district is also generally healthy though hotter than the plateaus, and malarial fever prevails in the lower valleys. Malarial fever is also prevalent throughout the low veld, but above 3000 ft. is usually of a mild type. Nearly all the country below that elevation is unsuitable for colonization by whites, while the Limpopo flats and other low tracts, including the district between the Drakensberg and the Lebombo hills are extremely unhealthy, blackwater fever being endemic. In the low veld the shade temperature in summer rises to 113° F., but the nights are generally cool, and down to 2000 ft. frost occurs in winter. The rainfall in the low country is more erratic than on the plateau, and in some districts a whole year will pass without rain.

Flora.—The general characteristic of the flora is the prevalence of herbaceous over forest growths; the high veld is covered by short sweet grasses of excellent quality for pasturage; grass is mingled with protea scrub in the middle veld; the banken veld has a richer flora, the valley levels are well wooded, scattered timber trees clothe their sides and the hills are covered with aloe, euphorbia, protea and other scrub growths. Among the timber trees of this region is the bolkenhout of terblanz (*Faurea Saligna*) which yields a fine wood resembling mahogany. The scrub which covers the low veld consists mainly of gnarled stunted thorns with flattened umbrella shaped crowns, most of the species belonging to the sub-order mimoseae. A rare species is the acacia erioloba Rameel doorn, akin to the acacia giraffae of Bechuanaland. The wild seringa (*Burkea africana*) is also characteristic of the low veld and extends up the slopes of the plateau. The meroola (*sclerocarya caffra*) a medium sized deciduous tree with a rounded spreading top is found in the low veld and up the slopes to a height of 4500 ft. It is common in the lower slopes of the rands of the low veld. Cotton and cotton-like plants and vines are also native to the low veld. Few of the low veld bushes are large or straight enough to furnish any useful wood, and timber trees are wholly absent from the level country. The forest patches are confined to the deep kloofs of the mountains, to the valleys of the larger rivers and to the sea-slopes of the Drakensberg and other ranges, where they flourish in regions exposed to the sea mists. These patches, called "woodbushes," contain many hardwood trees of great size, their flora and fauna being altogether different from that immediately outside the wood. Common species in the woodbush are three varieties of yellow wood (*Podocarpus*), often growing to an enormous size, the Cape beech (*myrsine*), several varieties of the wild pear (*Olinia*) and of stinkwood (*Oreodaphne*) ironwood and ebony. The largest forest areas are in the Pongola district and the Haenertsburg and

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[1] For geology see: F. H. Hatch and G. S. Corstorphine, *The Geology of South Africa* (London, 2nd ed., 1909); G. A. F. Molengraaff, *Géologie de la République Sud-africaine du Transvaal*, *Bull. de la Soc. Géol. de France*, 4 série, tome i., pp. 13–92 (1901). (Translation by J. H. Ronaldson, Edinburgh and Johannesburg, 1904); *Reports* and *Memoirs*, Geol. Survey (Transvaal, 1903, et seq.); H. Kynaston, *The Geology of the Transvaal and the Orange River Colony, Handbook, British Association* (Cape Town, 1905); *Trans. Geol. Soc. S. Africa* (Johannesburg).

[2] Exceptionally very heavy rain is experienced on the Rand. In January 1907 seven inches of rain fell in 24 hours.

Woodbush districts north of the Olifants river. Mimosa and the wild wilge-boom (*Salix capensis*) are the common trees on the banks and rivers, while the weeping willow is frequent round the farmsteads.

Many trees have been introduced and considerable plantations made, as for instance on the slopes between Johannesburg and Pretoria. Among the most successful of the imported trees are citrus trees, the Australian wattle and the eucalyptus. Tobacco and the vine both flourish and most European fruits and vegetables thrive. Of native fruits the misple (*Vangueria infausta*), miscalled the wild medlar, is of excellent flavour. It is common on the rands and kopjes of the bush veld. Rose and other flowering shrubs and trees grow well on the banken veld and in the valleys. A large yellow tulip (*Homerica pallida*) is one of the most abundant flowers on moist vlei lands on the high veld and is occasionally met with in the low veld; slangkop (*Urginea Burkei*) with red bulbs like a beetroot is a low bush plant apparently restricted to the Transvaal and adjacent Portuguese territory. Both these and many other plants such as gift-blaar and drouk-gras are poisonous to cattle. These poisonous plants are found chiefly in the banken and low veld.

Fauna.—When first entered by white men the Transvaal abounded in big game, the lion, leopard, elephant, giraffe, zebra and rhinoceros being very numerous, while the hippopotamus and crocodile were found in all the rivers. The indiscriminate destruction of these animals has greatly reduced their numbers and except in the Pongola district, at one or two other places on the Portuguese frontier, and along the Limpopo the hippopotamus, rhinoceros and crocodile are now extinct in the province. A few elephants, giraffes and zebras (*equus burchelli*—the true zebra is extinct) are still found in the north and north-eastern districts and in the same regions lions and leopards survive in fair numbers. Other animals fairly numerous are the spotted hyena, long-eared fox, jackal, aard wolf, red lynx, wild cat, wild dog and wart hog. Many species of antelope are found, mostly in small numbers, including the kudu, hartebeest, the sable and roan antelope, the white tailed and the brindled gnu, waterbuck, red buck, duiker, blesbok, palla, springbuck (numerous), steinbok, grysbok and klipspringer. The Africander breed of cattle is a well-marked variety, and a characteristic native domestic animal. Whether originally imported from Europe by the Portuguese or brought from the north by Africans is not certain. It is not found in a wild state and the auffalo (*bos caffer*) is almost if not quite extinct in the Transvaal. Among edentata the ant-bear, scaly ant-eater and porcupine are plentiful. The spring hare (*pedetes capensis*) abounds. Baboons and other apes are fairly common and there are several species of snakes. The ostrich is found in the Marico and Limpopo districts, and more rarely elsewhere; the great kori bustard and the koorhaan are common.

Insects abound, the greatest pest being the taetse fly, common in the low veld. Six species of tick, including the blue tick common throughout South Africa, are found, especially in the low veld, where they are the means of the transmission of disease to cattle. Mosquitoes, locusts and ants are also common.

The baba or cat fish and the yellow fish are plentiful in the rivers and the trout has been acclimatized.

To preserve the native fauna the low country on the Portuguese frontier has been made a game reserve. It is nearly 300 m. long with an average breadth of 50 m. Other reserves have been constituted in the north of the province.

Inhabitants.—The population of the Transvaal, on the 17th of April 1904, when the first complete census of the country was taken, was 1,269,951 (including 8215 British soldiers in garrison),[1] or 11·342 persons per sq. m. Of these 20·67 %, namely 297,277, were European or white. Of the coloured population 937,127 were aboriginals; and 35,547 were of mixed or other coloured races. Of the whites 178,244 (59·95%) were males. The white population is broadly divisible into the British and Dutch elements, the percentage of other whites in 1904 being but 8·6. The Dutch, as their usual designation, Boers, implies, are mainly farmers and stock-raisers and are still predominant elsewhere than in the Witwatersrand and Pretoria districts. They speak the patois of Dutch known as the *Taal*. The British element is chiefly gathered in Johannesburg and other towns on the Rand and in Pretoria. The total white population in the Witwatersrand and in Pretoria in 1904 was 135,135, and the strength of the British in these districts is shown by the fact that only 20% was Transvaal born. Of those born outside the Transvaal 24·6% came from other British possessions in Africa and 24·92% from Great Britain or British colonies other than African. Of the non-British or Boer whites Russians form 3·01%, Germans 1·62% and Dutch (of Holland) 1·14%.

The natives are found chiefly in Zoutpansberg district, where there were 314,797 at the 1904 census, and the adjoining districts of Lydenburg and Waterberg, *i.e.* in the northern and north-eastern region of the country. The natives belong to the Bantu negro race and are represented chiefly by Basuto, Bechuana, Bavenda, and Xosa-Zulu tribes. None of these peoples has any claim to be indigenous, and, save the Bavenda, all are immigrants since *c.* 1817–1820, when the greater part of the then inhabitants were exterminated by the Zulu chief Moslikatze (see § *History*). After that event Basuto entered the country from the south, Bechuana from the west and Swazi, Zulu, Shangaan and other tribes from the east and south-east.

The Basuto, who number 410,020 and form 40% of the total population, are now found mostly in the central, northern and north-eastern districts, forming in Lydenburg about 67%, and in Zoutpansberg about 50% of the inhabitants. The Bechuana, who number 64,751, are almost confined to the western and south-western districts.

Next, numerically, to the Basuto and Bechuana peoples are the tribes known collectively as Transvaal Kaffirs, of whom there were 159,860 enumerated at the 1904 census. Altogether the Transvaal Kaffirs form 50% of the inhabitants of Waterberg district, 30% of Zoutpansberg district and 18% of Middelburg district. Zulus number 75,601 and form 54% of the population in Wakkerstroom district and 18% in Standerton district. Elsewhere they are very thinly represented. Swazis form more than half the total population of the Barberton and Ermelo districts and are also numerous in Wakkerstroom. In Barberton, Lydenburg and Zoutpansberg districts Shangaan and other east coast tribes are settled, 80,834 being returned as born in the Transvaal. The Shangaan are members of a Bantu tribe from the Delagoa Bay region who took refuge in the Transvaal between 1860 and 1862 to escape Zulu raids. They were for some time ruled by a Portuguese, Joao Albasini, who had adopted native customs. Since 1873 Swiss Protestant missionaries have lived among them and many of the Shangaans are Christians and civilized. Several other east coast tribes, such as the Bankuna, are of mixed Zulu and Shangaan blood. Among the mixed and other coloured races in the census returns figure 1592 Bushmen, 3597 Hottentots and 1147 Koranna; these people are found chiefly in the south-western regions and are remnants of the true aboriginal population.

Besides the tribes whose home is in the Transvaal considerable numbers of natives, chiefly members of east coast tribes, Cape Kaffirs and Zulus, go to the Witwatersrand to work in the gold and other mines. In all there were, in 1904, 135,042 Bantus in the country born elsewhere. Many east coast natives after working in the mines settle in the northern Transvaal. Of the aboriginal South Africans in the Transvaal, at the 1904 census, 77·69% were born in the Transvaal. Among the aborigines the number of females to males was 114 to 100. (See further KAFFIRS; BECHUANAS; ZULULAND; BUSHMEN; HOTTENTOTS; and for languages, BANTU LANGUAGES).

The number of Asiatics in the Transvaal in April 1904 was 12,320, including 904 Malays, natives of South Africa, and 9986 British Indians. They were nearly all domiciled in the Witwatersrand and in the towns of Pretoria and Barberton, where they are engaged mainly in trade.

Administrative Divisions and Chief Towns.—The province is divided into sixteen magisterial districts. Zoutpansberg, 25,654 sq. m.; Waterberg, 15,503 sq. m.; Lydenburg, 9868 sq. m., occupy the north and north-eastern parts of the country and include most of the low veld areas. Barberton district, 5106 sq. m., is east central. Piet Retief district (in the south-east), 1673 sq. m., lies between Swaziland and Natal. Along the southern border, going east to west from Piet Retief, are the districts of Wakkerstroom, 2128 sq. m.; Standerton, 1959 sq. m.; Heidelberg, 2410 sq. m.; Potchefstroom, 4805 sq. m.; Wolmaransstad, 2169 sq. m., and, occupying the south-western corner of the province, Bloemhef, 3003 sq. m. In the west are the districts of Lichtenburg, 4487 sq. m.; Marico, 3626 sq. m. and Rustenberg, 9511 sq. m. The central regions are divided into the districts of Witwatersrand, 1653 sq. m.; Pretoria, 6525 sq. m.; Middelburg, 4977 sq. m.; Carolina, 1877 sq. m.; Ermelo, 2995 sq. m. and Bethel, 1959 sq. m. It will be seen that twenty districts are enumerated, these being the divisions under the Boer government and still commonly used. In 1904 Bloemhof was officially included in Wolmaransstad; Bethel in Standerton; Piet Retief in Wakkerstroom, and Carolina in Ermelo. Each district is sub-divided into field-cornetcies, the cornetcies being themselves divided, where necessary, into urban and rural areas. For parliamentary purposes the districts are divided into single member constituencies. The capital of the province, and of the Union is Pretoria, with a population (1904) of 36,839 (of whom 21,114 were whites). Johannesburg, the centre of the gold-mining industry, had a population, within the municipal boundary, of 155,642 (83,363 whites). Other towns within the Witwatersrand district are Germiston (79,477), Boksburg (14,757) and Roodepoort-Maraisburg (19,949), virtually suburbs of Johannesburg, and Krugersdorp (20,073) and Springs (5270), respectively at the western and east ends of the district. Besides Pretoria and the towns in the Witwatersrand district, there are few urban centres of any size. Potchefstroom, in the south near the Vaal (pop. 9348), is the oldest town in the Transvaal. Klerksdorp (4276) is also near the Vaal, S.S.W. of Potchefstroom. Middelburg (5085) is the largest town on the railway between Pretoria and Delagoa Bay; Barberton (2433), the centre of the De Kaap gold-fields, lies on the slopes of the Drakensberg overlooking the De Kaap valley.

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[1] For most purposes this military element is *omitted* in the census returns.

Communications.—Before 1888 the only means of communication was by road. In that year the government sanctioned the building of a "steam tramway"—a railway in all but name—from the Boksburg collieries to the Rand gold mines. In 1890 the construction of the Transvaal section of the railway to connect Pretoria with Delagoa Bay was begun, the line from Lourenço Marques having been completed to Komati Poort in December 1887. The line to Pretoria was not opened until July 1895. Meantime, in September 1892, the Cape railway system had been extended to Johannesburg and in December 1895 the through line between Durban and Pretoria was completed. Since that date many other lines have been built. The majority of the railways are the property of and are worked by the state. With the exception of a few purely local lines they are of the standard South African gauge—3 ft. 6 in. The lines all converge on Johannesburg. The following table gives the distances from that city to other places in South Africa[1]:—

Inland Centres—	
To Pretoria	46 miles.
„ Kimberley	310 „
„ Bloemfontein	263 „
„ Bulawayo (via Fourteen Streams)	979 „
„ Salisbury („ „)	1279 „
Seaports—	
To Cape Town (via Kimberley)	957 „
„ „ (via Bloemfontein)	1013 „
„ Port Elizabeth	714 „
„ East London	665 „
„ Durban	483 „
„ Lourenço Marques (via Pretoria)	396 „

Besides the lines enumerated the other railways of importance are: (1) A line from Johannesburg eastward via Springs and Breyten to Machadodorp on the Pretoria-Delagoa Bay railway. (2) A line, 68 m. long from Witbank, a station on the Pretoria-Delagoa Bay line, to Brakpan on the Springs line. By (1) the distance between Johannesburg and Lourenço Marques is 364 m., by (2) 370 m. A continuation of the Springs-Breyten line eastward through Swaziland to Delagoa Bay will give a second independent railway from that port to the Rand, some 60 m. shorter than the route via Pretoria, while from Breyten a line (90 m. long) runs south and east to Ermelo and Piet Retief. (3) A line from Krugersdorp to Zeerust (128 m.). (4) A line from Pretoria to Rustenburg (61 m.). (5) A line from Pretoria to Pietersburg (177 m.). This line was continued (1910) north-west to effect a junction with (6) the "Selati" railway, which, starting from Komati Poort, runs north-west and was in 1910 continued to Leydsdorp. North of the junction with the Pietersburg line the railway goes towards the Limpopo. (7) A line from Belfast on the Pretoria-Delagoa Bay railway to Lydenburg (65 m.). (8) A line from Potchefstroom to Lichtenburg (70 m.).

There is an extensive telegraphic system linking the towns of the province to one another, and, through the surrounding countries, with Europe and the rest of the world. There is inland communication via Rhodesia with British Central Africa and Ujiji on Lake Tanganyika. The telegraph lines within the Transvaal have a length of about 3000 m. There is a well-organized postal service with about 400 offices. In connexion with the postal services to outlying districts there is a public passenger service by mailcarts. In the Pietersberg district zebras are occasionally employed.

Mineral Resources.—The Transvaal, the principal gold producing country in the world, is noted for the abundance and variety of its mineral resources. The minerals chiefly mined besides gold are diamonds and coal, but the country possesses also silver, iron, copper, lead, cobalt, sulphur, saltpetre and many other mineral deposits.

Gold.—The principal gold-bearing reefs are found along the Witwatersrand ("The Rand"). Probably connected with the Rand reefs are the gold-bearing rocks in the Klerksdorp, Potchefstroom and Venterskroon districts. Other auriferous reefs are found all along the eastern escarpment of the Drakensberg and are worked in the De Kaap (Barberton) district, on the Swaziland frontier, in the Lydenburg district, in the Murchison Range and in other places in the Zoutpansberg. Goldfields also exist in the Waterberg and on the western frontier in the Marico district (the Malmani fields). The total value of the gold extracted from mines in the Transvaal up to the end of 1909 was about £246,000,000.

a. The Witwatersrand and Neighbouring Mines.—The Rand reefs, first mined in 1886, cover a large area. The main reef, continuously traced, measures about 62 m. and runs in an east and west direction. The gold is found in minute particles and in the richest ores the metal is rarely in visible quantities before treatment. In many places the main reef lies at a great depth and some bore-holes are over 5500 ft. deep. The yield of the Rand mines, in 1887 but 23,000 oz., rose in 1888 to 208,000 oz. In 1892 the yield was 1,210,000 oz.; in 1896 it exceeded 2,280,000 oz. and in 1898 was 4,295,000 oz. The war that followed prevented the proper working of the mines. In 1905 when a full supply of labour was again available the output was 4,760,000 oz., in which year the sum distributed in dividends to shareholders in the Rand mines was over £4,800,000. The total output from the Rand mines up to the end of 1908 was 56,477,240 oz. (see GOLD, and JOHANNESBURG). The Klerksdorp and Potchefstroom goldfields, known also as the Western Rand, were proclaimed in 1887 and up to the close of 1908 had yielded 446,224 oz.

b. The De Kaap (*Barberton*) *Fields.*—Gold was discovered in this district of the Drakensberg in 1875, but it was not until 1884 that the fields attracted much attention. The mines are, in general, situated on the slopes of the hills and are easily opened up by adits. The reefs are narrower than those of the Rand, and the ore is usually very hard. The output, 35,000 oz. in 1889, was 121,000 oz. in 1896, but only 43,000 oz. in 1905. The total production (including the Komati and Swaziland fields) to the end of 1908 was 1,097,685 oz.

c. The Lydenburg and other Fields.—The Lydenburg fields, reported to have been worked by the Portuguese in the 17th century, and rediscovered in 1869, though lying at an elevation of 4500 to 5000 ft. are alluvial—and the only rich alluvial goldfields in South Africa. The ground containing the gold is soil which has escaped denudation. Though several large nuggets have been found (the largest weighing 215 oz.), the total production is not great, the highest output obtained by washing being worth about £300,000 in one year. Besides the alluvial deposits a little mining is carried on, gold being present in the thin veins of quartz which cross the sandstone. The chief centres of the fields are Lydenburg, Pilgrims Rest and Spitzkop. The total output of the Lydenburg fields up to the end of 1908 is estimated at 1,200,000 oz. Farther north, in the Zoutpansberg and on its spurs are the little-worked mines generally known as the Low Country goldfields. Near Pietersburg in the Zoutpansberg is the Eersteling, the first mine worked in the Transvaal. Operations began in 1873 but in 1880 the machinery was destroyed by the Boers. It was not until 1904 that prospecting in the neighbourhood was again undertaken. The fields in the Waterberg and along the Malmani river are very small producers. The total yield to the end of 1908 of the Zoutpansberg, Low Country and other minor fields was 160,535 oz.

Diamonds.—The chief diamond fields are in the Pretoria district. The ground was discovered to be diamondiferous in 1897, but it was not until 1903, when mining began on the Premier mine, situated 20 m. north-east of Pretoria, that the wealth of the fields was proved. The site of the Premier mine had been recognized as diamond-bearing in March 1898. The owner of the land, a Boer named Prinsloo, refused to allow experimental spade work, but after the conclusion of the Anglo-Boer War in 1902 sold his property for £55,000 to T. Cullinan (a Cape colonist and one of the chief contractors in the building of Johannesburg), whose faith in the richness of the ground was speedily justified. In June 1903 mining began and the diamonds found in the first five months realized over £90,000. On the 27th of January 1905, the largest diamond in the world, weighing 3025¾ carats, over 1⅓ lb avoirdupois, was found in the mine and named the Cullinan. The Premier mine is of the same character as the diamond mines at Kimberley (see DIAMOND), and is considerably larger. The area of the "pipe" containing blue ground is estimated at 350,000 sq. yds.

Besides the Pretoria fields there are diamondiferous areas (alluvial diggings) in the Bloemhof district on the Vaal river north-east of Kimberley, and in other regions. In 1898 the output for the whole of the Transvaal was valued at £44,000. The output since the opening of the Premier mine has been: 1903–1904, £685,720; 1904–1905, £1,198,530; 1905–1906, £968,229; 1906–1907, £2,203,511; 1907–1908, £1,879,551; 1908–1909, £1,295,296.

Coal and other Minerals.—There are extensive beds of good coal, including thick seams of steam coal near the Rand and other goldfields. Coal appears to have been first discovered in the neighbourhood of Bronkhorst Spruit between the Wilge and Olifants rivers, where it was so near the surface that farmers dug it up for their own use. In 1887 coal was found at Boksburg in the East Rand, and a mine was at once started. The principal collieries are those at Boksburg and at Brakpan, also on the East Rand, with a coal area of 2400 acres; at Vereeniging and Klerksdorp, near the Vaal; at Watervaal, 12 m. north of Pretoria; and in the Middelburg district, between Pretoria and Lourenço Marques. Like that of Natal the Transvaal coal burns with a clear flame and leaves little ash. The mines are free from gas and fire damp and none is more than 500 ft. deep. The output in 1893, the first year in which statistics are available, was 548,534 tons (of 2000 lb); in 1898 it was 1,907,808 tons, and for the year ending 30th of June 1909 was 3,312,413 tons, valued at £851,150.

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[1] For projected routes, shortening the journey between Europe and Johannesburg, see the *Geog. Journ.*, Dec. 1910.

Iron and copper are widely distributed. The Yzerberg near Marabastad in the Zoutpansberg consists of exceedingly rich iron ore, which has been smelted by the natives for many centuries. Silver is found in many districts, and mines near Pretoria have yielded in one year ore worth £30,000.

Salt is obtainable from the many *pans* in the plateaus, notably in the Zout(salt)pansberg, and was formerly manufactured in considerable quantities.

Agriculture.—Next to mining agriculture is the most important industry. At the census of 1904 over 500,000 persons (excluding young children), or 37% of the population, were returned as engaged in agriculture. Some 25% more women than men were so employed, this preponderance being due to the large number of Kaffir women and the few native men who work in the mealie fields. The chief occupation of the majority of the white farmers is stock-raising. The high veld is admirably adapted for the raising of stock, its grasses being of excellent quality and the climate good. Even better pasture is found in the low veld, but there stock suffers in summer from many endemic diseases, and in the more northerly regions is subject to the attack of the tsetse fly. The banken veld is also unsuited in summer for horses and sheep, though cattle thrive. Much of the stock is moved from the lower to the higher regions according to the season. Among the high veld farmers the breeding of merino sheep is very popular.

The amount of land under cultivation is very small in comparison with the area of the province. In 1904 only 951,802 acres, or 1·26% of the total acreage was under cultivation, and of the cultivated land nearly half was farmed by natives. The small proportion of land tilled is due to many causes, among which paucity of population is not the least. Moreover while large areas on the high veld are suitable for the raising of crops of a very varied character, in other districts, including a great part of the low veld, arable farming is impossible or unprofitable. Many regions suffer permanently from deficient rainfall; in others, owing to the absence of irrigation works, the water supply is lost, while the burning of the grass at the end of summer, a practice adopted by many farmers, tends to impoverish the soil and render it arid. The country suffers also from periods of excessive heat and general drought, while locusts occasionally sweep over the land, devouring every green thing. In some seasons the locusts, both red and brown, come in enormous swarms covering an area 5 m. broad and from 40 to 60 m. long. The chief method employed for their destruction is spraying the swarms with arsenic. The districts with the greatest area under cultivation are Heidelberg, Witwatersrand, Pretoria, Standerton and Krugersdorp. The chief crops grown for grain are wheat, maize (mealie) and kaffir corn, but the harvest is inadequate to meet local demands. Maize is the staple food of the Kaffirs. Since 1906 an important trade has also arisen in the raising of mealies for export by white farmers. Oats, barley and millet are largely grown for forage. Oats are cut shortly before reaching maturity, when they are known as oat-hay. The chief vegetables grown are potatoes, pumpkins, carrots, onions and tomatoes.

Fruit farming is a thriving industry, the slopes of the plateaus and the river valleys being specially adapted for this culture. At the census of 1904 over 3,032,000 fruit trees were enumerated. There were 163,000 orange trees and nearly 60,000 other citrus trees, 430,000 grape vines, 276,000 pine plants and 78,000 banana plants. Oranges are cultivated chiefly in the Rustenburg, Waterberg, Zoutpansberg and Pretoria districts, grapes in Potchefstroom, Pretoria and Marico, as well as in the Zoutpansberg and Waterberg, to which northern regions the cultivation of the banana is confined. In the tropical district of the Limpopo valley there is some cultivation of the coffee-tree, and this region is also adapted for the growing of tea, sugar, cotton and rice. Tobacco is grown in every district, but chiefly in Rustenburg. Of the 3,032,000 lb of tobacco grown in 1904, Rustenburg produced 884,000 lb.

A department of agriculture was established in 1902, and through its efforts great improvements have been made in the methods of farming. To further assist agriculture a land bank was established by the government in 1907 and an agricultural college in 1910.

Land Settlement.—The land board is a government department charged with the control of Crown lands leased to settlers on easy terms for agricultural purposes. Between 1902 and 1907 about 550 families were placed on the land, their holdings aggregating over 500,000 acres. The Crown lands cover in all about 21,500,000 acres. Large areas of these lands, especially in the northern districts, are used as native reserves.

Other Industries.—There are few manufacturing undertakings other than those connected with mining, agriculture and the development of Johannesburg. There is a large factory for the supply of dynamite to the gold mines. The building and construction trade is an important industry on the Rand, where there are also brick-works, iron and brass foundries, breweries and distilleries. There are a number of flour mills and jam factories in various centres. A promising home industry, started under English auspices after the war of 1899–1902, is the weaving by women of rugs, carpets, blankets, &c., from native wool.

Export and Import Trade.—Before the discovery of gold the trade of the Transvaal was of insignificant proportions. This may be illustrated by the duties paid on imports, which in 1880 amounted to £20,306. In 1887 when the gold-mining industry was in its infancy the duty on imports had risen to £190,792, and in 1897, when the industry was fully developed, to £1,289,039. The Anglo-Boer War completely disorganized trade, but the close of the contest was marked by feverish activity and the customs receipts in 1902–1903 rose to £2,176,658. A period of depression followed, the average annual receipts for the next three years being £1,683,159. In 1908–1909 they were £1,588,960.

The chief exports are gold and diamonds. Of the total exports in 1908, valued at £33,323,000, gold was worth £29,643,000 and diamonds £1,977,000. Next in value came wool (£226,000), horses and mules (£110,000), skins, hides and horns (£106,000), tobacco (£89,000), tin, coal, copper and lead. The gold and diamonds are sent to England via Cape Town; the other exports go chiefly to Delagoa Bay. The imports, valued at £16,196,000 in 1908, include goods of every kind. Machinery, provisions, largely in the form of tinned and otherwise preserved food, and liquors, clothing, textiles and hardware, chemicals and dynamite, iron and steel work and timber, and jewelry are the chief items in the imports. Of the imports about 50% comes from Great Britain and about 20% from British colonies (including other South African states). Half the imports reach the Transvaal through the Portuguese port of Lourenço Marques, Durban taking 25% and the Cape ports the remainder. There is free trade between the Transvaal and the other British possessions in South Africa, and for external trade they all adhere to a Customs Union which, as fixed in 1906, imposes a general *ad valorem* duty of 15% on most goods save machinery, on which the duty is 3%. A rebate of 3% is granted on imports from Great Britain.

Constitution.—The existing constitution dates from 1910. The province is represented in the Union Parliament by eight senators and thirty-six members of the House of Assembly. For parliamentary purposes the province is divided into single-member constituencies. Every adult white male British subject is entitled to the franchise, subject to a six months' residential qualification.[1] There is no property qualification. All electors are eligible to the assembly. Voters are registered biennially, and every five years there is an automatic redistribution of seats on a voters' basis.

Central Government.—At the head of the executive is a provincial administrator, appointed by the Union ministry, who holds office for five years and is assisted by an executive committee of four members elected by the provincial council. The provincial council consists of 36 members elected for the same constituencies and by the same electorate as are the members of the House of Assembly. The provincial council, which has strictly local powers, sits for a statutory period of three years. The control of elementary education was guaranteed to the provincial council for a period of five years from the establishment of the Union.

In May 1903 an inter-colonial council was established to deal with the administration of the railways in the Transvaal and Orange River Colony (known as the Central South African railways), the South African constabulary and other matters common to the Orange River and Transvaal colonies. This council was presided over by the governor of the Transvaal and formed an important part of the administrative machinery. By agreement between the two colonies the council was dissolved in 1908. In 1910 the control of the railways passed to the harbours and railway board of the Union of South Africa.

Local Government.—The unit of administration is the field cornetcy. The semi-military organization of these divisions, which existed under the South African republic, has been abolished, and field-cornets, who are nominated by the provincial government, are purely civil officials charged with the registration of voters, births and deaths, the maintenance of public roads, &c. The chief local authorities are the municipal bodies, many "municipalities" being rural areas centred round a small town. The municipal boards possess very wide powers of local government. The Witwatersrand municipalities are for certain purposes combined into one authority, and representatives of these municipalities, together with representatives of the chamber of mines, compose the Rand water board. The basis of municipal qualification is ownership of real property of the value of £100, or the tenancy of premises of the value of £300, or annual value of £24. Neither aliens nor coloured British subjects can exercise the franchise.

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[1] The number of electors at the first registration (1907) was 105,368.

Finance.—In 1883, before the Rand gold mines had been found revenue and expenditure were about £150,000; in 1887, when the mines were beginning to be developed, the receipts were £668,000 and the expenditure £721,000; in 1889 the receipts had risen to £1,577,000 and the expenditure to £1,226,000. In 1894 the receipts first exceeded two millions, the figures for that year being: revenue £2,247,000, expenditure £1,734,000. The figures for the four following years were:—

	Revenue.	Expenditure.
1895	£3,539,000	£2,679,000
1896	£4,807,000	£4,671,000
1897	£4,480,000	£4,394,000
1898	£3,983,000	£3,971,000

The public debt of the Boer government was £2,500,000. In 1899 war broke out and the finances of the country were disorganized. The accounts of the colony began, for normal purposes, with the year ending 30th of June 1903, and ended in June 1910 on the establishment of the Union. In May 1903 a loan of £35,000,000, guaranteed by the imperial government and secured on the general revenues of the Transvaal and Orange River colonies, was issued to the extent of £30,000,000, the balance being raised about the middle of 1904. This loan bears interest at 3% per annum, with a sinking fund of 1%, and as to the £30,000,000 was issued at par, the £5,000,000 being put up to tender and realizing an average price of £98, 10s. 3d. The principal head in the allocation of this loan was the purchase of the railways in the two colonies at a cost of £13,520,000, while an additional £5,958,000 was devoted to the building of new lines, purchases of rolling stock, &c. The debt of the South African Republic was paid off; £542,000 went to make good the deficit on the administration for 1901–1902; the sum of £1,561,000 was paid to burghers of the Cape Colony and Natal as compensation for war losses; £3,000,000 was devoted to land settlement schemes and £2,000,000 to public works other than railways. The railways were treated as the common property of both colonies, and to administer them and other common services the inter-colonial council was created. In addition to the charges enumerated £5,000,000 were spent out of the loan on "repatriation and compensation" of burghers who had suffered during the war.[1] In addition to the £35,000,000 guaranteed loan of 1903–1904 two small loans for land settlement and public works, together amounting to £254,800, were issued, and in 1907 an imperial guarantee was given for the raising of another loan, of £5,000,000, by the colonial government. The act authorizing the loan devoted £2,500,000 to the establishment of a land and agricultural bank, and £2,500,000 to railways, public works, irrigation and agricultural settlement and development. The loan was raised, as to £4,000,000, in January 1909, the average price obtained being £96, 3s. 7d.

The chief sources of revenue are customs, mining royalties, railways, native revenue (poll tax and passes), posts and telegraphs, stamp and transfer duties, land revenue and taxes on trades and professions. A tax of 10% is levied on the annual net produce of all gold workings (proclamation of 1902) and the government takes 60% of the profits on diamond mines. In 1907 an excise duty was, for the first time, levied on beer. The principal heads of expenditure are on railways and other public works, including posts and telegraphs, justice, education, police, land settlement and agriculture generally, mines and native affairs. Since June 1910 the control of state finance passed to the Union parliament, but the Transvaal provincial council is empowered to raise revenue for provincial purposes by direct taxation and, with the consent of the Union government, to borrow money on the sole credit of the province.

In the five years 1902–1907 the average annual receipts and expenditure amounted to £4,500,000, exclusive of the sums received and expended on account of the loans mentioned. The inter-colonial council received and spent in the four years 1903–1907 over £21,500,000, including some £3,500,000 paid in from revenue by the Transvaal and Orange River colonies to make good deficits. Fully two-thirds of the revenue and expenditure of the Council was derived from and spent upon the Transvaal, so that had the accounts of the two colonies been entirely distinct the figures of the Transvaal budget for 1903–1907 would have balanced at about £8,500,000 a year. In July 1907 when the control of the finances passed into the hands of the Transvaal legislature the credit balance on the consolidated fund was £960,000. In 1908 the inter-colonial council was dissolved, but the railways continued to be administered as a joint concern by a railway board on which the governments of both colonies were represented. This board in 1910 handed over its duties to the harbour and railway board of the Union. The Transvaal revenue (apart from railway receipts) in 1908–1909 was £5,735,000, the corresponding expenditure £4,524,000. The budget figures for 1909–1910 were: revenue £5,943,000; expenditure £5,231,000. The diamond revenue yielded £235,000 and the gold profits tax £965,000. The balance handed over to the Union government was £1,015,000.

Justice.—The laws are based on Roman-Dutch law, as modified by local acts. Courts of first instance are presided over by magistrates, the whole colony being divided into sixteen magisterial wards. There is a provincial division of the Supreme Court of South Africa sitting at Pretoria (consisting of a judge president and six puisne justices) with original and appellate jurisdiction in civil and criminal matters. A local division of the Supreme Court, formerly known as the Witwatersrand high court (consisting of one or more judges of the Supreme Court) sits permanently at Johannesburg and has civil and criminal jurisdiction throughout the Rand. Circuit courts are held as occasion requires.

Police.—Pretoria and Johannesburg have their own police forces. The rest of the province is policed by the South African constabulary, a body 3700 strong, to which is also entrusted customs preventive work, fire brigade work and such like functions.

Education.—Since 1910 education other than elementary is under the control of the Union parliament. The provincial council is responsible for elementary education. At the head of the permanent staff is a director of education. School boards and district committees are formed, but their functions are almost entirely advisory. In accordance with the terms of the Education Act of 1907 of the Transvaal colony, state schools are provided for the free instruction of all white children in elementary subjects. Attendance at school between the ages of 7 and 14 is, with certain exceptions, compulsory. The medium of instruction in the lower standards is the mother tongue of the children. Above standard III. English is the medium of instruction. No religious tests are imposed on teachers and religious teaching is confined to undenominational Bible teaching. No government grants are given to private schools. (In 1906 members of the Dutch community established a "Christian National Education" organization and opened a number of denominational schools.) Secondary education is provided in the towns and high schools are maintained at Pretoria, Johannesburg and Potchefstroom. There are University colleges at Pretoria and Johannesburg. Education of the natives is chiefly in the hands of the missionaries, but the government gives grants in aid to over 100 schools for natives. At the census of 1904 the natives able to read formed less than 1% of the population. At the same census 95% of the white population over 21 were able to read and write; of the whites between the ages of 5 and 14 59% could read and write.

State schools for white children were established by the Boer government, and in the last year (1898) before the British occupation there were 509 schools and 14,700 scholars, the education vote that year being £226,000., In 1902 the property vested in various school committees was transferred to government and control of the schools vested in a department of state. In 1909 there were 670 government elementary schools, with more than 42,000 scholars. In 1907–1908 the education vote exceeded £500,000.

Religion.—Of the total population 26·69% are Christians, and of the Christians 80% are whites. No fewer than 70% of the people, including the bulk of the natives, are officially returned as of no religion.' Of the 336,869 Christians 69,738 were natives. Nearly half of the white community, 142,540 persons, belong to one or other of the Dutch Churches in the Transvaal, but they have only 4305 native members. Of Dutch Churches the first and chief is the Nederduitsch Hervormde Kerk, founded by the Voortrekkers and originally the state Church. The others are the Nederduitsch Gereformeerde Kerk, an offshoot of the Church of the same name at the Cape, and the Gereformeerde Kerk (the "Dopper" Church) with some 15,000 members and adherents in the Transvaal. The "Dopper" Church, an offshoot of the Separatist Reformed Church of Holland, is distinguished from the other Dutch churches in being more rigidly Calvinistic and "Biblical," and in not using hymns. A "Scouts" Church was formed at the end of the war of 1899–1902 by burghers who had previously acted as "National Scouts" and were ostracized by the synods of their former Churches. After some years of friction "National Scouts" were however readmitted, on terms, to their former membership.

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[1] Besides this £5,000,000 an additional sum of £9,500,000 was spent by the imperial government in relieving the necessities of those who had suffered during the war, but of this £9,500,000 the sum of £2,500,000 was in payment for goods received.

The Anglicans number 67,882 (including 13,033 natives), and are 19% of the European population. At the head of the community is the bishop of Pretoria. Next in numbers according to European membership among the Protestant bodies are Presbyterians, 19,821 (including 1194 natives), and Methodists 37,812 (including 20,648 natives). The Lutherans are the chief missionary body. Of a total membership of 24,175 only 5770 are European. The Protestant European community amounts altogether to 35% of the white population. The Roman Catholics number 16,453 (including 2005 natives) and form 5% of the European population. and the Hebrews 15,478 or 5·34% of the European inhabitants.

Defence.—A strong garrison of the British army is maintained in the province, the headquarters of all the imperial military forces in South Africa being at Pretoria. These forces are under the command of a lieutenant-general, who, however, acts under the supreme direction of the governor-general. The Transvaal forms a distinct district command under a major-general.

A volunteer force was established in 1904, for service within the Transvaal, or wherever the interests of the country might require. The force, disciplined and organized by a permanent staff of officers and non-commissioned officers of the regular army, is about 6500 strong, and consists of a brigade of artillery, four mounted, three composite and four infantry corps, a cyclist corps, &c. There are also cadet companies some 3000 strong. (F. R. C.)

HISTORY

A. *Foundation of the Republic.*—At the beginning of the 19th century the country now known as the Transvaal was inhabited, apparently somewhat sparsely, by Bavenda and other Bantu negroes, and in the south-west by wandering Bushmen and Hottentots. About 1817 the country was invaded by the chieftain Mosilikatze and his impis, who were fleeing from the vengeance of Chaka, king of the Zulus. The inhabitants were unable to withstand the attacks of the disciplined Zulu warriors—or Matabele, as they were henceforth called—by whom large areas of central and western Transvaal were swept bare. The remnants of the Bavenda retreated north to the Waterberg and Zoutpansberg, while Mosilikatze made his chief kraal at Mosega, not far from the site of the town of Zeerust. At that time the region between the Vaal and Limpopo was scarcely known to Europeans. In 1829, however, Mosilikatze was visited at Mosega by Robert Moffat, and between that date and 1836 a few British traders and explorers visited the country and made known its principal features. Such was the situation when Boer emigrants first crossed the Vaal.

Potgieter.

The causes which led to the exodus of large numbers of Dutch farmers from Cape Colony are discussed elsewhere (see SOUTH AFRICA and CAPE COLONY). Here it is only necessary to state that the *Voortrekkers* were animated by an intense desire to be altogether rid of British control, and to be allowed to set up independent communities and govern the natives in such fashion as they saw fit. The first party to cross the Vaal consisted of 98 persons under the leadership of Louis Trichard and Jan van Rensburg. They left Cape Colony in 1835 and trekked to the Zoutpansberg. Here Rensburg's party separated from the others, but were soon afterwards murdered by natives.[1] Trichard's party determined to examine the country between the Zoutpansberg and Delagoa Bay. Fever carried off several of their number, and it was not until 1838 that the survivors reached the coast. Eventually they proceeded by boat to Natal. Meantime, in 1836, another party of farmers under Andries Hendrik Potgieter had established their headquarters on the banks of the Vet river. Potgieter and some companions followed the trail of Trichard's party as far as the Zoutpansberg, where they were shown gold workings by the natives and saw rings of gold made by native workmen. They also ascertained that a trade between the Kaffirs and the Portuguese at Delagoa Bay already existed. On returning to the Vet, Potgieter learned that a hunting party of Boers which had crossed the Vaal had been attacked by the Matabele, who had also killed Boer women and children. This act led to reprisals, and on the 17th of January 1837 a Boer commando surprised Mosilikatze's encampment at Mosega, inflicting heavy loss on the Matabele without themselves losing a man. In November of the same year Mosilikatze suffered further heavy losses at the hands of the Boers, and early in 1838 he fled north beyond the Limpopo, never to return. Potgieter, after the flight of the Matabele, issued a proclamation in which he declared the country which Mosilikatze had abandoned forfeited to the emigrant farmers. After the Matabele peril had been removed, many farmers trekked across the Vaal and occupied parts of the district left derelict. Into these depopulated areas there was also a considerable immigration of Basuto, Bechuana and other Bantu tribes.

The first permanent white settlement north of the Vaal was made by a party under Potgieter's leadership. That commandant had in March 1838 gone to Natal, and had endeavoured to avenge the massacre of Piet Retief and his comrades by the Zulus. Jealous, however, of the preference shown by the Dutch farmers in Natal to another commandant (Gert Maritz), Potgieter speedily recrossed the Drakensberg, and in November 1838 he and his followers settled by the banks of the Mooi river, founding a town named Potchefstroom in honour of Potgieter. This party instituted an elementary form of government, and in 1840 entered into a loose confederation with the Natal Boers, and also with the Boers south of the Vaal, whose headquarters were at Winburg. In 1842, however, Potgieter's party declined to go to the help of the Natal Boers, then involved in conflict with the British. Up to 1845 Potgieter continued to exercise authority over the Boer communities on both sides of the Vaal. A determination to keep clear of the British and to obtain access to the outer world through an independent channel led Potgieter and a considerable number of the Potchefstroom and Winburg burghers in 1845 to migrate towards Delagoa Bay. Potgieter settled in the Zoutpansberg, while other farmers chose as headquarters a place on the inner slopes of the Drakensberg, where they founded a village called Andries Ohrigstad. It proved fever-ridden and was abandoned, a new village being laid out on higher ground and named Lydenburg in memory of their sufferings at the abandoned settlement.

The Sand River Convention.

Meantime the southern districts abandoned by Potgieter and his comrades were occupied by other Boers. These were joined in 1848 by Andries W. J. Pretorius (*q.v.*), who became commandant of the Potchefstroom settlers. When the British government decided to recognize the independence of the Transvaal Boers it was with Pretorius that negotiations were conducted. On the 17th of January 1852 a convention was signed at a farm near the Sand river in the Orange sovereignty by assistant commissioners nominated by the British high commissioner on the one hand, and by Pretorius and other Boers on the other. The first clause was in the following terms:—

> The assistant commissioners guarantee in the fullest manner, on the part of the British government, to the emigrant farmers beyond the Vaal river, the right to manage their own affairs, and to govern themselves according to their own laws, without any interference on the part of the British government, and that no encroachment shall be made by the said government on the territory beyond to the north of the Vaal river, with the further assurance that the warmest wish of the British government is to promote peace, free trade, and friendly intercourse with the emigrant farmers now inhabiting, or who hereafter may inhabit, that country; it being understood that this system of non-interference is binding upon both parties.

At this time there were settled north of the Vaal about 5000 families of European extraction—about 40,000 persons, including young children. They had obtained independence, but they were far from being a united people. When Pretorius conducted the negotiations which led to the signing of the Sand River Convention he did so without consulting the volksraad, and Potgieter's party accused him of usurping power and aiming at domination over the whole country. However, the volksraad, at a meeting held at Rustenburg on the 16th of March 1852, ratified the convention, Potgieter and Pretorius having been publicly reconciled on the morning of the same day. Both leaders were near the end of their careers; Potgieter died in March and Pretorius in July 1853.

Whatever their internal dissensions the Boers were united in regard to what they considered their territorial rights, and in the interval between the signing of the Sand River Convention and the death of Pretorius an incident occurred significant alike of their claims to jurisdiction over enormous areas and of their manner of treating the natives. Within a few weeks of the signing of the convention Pretorius had asked the British authorities to close the "lower road" to the interior, that is the route through Bechuanaland, opened up by Moffat, Livingstone and other missionaries. Pretorius alleged that by this means the natives were obtaining firearms. At the same time the Transvaal Boers claimed that all the Bechuana country belonged to them, a claim which the British government of that day did not think it worth while to contest. No boundary westward had been indicated in the Sand River Convention. The Barolong, Bakwena and other Bechuana tribes, through whose lands the "lower road" ran, claimed however to be independent, among them Sechele (otherwise Setyeli), at whose chief kraal—Kolobeng—Livingstone was then stationed. Sechele was regarded by the Boers as owing them allegiance, and in August 1852 Pretorius sent against him a commando (in which Paul Kruger served as a field cornet), alleging that the Bakwena were harbouring a Bakatla chief who had looted cattle belonging to Boer farmers. It was in this expedition that Livingstone's house was looted. There was little fighting, but the commando carried off between two and three hundred native women and children—some of whom were redeemed by their friends, and some escaped, while many of the children were apprenticed to farmers. Sechele's power was not broken, and he appealed for British protection, which was not then granted. The incident was, however, but the first step in the struggle for the possession of that country (see BECHUANALAND). It served to strengthen the unfavourable impression formed in England of the Transvaal Boers with regard to their treatment of the natives; an impression which was deepened by tidings of terrible chastisement of tribes in the Zoutpansberg, and by the Apprentice Law passed by the volksraad in 1856—a law denounced in many quarters as practically legalizing slavery.

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[1] Two small children were spared and brought up as Kaffirs. In 1867 they were given over to the Boer government by the Swazis, who had acquired them from their captors.

Potchefstroom Assembly, 1856.

On the death of Andries Pretorius his son Marthinus W. Pretorius (*q.v.*) had been appointed his successor, and to the younger Pretorius was due the first efforts to end the discord and confusion which prevailed among the burghers—a discord heightened by ecclesiastical strife, the points at issue being questions not of faith but of church government. In 1856 a series of public meetings, summoned by Pretorius, was held at different districts in the Transvaal for the purpose of discussing and deciding whether the time had not arrived for substituting a strong central government in place of the petty district governments which had hitherto existed. The result was that a representative assembly of delegates was elected, empowered to draft a constitution. In December this assembly met at Potchefstroom, and for three weeks was engaged in modelling the constitution of the country. The name "South African Republic" was adopted as the title of the state, and the new constitution made provision for a volksraad to which members were to be elected by the people for a period of two years, and in which the legislative function was vested. The administrative authority was to be vested in a president, aided by an executive council. It was stipulated that members both of the volksraad and council should be members of the Dutch Reformed Church, and of European blood. No equality of coloured people with the white inhabitants would be tolerated either in church or state. In reviewing an incident so important in the history of the Transvaal as the appointment of the Potchefstroom assembly it is of interest to note the gist of the complaint among the Boers which led to this revolution in the government of the country as it had previously existed. In his *History of South Africa* Theal says: "The community of Lydenburg was accused of attempting to domineer over the whole country, without any other right to pre-eminence than that of being composed of the earliest inhabitants, a right which it had forfeited by its opposition to the general weal." In later years this complaint was precisely that of the Uitlanders at Johannesburg. To conciliate the Boers of Zoutpansberg the new-born assembly at Potchefstroom appointed Stephanus Schoeman, the commandant-general of the Zoutpansberg district, commandant-general of the whole country. This offer was, however, declined by Schoeman, and both Zoutpansberg and Lydenburg indignantly repudiated the new assembly and its constitution. The executive council, which had been appointed by the Potchefstroom assembly, with Pretorius as president, now took up a bolder attitude: they deposed Schoeman from all authority, declared Zoutpansberg in a state of blockade, and denounced the Boers of the two northern districts as rebels.

Presidency of Marthinus Pretorius.

Further to strengthen their position, Pretorius and his party unsuccessfully endeavoured to bring about a union with the Orange Free State. Peaceful overtures having failed, Pretorius and Paul Kruger placed themselves at the head of a commando which crossed the Vaal with the object of enforcing union, but the Free State compelled their withdrawal (see ORANGE FREE STATE). Within the Transvaal the forces making for union gained strength notwithstanding these events, and by the year 1860 Zoutpansberg and Lydenburg had become incorporated with the republic. Pretoria, newly founded, and named in honour of the elder Pretorius, was made the seat of government and capital of the country. The ecclesiastical efforts at unity had not been equally successful. The Separatist Reformed Church of Holland had sent out a young expositor of its doctrines named Postma, who, in November 1858, became minister of Rustenburg. In the following year a general church assembly endeavoured to unite all the congregations in a common government, but Postma's consistory rejected these overtures, and from that date the Separatist (or Dopper) Church has had an independent existence (see *ante*, § *Religion*). Paul Kruger, who lived near Rustenburg, became a strong adherent of the new church.

Internal Dissensions.

Pretorius, while still president of the Transvaal, had been elected, through the efforts of his partisans, president of the Orange Free State. He thereupon (in February 1860) obtained six months' leave of absence and repaired to Bloemfontein, in the hope of peacefully bringing about a union between the two republics. He had no sooner left the Transvaal than the old Lydenburg party, headed by Cornelis Potgieter, landdrost of Lydenburg, protested that the union would be much more beneficial to the Free State than to the people of Lydenburg, and followed this up with the contention that it was illegal for any one to be president of the South African Republic and the Free State at the same time. At the end of the six months Pretorius, after a stormy meeting of the volksraad, apparently in disgust at the whole situation, resigned the presidency of the Transvaal. J. H. Grobelaar, who had been appointed president during the temporary absence of Pretorius, was requested to remain in office. The immediate followers of Pretorius now became extremely incensed at the action of the Lydenburg party, and a mass meeting was held at Potchefstroom (October 1860), where it was resolved that: (*a*) the volksraad no longer enjoyed its confidence; (*b*) that Pretorius should remain president of the South African Republic, and have a year's leave of absence to bring about union with the Free State; (*c*) that Schoeman should act as president during the absence of Pretorius; (*d*) that before the return of Pretorius to resume his duties a new volksraad should be elected.

If at this stage of their existence the real ambition of the Transvaal Boers was to found a strong and compact republican state, their conduct in opposing a scheme of union with the Orange Free State was foolish to a degree. The events of the year 1860, as well as of all the years that followed down to British annexation in 1877, show that licence rather than liberty, a narrow spirit of faction rather than patriotism, were the dominant instincts of the Boer. Had the fusion of the two little republics which Pretorius sought to bring about, and from which apparently the Free State was not averse, actually been accomplished in 1860, it is more than probable that a republican state on liberal lines, with some prospect of permanence and stability, might have been formed. But a narrow, distrustful, grasping policy on the part of whatever faction might be dominant at the time invariably prevented the state from acquiring stability and security at any stage of its history.

The complications that ensued on the action of the Pretorius party subsequent to his resignation were interminable and complicated. Some of the new party were arraigned for treason and fined; and for several months there were two acting presidents and two rival governments within the Transvaal. At length Commandant Paul Kruger called out the burghers of his district and entered into the strife. Having driven Schoeman and his followers from Pretoria, Kruger invaded Potchefstroom, which, after a skirmish in which three men were killed and seven wounded, fell into his hands. He then pursued Schoeman, who doubled on his opponent and entered Potchefstroom. A temporary peace was no sooner secured than Commandant Jan Viljoen rose in revolt and engaged Kruger's forces. Viljoen's commando, with which Pretorius was in sympathy, was known as the Volkslеger, or Army of the People. Kruger's force called itself the Staatsleger or Army of the State. Pretorius in 1863 resigned his Free State presidency and offering himself as mediator (not for the first time) succeeded at length in putting a period to the confused series of intestine quarrels. In January 1864 a conference, which lasted six days, was held between the parties and an agreement was reached. This was followed by a new election for president, and once more Pretorius was called upon to fill that office. Kruger was appointed commandant-general.

The Charge of Slavery against the Boers.

Civil strife for a time was at an end, but the injuries inflicted on the state were deep and lasting. The public funds were exhausted; taxes were impossible to collect; and the natives on the borders of the country and in the mountains of the north had thrown off all allegiance to the state. The prestige of the country was practically gone, not only with the world outside, but, what was of still more moment, with her neighbour the Free State, which felt that a federation with the Transvaal, which the Free State once had sought but which it now forswore, was an evil avoided and not an advantage lost. A charge frequently laid at the door of the Boers, at that time and since, was that of enslaving the black races. This charge was not without some justification. It is true that laws prohibiting slavery were in existence, but the Boer who periodically took up arms against his own appointed government was not likely to be, nor was he, restrained by laws. Natives were openly transferred from one Boer to another, and the fact that they were described as apprentices by the farmers did not in the least alter the status of the native, who to all intents and purposes became the property of his master. These apprentices, mostly bought from slave traders when little children, formed, however, a very small proportion of the native population, and after some fifteen years' servitude were usually allowed their freedom. Natives enjoying tribal government were not enslaved, but nothing could exceed in ferocity the measures taken to reduce recalcitrant tribes to submission. Education, as need hardly be said, was in the 'sixties at a very low ebb, and nothing approaching the standard of a high school existed. The private tutor was a good deal in demand, but his qualifications were of the slightest. An unsuccessful European carpenter or other mechanic, or even labourer, not infrequently occupied this position. At the various churches such elementary schools as existed were to be found, but they did not profess to teach more than a smattering of the three "R's" and the principles of Christianity.

Zoutpansberg Native Rising, 1865-8.

In 1865 an empty exchequer called for drastic measures, and the volksraad determined to endeavour to meet their liabilities and provide for further contingencies by the issue of notes. Paper money was thus introduced, and in a very short time fell to a considerable discount. In this same year the farmers of the Zoutpansberg district were driven into laagers by a native rising which they were unable to suppress. Schoemansdal, a village at the foot of the Zoutpansberg, was the most important settlement of the district, and the most advanced outpost in European occupation at that time in South Africa. It was just within the tropics, and was situated in a well-watered and beautiful country. It was used as a base by hunters and traders with the interior, and in its vicinity there gathered a number of settlers of European origin, many of them outcasts from Europe or Cape Colony. They earned the reputation of being the most lawless white inhabitants in the whole of South Africa. When called upon to go to the aid of this settlement, which in 1865–1866 was sore pressed by one of the mountain Bantu tribes known as the Baramapulana, the burghers of the southern Transvaal objected that the white inhabitants of that region were too lawless and reckless a body to merit their assistance. In 1867 Schoemansdal and a considerable portion of the district were abandoned on the advice of Commandant-general Paul Kruger, and Schoemansdal finally was burnt to ashes by a party of natives. It was not until 1869 that peace was patched up, and the settlement arrived at left the mountain tribes in practical independence. Meanwhile the public credit and finances of the Transvaal went from bad to worse. The paper notes already issued had been constituted by law legal tender for all debts, but in 1868 their power of actual purchase was only 30% compared with that of gold, and by 1870 it had fallen as low as 25%. Civil servants, who were paid in this depreciated scrip, suffered considerable distress. The revenue for 1869 was stated as £31,511; the expenditure at £30,836.

Efforts to obtain a Seaport.

The discovery of gold at Tati led President Pretorius in April 1868 to issue a proclamation extending his territories on the west and north so as to embrace the goldfield and all Bechuanaland. The same proclamation extended Transvaal territory on the east so as to include part of Delagoa Bay. The eastern extension claimed by Pretorius was the sequel to endeavours made shortly before, on the initiative of a Scotsman, to develop trade along the rivers leading to Delagoa Bay. It was also in accord with the desire of the Transvaal Boers to obtain a seaport, a desire which had led them as early as 1860 to treat with the Zulus for the possession of St Lucia Bay. That effort had, however, failed. And now the proclamation of Pretorius was followed by protests on the part of the British high commissioner, Sir Philip Wodehouse, as well as on the part of the consul-general for Portugal in South Africa. The boundary on the east was settled by a treaty with Portugal in 1869, the Boers abandoning their claim to Delagoa Bay; that on the west was dealt with in 1871.

The Keate Award.

The Sand River Convention of 1852 had not defined the western border of the state, and the discovery of gold at Tati to the north-west, together with the discovery of diamonds on the Vaal in 1867, offered Pretorius every inducement to extend his boundary. Although to-day the great diamond mines are south of the Vaal River, the early discoveries of diamonds were made chiefly on the northern bank of the Vaal, near the site of the town now known as Barkly West. This territory was claimed by the South African Republic, by Barolong and Batlapin Bechuanas, by Koranas, and also by David Arnot, on behalf of the Griqua captain, Nicholas Waterboer. To settle the boundary question an arbitration court was appointed consisting of a Transvaal landdrost, A. A. O'Reilly, on behalf of the South African Republic, and John Campbell on behalf of the other claimants, with Lieutenant-Governor Keate of Natal as referee. The judges disagreed, and the final decision, afterwards known as the Keate award, was given by the referee on the 17th of October 1871. The decision was in favour of Waterboer, who had, on the 25th of August 1870, before the appointment of the arbitration court, offered his territory to Great Britain, and it was understood by all the parties interested that that offer would be accepted. The award, admittedly just on the evidence before Keate, placed, however, outside the territory of the republic the Bloemhof district, in which district Boer farmers were settled, and over which the Pretoria government had for some years exercised jurisdiction. A few days after the publication of the Keate award Sir Henry Barkly, the British high commissioner, issued proclamations taking over Waterboer's territory under the title of Griqualand West (*q.v.*). The eastern boundary of the new territory was made to include the region between the Harts river and the Vaal, in which the diamond diggings were situated, but not the Bloemhof district. To this district Sir Henry Barkly asserted the British rights, but no steps were taken to enforce them and as a matter of fact the Bloemhof district continued to be part of the Transvaal.

Burgers becomes President, 1872.

The award caused a strong feeling of resentment among the Boers, and led to the resignation of President Pretorius and his executive. The Boers now cast about to find a man who should have the necessary ability, as they said, to negotiate on equal terms with the British authorities should any future dispute arise. With this view they asked Mr (afterwards Sir John) Brand, president of the Free State, to allow them to nominate him for the presidency of the South African Republic. To this President Brand would not consent. He recognized that, even at this early stage of their history, the Transvaal Boers were filled with the wildest ideas as to what steps they would take in the future to counteract the influence of Great Britain. Brand intimated to many of the leading Transvaal Boers that in his opinion they were embarking on a rash and mistaken policy. He urged that their true interests lay in friendship with, not in hostility to, Great Britain and the British. Having failed with Brand, the Boers invited the Rev. Thomas François Burgers, a member of a well-known Cape Colony family and a minister of the Dutch Reformed Church, to allow himself to be nominated. Burgers accepted the offer, and in 1872 was elected president. About this time gold reefs were discovered in the Zoutpansberg district near Marabastad, and a few gold seekers from Europe and Cape Colony began to prospect the northern portions of the Transvaal. The miners and prospectors did not, however, exceed a few hundred for several years.

The appointment of Burgers to the presidency in 1872 was a new departure. He was able, active and enlightened, but he was a visionary rather than a man of affairs or sound judgment. Instead of reducing chaos to order and concentrating his attention, as Brand had done in the Free State, on establishing security and promoting industry, he took up, with all its entanglements, the policy of intrigues with native chiefs beyond the border and the dream of indefinite expansion. In 1875 Burgers proceeded to Europe with the project of raising a loan for the construction of a railway to Delagoa Bay. He was empowered by the volksraad to raise £300,000, but with great difficulty he obtained in Holland the sum of £90,000 only, and that at a high rate of interest. With this inadequate sum some railway plant was obtained, and subsequently lay for ten years at Delagoa Bay, the scheme having to be abandoned for want of funds. On his return to the Transvaal in 1876 Burgers found that the conditions of affairs in the state was worse than ever. The acting-president had in his absence been granted leave by the volksraad to carry out various measures opposed to the public welfare; native lands had been indiscriminately allotted to adventurers, and a war with Sikukuni (Secocoeni), a native chief on the eastern borders of the country, was imminent. A commando was called out, which the president himself led. The expedition was an ignominious failure, and many burghers did not hesitate to assign their non-success to the fact that Burgers's views on religious questions were not sound. Burgers then proceeded to levy taxes, which were never paid; to enrol troops, which never marched; and to continue the head of a government which had neither resources, credit nor power of administration. In 1877 the Transvaal one-pound notes were valued at one shilling cash. Add to this condition of things the fact that the Zulus were threatening the Transvaal on its southern border, and the picture of utter collapse which existed in the state is complete.

B. *First Annexation by Great Britain.*—This condition of affairs coincided with the second movement in South Africa for a confederation of its various colonies and states, a movement of which the then colonial secretary, the 4th earl of Carnarvon, was a warm advocate. As to the Transvaal in particular, it was felt by Lord Carnarvon "that the safety and prosperity of the republic would be best assured by its union with the British colonies." Sir Theophilus Shepstone (*q.v.*) was given a commission, dated the 5th of October, 1876, instructing him to visit the Transvaal and empowering him, if it was desired by the inhabitants and in his judgment necessary, to annex the country to the British crown. Sir Theophilus went to Pretoria in January 1877, with an escort of twenty-five mounted police, and entered into conferences with the president and executive as to the state of the country. By this time Burgers was no longer blinded by the foolish optimism of a visionary who had woven finespun theories of what an ideal republic might be. He had lived among the Boers and attempted to lead their government. He had found their idea of liberty to be anarchy, their native policy to be slavery, and their republic to be a sham. His was a bitter awakening, and the bitterness of it found expression in some remarkable words addressed to the volksraad:

> "I would rather," said Burgers in March 1877, "be a policeman under a strong government than the president of such a state. It is you—you members of the Raad and the Boers—who have lost the country, who have sold your independence for a drink. You have ill-treated the natives, you have shot them down, you have sold them into slavery, and now you have to pay the penalty. . . . We should delude ourselves by entertaining the hope that matters would mend by-and-by. . . . Do you know what recently happened in Turkey? Because no civilized government was carried on there, the Great Powers interfered and said, 'Thus far and no farther.' And if this is done to an empire, will a little republic be excused when it misbehaves? . . If we want justice, we must be in a position to ask it with unsullied hands. . . ."

British Annexation, 1877.

After careful investigation Shepstone satisfied himself that annexation was the only possible salvation for the Transvaal. He had gone to Pretoria hoping that the Transvaal volksraad would accept Carnarvon's federation scheme; but the federation proposals were rejected by the raad. Shepstone was willing to find some way other than simple annexation out of the difficulty, but none appeared to present itself. The treasury was empty, the Boers refused to pay their taxes, and there was no power to enforce them. A public debt of £215,000 existed, and government contractors were left unpaid. Sir Theophilus Shepstone, finding that the raad would not adopt any remedial measures, on the 12th of April 1877 issued a proclamation annexing the country. The proclamation stated (among other things): "It is the wish of Her Most Gracious Majesty that it [the state] shall enjoy the fullest legislative privileges compatible with the circumstances of the country and the intelligence of its people." The wisdom of the step taken by Shepstone has been called in question. For many years subsequently the matter was so surrounded with the sophistry of English party politics that it was difficult for Englishmen to form any impartial opinion. The history of the Transvaal is more complete and better understood to-day than it was in 1877, and no one who acquaints himself with the facts will deny that Shepstone acted with care and moderation. The best evidence in favour of the step is to be found in the publicly expressed views of the state's own president, Burgers, already quoted. Moreover, the menace of attack on the Zulu side was a serious one, however able the Boers may have been to meet a foe who fought in the open, and who had been beaten by them in previous wars. Even before annexation had occurred, Shepstone felt the danger so acutely that he sent a message to Cetywayo, the Zulu chief, warning him that British annexation was about to be proclaimed and that invasion of the Transvaal would not be tolerated. To this warning Cetywayo, who, encouraged by the defeat of the Boers at Sikukuni's hands, had already gathered his warriors together, replied: "I thank my father Somtseu [Shepstone] for his message. I am glad that he has sent it, because the Dutch have tired me out, and I intended to fight with them . . . and to drive them over the Vaal. . . ." A still further reason for Shepstone's annexation, given by Sir Bartle Frere, was that Burgers had already sought alliance with European powers, and Shepstone had no reason to doubt that if Great Britain refused to interfere, Germany would intervene. Moreover, apart from the attitude of President Burgers, which cannot be said to have been one of active opposition, a considerable number of the Boers accepted the annexation with complacency. Burgers himself left the Transvaal a disappointed, heart-broken man, and a deathbed statement published some time after his decease throws a lurid light on the intrigues which arose before and after annexation. He shows how, for purely personal ends, Kruger allied himself with the British faction who were agitating for annexation, and to undermine him and endeavour to gain the presidency, urged the Boers to pay no taxes. However this may be, Burgers was crushed; but as a consequence the British government and not Paul Kruger was, for a time at least, master of the Transvaal. In view of his attitude before annexation, it was not surprising that Kruger should be one of the first men to agitate against it afterwards. The work of destruction had gone too far. The plot had miscarried. And so Kruger and Dr Jorissen, by whom he was accompanied, were the first to approach Lord Carnarvon with an appeal for revocation of the proclamation. Lord Carnarvon's reply was that the act of annexation was an irrevocable one. Unfortunately the train of events in England favoured the intrigues of the party who wished the annexation cancelled. In 1878 Lord Carnarvon resigned, and there were other evidences of dissension in the British cabinet.

Agitation for independence.

Kruger, who since the annexation had held a salaried appointment under the British Government, again became one of a deputation to England. His colleague was Piet Joubert. They laid their case before Sir Michael Hicks Beach (who had succeeded Lord Carnarvon) but met with no success. Sir Michael, however, in a despatch dated September the 16th 1878, reiterated the intention of the British cabinet to grant the state "to the utmost practicable extent, its individuality and powers of self-government under the sovereignty of the queen." On the occasion of Kruger's second mission to endeavour to get the annexation revoked Sir T. Shepstone determined to dispense with his further services as a government servant, and terminated the engagement. In the beginning of 1879 Shepstone was recalled and Colonel Owen Lanyon, who had served in Bechuanaland and was then administrator of Griqualand West, was appointed administrator in the Transvaal. In the meantime, the Zulu forces which threatened the Transvaal had been turned against the British, and the disaster of Isandhlwana occurred. Rumours of British defeat soon reached the Transvaal, and encouraged the disaffected party to become bolder in their agitation against British rule. Thus Sir Bartle Frere wrote at the time: "All accounts from Pretoria represent that the great body of the Boer population is still under the belief that the Zulus are more than a match for us, that our difficulties are more than we can surmount, and that the present is the favourable opportunity for demanding their independence." In April Frere visited Pretoria and conferred with the Boers. He assured them that they might look forward to complete self-government under the Crown, and at the same time urged them to sink political differences and join hands with the British against their common enemy, the Zulus. The Boers, however, continued to agitate for complete independence, and, with the honourable exception of Piet Uys, a gallant Boer leader, and a small band of followers, who assisted Colonel Evelyn Wood at Hlobani, the Boers held entirely aloof from the conflict with the Zulus, a campaign which cost Great Britain many lives and £5,000,000 before the Zulu power was finally broken. In June Sir Garnet Wolseley went to South Africa as commander of the forces against the Zulus, and as high commissioner "for a time," in the place of Sir Bartle Frere, of the Transvaal and Natal. Meantime Frere's proposals to fulfil the promises made to grant the Boers a liberal constitution were shelved. After the "settlement" of the Zulu question, Sir Garnet Wolseley proceeded to Pretoria and immediately organized an expedition against Sikukuni, who throughout the Zulu campaign had been acting under the advice of Cetywayo. Sikukuni's stronghold was captured and his forces disbanded.

Effect of Mr Gladstone's Speeches in England.

Sir Garnet Wolseley now assured the Boers at a public gathering that so long as the sun shone the British flag would fly at Pretoria. In May 1880 he returned to England, having established in the Transvaal a legislative council with powers so limited as to convince many of the Boers that there was no intention of fulfilling Shepstone's promises. Meanwhile events in Great Britain had once more taken a turn which gave encouragement to the disaffected Boers. Already in November 1879 Gladstone had conducted his Midlothian campaign. In one speech, referring to Cyprus and the Transvaal, he said: "If those acquisitions were as valuable as they are valueless, I would repudiate them, because they were obtained by means dishonourable to the character of our country." And in another speech he said that the British had insanely placed themselves in the strange predicament of the free subjects of a monarchy going to coerce the free subjects of a republic. Expressions such as these were translated into Dutch and distributed among the Boers, and they exercised a good deal of influence in fanning the agitation already going on in the Transvaal. So keenly were the Midlothian speeches appreciated by the Boers that the Boer committee wrote a letter of thanks to Gladstone, and expressed the hope that should a change in the government of Great Britain occur, "the injustice done to the Transvaal might find redress." In April 1880, this change in the British Government did occur. Gladstone became prime minister, and shortly afterwards Frere was recalled. Could events be more auspicious for the party seeking retrocession? On being directly appealed to by Kruger and Joubert, Gladstone however replied that the liberty which they sought might be "most easily and promptly conceded to the Transvaal as a member of a South African Confederation." This was not at all what was wanted, and the agitation continued. Meanwhile in the Transvaal, concurrently with the change of prime minister and high commissioner, the administrator, Colonel Lanyon, began vigorously to enforce taxation among the Boers. Men who would not pay taxes to their own appointed governments, and who were daily expecting to be allowed to return to that condition of anarchy which they had come to regard as the normal order of things, were not likely to respond willingly to the tax-gatherer's demands. That many of them refused payment in the circumstances which existed was natural.

Outbreak of War, 1880.

In November matters were brought to a head by the wagons of a farmer named Bezuidenhout being seized in respect of the non-payment of taxes, and promptly retaken from the sheriff by a party of Boers. Lanyon began to recognize that the position was becoming grave, and telegraphed to Sir George Colley, the high commissioner of South-East Africa, for military aid. This, however, was not immediately available, and on the 13th of December the Boers in public meeting at Paardekraal resolved once more to proclaim the South African Republic, and in the meantime to appoint a triumvirate, consisting of Kruger, Pretorius and Joubert, as a provisional government. Within three days of the Paardekraal meeting a letter was sent to the administrator demanding the keys of the government offices. Formal proclamation of the republic was made on the 16th of December (Dingaan's Day) at Heidelberg. Hostilities forthwith began. Meanwhile pressure was put on the British prime minister to carry out the policy he had avowed while out of office. But it was not until Great Britain was suffering from the humiliation of defeat that he was convinced that the time for granting that retrocession had arrived. The first shots fired were outside Potchefstroom, which was then occupied by a small British garrison (see POTCHEFSTROOM). On the 20th of December some 240 men under Colonel Anstruther, chiefly belonging to the 94th Regiment, while marching from Lydenburg to Pretoria, were surprised at Bronkhorst Spruit, and cut up by the Boer forces. Half the men were killed and wounded; the other half including some officers, were taken prisoners. Captain Elliot, one of the prisoners, who had been released on parole, was shot dead by Boers while crossing the Vaal, and Captain Lambert, another paroled prisoner who accompanied Elliot, was also shot,

Majuba Hill, 1881.

but escaped. Pretoria, Rustenberg, Lydenburg, and other smaller towns had been placed in a position of defence under the directions of Colonel Bellairs, who remained in command at Pretoria, the garrison consisting of a small number of troops and the loyal inhabitants. Sir George Colley, with about 1400 men, marched towards the Transvaal frontier, but before reaching it he found, on the 24th of January 1881, that the Boers had already invaded Natal and occupied Laing's Nek. He pitched his camp at Ingogo. Having been defeated at Laing's Nek, and suffered considerable loss in an engagement near Ingogo, Colley took a force to the top of Majuba, a mountain overlooking the Boer camp and the nek. He went up during the night, and in the morning was attacked and overwhelmed by the Boers (Feb. 27). Of the 554 men who constituted the British force on Majuba, 92 were killed and 134 wounded, Sir George Colley himself being amongst those who were slain.

Ten days previous to the disaster at Majuba Sir Evelyn Wood had arrived at Newcastle with reinforcements. On Colley's death he assumed command. Negotiations had been opened with the Boers before the attack on Majuba and the British cabinet refused to allow that disaster to influence their action. On the 6th of March a truce was concluded and on the 21st terms of peace were arranged between the Boer triumvirate and Sir Evelyn Wood. The most important of these terms were that the Transvaal should have complete internal self-government under British suzerainty and that a British resident should be stationed at Pretoria. Another article reserved to her majesty "the control of the external relations of the said state, including the conclusion of treaties and the conduct of diplomatic intercourse with foreign powers," and the right to march troops through the Transvaal. The boundaries of the state were defined, and to them the Transvaal was strictly to adhere. These terms practically conceded all that the Boers demanded, and were never regarded as anything else than surrender either by the Boers or the loyalists in South Africa. The agreement had hardly been concluded when Sir Frederick Roberts arrived at the Cape with 10,000 troops, and after spending forty-eight hours there returned to England.

In the meantime, while the British general was making a treaty under the instructions of British ministers on the frontier, the beleaguered garrisons of Pretoria, Potchefstroom, and other smaller towns were gallantly holding their own. The news of the surrender reached Pretoria through Boer sources, and when first received there was laughed at by the garrison and inhabitants as a Boer joke. When the bitter truth was at length realized, the British flag was dragged through the dust of Pretoria streets by outraged Englishmen. Presently there assembled in Pretoria a commission to elaborate the terms of peace. On the one side were the Boer triumvirate, on the other Sir Evelyn Wood, Sir Hercules Robinson (Frere's successor in the high commissionership), and Sir J. H. de Villiers, chief justice of Cape Colony, while President Brand of the Orange Free State gave the commission the benefit of his advice. The terms agreed upon were drawn up in the form of a convention and signed (Aug. 3).

Pretoria Convention.

The preamble to the Pretoria Convention of 1881 contained in brief but explicit terms the grant of self-government to the Boers, subject to British suzerainty. In later years, when the Boers desired to regard the whole of this convention (and not merely the articles) as cancelled by the London Convention of 1884, and with it the suzerainty, which was only mentioned in the preamble, Mr Chamberlain, a member of the cabinet of 1880–1885, pointed out that if the preamble to this instrument were considered cancelled, so also would be the grant of self-government.

The government of the state was handed over to the triumvirate on the 8th of August and was continued in their name until May 1883, when Kruger was elected president.

C. *From the Retrocession to 1899.*—The retrocession of the Transvaal was a terrible blow to the loyalists. The Boers, on the other hand, found themselves in better plight than they had ever been before. Their native foes had been crushed by British forces; their liabilities were consolidated into a debt to Great Britain, to be repaid at convenience and leisure—as a matter of fact, not even interest was paid for some time. If ever a small state was well treated by a large one, the Transvaal was so in the retrocession of 1881. Unfortunately, this magnanimity was forthcoming after defeat. It appeared as though a virtue had been made of a necessity, and the Boers never regarded it in any other light.

The New Régime.

The new volksraad had scarcely been returned and the Pretoria Convention ratified (Oct. 25) before a system of government concessions to private individuals was started. These concessions, in so far as they prejudiced the commerce and general interests of the inhabitants, consisted chiefly in the granting of monopolies. Among the first monopolies which were granted in 1882 was one for the manufacture of spirituous liquor. The system continued steadily down to 1899, by which time railways, dynamite, spirits, iron, sugar, wool, bricks, jam, paper and a number of other things were all of them articles of monopoly. In 1882 also began that alteration of the franchise law which subsequently developed into positive exclusion of practically all save the original Boer burghers of the country from the franchise. In 1881, on the retrocession, full franchise rights could be obtained after two years' residence; in 1882 the period of residence was increased to five years. Meanwhile the land-hunger of the Boers became stimulated rather than checked by the regaining of the independence of their country. On the western border, where the natives were of less warlike character than those on their southern and northern frontiers, intrigues were already going on with petty tribal chiefs, and the Boers drove out a portion of the Barolongs from their lands, setting up the so-called republics of Stellaland and Goshen. This act called forth a protest from the 15th Lord Derby (now secretary of state for the colonies), stating that he could not recognize the right of Boer freebooters to set up governments of their own on the Transvaal borders. This protest had no effect upon the freebooters, who issued one proclamation after another, until in November 1883 they united the two new republics under the title of the "United States of Stellaland." Simultaneously with this "irresponsible" movement for expansion, President Kruger proceeded to London to interview Lord Derby and endeavour to induce him to dispense with the suzerainty, and to withdraw other clauses in the Pretoria Convention on foreign relations and natives, which were objectionable from the Boer point of view. Moreover, Kruger requested that the term "South African Republic" should be substituted for Transvaal State.

London Convention, 1884.

The result was the London Convention of the 27th of February 1884. In this document a fresh set of articles was substituted for those of the Pretoria Convention of 1881. In the articles of the new convention the boundaries were once more defined, concessions being made to the Transvaal on the Bechuanaland frontier, and to them the republic was bound to "strictly adhere." In what followed it must always be remembered that Lord Derby began by emphatically rejecting the first Boer draft of a treaty on the ground that no treaty was possible except between equal sovereign states. Moreover, it is undeniable that Lord Derby acted as though he was anxious to appear to be giving the Boers what they wanted. He would not formally abolish the suzerainty, but he was willing not to mention it; and though, in substituting new articles for those of the Pretoria Convention he left the preamble untouched, he avoided anything which could commit the Boer delegates to a formal recognition of that fact. On the other hand, he was most indignant when in the House of Lords he was accused by Lord Cairns of impairing British interests and relinquishing the queen's suzerainty. He declared that he had preserved the thing in its substance, if he had not actually used the word; and this view of the matter was always officially maintained in the colonial office (which, significantly enough, dealt with Transvaal affairs) whatever the political party in power. Unfortunately, the timid way in which it was done made as ineffaceable an impression on Kruger even as the surrender after Majuba. Article 4 stated:

> "The South African Republic will conclude no treaty or engagement with any state or nation, other than the Orange Free State, nor with any native tribe to the eastward or westward of the Republic, until the same has been approved by her Majesty the Queen."

The other article to which the greatest interest was subsequently attached was art. 14:

> "All persons, other than natives, conforming themselves to the laws of the South African Republic (*a*) will have full liberty, with their families, to enter, travel, or reside in any part of the South African Republic; (*b*) they will be entitled to hire or possess houses, manufactories, warehouses, shops and premises; (*c*) they may carry on their commerce either in person or by any agents whom they may think fit to employ; (*d*) they will not be subject, in respect of their persons or property, or in respect of their commerce or industry, to any taxes, whether general or local, other than those which are or may be imposed upon citizens of the said Republic."

Territorial Expansion Efforts.

Economic Developments: Gold Industry.

Notwithstanding the precise fixing of the boundaries of the republic by the London Convention, President Kruger endeavoured to maintain the Boer hold on Goshen and Stellaland, but the British government on this point proved firm, and an expedition set out in 1884 under Sir Charles Warren, broke up the freebooters' two states, and occupied the country without a shot being fired (see Bechuanaland). The expedition cost Great Britain a million and a half, but the attempt at farther extension westwards was foiled, and a little later treaties with Lobenguela and the grant to Cecil Rhodes and his co-directors of a charter for the British South Africa Company put a check on designs the Boers held to expand northward (see Rhodesia). On the eastern border a similar policy of expansion was followed by the Boers, and in this instance with more success. Following up the downfall of the Zulu power after the British conquest in 1879, several parties of Boers began intriguing with the petty chiefs, and in May 1884, in the presence of 10,000 Zulus, they proclaimed Dinizulu, the son of Cetywayo, to be king of Zululand (see Zululand). As a "reward" for their services to the Zulus, the Boers then took over from them a tract of country in which they established a "New Republic." In 1886 the "New Republic" with limits considerably narrowed, was recognised by Great Britain, and the territory became incorporated with the Transvaal in 1888. Their eastern boundary, in the teeth of the spirit of the conventions, and with but scant observance of the letter, was by this means considerably extended. A similar policy eventually brought Swaziland almost entirely under their dominion (see Swaziland). At the same time President Kruger revived the project of obtaining a seaport for the state, one of the objects of Boer ambitions since 1860 (vide *supra*). Kruger endeavoured to acquire Kosi Bay, to the north of Zululand and only 50 m. east of the Swazi frontier. Meanwhile, events occurring within the state augured ill for the future of the country. In 1884 a concession to a number of Hollander and German capitalists of all rights to make railways led to the formation of the Netherlands Railway Company. This company, which was not actually floated till 1887, was destined to exercise a disastrous influence upon the fortunes of the state. Gold digging had hitherto enjoyed in the Transvaal but a precarious existence. In 1883 the discovery of Moodie's Reef near the Kaap Valley led to a considerable influx of diggers and prospectors from the colonies and Europe, and by 1884 the Sheba Mine had been opened up, and Barberton, with a population of 5000 inhabitants, sprung into existence. In 1886 the Rand goldfields, which had just been discovered, were proclaimed and Johannesburg was founded. From that time the gold industry made steady progress until the Rand gold mines proved the richest and most productive goldfield in the world. As the industry prospered, so did the European population increase. The revenue of the state went up by leaps and bounds. At the end of 1886 Johannesburg consisted of a few stores and some few thousand inhabitants. In October 1896 the sanitary board census estimated the population as 107,078, of whom 50,907 were Europeans. The wealth which was pouring into the Boer state coffers exceeded the wildest dreams of President Kruger and his followers. Land went up in value, and farms, many of them at comparatively remote distances from the goldfields, were sold at enormously enhanced prices. In fact, so attractive did this sale of land become to the Boers that they eventually parted with a third of the whole land area of the country to Uitlander purchasers. Yet in spite of the wealth which the industry of the Uitlanders was creating, a policy of rigid political exclusion and restriction was adopted towards them.

Relations with the rest of South Africa.

An attempt was made in 1888, after the conference held between Cape Colony, the Orange Free State and Natal, to induce the Transvaal to enter a customs union. Kruger would have none of it, although by so doing he could have obtained permission for a settlement at and railway to Kosi Bay. A convention to this effect was signed in August 1890, the Transvaal being allowed three years in which to take advantage of its provisions. Kruger's design at this time was to bring the whole of the external trade of the state, which was growing yearly as the gold industry developed, through Delagoa Bay and over the Netherlands railway. His hostility towards Great Britain and even Cape Colony led him to adopt a commercial policy both narrow and prejudicial to the interests of the gold industry. In the appointment of F. W. Reitz as president of the Orange Free State (January 1889) on the death of Sir John Brand, Kruger recognized a new opportunity of endeavouring to cajole the Free State. Brand had arranged, in the teeth of the strongest protests from Kruger, that the Cape railway should extend to Bloemfontein and subsequently to the Vaal river. Kruger now endeavoured to control the railway policy of the Free State, and induced that republic to agree to a treaty whereby each state bound itself to help the other whenever the independence of either should be threatened or assailed, unless the cause of quarrel was, in the eyes of the state called in to assist, an unjust one (see Orange Free State).

Oligarchical Restrictions.

In 1890 a feeling of considerable irritation had grown up among the Uitlanders at the various monopolies, but particularly at the dynamite monopoly, which pressed solely and with peculiar severity upon gold miners. Requests for consideration in the matter of the franchise, and also for a more liberal commercial policy in the matter of railways, dynamite and customs dues, began to be made. In response Kruger enacted that the period of qualification for the full franchise should now be raised to ten years instead of five. He at the same time instituted what was called a second chamber, the franchise qualifications for which were easier, but which was not endowed with any real power. During this year Kruger visited Johannesburg, and what was known as "the flag incident" occurred. He had by this time rendered himself somewhat unpopular, and in the evening the Transvaal flag, which flew over the landdrost's house, was pulled down. This incensed Kruger so much that for many years he continued to quote it as a reason why no consideration could be granted to the Uitlanders.

Uitlander Grievances.

By 1892 the Uitlanders began to feel that if they were to obtain any redress for their grievances combined constitutional action was called for, and the first reform movement began. The Transvaal National Union was formed. This consisted at the outset chiefly of mercantile and professional men and artisans. The mining men, especially the heads of the larger houses, did not care at this juncture to run the risk of political agitation. The Hon. J. Tudhope, an ex-minister in the Cape government, was elected chairman of the union. The objects of this body were avowed from the outset. They desired equal rights for all citizens, the abolition of monopolies and abuses, together with the maintenance of the state's independence. In the furthering of this policy Tudhope was supported by Charles Leonard and his brother

James Leonard, at one time attorney-general of Cape Colony. Both the Leonards, as well as many of their followers, were South Africans by birth. They, in common with the great bulk of the Uitlanders, recognized that the state had every right to have its independence respected. But they asserted that a narrow and retrogressive policy, such as Kruger was following, was the very thing to endanger that independence. The soundness of these views and the legitimacy of Uitlander aspirations were recognized by a few Boer officials at Pretoria. Some prominent burghers even spoke at Uitlander meetings in favour of the Uitlander requests. At a later date, Chief Justice Kotze, when on circuit, warned the Boers that in its retrogressive action the government was undermining the *grondwet* or constitution of the state. It soon became evident that one course, and one only, lay open to President Kruger if he desired to avert a catastrophe. It was to meet in a friendly spirit those men who had by their industry converted a poor pastoral country into a rich industrial one, who represented more than half the inhabitants, who paid more than three-fourths of the revenue, and who were anxious to join him as citizens, with the rights of citizenship. He chose a course diametrically opposite. In an interview accorded to seven delegates from the National Union, in 1892, he told Charles Leonard to "go back and tell your people that I shall never give them anything. I shall never change my policy. And now let the storm burst." In 1894 there occurred an incident which not only incensed the Uitlanders to fury, but called for British intervention.

Commandeering Incident, 1894.

A number of British subjects resident in the Transvaal, in spite of their having no political status, were commandeered to suppress a native rising. This led to a protest, and eventually a visit to Pretoria, from Sir Henry Loch the high commissioner. In the negotiations which followed, President Kruger at length agreed to extend "most favoured nation" privileges to British subjects in reference to compulsory military service, and five British subjects who had been sent as prisoners to the front were released. This result was not, however, achieved before President Kruger had done his utmost to induce Sir Henry Loch to promise some revision in favour of the Transvaal of the London Convention. Following this incident came a further alteration in the franchise law, making the franchise practically impossible to obtain. At a banquet given in honour of the German emperor's birthday in Pretoria in January 1895, Kruger referred in glowing terms to the friendship of Germany for the Transvaal, which in the future was to be more firmly established than ever. This speech was public evidence of what was known to be going on behind the scenes.

German Flirtation.

The German consul at Pretoria at this juncture was a volatile, sanguine man, with visionary ideas of the important part Germany was to play in the future as the patron and ally of the South African Republic, and of the extent to which the Bismarckian policy might go in abetting an anti-British campaign. Whether he deceived himself or not, he led President Kruger and the Boers to believe that Germany was prepared to go to almost any length in support of the Transvaal if any opportunity occurred. His influence was an undoubted factor in the Kruger policy of that time.

Drifts Incident.

The Delagoa Bay railway being at length completed to Pretoria and Johannesburg, Kruger determined to take steps to bring the Rand traffic over it. The Netherlands railway began by putting a prohibitive tariff on goods from the Vaal river. Not to be coerced in this manner, the Rand merchants proceeded to bring their goods on from the Vaal by wagon. Kruger then closed the drifts (or fords) on the river by which the wagons crossed. He only reopened them after the receipt of what was tantamount to an ultimatum on the subject from Great Britain.

Boer Road to the Sea Blocked.

In May 1895, on the urgent representations of Sir Henry Loch, the British government annexed Tongaland, including Kosi Bay, thus making the British and Portuguese boundaries conterminous on the coast of south-east Africa. In the previous month certain native territories between Tongaland and Swaziland had been annexed by Great Britain. The Boers, who had failed to fulfil the conditions under which they might have secured Kosi Bay, nevertheless resented this action, which took away from them all chance of obtaining a seaport. Kruger telegraphed that "this annexation cannot be regarded by this government otherwise than as directed against this republic. They must therefore regard it as an unfriendly act, against which they hereby protest." The protest was unheeded, the British government having realized the international complications that might ensue had the Transvaal a port of its own.

Uitlander Reform Movement.

At this time the Uitlanders formed a majority of the population, owned half the land and nine-tenths of the property, and they were at least entitled to a hearing. When in August 1895 they forwarded one of their many petitions praying for redress of their grievances and an extension of the franchise, their petition, with over 35,000 signatures, was rejected with jeers and insult. One member of the Raad, during a debate in the chamber, called upon the Uitlanders to "come on and fight" for their rights if they wanted them. The words were but the utterance of an individual Raad member, but they were only a shade less offensive than those used by Kruger in 1892, and they too accurately describe the attitude of the Boer executive. In September a meeting of the chambers of mines and commerce was held at Johannesburg, and a letter on various matters of the greatest importance to the mining industry was addressed to the Boer executive. It was never vouchsafed an answer. What the next step should be was freely discussed. Some urged an appeal to the Imperial government; but others, especially men of colonial birth and experience, objected that they would be leaning on a broken reed. That men who had still the memory of Majuba in their hearts should have felt misgiving is not to be wondered at. At this juncture (October 1895) came overtures to the leading Uitlanders from Cecil Rhodes, then prime minister of Cape Colony, and from Dr Jameson, leading to the Jameson Raid.

The "Jameson Plan."

To one or two men this scheme, subsequently known as the Jameson Plan, had been revealed in the previous June, but to the majority even of the small group of leaders it was not known till October or November 1895. The proposition came in a tempting hour. Rhodes and Jameson, after considerable deliberation, came to the conclusion that they might advantageously intervene between Kruger and the Uitlanders. They induced Alfred Beit, who was an old personal friend of Rhodes, and also largely interested in the Rand gold mines, to lend his co-operation. They then submitted their scheme to some of the Uitlander leaders. Between them it was arranged that Jameson should gather a force of 800 men on the Transvaal border; that the Uitlanders should continue their agitation; and that, should no satisfactory concession be obtained from Kruger, a combined movement of armed forces should be made against the government. The arsenal at Pretoria was to be seized; the Uitlanders in Johannesburg were to rise and hold the town. Jameson was to make a rapid march to Johannesburg. Meanwhile, in order to give Kruger a final chance of making concessions with a good grace, and for the purpose of stating the Uitlander case to the world, Charles Leonard, as chairman of the National Union, issued a historic manifesto, which concluded as follows:—

> We have now only two questions to consider: (*a*) What do we want? (*b*) How shall we get it? I have stated plainly what our grievances are, and I shall answer with equal directness the question, What do we want? We want (1) the establishment of this republic as a true republic; (2) a *grondwet* or constitution which shall be framed by competent persons selected by representatives of the whole people and framed on lines laid down by them—a constitution which shall be safeguarded against hasty alteration; (3) an equitable franchise law, and fair representation; (4) equality of the Dutch and English languages; (5) responsibility to the heads of the great departments of the legislature; (6) removal of religious disabilities; (7) independence of the courts of justice, with adequate and secured remuneration of the judges; (8) liberal and comprehensive education;

(9) efficient civil service, with adequate provision for pay and pension; (10) free trade in South African products. That is what we want. There now remains the question which is to be put before you at the meeting of the 6th of January, viz. How shall we get it? To this question I shall expect from you an answer in plain terms according to your deliberate judgment.

The Jameson conspiracy fared no worse and no better than the great majority of conspiracies in history. It failed in its immediate object. Jameson did not obtain more than 500 men. Johannesburg had the greatest difficulty in smuggling in and distributing the rifles with which the insurgents were to be armed. The scheme to seize the Pretoria fort had to be abandoned, as at the time fixed Pretoria was thronged with Boers. Finally, to make confusion worse confounded, Jameson, becoming impatient of delay, in spite of receiving direct messages from the leaders at Johannesburg telling him on no account to move, marched into the Transvaal.

Collapse of Jameson Raid.

The policy of delay in the execution of the plot which the Uitlander leaders found themselves compelled to adopt was determined by a variety of causes. Apart from the difficulty of obtaining arms, a serious question arose at the eleventh hour which filled some of the Uitlanders with mistrust. The reform leaders in the Transvaal, down to and including the Johannesburg rising, had always recognized as a cardinal principle the maintenance of the independence of the state. From Cape Town it was now hinted that the movement in which Jameson was to co-operate should, in Rhodes's view, be carried out under the British flag. A meeting of Uitlander leaders was hastily summoned on the 25th of December. Two messengers were that night despatched to interview Rhodes, who then gave the assurance that the flag question might be left to a plebiscite of the inhabitants of the Transvaal[1] (see Blue-book, 1897, 165, p. 21). It was determined nevertheless to postpone action; however, on the 29th of December, Jameson started, and the news of his having done so reached Johannesburg from outside sources. A number of leading citizens were at once formed into a reform committee. In the absence of Charles Leonard, who had been sent as one of the delegates to Cape Town to interview Rhodes, Lionel Phillips, a partner in Messrs Eckstein & Co., the largest mining firm on the Rand, was elected chairman. Phillips had been for three years in succession chairman of the chamber of mines, and he had persistently for several years tried to induce Kruger to take a reasonable view of the requirements of the industry. Under the supervision of the reform committee, such arms as had been smuggled in were distributed, and Colonel Frank Rhodes was given charge of the armed men. A large body of police was enrolled, and order was maintained throughout the town. On the 2nd of January 1896 Jameson, who found himself at Doornkop in a position surrounded by Boers, surrendered. Jameson and his men were conveyed to Pretoria as prisoners, and subsequently handed over to the high commissioner (Sir Hercules Robinson, who had succeeded Sir Henry Loch in June 1895).

The Kaiser's Telegram.

Significant of the attitude of Germany—whose "flirtation" with the Transvaal has been noted—was an open telegram sent by the emperor William II. the day after the surrender of Jameson congratulating Kruger that "without appealing to the help of friendly powers" he had repelled the raiders. The British government rejoined by commissioning a flying squadron and by calling attention to the London Convention, reserving the supervision of the foreign relations of the Transvaal to Great Britain. In Johannesburg meanwhile the Kruger government regained control. The whole of the reform committee (with the exception of a few who fled the country) were arrested on a charge of high treason and imprisoned in Pretoria. In April, at the trial, the four leaders—Lionel Phillips, Frank Rhodes, J. H. Hammond and George Farrar, who in conjunction with Charles Leonard had made the arrangements with Jameson—were sentenced to death, the sentence being after some months' imprisonment commuted to a fine of £25,000 each. The rest of the committee were each sentenced to two years' imprisonment, £2000 fine or another year's imprisonment, and three years' banishment. This sentence, after a month's incarceration, was also commuted. The fine was exacted, and the prisoners, with the exception of Woolls Sampson and W. D. (Karri) Davies, were liberated on undertaking to abstain from politics for three years in lieu of banishment. Messrs Sampson and Davies, refusing to appeal to the executive for a reconsideration of their sentence, were retained for over a year.

The Surrender of Johannesburg.

Sir Hercules Robinson was unfortunately in feeble health at the time, and having reached Pretoria on the 4th of January, he had to conduct negotiations under great physical disadvantage. He had no sooner learnt of the raid in Cape Town than he issued a proclamation through Sir Jacobus de Wet, the British resident at Pretoria, warning all British subjects in Johannesburg or elsewhere from aiding and abetting Jameson. This was freely distributed among the public of Johannesburg. While in Pretoria the high commissioner in the first instance addressed himself to inducing Johannesburg to lay down its arms. He telegraphed to the reform committee that Kruger had insisted "that Johannesburg must lay down arms unconditionally as a precedent to any discussions and consideration of grievances." On the following day, the 7th of January, Sir Hercules telegraphed again through the British agent, who was then at Johannesburg, saying: "That if the Uitlanders do not comply with my request they will forfeit all claims to sympathy from Her Majesty's government and from British subjects throughout the world, as the lives of Jameson and the prisoners are now practically in their hands." The two thousand odd rifles which had been distributed among the Uitlanders were then given up. With regard to the inducements to this step urged upon the reform committee by the high commissioner, it is only necessary to say with reference to the first that the grievances never were considered, and with reference to the second it subsequently appeared that one of the conditions of the surrender of Jameson's force at Doornkop was that the lives of the men should be spared. It was after the Johannesburg disarmament that Kruger had sixty-four members of the reform committee arrested, announcing at the same time that his motto would be "Forget and forgive." Sir Hercules Robinson, in response to a message from Mr Chamberlain, who had been secretary of state for the colonies since July 1895, urging him to use firm language in reference to reasonable concessions, replied that he considered the moment inopportune, and on the 15th of January he left for Cape Town. In 1897 he was succeeded in the high commissionership by Sir Alfred Milner.

After the Raid.

In the period which intervened between the Jameson raid and the outbreak of the war in October 1899 President Kruger's administration continued to be what it had been; that is to say, it was not merely bad, but it got progressively worse. His conduct immediately after Johannesburg had given up its arms, and while the reform committee were in prison, was distinctly disingenuous. Instead of discussing grievances, as before the Johannesburg disarmament he had led the high commissioner to believe was his intention, he proceeded to request the withdrawal of the London Convention, because, among other things, "it is injurious to dignity of independent republic." When Kruger found that no concession was to be wrung from the British government, he proceeded, instead of considering grievances, to add considerably to their number. The Aliens Expulsion and Aliens Immigration Laws, as well as the new Press Law, were passed in the latter part of 1896.

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[1] Jameson, speaking at Durban on the 9th of August 1910, declared that the raid was not racial in the sense usually understood, but an effort towards federation. During the raid he carried a letter containing the names of the proposed new executive, and had the raid succeeded it was proposed to make General Lukas Meyer (d. 1902) president. Jameson subsequently explained that Rhodes and he in designating "an eminent Dutchman" as president of "the new provincial republic" had had no communication with Meyer on the subject. Neither he (Jameson) nor Rhodes had any knowledge of a proposal, to which General Botha had publicly referred, that Charles Leonard should be president. (See the *Cape Times Weekly Edition*, Sept. 7, 1910, p. 15.)

Petition to the Queen.

In 1897 a decision of Chief Justice Kotze was overruled by an act of the volksraad. This led to a strong protest from the judges of the high court, and eventually led to the dismissal of the chief justice, who had held that office for over twenty years, and during the whole of that time had been a loyal and patriotic friend to his country. An industrial commission appointed during this year by President Kruger fared no better than the high court had done. The commission was deputed to inquire into and report on certain of the grievances adversely affecting the gold industry. Its constitution for this purpose was anomalous, as it consisted almost entirely of Transvaal officials whose knowledge of the requirements of the industry was scanty. In spite of this fact, however, the commission reported in favour of reform in various directions. They urged, among other things, due enforcement of the liquor law, more police protection, the abolition of the dynamite concession, and that foodstuffs should be duty free. These recommendations made by President Kruger's own nominees were practically ignored. In 1898, to strengthen his relations with foreign powers, Kruger sent the state secretary, Dr Leyds,[1] to Europe as minister plenipotentiary, his place on the Transvaal executive being taken by Mr Reitz, the ex-president of the Free State. At home Kruger continued as obdurate as ever. In January 1899 Mr Chamberlain pointed out in a despatch to President Kruger that the dynamite monopoly constituted a breach of the London Convention. To help the Transvaal government out of its difficulty, and to make one more effort towards conciliation, the financial houses of Johannesburg offered to lend the Transvaal government £600,000 wherewith to buy out the dynamite company, and so terminate the scandal and bring some relief to the industry. The offer was not accepted. Meantime Sir Alfred Milner had also endeavoured to induce the Transvaal government to grant the necessary reforms, but his efforts were equally unavailing (see MILNER, VISCOUNT). In March the Uitlanders, hopeless of ever obtaining redress from President Kruger, weary of sending petitions to the Raad only to be jeered at, determined to invoke intervention if nothing else could avail, and forwarded a petition to Queen Victoria. This petition, the outcome of the second Uitlander movement for reform, was signed by 21,000 British subjects, and stated the Uitlander position at considerable length. The following extract conveys its general tenor:—

> The condition of your Majesty's subjects in this state has become well-nigh intolerable. The acknowledged and admitted grievances, of which your Majesty's subjects complained prior to 1895, not only are not redressed, but exist to-day in an aggravated form. They are still deprived of all political rights, they are denied any voice in the government of the country, they are taxed far above the requirements of the country, the revenue of which is misapplied and devoted to objects which keep alive a continuous and well-founded feeling of irritation, without in any way advancing the general interest of the state. Maladministration and peculation of public moneys go hand in hand, without any vigorous measures being adopted to put a stop to the scandal. The education of Uitlander children is made subject to impossible conditions. The police afford no adequate protection to the lives and property of the inhabitants of Johannesburg; they are rather a source of danger to the peace and safety of the Uitlander population.

In response to this appeal, Mr Chamberlain, in a despatch dated the 10th of May, proposed a conference at Pretoria. Six days before Sir Alfred Milner had telegraphed to London a summary of the situation, comparing the position of the Uitlanders to that of helots and declaring the case for intervention to be overwhelming. Neither of these despatches was made public at the time. But on the very day Mr Chamberlain wrote his despatch the friends of the Transvaal government in Cape Colony and the Orange Free State invited Sir Alfred Milner to meet President Kruger at Bloemfontein, hoping to be able to exert pressure on both parties and to arrange a settlement as favourable as possible to the Transvaal. The conference opened on the 31st of May and closed on the 5th of June. It no sooner opened than it was evident that Kruger had come to obtain, not to grant, concessions. He offered, it is true, a seven years' franchise law in place of the five years' franchise which Sir Alfred Milner asked for. But apart from the relief suggested being entirely inadequate, it was only to be given on certain conditions, one of which was that all future disputes which might arise between the Transvaal and the Imperial government should be referred to a court of arbitration, of which the president should be a foreigner. No arrangement was possible on such terms. Meanwhile feeling was running high at Johannesburg and throughout South Africa. Meetings were held in all the large towns, at which resolutions were passed declaring that no solution of the Transvaal question would be acceptable which did not provide for equal political rights for all white men. Sir Alfred Milner urged the home government strongly to insist upon a minimum of reform, and primarily the five years' franchise; and Mr Chamberlain, backed by the cabinet, adopted the policy of the high commissioner. (A. P. H.; F. R. C.)

Bloemfontein Conference.

D. *The Crisis of 1899.*—A state of extreme diplomatic tension lasted all the summer. The British public, in whom there had always been the latent desire to retrieve the surrender to the Boers which had followed the disaster at Majuba, were at last awakened by the ministerialist press to the necessity of vindicating British influence in South Africa, and the government soon found that, in spite of a highly articulate Radical minority, the feeling of the country was overwhelmingly behind them. It was not then realized either by the public or the government how seriously, and with what considerable justification, the Boers believed in their ability, if necessary, to sweep the British "into the sea." President Kruger had every expectation of large reinforcements from the Dutch in the two British colonies; he believed that, whatever happened, Europe would not allow Boer independence to be destroyed, and he had assured himself of the adhesion of the Orange Free State, though it was not till the very last moment that President Steyn formally notified Sir Alfred Milner of this fact. The Boers profoundly despised the military power of Great Britain, and there was no reason why they, any more than Germany or France, should contemplate the possibility of the empire standing together as a whole in such a cause. In England, on the other hand, it was thought by most people that if a firm enough attitude were adopted Mr Kruger would "climb down," and the effect of this error was shown partly in the whole course of the negotiations, partly in the tone personally adopted by Mr Chamberlain. It was only later that it was seen that if Great Britain intended effectually to champion the Uitlander cause, the moment for a test of strength had inevitably arrived. Negotiations could only bring the conflict a little nearer, delay it a little longer, or supply an opportunity to either side to justify its action in the eyes of the world. The conditions of the problem were such that unless Great Britain were to accept a humiliating rebuff, any correspondence, however skilfully conducted, was bound to bring into greater prominence the standing causes of offence between the two sides. The exchange of despatches soon led to a complete *impasse.* The persistent attempt of the South African Republic to assert its full independence, culminating in a formal denial of British suzerainty, made it additionally incumbent on Great Britain to carry its point as to the Uitlander grievances, while, from Mr Kruger's point of view, the admission of the Uitlanders to real political rights meant the doom of his oligarchical régime, and appeared in the light of a direct menace to Boer supremacy. The franchise, again, was an internal affair, in which the convention gave Great Britain no right to interfere, while if Great Britain relied on certain definite breaches of the convention, satisfaction for which was sought in the first place in such a guarantee of amendment as the Uitlander franchise would involve, the Boer answer was an offer of arbitration, a course which Great Britain could not accept without admitting the South African Republic to the position of an equal. Here was material enough for an explosion, even if personal misunderstandings and aggravations, adding fuel to the fire, had not naturally occurred (or even been deliberately plotted) during the negotiations. But the truth was that the Boers thought they stood to gain by fighting, while the British, though not expecting war, and acting up till the last month or so on the assumption that serious military preparations were either unnecessary or sufficiently unlikely to be necessary to make them politically inexpedient, had with no less confidence committed themselves to a policy which was impracticable on peaceful terms.

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[1] Dr W. J. Leyds, a Hollander born in Java in 1859, went out to the Transvaal in 1884 as attorney-general and was, in 1887, made government commissioner for the Netherlands (S. A.) railway. In 1890 he became state secretary and in that position was regarded as Kruger's right-hand man.

After July the tactics of the Boer executive were simply directed towards putting off a crisis till the beginning of October, when the grass would be growing on the veld, and meanwhile towards doing all they could in their despatches to put the blame on Great Britain. At last they drafted, on the 27th of September, an ultimatum to the British government. But, although ready drafted, many circumstances conspired to delay its presentation. Meanwhile, the British war office began to act. Certain departmental details were despatched to South Africa to form a working nucleus for military bases, and early in September the cabinet sanctioned the despatch to Natal from India of a mixed force, 5600 strong, while two battalions were ordered to South Africa from the Mediterranean. Sir George White was nominated to the chief command of the forces in Natal, and sailed on the 16th of September, while active preparations were set on foot in England to prepare against the necessity of despatching an army corps to Cape Town, in which case the chief command was to be vested in Sir Redvers Buller. Fortunately, although the draft of an ultimatum was lying in the state secretary's office in Pretoria, the Boers, unprepared in departmental arrangements which are necessary in large military operations, were unable to take the field with the promptitude that the situation demanded. They consequently forfeited many of the advantages of the initiative.

The military strength of the two republics was practically an unknown quantity. It was certain that, since the troublous times of 1896, the Transvaal had greatly increased its armaments; but at their best, except by a very few,[1] the Boers were looked upon by British military experts as a disorganized rabble, which, while containing many individual first-class marksmen, would be incapable of maintaining a prolonged resistance against a disciplined army. As was to be subsequently shown, the hostilities were not confined to opposition from the fighting strength of the two little republics alone; the British had to face Dutch opposition in their own colonies. The total fighting strength of the Boer republics is difficult to ascertain exactly. General Botha stated that there were 83,000 burghers from 15 to 65 years of age on the commando lists. Lord Kitchener put the total number of combatants on the Boer side at 95,000 (Cd. 1790, p. 13). The British official *History of the War* gave the number as 87,000; another calculation, based on the number killed, taken prisoner and surrendered, made the total 90,000. In the second (1901) rebellion of the Cape Dutch about 8000 joined the burgher forces. The number of Boers in the field at any one period was probably little more than 40,000. But the fact that it was to a large extent a struggle with a nation in arms doubled the numbers of the force that the Transvaal executive was able to draw upon. The bulk of the Dutch levies were organized on the burgher system—that is, each district was furnished with a commandant, who had under him field-cornets and assistant field-cornets, who administered the fighting capacity of the district. Each field-cornet, who, with the commandant, was a paid official of the state, was responsible for the arms, equipment and attendance of his commando.

The plan of campaign which found favour with the Boers, when they determined to put their differences with Great Britain to the test by the ordeal of the sword, was to attack all the principal British towns adjacent to their own borders; at the same time to despatch a field army of the necessary dimensions to invade and reduce Natal, where the largest British garrison existed. It is not too much to suppose that the executive in Pretoria had calculated that the occupation of Durban would inspire the entire Dutch nation with a spirit of unanimity which would eventually wrest South Africa from the British. On paper the scheme had everything to recommend it as the expedient most likely to bring about the desired end. But the departmental executive could not launch the Natal invading force as early as had been anticipated, and it was not until the 9th of October that the ultimatum was presented to Sir (then Mr) Conyngham Greene, the British agent at Pretoria. The scheduled demands were as follow:—

The Ultimatum.

"*a.* That all points of mutual difference shall be regulated by the friendly course of arbitration, or by whatever amicable way may be agreed upon by the government with Her Majesty's Government.

"*b.* That the troops on the borders of this republic shall be instantly withdrawn.

"*c.* That all reinforcements of troops which have arrived in South Africa since the 1st of June 1899 shall be removed from South Africa within a reasonable time, to be agreed upon with this government, and with a mutual assurance and guarantee on the part of this government that no attack upon or hostilities against any portion of the possessions of the British Government shall be made by the republic during further negotiations within a period of time to be subsequently agreed upon between the governments, and this government will, on compliance therewith, be prepared to withdraw the armed burghers of this republic from the borders.

"*d.* That Her Majesty's troops now on the high seas shall not be landed in any part of South Africa."

To these demands the Transvaal government required an answer within 48 hours.

There could be only one reply, and on Wednesday, the 11th of October 1899, at five o'clock p.m., a state of war existed between the British government and the two Boer republics. On the following day the Boer attack on an armoured train at Kraaipan, a railway station in Cape Colony south of Mafeking and close to the western frontier of the Transvaal, witnessed the first hostile shot of a bloody war, destined to plunge South Africa into strife for two years and a half. (H. Ch.)

Stages of the War.

E. *The War of 1899–1902.*—For the purposes of history the South African War may be conveniently divided into five distinct periods. The first comprises the Boer invasion, terminating with the relief of Ladysmith on the 28th of February. The second, the period of Boer organized resistance, may be said to have finished with the occupation of Komati Poort in October 1900 (a month after Lord Roberts's formal annexation of the Transvaal) and the flight of President Kruger. The third may be characterized as a period of transition; it marks the adoption in earnest of a guerrilla policy on the part of the enemy, and an uncertain casting about on the part of the British for a definite system with which to grapple with an unforeseen development. This phase endured up to the failure of the Middelburg negotiations in March 1901. The next stage was that which saw the slow building up of the blockhouse system and the institution of small punitive columns, and may be considered to have extended until the close of 1901. The fifth, and last period—which, after all other expedients had failed, finally brought the residue of uncaptured and unsurrendered burghers to submission—was the final development of the blockhouse system, wedded to the institution of systematic "driving" of given areas, which operations were in force until the 31st of May 1902, when peace was ratified at Pretoria.

The first of these periods saw the severest fighting of the

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[1] Lord Wolseley foresaw the strength of the Boers. Writing on the 12th of September 1899 he said, "If this war comes off it will be the most serious war England has ever had" (see *Military Life of the Duke of Cambridge*, ii. 421).

Operations in Natal.

campaign. It opened with the investment of Mafeking by a Transvaal force under P. A. Cronje and the envelopment of Kimberley by Free State commandos under General Wessels. But these were minor operations. The main Boer effort was made in Natal, where their forces were commanded by P. J. Joubert, while Lieut.-General Sir George White was the British commander-in-chief. The northern part of Natal presented two faces of a triangle to the two enemies, the short base being formed by the Tugela river. Close to the head of the triangle at Dundee and Glencoe was posted a small British force under Major-General Sir W. Penn Symons. Against this force there advanced a Boer force under Lukas Meyer from the east, and, more slowly, the foremost portion of the main Boer army from the north, while at the same time other Transvaalers descended upon the railway between Glencoe and Ladysmith, and the Free Staters from the passes of the Drakensberg advanced towards Ladysmith, the British centre of operations at which the reinforcements sent from India gathered. On the 20th of October the Dundee brigade vigorously and successfully attacked Talana Hill, and drove back Lukas Meyer, but this success was dearly bought. Symons was mortally wounded, and 226 officers and men were killed and wounded. Half the mounted men lost their way in attempting to pass the enemy's flank and were taken, and the brigade, threatened to its left rear by Joubert's advance and by the force that had seized the railway, only escaped being enveloped by retreating upon Ladysmith, where it arrived in an exhausted state on the 26th of October. Meanwhile Sir George White had discovered the Boer force on the railway, and, though anxious on account of the advance of the Free Staters, on the 21st, stimulated by the news of Talana, he sent out a force of all arms under General (Sir John) French to drive the Boers from Elandslaagte and so to clear Symons's line of retreat. This was accomplished by French and his subordinate, Colonel (Sir) Ian Hamilton, in the action of Elandslaagte on the 21st of October (British losses, 258 all ranks). But on the 22nd the Free Staters' advance caused the victorious force to be recalled to Ladysmith, and the third action north of that town, Rietfontein (24th), was only a demonstration to cover the retirement of the Dundee force. By the 29th of October all the British forces at the front and their reinforcements had fallen in on Ladysmith, which the Transvaalers on the north and east and the Free Staters on the west side began to invest. Before the junction of the two allied wings was complete Sir George White attempted by a general attack to break up their line. The result of this decision was the battle of Lombard's Kop, outside Ladysmith, in which the whole of the available British force was engaged. The engagement was disastrous to the British, who had undertaken far too comprehensive an attack, and the Natal Field Force was obliged to fall back upon Ladysmith with the loss of 1500 men, including a large number of prisoners belonging to the left column under Lieut.-Colonel F.R.C. Carleton, who were cut off at Nicholson's Nek and forced to surrender by a mixed force of Transvaalers and Free Staters under Christian de Wet. From that day the rôle of the Natal Field Force was changed from that of a mobile field army into that of a garrison, and two days later it was completely isolated, but not before General French had succeeded in escaping south by train, and the naval authorities had been induced by Sir George White's urgent appeals to send into the town a naval brigade with a few guns of sufficient range and calibre to cope with the heavy position artillery which Joubert was now able to bring into action against the town.

Buller's Arrival.

Failures of Methuen and Gatacre.

General Sir Redvers Buller, who had been appointed to the supreme command in South Africa as soon as it was perceived that war was imminent—his force being one army corps in three divisions, the divisional generals being Lord Methuen, Sir W. Gatacre and Sir C. F. Clery—arrived in Cape Town, ahead of his troops, on the day following Lombard's Kop. The situation which presented itself was delicate in the extreme. In Natal practically the whole of the available defence force was swallowed up by the steady success of the invasion; on the western frontier two British towns were isolated and besieged, and Boer commandos were on the point of invading Cape Colony, where the Dutch population seemed on the verge of rebellion. The army corps was about to arrive, practically as a whole unit, in South Africa; but it was evident that the exigencies of the situation, and the widely divided areas of invasion, would at least defer the execution of the plan which had been formed for an invasion of the Orange Free State from Cape Colony. The first duty was to effect the relief of the British forces which had been rendered immobile, and another duty imposed by political circumstances was to relieve Kimberley (where Cecil Rhodes was), while the prospect of rebellion forbade the complete denudation of the central part of the colony. Thus Sir Redvers Buller had no choice but to disintegrate the army corps. Clery and some brigades were sent to Natal; Gatacre with less than a brigade, instead of a division, was despatched to Queenstown, Cape Colony, while Lord Methuen, with a division, was sent off to relieve Kimberley. As November wore on, the situation did not improve. Cape Colony was invaded; while in Natal a flying column of Boers, pushing down from the Tugela, for a short time isolated the newly-arrived force under General (Sir) H. J. T. Hildyard, which opposed Joubert's advance on Pietermaritzburg at Estcourt. The situation in Natal seemed so serious that on the 22nd of November Sir Redvers Buller left Cape Town and sailed for Durban. In the meantime Lord Methuen had commenced his march to the relief of Kimberley. He encountered resistance at Belmont on the 23rd, but attacking resolutely he drove the Boers out of their strong positions. Two days later he won another action at Enslin. Still persevering he moved on to the Modder, where he was seriously opposed by De la Rey and P. A. Cronje, the latter having posted down from Mafeking with 2000 men and arrived on the previous night. The Boers, who held a river line, kept the British attack at bay all day, but eventually fell back, relinquishing the position after dark, as their right had been turned by General Pole-Carew's brigade. It was a long and wearing fight, in which the British lost 485 killed and wounded, and what was more serious, Lord Methuen (himself wounded) found that his force had exhausted its forward momentum, and that he would have to collect supplies and reinforcements on the Modder before fighting his next battle. The extent of the operations and the gravity of the situation now began to be felt in England; every available man was called up from the reserves, and the war office made what at the time appeared to be adequate provision for the waste which it was seen would occur. On the 30th of November the mobilization of a sixth division was ordered, offers of colonial aid were accepted, and every facility provided for local recruiting in the South African ports. Thus in the early days of December confidence was considerably restored. Buller was arranging for the relief of Ladysmith, which had already shown its spirit by two successful sorties against the besiegers' batteries. In every theatre the British strength was consolidating. But the full significance of the situation presented by these two small nations in arms had not yet been appreciated. The confidence restored by the lull during the early part of December was destined to be roughly shattered. On the 10th of December Gatacre essayed a night march and attack upon the enemy's position at Stormberg, and, misled by his guides in unknown ground, was himself surprised and forced to return with a loss of 719. On the following day Lord Methuen delivered an attack upon Cronje's position between the Upper Modder river and the Kimberley road, a line of kopjes called Spytfontein and Magersfontein. In a night attack on Magersfontein hill the Highland brigade came under heavy fire while still in assembly formation, and lost its general, A.G. Wauchope, and 750 men, and in the battle by day which followed the other brigades were unable to retrieve the failure, the total losses amounting to about 950. But even this could be suffered with equanimity, since Buller was about to bring his own force into play, and Buller, it was confidently supposed, would not fail. He had collected at Chieveley in Natal a brigade of mounted men, four brigades of infantry and six batteries of artillery, and he carried with him the trust alike of the army and the nation.

Buller's Failure. Lord Roberts sent out.

On the 15th of December Buller made his effort and failed. Behind the Tugela at Colenso were Louis Botha's forces covering the siege of Ladysmith, and, imperfectly acquainted with the topography, Buller sent a force to turn Botha's left, in conjunction with a frontal attack. But the flank attack became entangled in mass in a loop of the river and suffered heavily, and two batteries that formed part of the frontal attack came into action within a few hundred yards of unsuspected Boer trenches, with the result that ten guns were lost, as well as in all some 1100 men. Buller then gave up the fight. The full nature of the failure was not realized by the British public, nor the spirit in which the general had received the finding of fortune. He lost heart, and actually suggested to White the surrender of Ladysmith, believing this to be inevitable and desiring to cover White's responsibility in that event with his own authority; but White replied that he did not propose to surrender, and the cabinet at home, aware of Buller's despondency, appointed Field Marshal Lord Roberts to the supreme command, with Major-General Lord Kitchener as his chief of staff. A wave of military enthusiasm arose throughout the empire, and as the formation of a seventh division practically drained the mother-country of trained men, a scheme for the employment of amateur soldiers was formulated, resulting in the despatch of Imperial Yeomanry and Volunteer contingents, which proved one of the most striking features of the South African campaign. Pending the arrival of Lord Roberts and reinforcements, the situation in South Africa remained at a deadlock: the three besieged towns—Mafeking, Kimberley and Ladysmith—still held their own, but no headway was made by the relief columns; all they could do was to stand on the defensive. The only bright spot, as far as the British were concerned, was to be found in northern Cape Colony, where General French, with two cavalry brigades and details, by his skilful tactics and wonderful activity kept at arm's length a superior force of the enemy in the vicinity of Colesberg, an achievement the more noteworthy since he had pitted against him both De la Rey and De Wet, two of the three men of military genius produced by the war on the Boer side. On the 6th of January the Boers in Natal made a desperate attempt to storm Ladysmith. The garrison, though already weakened by privation and sickness, made a stubborn resistance, and after one of the fiercest engagements of the war, repulsed the attack at Caesar's Camp and Wagon Hill with severe loss to the enemy, itself having 500 casualties.

Spion Kop.

When Lord Roberts arrived in Cape Town on the 10th of January 1900 the three garrisons were still invested, and the relieving forces were still maintaining their rôle of passive resistance, while at the same time restraining the Dutch in Cape Colony. The commander-in-chief's first duty was to create a field army out of the tangle of units in Cape Colony. In the meantime, Sir Redvers Buller, who had been reinforced by Sir Charles Warren and the 5th division, essayed a second attempt to cross the Tugela, by turning the Boer left. But much time was consumed and the plan underwent several modifications before its execution began in earnest on the 16th of January. Warren was placed in command of the main body, which crossed the Tugela at Trichardt's Drift on the 17th and 18th. The mounted troops engaged a Boer force north-west of the point of passage, but were brought back to take part in a general right wheel of the forces of the Tugela, pivoting on Trichardt's Drift. But meantime the mobile enemy, whose original flank had been turned, had gathered at the new centre of gravity, and the upshot of several days' fighting was the retreat of the British. They had penetrated the enemy's right centre by the seizure of Spion Kop, but the force there became the target for the concentrated attacks of the Boers, and, after suffering heavily, was withdrawn (Jan. 24, 1900), with a loss of 1700 men.

By the 1st of February Lord Roberts had matured his plans and begun to prepare for their execution. On the 3rd of February he ordered a demonstration against the right of the Boer position at Spytfontein-Magersfontein to cover the withdrawal of General French and the cavalry from before Colesberg, and the concentration of his army at Modder River, disregarding another set-back in Natal to Sir Redvers Buller, who had against his advice made a third attempt to relieve Ladysmith on the 5th of February, and failed to make good the purchase which he secured across the Tugela (Vaal Krantz).

Roberts's Advance.

Paardeberg.

Lord Roberts's plan was first to concentrate to his left, taking every measure to induce the Boers to believe that the original scheme of invasion by the centre would now be resumed, and in this purpose he succeeded so well that his field army with the necessary transport for a cross-country march was assembled between the Orange and the Modder without serious mishap. Cronje at the new centre of gravity was not reinforced, all available Boers drawing down towards Colesberg. The concentration effected, Cronje still believed that the relief of Kimberley was the object of the gathering behind Modder River, and therefore held on to his Magersfontein kopje. The relief of Kimberley was indeed urgent, for dissensions between Rhodes and the military authorities had become acute. But to this part of the task only the cavalry division assembled under French was assigned. The army itself was to force Cronje into the open and then advance on Bloemfontein from the west. Roberts began his operations on the 11th of February. French started from Ramdam (near Graspan) eastward on that day, intending to make a wide sweep round Cronje's immobile army. Skirmishing with De Wet in the first stages of their ride, the cavalry brigades crossed the Modder at Klip Drift on the 13th. Cronje sent only detachments to oppose them, but these detachments were broken through by a sword-in-hand charge of the whole division, and Kimberley was relieved on the 15th. The infantry, meeting with great difficulties in its crossing of the Riet at Waterval owing to the country and its own unwieldy transport, followed 1½ to 2 days later. But Cronje had now realized his danger, and slipped away westward behind French and in front of the leading infantry at Klip Drift. This was deflected by Kitchener westward to follow up the Boer rearguard, and after some delay the remainder of the infantry, at first fronting northwards, swerved westward likewise, while French from Kimberley, with such of his men as he could mount on serviceable horses, headed off Cronje in the north-west. The result, after one premature and costly assault on Cronje's lines had been made by Kitchener, was the surrender of 4000 Boers at Paardeberg with their leader on the 29th of February, the anniversary of Majuba. At the same moment came in news at last of the relief of Ladysmith.

Relief of Ladysmith.

It was part of Roberts's purpose to relieve the pressure in Natal by his own operations. Buller began his fourth advance on the 14th of February, and though this was checked the foothold gained was not abandoned, and a fifth and last attempt (Pieter's Hill) was successful. Ladysmith was relieved on the 28th of February. It had fared worst of all the beleaguered garrisons, and its 22,000 inhabitants were almost at their last gasp when relief came. The casualties from shell-fire had been few, but those from sickness were very heavy. Buller's operations, too, had cost at Colenso 1100 men, at Spion Kop 1700, at Vaalkrantz 400, and now in the last long-drawn effort 1600 more—over 5000 in all. But the tide of war had changed. The Natal invaders fell back to the mountains which enclose the north of the colony; Oliver and Schoeman retired from Cape Colony before the small forces of Gatacre and Clements; and the presidents of the republics, realizing that the British Empire was capable of more resistance than they had calculated upon, put forward feelers aiming at the restoration of the *status quo* before the war. These proposals were rejected by Lord Salisbury: there could be no end now but a complete destruction of the Boer power.

The surrender of Cronje and the relief of Ladysmith for the time being paralysed the Boer resistance. Two half-hearted attempts were made on the 7th and 10th of March, at Poplar Grove and Driefontein, to stem Lord Roberts's advance upon

Capture of Bloemfontein.

Bloemfontein, President Kruger himself arriving on the scene to give confidence to his burghers; but the demoralization was so great that neither the military genius of the few nor the personal influence of the president could bolster up an adequate resistance, and on the 13th of March 1900 Lord Roberts's army marched into the Free State capital. This great move was persevered in and accomplished, in spite of the fact that at the very outset of the cross-country march (February 13) the great body of transport which had been collected at Ramdam had been cut off by De Wet (who had stayed on the Riet after French had shaken him off). It was therefore only made possible at all by reducing the rations of the fighting men to a minimum and by undertaking the risks of changing the line of communication three times. Naturally and necessarily the capture of Bloemfontein was followed by a period of reaction. It was not until the 29th of March that the new railway communication recommenced to feed the army. In the meantime rebellion had broken out in the Prieska district of Cape Colony, which was promptly quelled by Lord Kitchener. The halt at Bloemfontein was marked by the publication of proclamations, offering protection to the burghers, which, however, the invaders had not yet the power to fulfil. The enforced halt was unfortunate; it not only resulted in a bad outbreak of enteric, but it gave the Boers time to recuperate, and by the beginning of April they again took the initiative. The death of their commandant-general, Piet Joubert, on the 28th of March, seemed to mark a change in the fortunes of the Republican army. Christian De Wet, who had first come into prominence as the captor of Lord Roberts's convoy at Waterval, and was now operating east and south-west of Bloemfontein in order to counteract the influence of Roberts's numerous flying columns which rode hither and thither offering peace, added to his laurels by ambushing Broadwood's mounted brigade and horse artillery at Sannah's Post, just outside Bloemfontein, on the 31st of March. Four days later he reduced a detachment at Reddersburg, and then went south and invested Colonel Dalgety and a mixed force at Wepener, which was relieved after ten days by General Hunter's Ladysmith division, brought round to Aliwal North from Natal.

Relief of Mafeking.

Capture of Pretoria.

These successes, if they retarded Roberts's progress, at least enabled him to rearrange his forces in accordance with the new situation at leisure, and to re-establish his transport, rail and wheeled, and on the 1st of May the main army moved northwards upon the Transvaal capital. The main advance was taken with one cavalry and three infantry divisions (the cavalry commanded by French, and the infantry divisions by Generals Tucker, Pole-Carew and Ian Hamilton). Rundle's division took the right of the advance; Methuen and Hunter moving from Kimberley, formed the left. Kelly Kenny, Colvile and Chermside held the communications based on Bloemfontein. A flying column detached from Hunter, under Mahon, in conjunction with Colonel H. C. O. Plumer's Rhodesian levies from the north, on the 17th of May relieved Mafeking, where Colonel (Lieut.-General Sir) R. S. S. Baden-Powell had throughout shown a bold front and by his unconventional gaiety as well as his military measures had held off the assault until the last. The same day the Natal Field Force under Buller moved up into the Biggarsberg and occupied Dundee. On the 10th of May Lord Roberts had crossed the Sand River; on the 12th of May he entered Kroonstad. After a halt of eight days at Kroonstad, the main army again moved forward, and, meeting but small resistance, marched without a halt into Johannesburg, which was occupied on the 31st of May, the Orange Free State having been formally annexed by proclamation three days earlier. On the 30th of May President Kruger fled with the state archives, taking up his residence at Waterval Boven on the Komati Poort line. The gold mines were now securely in the possession of the British, and on the 5th of June Lord Roberts's army occupied the capital of the Transvaal practically without resistance, setting free about 3000 British prisoners of war detained there.

Diamond Hill.

Prinsloo's Surrender.

It had been anticipated that the occupation of both the capitals would have brought the hostilities to a close, but this was not the case, and though after the 5th of June regular resistance was at an end, the army of occupation had still to face two years of almost unprecedented partisan warfare. On the 8th of June Sir Redvers Buller, who had made a long halt after the relief of Ladysmith and reorganized his army and its line of communication, forced his way over Alleman's Nek, and on the following day occupied Laing's Nek, the Natal gate to the Transvaal, while the field marshal fought a widespread battle against Botha, De la Rey and Kemp at Diamond Hill, 20 m. east of Pretoria. The object of this action was to push back the Boers from the neighbourhood of Pretoria, but no sooner was this done than the north-western Transvaal became active, in spite of Hunter's and Baden-Powell's advance from Mafeking through this district. As the British line of operations now extended eastward from Pretoria, the advance of these Boers to the Magaliesberg threatened their rearward communications, and as Buller had moved far more slowly than the main army there was not as yet an alternative line through Natal. Most serious of all was the pressure between Bloemfontein and the Vaal, where the Free Staters, under De Wet and other commanders, had initiated the guerrilla as soon as Botha and the Transvaalers retired over the Vaal and ceased to defend them by regular operations. Large forces had been left behind during the advance on Johannesburg for the protection of the railway and the conquered territory, and these were now reinforced from Kimberley and elsewhere as well as from detachments of the main army. These, under Sir Archibald Hunter and Sir Leslie Rundle, successfully herded Prinsloo with 4000 Free Staters into the Brandwater Basin (July 29)—a very satisfactory result, but one seriously marred by the escape of De Wet, who soon afterwards raided the Western Transvaal and again escaped between converging pursuers under Kitchener, Methuen, Smith-Dorrien, Ian Hamilton and Baden-Powell.

Flight of Kruger.

Before this Lord Roberts had initiated a movement from Pretoria to sweep down to Komati Poort on the Portuguese frontier, in which Buller, advancing across country from the south, was to co-operate. On the 26th to 27th of August the combined forces engaged and defeated Botha in the action of Belfast or Bergendal, with the result that the enemy dispersed into the bush-veld north of the Middelburg railway. On the 30th of August the remainder of the British prisoners were released at Nooitgedacht. On the 6th of September Buller, crossing the track of the main army at right angles, occupied Lydenburg in the bush-veld, and five days later the aged president of the republic took refuge in Lourenço Marques. On the 13th of September Barberton was occupied by French, and on the 25th Komati Poort by Roberts's infantry. From October the military operations were confined to attempts to reduce guerrilla commandos which had taken the field. Mr Kruger, deserting his countrymen, left for Europe in a Dutch man-of-war, and General Buller sailed for Europe. The Boer leaders definitely decided upon a guerrilla and a wearing policy, deliberately dispersed their field army, and then swelled and multiplied the innumerable local commandos. On the 25th of the month the ceremony of annexing the Transvaal was performed at Pretoria.

Kitchener takes Command.

Raids by De Wet.

In November the prevailing opinion was that the war was over, and Lord Roberts, who had been appointed commander-in-chief at home, left South Africa, handing over the command to Lord Kitchener. Then followed a long period of groping for a means to cope with the development of guerrilla tactics, which for the next six months were at their zenith. The railway communications were constantly damaged, isolated posts and convoys captured, and the raiders always seemed able to avoid contact with the columns sent in pursuit. De Wet, after escaping from Brandwater Basin, was hunted north-westward, and crossed into the Transvaal, where, joining the local guerrilla bands, he surrounded an infantry brigade at Fredrikstad. But, unable to reduce it, and threatened on all sides, he turned back. On the 6th of November he was severely handled and his guns and wagons captured at Bothaville. But this misadventure only stimulated him. His emissaries roused the Free Staters west of Bloemfontein, and disaffection broke out in

Botha's Successes.

Cape Colony to an alarming degree, while, as forerunners of the promised invasion, scattered bodies of Free Staters crossed the Orange River to swell the rebellion. From Bothaville De Wet made for Thaba Nchu, where the Bloemfontein garrison held a cordon of posts. These were traversed on the 16th of November and the raiders passed on to Bethulie capturing Dewetsdorp and 500 men *en route.* Pursued closely and finding the rivers in flood De Wet hid some of his men under Kritzinger near the Orange and himself doubled back, traversing again the line of posts east of Bloemfontein. Kritzinger, Hertzog and bodies of Cape rebels raided Cape Colony as soon as they were able to cross the Orange, and Hertzog penetrated so far that he exchanged shots on the Atlantic coast with a British warship. All that the British forces under Sir Charles Knox and others could do was to localize the raids and to prevent the spread of rebellion. So far, however, energy and vigilance made them successful. Botha meanwhile held his own in the northern Transvaal, both against forces from Pretoria, Middelburg and Lydenburg, and against the Rhodesian Field Force under Sir F. Carrington, which had been sent up from Beira (by arrangement with the Portuguese) to southern Rhodesia. At the close of 1900 the commandos under the direct influence of Louis Botha attacked the railway posts on the Middelburg railway and captured Helvetia. De la Rey operated in the western Transvaal, and in concert with Beyers, whose presence in this region was not known to the British, he inflicted a sharp reverse on General R. A. P. Clements at Nooitgedacht in the Hekpoort valley on the 13th of December. Beyers then slipped away to the east, crossing the line between Johannesburg and Pretoria with impunity. Lord Kitchener called for more men, and on the 22nd of December the war office announced that 30,000 more mounted men would be despatched to the seat of war.

Concentration Policy.

With the opening of 1901 Lord Kitchener tried new schemes. He withdrew all his detached garrisons except in the most important centres, and set himself to make his railway communications perfectly secure. He determined to make the area of operations a waste, and instituted the concentration camps, into which he intended to bring the whole of the non-combatant inhabitants of the two republics. He despatched French with a large force to clear the south-eastern districts of the Transvaal and for the rest maintained a force to watch De Wet, and organized a defence force in Cape Colony, while using the residue of his mounted men to sweep the country of stock, forage and inhabitants. Although there were no great disasters, the new policy was not prolific in success. The enemy invariably dispersed before superior forces, and the removal of the women and children from the farms did not have the effect of disheartening the burghers as had been anticipated—it rather mended their vitality by relieving them of responsibility for their families' welfare. Nor were the Boer leaders destitute of comprehensive schemes. Botha arranged to penetrate Natal, De Wet to make a second attempt on the Colony, in connexion with Hertzog and Kritzinger. On the 10th of February De Wet, with five guns and 3000 men, carried out his promised invasion of Cape Colony. Passing the Bloemfontein-Thaba Nchu line a third time, he crossed the Orange to join Hertzog and rouse the Cape Dutch. But this invasion failed. By judicious use of the railway Kitchener concentrated sufficient troops in the colony to cope with the attempt, and, after being hunted for eighteen days, De Wet escaped back into the Orange River Colony with the loss of all his guns, munitions of war and half his force. In the northern Transvaal a force under Sir Bindon Blood cleared the country, but could not prevent Viljoen from escaping eastward to join Botha. Botha's activity in the south-east caused Kitchener to despatch a large force under French thither. This swept the country up to the Swaziland border. But Botha escaped. On the 3rd of March, after various raids and adventures in company with Smuts and Kemp, De la Rey, the lion of the western Transvaal, essayed an attack upon Lichtenburg, in which he was heavily repulsed. Signs of weakness were now apparent, and as a result Louis Botha, acting with the authority of Schalk Burger, the representative of President Kruger, opened negotiations with Kitchener. A meeting took place at Middelburg, Transvaal, on the 28th of February. These negotiations, however, broke down mainly over the treatment to be awarded to Cape rebels.

Blockhouse Policy.

The hostilities now entered upon a new phase. The establishment of a line of defensive posts between Bloemfontein and Ladybrand, though De Wet had three times traversed it, had given Kitchener an idea, and he resolved upon the scheme of fencing in areas by chains of blockhouses such as those already constructed for the protection of the railways. In the meantime, while these posts were under construction, the harrying of the commandos by mobile columns was continued. In March Babington, pursuing De la Rey after the latter's Lichtenburg misadventure, captured three guns and six maxims near Ventersdorp. In April Plumer occupied Pietersburg, the last remaining seat of government open to the enemy. Rawlinson captured a laager and guns at Klerksdorp, and, though neither De Wet nor De la Rey had been brought to book, matters had so far improved in May that municipal government was given to Johannesburg, and a certain number of mines were allowed to recommence working. Kemp was defeated by Dixon at Vlakfontein, after a desperate encounter. June brought little of moment, though the Boers scored two minor successes, Kritzinger capturing the village of Jamestown in Cape Colony, and Müller reducing a force of Victorians at Wilmansrust, south of Middelburg. In July there were further evidences of weakness on the part of the Boers, and Botha applied for permission to communicate with Kruger. This was allowed, but, as Kruger advised a continuance of the struggle, the slow course of the war continued. In the meantime, the concentration camps were becoming filled to overflowing, and a steady stream of captures and surrenders were reducing the hostile power of the republics.

In August a proclamation was promulgated formally threatening the Boer leaders who should not surrender with permanent banishment from South Africa, but this proclamation had very little effect. Smuts, with a small force from the Magaliesberg, traversed Orange River Colony and stimulated the Cape rebels afresh. But September showed some slight improvement in the situation in Cape Colony, where French was in supreme command. On the 5th Scobell captured Lotter, who was subsequently executed for murder: though this was balanced a few days later by Smuts's successful attack on the 17th Lancers at Tarkastad. In the south-eastern Transvaal Botha made a new effort to invade Natal, but, although he captured 300 men and three guns in an action on the 17th of September at Blood River Poort near Vryheid, his plans were rendered abortive by his failure to reduce the posts of Mount Prospect and Fort Itala in Zululand, which he attacked on the 26th, and he only escaped with difficulty from the converging columns sent against him. Desultory fighting continued till the close of the year, the balance of success being with the British, though on the 30th of October Botha, returning from the south-east towards Pretoria, defeated Colonel Benson's column at Bakenlaagte, Benson being killed. About the same time, the force in front of De la Rey and Kemp in the west being depleted to find the troops for larger operations, the Boers made a fierce surprise attack on Colonel Kekewich's column at Moedville, in which Kekewich was wounded and his troops hard pressed for a time. De la Rey next attacked part of Methuen's column near Zeerust, but was repulsed (Oct. 24). Affairs again took an unsatisfactory turn in Cape Colony, and on the 8th of October the whole colony was placed under martial law. In November an unsuccessful attempt was made by several columns to run De Wet to earth in the Lindley district, whither, after his second raid on Cape Colony, he had returned. But in December matters improved. The reverse at Bakenlaagte was repaired by a force under Bruce Hamilton. This swept the south-eastern Transvaal as French had done, and with no better effect, for Botha escaped. But the British commander thereupon began a constant succession of night marches and raids which practically blotted out the resistance in the eastern Transvaal. The corps of National Scouts (formed of burghers who had taken the oath of allegiance) was inaugurated and the Johannesburg stock exchange reopened. By the end of the year the blockhouse system was complete, but this phase of the war was destined to close badly as De Wet on Christmas Eve captured a large force of Yeomanry at Tweefontein, west of Harrismith.

The "Drives."

With 1902 the last phase of this protracted struggle commenced. The blockhouse system was practically finished, and Kitchener determined upon a new means of harassing the enemy, who still had a total of about 25,000 men in the field. But the blockhouses had already begun to serve the purpose for which they were designed. In the past the mobile columns, of which there were over sixty in the field, had always been bound to the railway for supply; now convoys could be pushed out to them along whatever blockhouse line they touched. In January Bruce Hamilton continued his successful night marches, and late in the month General Ben Viljoen was captured in the Leydenburg district. The only set-back was the descent which Beyers made upon Pietersburg, breaking into the concentration camp and carrying off a number of able-bodied refugees. Early in February Lord Kitchener commenced his first drive, and it was so successful that it was evident that the key to the situation had been found. First the country east of the line Bloemfontein-Vereeniging was swept four times over, then the method was employed in the Transvaal, east and west, and finally against the Cape rebels. There were a few small reverses, of which De la Rey's successful rush upon Paris's column and capture of Lord Methuen was the most important, but when some initial mistakes in the composition of the driving lines, which robbed the earlier drives of part of their effect, were made good, the system worked like a machine. The Boers were at last convinced of the futility of any attempt to prolong the struggle, and on the 23rd of March the representatives of the Boer governments came into Pretoria. Six weeks were spent in negotiation, and then a meeting of delegates, under the presidency of General Kemp, was held at Vereeniging.

Peace of Vereeniging.

As a result of this conference articles of peace were signed at Pretoria on the 31st of May, and the South African war was a history of the past. The terms of peace may be condensed into the following points: (1) Surrender of all burghers in the field, with all arms and munitions of war; (2) all burghers duly declaring themselves subjects of King Edward VII. to be repatriated; (3) no burghers who should surrender to be deprived of either their liberty or property; (4) no proceedings to be taken against burghers for any legitimate acts of war during the period of hostilities; (5) the Dutch language to be taught in public schools on the request of parents, and to be allowed in courts of law; (6) sporting rifles to be allowed upon the taking out of licences; (7) the military administration to be superseded by civil administration as soon as possible, the civil administration to lead up to self-government; (8) the question of the native franchise not to be considered until after the introduction of self-government; (9) landed property not to be subjected to any special tax to defray the cost of the war; (10) a commission to be formed to facilitate the repatriation of the burghers, a grant of £3,000,000 being given as compensation for the destruction of farms.

In the whole war the British lost 5774 killed and 22,829 wounded, while the Boers lost about 4000 killed. The number of Boer prisoners in the hands of the British at the end of the war was about 40,000. (L. J.*; C. F. A.)

F. *From the Annexation to 1911.*—On the 4th of July 1900, a month after the occupation of Pretoria, a commission was issued to Lord Roberts authorizing him to annex the Transvaal. The proclamation of annexation was dated the 1st of September. Lord Roberts held the post of administrator of the colony until his departure for England in December following, when he was succeeded by Sir Alfred Milner, the high commissioner. It was not, however, until March 1901 that Milner, who resigned his governorship of Cape Colony, arrived at Pretoria to inaugurate a civil administration.[1] Hostilities were still proceeding, but in the areas under control Lord Milner (who was raised to the peerage in May) speedily set the machinery of government in motion. The civil administration of justice began in April; in October a reformed judicial system, with Sir J. Rose Innes as chief justice, was put into operation; in 1902 this was followed by the establishment of a supreme court. Besides law, the important departments of finance and mines were organized, and steps taken to remedy the grievances of the commercial and mining classes. Sir David Barbour, who had presided over a commission to inquire into the concessions granted by the late republic, presented a valuable report in June, and suggested a tax of 10% on the profits of the gold mining industry, a suggestion carried out a year later (June 1902). Meantime Johannesburg had been given a town council, and some of the gold mines permitted to restart crushing (May 1901). In November of 1901 the main body of the Uitlanders were allowed to return to the Rand. They had fled the country immediately before the outbreak of war and had been living at the seaports. While thus caring for the urban areas the administration was equally alive to the needs of the country districts. A commission which had been appointed to inquire into schemes of land settlement reported in June, and this was followed by the creation of a land board in December 1901. Lord Milner cherished the ideal of racial fusion by the establishment of British settlers on a large scale. He also recognized the necessity, if agriculture was to be developed, of an extensive system of irrigation, and Sir William Willcocks, formerly of the Egyptian Irrigation Department, was engaged to draw up a comprehensive scheme, having in view also the needs of the gold mines. Another department taken in hand was that of education; and the success which attended the opening of schools in the refugee camps was most striking. At the time the articles of peace were signed at Pretoria, more than 17,000 Boer children were being educated in these camps under the supervision of Mr E. B. Sargant.

The Work of Reconstruction.

This work of reconstruction was carried out in face of many difficulties other than those inherent to the undertaking. More than one plot on the part of Boers who had taken the oath of allegiance was hatched in Johannesburg, the most serious, perhaps, being that of Brocksma, formerly third public prosecutor under the republic. On the 15th of September 1901 Brocksma and several others were arrested as spies and conspirators. Letters to Dr Leyds and to Dr Krause of a treasonable character were found in Brocksma's possession, and being found guilty of high treason he was shot (30th of September). Krause, who was then in London, was arrested, tried and convicted for attempting to incite to murder, and sentenced to imprisonment. In November another conspiracy, to seize Johannesburg with the help of General De la Rey, was discovered and frustrated. More injurious than plots of this nature was the political agitation carried on in Cape Colony and in Great Britain. This agitation was directed with particular virulence against the high commissioner, whose recall, it was asserted, would remove the chief obstacle to peace. Mr J. X. Merriman and Mr J. W. Sauer came to England in the summer of 1901 on a mission from the Cape Africanders, and received much encouragement from Radical politicians. Nevertheless, much had been done to establish order and restart commerce by the time peace was made.

After the signature of the articles of peace the work of reconstruction was accelerated. The end of the military government was signalled by the assumption (on the 21st of June) by Lord Milner of the title of governor of the Transvaal and by the creation of an executive council. The Boer leaders unreservedly accepted British sovereignty. Generals Botha, De Wet and De la Rey, however, paid a visit to England (August–September, 1902) in an unsuccessful endeavour to get the terms of peace modified in their favour; they received little encouragement from a tour they made on the continent of Europe. On their return to South Africa the Boer generals and their colleagues aided to some extent in the work of resettlement, but the seats offered to the Boers on the executive council were declined. The work of repatriation and resettlement was carried out by commissioners acting in conjunction with a central advisory committee at Pretoria. These supplied the people with food, shelter, stock and implements. The burgher and native concentration camps were rapidly broken up; by December 1902 only 7600 out of 70,000 were left in the burgher camps.

At this period Mr Chamberlain determined to visit South Africa and use his personal influence to help forward the settlement of the country. After the almost total cessation of commerce during the war, there was in the last half of 1902 and the beginning of 1903 a great impetus to trade. When Mr Chamberlain reached the Transvaal in January 1903 the feeling among the British section of the community was optimistic. Mr Chamberlain was well received by the Boer leaders; it was, however, to the Rand magnates that he turned for financial help. That large sums were imperatively needed to accomplish the work of reconstruction was apparent. An agreement was reached whereby a loan of £35,000,000, guaranteed by the imperial government, was to be raised for the benefit of the Transvaal and the Orange River Colony; a further loan of £30,000,000 was to be issued in instalments of £10,000,000 and paid into the British exchequer as the Transvaal's contribution towards the cost of the war. The first instalment of this loan, to be issued in 1904, was guaranteed by the great mining firms of Johannesburg. With the proceeds of the first loan the debt of the South African Republic was paid off, the Transvaal and the Orange River Colony railways were bought by the state, and new railways and other public works were undertaken. The £3,000,000 granted by the articles of peace, and other considerable sums, besides £7,000,000 from the loan, were expended on repatriation and compensation.

The efforts made by the administration to restore the Boers to the land, to develop the material resources of the country,

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[1] Milner became at the same time administrator of Orange River Colony. Several of the reforms adopted for the Transvaal applied to or affected the sister colony. (See ORANGE FREE STATE.)

Economic Depression and Chinese Labour.

and to remove all barriers to the intellectual and moral development of the people, were soon, however, hampered by severe commercial depression. One of the least results of this depression was that the second war loan arranged by Mr Chamberlain was never issued, Great Britain finally (in 1906) abandoning all her claims. The commercial depression was due to many causes; of these the most apparent was the shortage of labour at the Rand mines. When work restarted after the war, the mine owners offered the Kaffir workmen little more than half the wages paid in 1898; but this effort at economy was abandoned, and the old rates of pay were restored in January 1903. Nevertheless, the labour available continued to be very much below the needs of the mines. The consequent small gold output meant a serious decrease of revenue, which was not compensated for by the heavy tax levied on the output of the Premier diamond mine, where operations began in 1903. Finally, to enable them to work their mines to their full capacity, the Rand houses asked for leave to import Chinese labourers.[1] Milner, anxious above everything else to obtain sufficient revenue to carry on his work of reconstruction, gave his consent to the experiment. The home government concurred, and during 1904–1906 over 50,000 Chinese were brought to the Rand on three-years' indentures. The objections to the introduction of the Chinese, urged in South Africa, in Great Britain and in other parts of the British Empire, are discussed under SOUTH AFRICA: *History*, § *D*.; here it need only be added that in the Transvaal the point upon which all parties were agreed was that no new racial or economic complications should be permitted; and these were guarded against by the restriction of the coolies to unskilled labour in the gold mines and by their compulsory repatriation. By the introduction of the Chinese the gold output from the mines was greatly increased, with the result that the Transvaal suffered less than any other part of South Africa from the restriction of commerce, which lasted for several years.

Position of British Indians.

The discussions in the legislative council on the Chinese coolie question had been accompanied by a demand on the part of the Boers that such an important step should not be taken "without the constitutional approval of the white people of the Transvaal"; and after the importation of the coolies had begun, the agitation for the grant of representative institutions grew in volume The British government was also of opinion that the time was near for the setting up of such institutions, and the pending grant of a constitution to the Transvaal was announced in parliament in July 1904. Meantime the existing (nominated) legislative council was dealing with another and a vital phase of the Asiatic question. There were in the Transvaal some 10,000 British Indians, whose right to "enter, travel or reside" in the country was secured by the London convention of 1884. Under republican rule these Indians—who were mainly small shopkeepers, but included some professional men of high standing—had suffered many restrictions, and their cause had been espoused by the British government. Nevertheless, under British rule their situation was in no way improved, and a determination was shown by the European inhabitants of the Transvaal further to restrict their privileges and at the same time to stop the immigration of other Indians. In this matter the Boer and British sections of the community were in agreement, and they had the support of the Transvaal government and of the other South African colonies. The problem was both economic and racial, and on both grounds South Africans showed a determination to exclude the competition of Indians and other Asiatics. Mr Alfred Lyttelton (who had succeeded Mr Chamberlain as secretary of state for the colonies) endeavoured to meet the wishes of the Transvaal by sanctioning legislation which would greatly restrict the immigration of Indians, but he would allow no tampering with the rights of Indians already in the colony. In 1907 the royal assent was given to bills restricting the immigration of Asiatics and providing for the registration of all Asiatics in the country.

Self-Government—the Botha Ministry.

In accordance with the promise made in 1904 a constitution for the Transvaal on representative lines was promulgated by letters patent on the 31st of March 1905; but there was already an agitation for the immediate grant of full self-government, and on the accession to office of the Campbell-Bannerman administration in December 1905 it was decided to accede to it. New letters patent[2] were issued (December 12, 1906), and the first general election (February 1907) resulted in the return of a majority belonging to *Het Volk*, a Boer organization formed for political purposes. (See further, SOUTH AFRICA: *History*, § *D*.) Sir Richard Solomon,[3] it was thought, might have formed a coalition cabinet, but he was among the defeated candidates. Lord Selborne, who had during 1905 succeeded Lord Milner as high commissioner and governor of the Transvaal, entrusted General Botha with the formation of a ministry. Botha chose as his colleagues Messrs J. C. Smuts (colonial secretary), Jacob de Villiers (attorney-general), H. C. Hull (colonial treasurer), J. F. B. Rissik (minister of lands and native affairs) and E. P. Solomon (minister of public works). These were all men of progressive, in some respects democratic, views, and in thus forming his cabinet General Botha showed his determination not to be dominated by the "back veld" Boers. Botha was strengthened in his attitude by the firm action of the Progressive (*i.e.* the ex-Uitlander) party, which secured 21 seats (out of a total of 69) in the legislative chamber, entirely in the Rand and Pretoria districts, and was led by Sir George Farrar and Sir Percy Fitzpatrick.[4] The government, which obtained an imperial guarantee for a loan of £5,000,000, announced that while there would be no wholesale repatriation of Chinese, the labour ordinance under which they were recruited would not be renewed, and by February 1910 all the Chinese coolies had returned home. At the same time successful efforts were made by the ministry to increase the supply of Kaffir labour for the mines. In the re-establishment of the field cornets and in other directions a return was made to the republican forms of administration, and on the education question an agreement satisfactory to both the British and Dutch-speaking communities was reached. Ample facilities were given for the teaching of Dutch, but it was provided that no pupil should be promoted to a higher standard unless he (or she) was making satisfactory progress in the knowledge of English.

The Union Movement.

One of the first problems which confronted the Botha ministry was the attitude to be adopted towards the other British colonies in South Africa. Lord Milner, by the creation of an inter-colonial board—which administered the railways of the Transvaal and Orange River Colony and controlled the constabulary of both colonies—and in other ways (*e.g* the inclusion of the Transvaal in the South Africa customs union), had endeavoured to pave the way for federation. Mr Chamberlain when in South Africa in 1903 had also put forward federation as the desired goal. The existence of the inter-colonial council hampered, however, the freedom of the Transvaal government, and steps were taken to determine it.

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[1] A careful summary of the facts regarding the shortage of labour and of the economic situation in the Transvaal at that time, together with the debates in the legislative council, will be found in *The Annual Register* for 1903, from the pen of Mr H. Whates.

[2] The letters patent provided, as to the Chinese coolies, that no further licences be issued for the introduction of indentured labour, and that none of the contracts be renewed.

[3] Sir Richard Solomon (b. 1850) was attorney-general of Cape Colony 1898–1900, attorney-general of the Transvaal 1902, and acting lieutenant-governor of the Transvaal 1905. He resigned office to contest a seat for the Transvaal parliament. Subsequently he was agent-general for the Transvaal in London, and (1910) agent-general for the Union of South Africa.

[4] Sir George Herbert Farrar (b. 1859) was a son of Charles Farrar, M.D., of Chatteris, England, and was a member of the Johannesburg Reform committee at the time of the Jameson Raid. He served in the war of 1899–1902, and was knighted in the last-named year. Sir James Percy Fitzpatrick (b. 1862) was a native of Cape Colony. He went to the Transvaal in 1884 and became honorary secretary to the Johannesburg Reform committee. He was the author of *The Transvaal from Within; Jock of the Bushveld*, &c.

Nevertheless, on economic as well as political grounds, the leaders of both parties in the Transvaal were prepared to consider favourably the proposals put forward by Dr Jameson at the close of 1906 for a closer union of all the self-governing colonies, and the first direct step to that end was taken at an inter-colonial conference held in May 1908. The history of this movement, which resulted in the establishment of the Union of South Africa on the 31st of May 1910, is given under SOUTH AFRICA: *History*, § *D*. Apart from this movement the most notable events in the Transvaal at this period were the development of agriculture,[1] the gradual revival of trade (the output of the gold mines in 1909 totalled £30,925,000, and at the end of the year 156,000 native labourers were employed), and the continued difficulty with regard to British Indians. Ministers declared their determination to keep the Transvaal a white man's country. With the example of Natal before them as a warning, it was (they argued) to the whites a question of life and death, and unless registration were enforced they could not prevent the surreptitious entry of new-comers. Attempts at compromise made in 1908 ended in failure For failing to register Mr M. V. Gandhi and other leaders were imprisoned, and large numbers of Indians were deported. Notwithstanding the remonstrances of the Indian government, the imperial authorities could not effectively intervene; a self-governing colony (in which whites alone possessed the franchise) must be allowed to take its own course. By the end of 1909 it was stated that 8000 Indians—most of whom claimed the right of domicile—had been compelled to leave the country, while 2500 had been imprisoned for failure to comply with the Registration Act. The establishment of the Union of South Africa removed from the competence of the Transvaal provincial council all legislation specially or differentially affecting Asiatics. Thereupon the Union ministry was urged by the British government to effect a permanent settlement acceptable to all parties. The ministry replied (July 23, 1910) that whatever policy might be adopted regarding Indians legitimately resident in South Africa, unrestricted Indian immigration into the Transvaal would not be permitted (see Blue-book Cd. 5363).

When the Union was established General Botha became prime minister, two of his colleagues, Messrs Smuts and Hull, also joining the Union ministry. A fourth minister—Mr Rissik—was appointed first administrator of the Transvaal province, while a fifth minister, Mr E. P. Solomon, became a senator of the Union parliament. The elections to the Union House of Assembly, held in September, were notable as showing the strength of the Progressive (or Unionist) party General Botha was defeated at Pretoria East by Sir Percy Fitzpatrick, and at Georgetown—a Rand constituency—Mr Hull was beaten by Sir George Farrar. Both ministers, however, subsequently secured seats elsewhere.

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(F. R. C.)

TRANSVERSE RIB (Fr. *arc doubleau*), the term in architecture given to the rib of a vault which is carried across the nave, dividing the same into bays. Although as a rule it was sunk in the barrel vault of the Thermae, it is found occasionally below it, as in the Piscina at Baiae and the so-called Baths of Diana (Nymphaeum) at Nimes. In the Romanesque and Gothic styles it becomes the principal feature of the vault, so much so that Scott termed it the master rib (see VAULT)

TRANSYLVANIA[1] (Lat. *Transsilvania*; Ger. *Siebenbürgen*; Hung. *Erdély*; Rumanian, *Ardeal*), a former principality (*Grossfurstentum*) occupying the extreme eastern portion of the kingdom of Hungary It is bounded by Hungary proper on the W and N., by Bukovina on the N.E. and by Rumania on the E. and S., and has an area of about 21,000 sq. m.

Transylvania has the form of an irregular circle, and is a high plateau of a mean altitude of 1000–1600 ft. above sea-level, surrounded on all sides by mountains. These are known under the general name of Transylvanian Mountains (*q v*), which are the south-eastern continuation of the Carpathian system, and fill the interior of the country with their ramifications. On the west or Hungarian side there are comparatively easy passes into the interior, but on the east and south frontiers the lofty mountains give Transylvania the aspect of a huge natural fortress. Among the highest peaks are Negoi (8345 ft.), Bucsecs (8230 ft.), Pietrosu (7544 ft.) and Konigstein (7352 ft.). There are numerous valleys, ravines and cañons in the network of mountains covering the interior of the country The principal plains are: in the valley of the Szamos near Dés and Besztercze (Bistritz); in the middle course of the Maros the beautiful Hátszeg valley; the fertile Cibin valley around Nagy-Szeben; the valley of the Aluta near Csik-Szereda, and the one extending from Reps to the Roteturm pass; and lastly the beautiful and fertile Burzenland in the vicinity of Brassó. The altitude of the valleys generally increases towards the east of Transylvania, the lowest depression being found in the western part of the Maros valley. Almost in the centre of the country lies a fertile plain about 60 m. in length and 50 m. in breadth, called Mezöség or the Transylvania plain. The principal rivers of Transylvania, which are either tributaries of the Theiss, or flow direct into the Danube, are: the Maros, which rises in the mountains forming the eastern wall of Transylvania, and taking first a northern course flows through the country from east to west; its principal affluents are the Görgeny, the Great and Little Kokel or Nagy and Kis Kukullö, the Strell (Sztrigi) and the Cserna on the left, and on the right the Ampoly and the Aranyos, which is rich in auriferous sediments. The Aluta (Alt or Olt) rises not far from the Maros, but takes a southerly direction and pierces the Carpathians at the Roteturm pass, to enter Rumania; its principal tributaries in Transylvania are the Vargyas, the Homorod, the Cibin and the Burzen. The Szamos, formed by the junction of the Great (Nagy) and Little (Kis) Szamos, whose principal affluent is the Bistritz; the Zsil or Jiul; and the White and the Swift Körös are the other principal rivers. The largest lake of Transylvania is the Czeger or Hodosser See, 13 m. long, situated near Szamos-Ujvar, while a great number of small but beautiful mountain lakes are found. The climate of Transylvania is healthy; hot summers alternate with very cold winters, but the rainfall is not great. Transylvania abounds in mineral springs of all kinds, especially saline and chalybeate, the principal ones being found at Borszek, Elöpatak, Homorod, Rodna, Tusnád and Zaizon.

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[1] The government expended over £1,000,000 on a land and agriculture bank and in 1910 made a grant of £100,000 towards the establishment of a college of agriculture at Pretoria.

[1] The Latin name appears first after the 12th century, and signifies "beyond the woods," *i.e.* from Hungary; the Hungarian and Rumanian name both mean "forest land." The German name is usually derived from the seven principal fortified towns or "burgs," founded by the German colonists, though some authorities prefer to connect it with the Cibin Mountains on the south frontier.

The principal occupations of the inhabitants are agriculture, cattle-rearing and mining. Of the total area of Transylvania 22·6% is arable land; 16·5% meadows and gardens; 9·5% pastures and 0·5% vineyards; while 37·3% is covered by forests and 13·5% is unproductive soil. The vegetation of Transylvania is luxuriant, except of course in the higher mountain zones. Fruits abound, as apples, pears, peaches, apricots, plums, cherries, chestnuts and almonds; mulberries are also cultivated. The vine flourishes best in the valley of the Maros. The chief crop is maize; but wheat, rye and other grains, potatoes, saffron, hemp, flax and tobacco are also grown. On the boundary mountains the trees are mainly coniferous; in the interior oaks, elms, beeches and ashes are conspicuous.

Bears, wolves, foxes, boars and various varieties of game are found, and on some of the mountains the chamois. There is abundant pasturage on which excellent cattle are reared, and in some districts buffaloes are bred for draught purposes. More important is the breeding of a sturdy race of horses, thousands of which are annually exported. The mountains maintain large flocks of sheep, of which two kinds are distinguished—with a fine short-stapled and a coarse long-stapled wool respectively. Silkworms are bred, and some silk is spun; and the export of honey and wax is not inconsiderable. Transylvania possesses the richest gold mines in Europe, and this metal is also "washed" in some of the streams, chiefly by gipsies. The gold is often found in conjunction with tellurium (first discovered in Transylvania in 1782) and is extracted principally at Nagyág, Kapnik-Bánya, Zalatna and Vöröspatak. In 1900 the value of the gold extracted was £300,000. Silver, copper, lead and iron are worked to some profit, while arsenic, alum, graphite, marble, porcelain, precious and building stones are also found. Coal is mined in the valley of the Zsil, but the abundance of timber has retarded its exploitation. Some of the saline springs yield salt enough to render their evaporation profitable. The principal places where salt is extracted are at Maros-Ujvár, Dés-Akna, Kolozs, Torda and Vizakna. In 1900 the value of the mineral products, except salt, was £1,000,000.

The industry of Transylvania, although not very developed, made some progress during the last quarter of the 19th century, and is mostly in the hands of the "Saxons." The principal branches are brewing, distilling, flour-milling, sugar, leather, paper, petroleum-refineries, cloth and earthenwares. The production of linen from flax and hemp is a home industry throughout Transylvania. The commerce is fairly active, and is mainly in cattle, dairy products, wood and wooden articles, and petroleum.

The population in 1900 numbered 2,456,838. Until 1848 the chief influence and privileges, as well as the only political rights, were divided among the three "privileged nations" of the Hungarians, Szeklers and Saxons. The first are the descendants of the Magyar conquerors. The Szeklers are of disputed origin, but closely akin to the Magyars (see SZEKLERS). The Saxons are the posterity of the German immigrants brought by King Geza II. (1141-1161) from Flanders and the lower Rhine to cultivate and repeople his desolated territories. At first these were known as Teutones, Teutonici Hospites and Flandrenses, but since the beginning of the 13th century the general name of "Saxons," as tantamount to "Germans," has prevailed. They are generally the most advanced section of the population. Their literary language is High German, but their spoken language is more of the Low German character. The Hungarians and Szeklers together number 814,994, and the Saxons 233,019, but by far the most numerous element, though long excluded from power and political equality, is formed by the Rumanians, 1,397,282 in number, who are spread all over the country. The gipsies of Transylvania, who are heard of under a voivode or prince of their own in 1417, are estimated at 50,000; many of them have taken to agriculture or gold-washing. Jews, Armenians, Bulgarians, Ruthenians and Greeks are also represented in the medley of peoples. The Magyars are mostly Roman Catholics or Unitarians, the Germans Protestants, and the Rumanians adherents of the Greek Church

Transylvania, which was completely incorporated with Hungary in 1868, forms since 1876 one of the seven large administrative divisions into which Hungary was divided in that year. It was subdivided into fifteen countries, and contains the following principal towns: Kolozsvár, Brassó, Nagy-Szeben, Maros-Vásárhely, Besztercze, Fogaras, Torda, Segesvár, Gyula-Fehérvár, Dés, Szamos-Ujvár.

History.—Transylvania formed part of the Roman province of Dacia. After the withdrawal of the Romans the country became for centuries the prey of the various peoples who swept across it in their restless migrations. At the beginning of the 11th century (1004) Stephen I. of Hungary made himself master of the land, which was thenceforward governed as a Hungarian province by a voivode. As mentioned above, King Geza II. introduced German colonists, who founded Nagy-Szeben (Hermannstadt), and in 1211 King Andreas II. called in the German Teutonic orders, who settled in the Burzenland. These German colonists were granted special privileges, and founded many of the Transylvanian towns. As by the death of King Louis II. in 1526 the Hungarian crown fell to the house of Austria, the voivode John Zapolya succeeded in rendering himself independent. He and his successors, who were generally elected by the people, were supported by the Turks against the House of Austria, while the difficult nature of their country preserved them on the other hand from becoming too dependent on their powerful allies. After the defeat of the Turks at Vienna in 1683, their influence in Transylvania waned, and in 1699, by the peace of Carlowitz, the Porte acknowledged the suzerainty of Leopold I. of Austria over Transylvania. By the Leopoldine diploma of 1691 Leopold had guaranteed the ancient rights and laws of the land, and united it formally with the Hungarian crown. In 1765 Maria Theresa made it a grand principality (Grossfürstentum). The efforts of the Rumanian inhabitants to secure recognition as a fourth "nation," and the opposition of the non-Magyar population to a closer union with Hungary, led to troubles early in the 19th century, culminating in 1848. In 1849 Transylvania was divided from Hungary by an imperial decree, and became an Austrian crown-land; but in 1860 Transylvania became an autonomous province, with a separate Diet, and a high executive power of its own. The Diet assembled in Nagy-Szeben in 1863 decreed the complete separation from Hungary, the union with Austria, and the recognition of the Rumanians as the "fourth nation." But the Hungarian government did not recognize this Diet, and the Diet assembled at Kolozsvár in 1865, in which the Hungarians had the majority, decreed again the union with Hungary. By the compromise of 1867 Austria granted the union of Transylvania with Hungary, which was completed in 1868. Transylvania lost every vestige of autonomy, and was fully and completely incorporated with Hungary Since that time the Magyarization of the principality has steadily been carried through, in spite of the bitter protests and discontent of both the Saxons and Rumanians. A Hungarian university was founded at Kolozsvár in 1872; and Hungarian is recognized as the official language.

See F Umlauft, *Die Länder Österreich-Ungarns in Wort und Bild*, vol xiii. (Vienna, 1881), E A. Bielz, *Siebenburgen* (3rd ed., Hermannstadt, 1903); L. H. Gebhardi, *Geschichte des Grossfürstentums Siebenbürgen* (Vienna, 1803); S. Szilágyi, *Monumenta comitialia regni Transsylvaniae*, vols. i.–xxi. (Budapest, 1880-1898); F. Teutsch, *Geschichte der Siebenbürger Sachsen* (2 vols., 3rd ed., Hermannstadt, 1899).

TRANSYLVANIAN MOUNTAINS, the general name of the mountain system which surrounds the Transylvanian highland or plateau on all four sides, and forms the south-eastern and southern continuation of the Carpathian system (*q.v.*) At the mouths of the Visó and the Golden Bistritza, where the

Eastern or Wooded Carpathians end, the range of mountains divides and sends ramifications in two directions, to the south and to the west. These chains which enclose Transylvania, giving it the general aspect of a great natural fortress, are the most eastern offshoots of the mountain system of central Europe, and guard the approach from the east to the great Hungarian plain. They slope gently towards the interior of Transylvania, but rather abruptly towards Rumania, and while the western wall possesses several large and easy passes, the eastern and southern walls are much more difficult to cross.

The eastern wall of the Transylvania quadrilateral is composed of two parallel ranges of mountains divided by the valleys of the Maros and Aluta. The outer range is composed of the following groups: the Gyergyó Mountains (including the Kelemen range) with the highest peaks Kelemenhavas (6600 ft.) and Pietrosul (6908 ft); the Csik Mountains with the highest peaks Nagy-Hagymas (5900 ft.) and the volcanic Büdös (3300 ft.); and the Bereczk Mountains with the highest peak Lakócza (5830 ft.). The inner range is composed of the following groups: the Görgény Mountains with the highest peak Mezohavas (5826 ft.); the Hargitta Mountains with the highest peak Hargitta (5900 ft.); and the Barota Mountains with the highest peak Kukukhegy (5120 ft.). Near the mouths of the Maros and the Aluta are situated the celebrated Györgyö valley, one of the most beautiful in the whole Transylvania, and the famous Borszék valley with its mineral springs.

The southern wall of the Transylvanian highland is occupied by the Transylvanian Alps. They have a length of 230 m., and are the highest and wildest mountain range of the whole Transylvanian system, resembling the High Tatra in their bold and high peaks, their beautiful scenery, and their flora. The Transylvanian Alps rise to an altitude of 7200 ft. above the level of the Danubian (Rumanian) plain, and are divided into a considerable number of groups. From east to west these groups are: the Bodza Mountains with the highest peak Csukás (Ciucas, 6424 ft.); the Burzenland Mountains with the beautiful peaks of Bucsecs (8230 ft.), Konigstein (7352 ft.) and Schuler (5910 ft.); the high Forgaras group, extending to the Roteturm pass, and containing Negoi (8345 ft.), the highest peak in the Transylvanian mountains, Butyan (8230 ft.) and Surul (7482 ft.). West of the Roteturm pass the Transylvanian Alps are also known under the name of the Hátszeg Mountains, and consist of the following groups: the Cibin Mountains with the highest peak Cindrel (7366 ft.); the Paringul Mountains with the highest peak Mandra (8260 ft.); the Vulkan Mountains, and the Hátszeg Mountains proper with the beautiful peak Retiezat (8125 ft.). The south-western part of the Transylvanian Alps is formed by the Cserna or Ruszka Mountains with the highest peak Verfu Petri (8140 ft.) whose offshoots, of a mean altitude of 3200–4700, known as the Banat Mountains, fill the Banat. The southern part of the Cserna Mountains, known as the Stretinye Mountains, extend to the Danube, and together with the Miroch Mountains, on the right side of the Danube, and belonging, therefore, to the Balkan system, form the famous gorge of the Iron Gate near Orsova.

The western and northern wall of the Transylvanian quadrilateral do not present the character of an uninterrupted chain of mountains, but possess many low and easy passes towards the Hungarian plain. Going from south to north the principal groups are: the Transylvanian Ore Mountains with the basaltic mass of the Detunata (3768 ft.) near Abrudbánya; the Bihar Mountains, with romantic scenery and numerous caverns, with the highest peak the Cucurbeta (6045 ft.); to the east of this group are the Aranyos Mountains with the highest peak, the Muntelui Mare (5970 ft.), to the south-west of Kolozsvár; then come the Meszes group and the Kraszna Mountains. The northern wall is formed by the Lápós Mountains with the highest peak Ciblesiu (6020 ft.), and the Rodna Mountains with the highest peaks Muncsel (5835 ft.), Pietrosu (7544 ft.) and Ineu (7484 ft.).

Inside this mountainous quadrilateral lies the Transylvanian highland or plateau, which has a mean elevation of 1000–1600 ft. It is improperly called a plateau, for it does not possess anywhere extensive plains, but is formed of a network of valleys of various sizes, ravines and cañons, united together by numerous small mountain ranges, which usually attain a height of 500–800 ft. above the altitude of the valley.

In the Transylvanian Mountains the principal passes are: the Rodna, the Borgo, the Tölgyes and the Békás. Then come the Gyimes, the Uz and Oitoz, the Bodza or Buzeu, the Tömös or Predeal pass, crossed by the railway from Brassó to Bucharest, the famous Roteturm pass (1115 ft.) through the narrow gorge of the Aluta, crossed by the railway from Nagy-Szeben to Bucharest, the Vulkan, the Teregova pass, and the Iron Gate pass, both crossed by the railway from Temesvár to Craiova. All those passes lead from Transylvania into Rumania. From Transylvania into Hungary are the Bánffy-Hunyad pass, crossed by the railway from Nagy-Várad to Kolozsvár, and the defile of the Maros crossed by the railway from Arad to Broos. In the interior of Transylvania are the Szent-Domokos pass near Csik-Szereda leading from the valley of the Aluta to that of the Maros (near their respective mouths), and the pass of Csik-Szereda over the Hargitta Mountains.

TRAP (O. Eng. *treppe* or *træppe*, properly a step, as that on which an animal places its foot and is caught, cf. Ger. *Treppe*, flight of stairs), a mechanical device for the snaring or catching anything, and especially wild animals. Traps for animals are of great antiquity, and no savage people has ever been discovered, whatever its culture scale, that did not possess some variety of snare. In the most primitive form of trap no mechanism need be present, *e.g.* a cavity into which the animal walks, as the pitfall of the Arabs and Africans or the snow-hole of the Eskimos. Dr O. T. Mason has divided traps into three classes: *enclosing* traps, which imprison the victim without injury; *arresting* traps, which seize the victim without killing it, unless it be caught by the neck or round the lungs; and *killing* traps, which crush, pierce or cut to death.

Enclosing traps include the pen, cage, pit and door-traps. Pen-traps are represented by the fences built in Africa into which antelopes and other animals are driven; and by fish-seines and pound-nets. Among cage-traps may be mentioned bird-cones filled with corn and smeared with bird-lime, which adhere to the bird's head, blinding it and rendering its capture easy; the fish-trap and lobster-pot; and the coop-traps, of which the turkey-trap is an example. This consists of a roofed ditch ending in a cul-de-sac into which the bird is led by a row of corn-kernels. Over the further end a kind of coop is built; the bird, instead of endeavouring to retrace its steps, always seeks to escape upward and remains cooped. Pitfalls include not only those dug in the earth, at the bottom of which knives and spears are often fixed, but also several kinds of traps for small animals. One of these consists of a box near the top of which a platform is hung, in such a way that, when the animal leaps upon it to secure the bait, it is precipitated into the bottom of the box, while the platform swings back into place. Another kind of pitfall is formed of a sort of funnel of long poles, into which birds fall upon alighting on a perfectly balanced bar, to which a dish of corn is made fast. The door-traps form a large and varied class, ranging in size from the immense cage with sliding door in which such beasts as tigers are caught, to the common box-trap for mice or squirrels, the door of which falls when the spindle upon which the bait is fixed is moved. The box-trap with a simple ratchet door, allowing the animal or bird to push under the door or wires which fall back and imprison them, is alike an enclosing and an arresting trap. There are four general classes of arresting traps, the mesh, the set-hook, the noose and the clutch. The mesh-traps include the mesh and thong toils used of old for the capture of the lion and other large game, and the gill-net in the meshes of which fish are caught by the gills. To the set-hook division are reckoned the set-lines of the angler, several kinds of trawls and the toggle or gorge attached to a line, which the animal, bird or fish swallows only to be held prisoner. The noose-trap class is a very extensive one. The simplest examples are the common slip-noose snares of twine, wire or horsehair, set for birds or small mammals either on their feeding grounds or runways, the victim being caught by the neck, body or foot as it tries to push through the noose. When the noose is used with bait it is generally attached to a stout sapling, which is bent over and kept from springing back by some device of the "figure-4" kind. This is constructed of three pieces of wood, one of the horizontal spindle on which the bait is placed, one of the upright driven into the ground, and the third the connecting cross-piece, fitted to the others so loosely that only the strain of the elastic sapling keeps the trap together. When the victim tries to secure the bait he dislodges the cross-piece and is caught by the noose, which is spread on the ground under the bait. The Patagonians take the vicuna with one variety of this snare, and, before the moose (*Cervus alces*) was protected by law in North America, even that animal, weighing often 1200 lb, was caught in snares of wire and rope. There are two widely different types of clutch-traps: bird-lime and other tenacious substances, and jaw and clap-traps. The simplest form of the first is adhesive fly-paper. A common practice in Italy is to smear with bird-lime the branches in the neighbourhood of a captive owl, which results in the capture of numbers of birds, gathered to scold at their common enemy. Examples of the clap-trap are the clap-net, consisting of two nets laid flat on the ground and attached to cords in such a manner that they fly up and close when the draw-cord is pulled by a concealed trapper; and the various other spring-traps used by bird-catchers. The jaw-traps are the most important class of device for the capture of fur-bearing animals, and are the product of civilization. While rude specimens are known to have existed in the middle ages, the *steel-trap* as used to-day dates from the middle of the 18th century, and reached perfection in the latter half of the 19th, the "Newhouse," named from the American inventor, having been the first trap of high grade. Steel-traps consist of two jaws, with or without teeth, which are worked by powerful single or double springs and are "sprung" when the victim steps upon the "pan," which is placed between the jaws and attached to a lever. They are made in many sizes, from the smallest, designed for rats, to the "Great Bear Tamer," weighing over 40 lb, with jaws of 16 in. in which lions, tigers and grizzly bears are trapped. The steel-trap is set and concealed in such a manner that the animal must step on its pan in passing over it to secure the bait. In trapping such wary animals as the sable, marten, mink, otter or beaver, great care is taken to obliterate all signs of the trap and of human presence, the scent of the hands being neutralized by smoking the traps or avoided by the use of gloves. In North America castoreum, musk, asafoetida, oil of anise and common fish-oil are used to entice the victims to the traps. Trails of some one of these scents are laid from different directions to the trap.

With the clutch-traps must also be reckoned the oldest form of steel-trap, now to be seen only in museums, the man-trap, which was used first about the middle of the 18th century when the systematic preservation of game rendered protection against poachers a necessity. Such a trap, from Gloucestershire, is over 6 ft. long, has 19-in. serrated jaws and weighs 88 lb. Another form of man-trap, the spring-gun, belongs to the next category, the killing traps, which are divided into traps of weight, point and edge. The most important of the weight class is the dead-fall, of which the typical form consists of a pen over whose narrow entrance one or more logs are laid across a lighter log, which is balanced upon a spindle necessarily struck by the entering animal, causing the logs to fall upon its back. In some cases the bait is attached to the spindle itself. The dead-fall was always the favourite trap of the American Indians, and is in use among many aboriginal tribes in Africa and South America. A slab of stone is often used as a weight. The common mouse-trap which kills either by a blow or strangulation is a variety of dead-fall. Of point-traps may be mentioned those of the impaling and the missile classes. An example of the former is the stake or spear placed by Arab and African tribes at the bottom of pitfalls for big game. Another impaling trap common in Africa is the harpoon down-fall, generally used for the hippopotamus. It consists of a heavily weighted harpoon suspended in such a way that the animal, passing beneath, breaks a cord and precipitates the harpoon upon itself. Another example of impalement is the hawk-trap, consisting of a circle of stout sharp wires, in the centre of which a live fowl is placed. A bird of prey attempting to secure the fowl is impaled upon the wires. Of missile traps the most universal are the ancient springbow and its modern representative the spring-gun. This is fixed upon stakes, or against a tree, with a line attached to the trigger and stretched immediately in front of the muzzle. An animal pressing against the string pulls the trigger and discharges the piece into its own body. An arrangement of sticks holding the bait in front of the muzzle is sometimes substituted for the string. Of edge-traps a curious example is the wolf-knife of Western America, which consists of a very sharp blade embedded in frozen fat. One of the wolves, licking the fat, cuts its tongue and a flow of blood ensues, with the result that not only the wolf itself but its companions become infuriated by the smell and taste, and the wounded beast, and often many of the others, are killed and devoured. The Alaskan knife-trap for large game consists of a heavy blade attached to a lever, which, when released by the animal biting at the bait, flies over and kills the victim.

See *Shifts and Expedients of Camp Life*, by W. B. Lord (1871); *Camp Life and the Tricks of Trapping*, by W. H. Gibson (1902); O. T. Mason, "Traps of the American Indians," *Annual Report*, Smithsonian Institution, for 1901; *The Story of the Trapper*, by A. C. Laut (1903).

TRAPANI (anc. *Drepanum*), a city and episcopal see of Sicily, capital of the province of the same name, situated on the west coast, 3 m. W. of the Monte San Giuliano, which rises above it, 121 m. W. by S. of Palermo by rail, and 47 m. direct. Pop. (1906), town 47,578, commune 68,986. The ancient Drepanum (δρέπανον, a sickle, from the shape of the low spit of land on which it stands) seems originally to have been the port of Eryx, and never to have been an independent city. It is represented by Virgil in the *Aeneid* as the scene of the death of Anchises, but first appears in history as an important Carthaginian naval station in the First Punic War (about 260 B.C.), part of the inhabitants of Eryx being transferred thither. Near Drepanum the Roman fleet was defeated in 250 B.C., while the struggle to obtain possession of it ended in the decisive Roman victory off the Aegates Islands in 241, which led to the conclusion of peace (see Punic Wars). It continued to be an important harbour, but never acquired municipal rights. Under the Norman kings, at the time of the first crusade, it became a place of importance; while it was a residence of the Aragonese kings. In the 16th and 17th centuries it was strongly fortified. In 1848 it was the first Sicilian city to rise against the Bourbons.

No remains of the classical period exist except a portion of the mole. There are some fine Gothic and baroque palaces, and a few churches with interesting details. The Oratorio S. Michele contains wooden groups representing scenes from the Passion, executed in the 17th century and used for carrying in procession. On the tiled pavement of Sta Lucia is an interesting view of Trapani, showing the strong fortifications on the land side, which have been demolished to permit of the extension of the town in that direction. The Madonna dell' Annunziata, about 1½ m. east of the town, founded in 1332, is now restored to its original style. The adjacent Cappella del Cristo Risorto contains a statue of the Virgin and Child in marble said to have been brought from Cyprus, to which an immense number of valuable offerings have been made, among them two bronze candelabra and a model of the city in silver; while the statue itself is hung with jewels, necklaces, cameos, rings, watches, &c. The modern town is clean and well built, with a fine esplanade on the south. It is a harbour of considerable importance. It was entered by 144 vessels, representing a tonnage of 129,164 in 1906. The imports showed a value of £276,674, the most important items being wheat, coal and timber; while the exports amounted to £143,347, the chief items being salt, wine, salt fish and building-stone. There are also large salt-pans to the south of the city, extending along the coast as far as Marsala, which produce about 200,000 tons of salt annually, of which in 1906 121,192 tons were exported, chiefly to Norway, Sweden, Canada and the United States. The numerous windmills are used for grinding the salt. (T. As.)

TRAP-BALL, or Knur and Spell (M. Eng. *knurre*, knot; Dan. *spil*, spindle), an old English game, which can be traced back to the beginning of the 14th century, and was commonly played in northern England as late as 18[illegible]5, but has since been practically confined to children (bat, trap and ball). It was played with a wooden trap, by means of which a ball (knur) of hard wood about the size of a walnut was thrown into the air, where it was struck by the player with the "trip-stick," a bat consisting of two parts: the stick, which was of ash or lancewood and about 4 ft. long, and the pommel, a piece of very hard wood about 6 in. long, 4 in. wide and 1 in. thick. This was swung in both hands, although shorter bats for one hand were sometimes used. Originally the ball was thrown into the air by striking a lever upon which it rested in the trap; but in the later development of the game, usually called knur and spell, a spell or trap furnished with a spring was used, thus ensuring regularity in the height to which the knur was tossed. The object of the game was to strike the knur the greatest possible distance, either in one or a series of strokes.

TRAPEZE, or Trapese, a form of swing, consisting of a cross-bar suspended by ropes and used for gymnastic exercises, acrobatic displays and the like. The name was so applied in French (*trapèze*) from the resemblance of the apparatus to a "trapezium" or irregular four-sided figure. The Greek τραπέζιον is a diminutive of τράπεζα, a table, literally a four-footed or four-legged object, being a shortened form of τετράπεζα (τετρα-, four, and πέζα, foot).

TRAPEZOPHORON, the Greek term (from τράπεζα, table, and φέρειν, to bear) given to the leg or pedestal of a small side table, generally in marble, and carved with winged lions or griffins set back to back, each with a single leg, which formed the support of the pedestal on either side. In Pompeii there was a fine example in the house of Cornelius Rufus, which stood behind the impluvium. These side tables were known as *mensae vasariae* and were used for the display of vases, lamps, &c. Sometimes they were supported on four legs, the example at Pompeii (of which the museums at Naples and Rome contain many varieties) had two supports only, one at each end of the table. The term is also applied to a single leg with lion's head, breast and forepaws, which formed the front support of a throne or chair.

TRAPPISTS, Cistercian monks of the reform instituted by Armand J. le B. de Rancé (*q.v.*), abbot of La Trappe, 1664. La Trappe was a Cistercian abbey near Soligny, in the diocese of Sées, in Normandy, founded 1140. It suffered grievously from the English wars and from commendatory abbots, so that towards 1650 the community was reduced to half a dozen monks who had long ceased to comply with the obligations of their state, and were an open scandal to the neighbourhood. Armand Jean de Rancé became commendatory abbot at the age of ten, 1636; and on his conversion from a worldly life he began to interest himself in his abbey and conceived the project of restoring the monastic life therein, 1662. With this object he visited La Trappe, but the monks were recalcitrant and threatened his life; through the intervention of Louis XIV. he was able to pension them off; they were replaced by a community of Cistercians of the strict observance, and the monastic buildings, which had fallen into ruin, were repaired at de Rancé's expense. He himself then entered the novitiate in one of the reformed Cistercian abbeys, and on his profession he came to La Trappe as regular abbot, 1664. But he desired a return to the full programme of the primitive Cistercians. His influence with Louis XIV. and with the court of Rome secured him a free hand in carrying out changes without trammel from the Cistercian superiors, who looked askance at the project; and he was able to persuade his community to adopt a manner of life beyond the original Cistercian practice, and far beyond St Benedict's rule. Thus they abstained wholly from wine and fish, and rarely ate eggs; on certain days they had only bread and water, and on two days in the year they went barefooted; and they slept in their day clothes: these practices are in contradiction to what St Benedict allowed. On the other hand manual labour occupied only 3½ hours, but the church services 7—herein reversing St Benedict's apportioning of the time. In short, the Trappist régime is probably the most penitential that has ever had any permanence in the Western Church. Yet it attracted vocations in such numbers that de Rancé had 300 monks under him. Through age and ill health he resigned his abbacy in 1695, and died five years later.

During the 18th century La Trappe continued faithful to de Rancé's ideas, but the observance spread only into two monasteries in Italy. It was the dispersal of the community at the French Revolution that turned the Trappists into a congregation in the Cistercian order and finally into a separate order. Dom Augustine de Lestrange, the novice-master at the time of the suppression in 1790, kept twenty of the monks together and obtained permission for them to settle at Val-Sainte in Fribourg, Switzerland. Here they made their life still stricter than that of La Trappe, and postulants flocked to them in such numbers that in two years' time colonies went forth to establish Trappist monasteries in England, Belgium, Piedmont, Spain and Canada; and in 1794 Dom Augustine was named by the Holy See Father Abbot of all these foundations, thus formed into a congregation. In 1817 they returned to La Trappe, many new foundations were made, and by Dom Augustine's death in 1827 there were in all some seven hundred Trappist monks. In the course of the century three or four congregations arose—a Belgian, an Italian, and two in France—each with a vicar subject to the general of the Cistercians. In 1892 these congregations were united into a single Order of Reformed Cistercians, or of Strict Observance, with an abbot-general resident in Rome and independent of the general of the Cistercians of the Common Observance. In 1898 the Trappists recovered possession of Citeaux, the mother-house of the Cistercians, secularized since the Revolution, and it was declared by Rome to be the head and mother house of the Reformed Cistercians, who thus were recognized as the authentic representatives of the primitive Cistercian movement.

The Trappists are a thriving and vigorous order. In 1905 they had 58 monasteries with 1300 professed choir monks and 1700 lay brothers. At the time of the recent expulsions (1903) they had twenty houses in France, and they have two or three in all the countries of western Europe, including England (Mount St Bernard, near Leicester) and Ireland (Mount Mellery in Waterford and Roscrea); also in the United States and in Canada. Besides they have a house in China, with over fifty Chinese monks; one each in Japan, Asia Minor, Palestine, Bosnia and Dalmatia, and four in various parts of Africa. The abbey of Mariannhill in Natal is devoted to the christianizing and civilizing of the Kaffirs; there are numerous stations with elementary schools and chapels, and at the abbey is a high school and printing-press for books in the Zulu and Basuto languages. In heathen countries the Trappists now give themselves up to missionary work and the task of civilizing the natives.

The first Trappist nunnery was the abbey of Les Clairet, near Chartres, which de Rancé persuaded to adopt his reforms. Dom Augustine de Lestrange established another in 1796, and now there are fifteen with 350 choir nuns and 500 lay sisters. One is in England at Stapehill, near Wimborne, founded in 1802. The manner of life of the nuns is almost the same as that of the monks.

See the *Lives* of de Rancé. A minute account of the observance is in de Rancé's *Règlemens de la Trappe* (1701). The beginning of the reform is told by Helyot, *Histoire des ordres religieux* (1718), vol. vi. ch. 1; the developments under Dom Augustine de Lestrange are described in the supplementary matter in Migne's *Dictionnaire des ordres religieux* (1858). The whole subject is well treated by Max Heimbucher, *Orden u. Kongregationen* (1907), vol. i. § 48; and in Wetzer und Welte, *Kirchenlexicon* (2nd ed.), and Herzog, *Realencyklopädie* (3rd ed.). A realistic and sympathetic picture of Trappist life is the redeeming feature of J. Huysman's *En route*. (E. C. B.)

TRAQUAIR, SIR JOHN STEWART, 1ST EARL OF (d. 1659), Scottish statesman, was the son of John Stewart, the younger, of Traquair in Peeblesshire, of a branch, originally illegitimate, of the house of Buchan, and was created Baron Stewart of Traquair in 1628 and earl of Traquair in 1633. He was appointed treasurer depute of Scotland and an extraordinary lord of session in 1630, and is said to have given the casting vote against the second Lord Balmerino at his trial in 1634, but afterwards obtained his pardon. From 1636 to 1641 he held the office of lord high treasurer of Scotland, and aided Charles I. in introducing the liturgy. He endeavoured to prevent a conflict by impressing on the king the necessity of caution and the danger of extreme measures against the rioters. He was, however, compelled to publish Charles's proclamation enforcing the use of the liturgy and forbidding hostile demonstrations on pain of treason (1638). This was followed by military measures in which Traquair assisted by secretly conveying munitions of war to Dalkeith Palace. He was, however, obliged to surrender the place with the regalia to the Covenanters (March 1639). After the treaty of Berwick he was appointed the king's commissioner to the assembly at Edinburgh (August 1639), and he assented in writing to the act abolishing episcopacy, but prevented its ratification by adjourning the opening of parliament. His apparent double-dealing made him suspected by both parties, and in 1641 the Scottish parliament issued a warrant for his arrest. In his absence he was sentenced to death, but, although the king secured the remission of this penalty, he was dismissed from his office of treasurer, and in 1644, for repairing to the court and opposing the covenant, he was declared an enemy to religion and fined 40,000 marks. His son, Lord Linton, whom he had sent to Montrose with a troop of horse, withdrew on the eve of the battle of Philiphaugh (September 1645) and it has been supposed that Traquair betrayed Montrose's plans to Leslie. He was readmitted to parliament in 1646, raised cavalry for the "engagement" between the king and the Covenanters, and was captured at Preston (1648). He was released by Cromwell in 1654, and died on the 27th of March 1659. He was succeeded by his only son John (*c.* 1622–1666), whose descendants held the title until 1861, when on the death of Charles, the 8th earl, it became dormant or extinct.

See also Spalding, *Memorialls* (Spalding Club); Sir James Balfour, *Annals* (ed. Haig, 1824); *Dict. Nat. Biog.* vol. liv.

TRASIMENE, LAKE (Lat. *Trasumenus Lacus*; Ital. *Lago Trasimeno*), a lake of Umbria, Italy, 12 m. W. from Perugia, 843 ft. above sea-level, 50 m. in circumference, and

8 m. to 14 m. across. Having no natural outlet, it was formerly subject to sudden rises, which occasioned inundations, and these in turn malaria. An artificial outlet was completed in 1898 from the south-east corner of the lake to the Caina, a small tributary of the Tiber. The work, which is about 4 m. long, cost only about £26,000. It is intended to leave about 2500 acres of land dry, and to convert another 2800 acres of marshy soil into cultivable land. The lake contains three small islands: Isola Maggiore, with a monastery, Isola Minore and Isola Polvese. Standing on a promontory jutting out into the lake is the town of Castiglione del Lago, which possesses a castle of the dukes of Cornia, built by Galeazzo Alessi, the architect of many of the Genoese palaces. Napoleon I. formed a project for draining the lake, which may ultimately be adopted. Here Hannibal disastrously defeated the consul C. Flaminius. Hannibal left his winter quarters in Cisalpine Gaul in the spring of 217 B.C. and crossed the Apennines, probably by the pass now known as the Passo dei Mandrioli (from Forlì to Bibbiena in the upper valley of the Arno). His march was much hindered by marshes (probably those in the Arno valley between Bibbiena and Arezzo). The Roman army under Flaminius was stationed at Arezzo (anc. *Arretium*), and Hannibal marched past it. Flaminius followed, and Hannibal occupied the heights on the north of the lake between Terontola and Tuoro, commanding the road from Cortona to Perugia, and also those on the east of Tuoro, so that when the Roman army (which had encamped the night before outside the entrance to the small valley of the brook now called Sanguineto, west of Tuoro), unable in the mists of early morning to see the enemy's forces, had entered the valley, it was surrounded and there was no escape except by forcing a passage. The vanguard succeeded in making their egress on the east by Passignano, but the defeat of the rest of the army was complete, the Romans losing no fewer than 15,000 men.

See T. Ashby in *Journal of Philology* (1908), and refs. (T. As.)

TRASS, the local name of a volcanic tuff occurring in the Eifel, where it is worked for hydraulic mortar. It is a grey or cream-coloured fragmental rock, largely composed of pumiceous dust, and may be regarded as a trachytic tuff. It much resembles the Italian puzzolana and is applied to like purposes. Mixed with lime and sand, or with Portland cement, it is extensively employed for hydraulic work, especially in Holland; whilst the compact varieties have been used as a building material and as a fire-stone in ovens. Trass was formerly worked extensively in the Brohl valley and is now obtained from the valley of the Nette, near Andernach.

TRAÙ (Serbo-Croatian *Trogir*; Lat. *Tragurium*), a seaport of Dalmatia, Austria. Pop. (1900) of town and commune, 17,064. Traù is situated 16 m. W. of Spalato by road, on an islet in the Traù channel, and is connected with the mainland and the adjoining island of Bua by two bridges. The city walls are intact on the north, where a 15th-century fort, the Castel Camerlengo, overlooks the sea. Above the main gateway the lion of St Mark is carved, and the general aspect of Traù is Venetian. Its streets, which are too narrow for wheeled traffic, contain many interesting churches and medieval houses, including the birthplace of the historian Giovanni Lucio (Lucius of Traù), author of *De regno Dalmatiae et Croatiae* (Amsterdam, 1666). The loggia, built by the Venetians, is a fine specimen of a 16th-century court of justice; and the cathedral is a basilica of rare beauty, founded in 1200 and completed about 1450. It was thus mainly built during the period of Hungarian supremacy; and, in consequence, its architecture shows clear signs of German influence. Among the treasures preserved in the sacristy are several interesting examples of ancient jewellers' work. Traù has some trade in wine and fruit. It is a steamship station, with an indifferent harbour.

Tragurium was probably colonized about 380 B.C. by Syracusan Greeks from Lissa, and its name is sometimes derived from *Troghilon* a place near Syracuse. Constantine Porphyrogenitus writing in the 10th century, regards it as a corruption of ἀγγυρίον, water melon, from a fancied similarity in shape. He states that Traù was one of the few Dalmatian cities which preserved its Roman character. In 998 it submitted to Venice; but in 1105 it acknowledged the supremacy of Hungary, while retaining its municipal freedom, and receiving, in 1108, a charter which is quoted by Lucio. After being plundered by the Saracens in 1123, it was ruled for brief periods by Byzantium, Hungary and Venice. In 1242 the Tatars pursued King Béla IV. of Hungary to Traù, but were unable to storm the island city. After 1420, when the sovereignty of Venice was finally established, Traù played no conspicuous part in Dalmatian history.

See T. G. Jackson, *Dalmatia, the Quarnero, and Istria* (Oxford, 1887); E. A. Freeman, *Sketches from the Subject and Neighbour Lands of Venice* (London, 1881); and G. Lucio, *Memorie istoriche di Tragurio, ora detto Traù* (Venice, 1673).

TRAUN, OTTO FERDINAND, COUNT VON ABENSPERG UND (1677–1748), Austrian field marshal, came of a noble family and was born on the 27th of August 1677 at Oldenburg. He was sent to Halle to complete his education, but in 1693 left the university to serve with the Prussian contingent of the allied army in the Low Countries. He saw much service in the War of the Grand Alliance, and at its close entered the imperial army. The War of the Spanish Succession soon followed, and Traun served with distinction in Italy and on the Rhine till 1709, when he became lieutenant-colonel and aide-de-camp to Field Marshal Count Guido Starhemberg (1654–1737) in Spain. A year later, for specially distinguished services, he was made colonel, and in 1712 chief of a regiment of foot. Soon after the close of the war he was again actively employed, and at the action of Francavilla in Sicily (June 20, 1719) he received a severe wound. For his services in this campaign in southern Italy he was promoted General-Feldwachtmeister in 1723. In 1727 he became governor of Messina, and in 1733 attained the rank of lieutenant field marshal. In 1734 he won a European reputation by his defence first of the pass of S. Germano and then of the half-ruined fortress of Capua, which he surrendered, marching out with the honours of war on the 30th of November. He was at once promoted Feldzeugmeister and employed in a difficult semi-political command in Hungary, after which he was made commander-in-chief in north Italy and interim governor-general of the Milanese, in which capacity he received the homage of the army and civil authorities on the accession of Maria Theresa in 1740. In the following year he was made a field-marshal. The Italian campaigns of the War of the Austrian Succession were successfully conducted by him up to 1743, when, on the death of Field-Marshal Count Khevenhüller (*q.v.*), he was made the principal military adviser of Prince Charles of Lorraine (*q.v.*), who commanded the Austrians in Bohemia and on the Danube. In this capacity he inspired the brilliant operations which led up to the passage of the Rhine (see AUSTRIAN SUCCESSION, WAR OF THE) and the skilful strategy whereby Frederick of Prussia was forced to evacuate Bohemia and Moravia (1744) without a battle. Traun's last active service was the command of an army which was sent to Frankfurt to influence the election of a new emperor to succeed Charles VII. He died at Hermannstadt on the 18th of February 1748.

See *Biographien k. k. Heerführer, herausgegeben v. d. Direktion des k. und k. Kriegsarchiv*; Thürheim, *F. M. Otto Ferdinand, Graf v. Abensperg und Traun.*

TRAUNSTEIN, a town and summer resort of Bavaria, situated, at an elevation of nearly 2000 ft., on the river Traun, 73 m. by rail S.E. of Munich. Pop. (1905), 7447. It distils salt from the brine of Reichenhall, whence (22 m. distant) it is brought in pipes. It has an historical museum, four churches (three of which are Roman Catholic), two fine fountains—a monument of the war of 1870–71 and one to King Maximilian II. There are saline baths and breweries. In the vicinity are Empfing, with baths of all kinds and a cold-water cure establishment on the Kneipp system. Traunstein received civic rights in 1375.

TRAUTENAU (Czech *Trutňov*), a town of Bohemia, 120 m. E.N.E. of Prague by rail. Pop. (1900), 14,777, mostly German. It is situated on the Aupa, a tributary of the Elbe, at the foot of the Riesengebirge, and possesses a beautiful church built in 1283 and restored in 1768. Trautenau is the centre of the Bohemian linen industry and has factories for the manufacture of paper and for the utilization of the waste products of the other mills. Trautenau was founded by German colonists invited to settle there by King Otto Kar II. of Bohemia, and received a charter as a town in 1340. It was the scene of two battles between the Prussians and Austrians on the 27th and the 28th of June 1866.

TRAVANCORE, a state of southern India, in political relation with Madras. Area, 7091 sq. m. In 1901 the population was 2,952,157, showing an increase of 15% in the preceding decade. The state stands sixteenth among the native states of India in area and third in population. Travancore extends more than 150 m. along the west coast as far as Cape Comorin, the southernmost point of the peninsula. The Western Ghats rise to an elevation of 8000 ft. and are clothed with primeval forest; they throw out spurs towards the coast, along which there is a belt of flat country of about 10 m. in width, covered with coco-nut and areca palms, which to a great extent constitute the wealth of the country. The whole surface is undulating, and presents a series of hills and valleys traversed from east to west by many rivers, the floods of which, arrested by the peculiar action of the Arabian Sea, spread themselves out into lagoons or backwaters, connected here and there by artificial canals, and forming an inland line of smooth-water communication for nearly the whole length of the coast. The chief river is the Periyar, 142 m. in length. Other important rivers are the Pambai and its tributary the Achenkoil, the Kallada, and the Western Tambraparni. Iron is abundant and plumbago is worked. Elephants are numerous, and tigers, leopards, bears, bison and various kinds of deer abound in the forests. Travancore has an abundant rainfall, with every variety of temperature. The principal ports are Alleppi, Quilon and Paravur; but there is no real harbour. The state has a fine system of roads, and the Cochin-Shoranur and the Tinnevelly-Quilon railways pass through it. The Periyar irrigation project conducts water through the ghats in a tunnel to irrigate the Madras district of Madura, for which compensation of Rs. 40,000 is annually paid to Travancore. Trade is large and increasing, the chief exports being copra, coir and other coco-nut products, pepper, tea, sugar, areca-nuts, timber, hides, coffee, &c. The capital is Trivandrum. The revenue is £670,000; tribute, £80,000; military force, 1360 infantry, 61 cavalry and 30 artillery with 6 guns. The maharaja of Travancore claims descent from Cheraman Perumal, the last Hindu monarch of united Malabar, whose date is variously given from A.D. 378 to 825. Though he is a Kshatriya, the succession follows the local custom of inheritance through females; consequently his *sanad* of adoption authorizes him to adopt sisters' sons. For some generations the rulers have been men of education and character, and the state is conspicuous for good administration and prosperity. Education, and female education in particular, is more advanced than in any other part of India. The two dominant sections of the population are the Namburi Brahmins and the Nairs or military caste. Native Christians, chiefly of the Syrian rite, form nearly one-fourth of the whole, being more numerous than in any Madras district.

See V. Nagam Aiya, *Travancore State Manual* (Trivandrum, 1906).

TRAVE, a river of north Germany, rising in the Oldenburg principality of Lübeck, between Eutin and Ahrensböck. Flowing at first southwards through small lakes and marshes, it then turns west and, confined within flat and sandy banks, enters the Prussian province of Schleswig-Holstein. It now bends due south to Oldesloe, from which point it is navigable. Hence it takes an easterly course, and, entering the territory of the free city of Lübeck, receives from the right the Stecknitz, through which and the Stecknitz canal built by the merchants of Lübeck in 1398) a direct water communication is maintained with the Elbe, and passing the city of Lübeck discharges itself into the Baltic at the port of Travemünde after a course of 58 m. Its lower course from Lübeck to the sea has been dredged to a depth of 25 ft., permitting sea-going vessels to lie alongside the wharves and quays.

TRAVELLER'S TREE, a remarkable tree, native of Madagascar and Réunion, with a straight stem reaching 30 ft. in height and bearing at the top a number of large long-stalked leaves which spread vertically like a fan. The leaf has a large sheath at the base in which water collects in such quantity as to yield a copious draught—hence the popular name. The plant is known botanically as *Ravenala Madagascariensis* and belongs to the same family as the banana (Musaceae).

TRAVEMÜNDE, a seaport of Germany, in the free state of Lübeck, situated on the Baltic, at the mouth of the Trave. Pop. (1905), 2017. It has an Evangelical church, dating from the end of the 15th century, and is a much frequented watering-place. There are extensive herring fisheries. Travemünde arose out of a stronghold placed here by Henry the Lion, duke of Saxony, in the 12th century to guard the mouth of the Trave, and the Danes subsequently strengthened it. It became a town in 1317 and in 1329 passed into the possession of the free city of Lübeck, to which it has since belonged. Its fortifications were demolished in 1807.

TRAVERSE, in fortification, a mass of earth or other material employed to protect troops against enfilade. It is constructed at right angles to the parapet manned by the defenders, and is continued sufficiently far to the rear to give the protection required by the circumstances, which, moreover, determine its height. A traverse is sometimes utilized as a casemate. Ordinary field-works, not less than those of more solid construction, require traversing, though if the trenches, instead of being continuous, are broken into short lengths, they are traversed by the unbroken earth intervening between each length. (For traversing in surveying see SURVEYING.)

TRAVERSE CITY, the county-seat of Grand Traverse county, Michigan, U.S.A., on the Boardman river, between Boardman Lake and the west arm of Grand Traverse Bay, in the N.W. part of the lower peninsula. Pop. (1900), 9407, of whom 2068 were foreign-born; (1910, census), 12,115. It is served by the Père Marquette, the Grand Rapids & Indiana and the Manistee & North-Eastern railways, and by steamboat line to Chicago and other lake ports. The climate, scenery and good fishing attract summer visitors. The city has a public library and a library owned by the Ladies' Library Association, and is the seat of the Northern Michigan Asylum for the Insane (opened 1885). There are various manufactures, and in 1904 the total value of the factory product was $2,176,903. Traverse City was settled in 1847, incorporated as a village in 1881 and chartered as a city in 1895.

TRAVESTY (Fr. *travestie*, from *travestir*, to disguise, *se travestir*, to change one's clothes; Lat. *trans*, across, and *vestire*, to clothe), a burlesque, particularly a grotesque imitation of a serious work of literature or art, in which the subject, characters, &c., are retained, but the style, language and treatment generally are exaggerated and distorted to excite ridicule (see also BURLESQUE).

TRAVNIK, the capital of a department of the same name in Bosnia; situated on the Lašva, a left-hand tributary of the Bosna, 44 m. by rail N.W. of Serajevo. Pop. (1895) about 6000. Travnik is mainly built round a steep mass of rock, crowned by an ancient citadel. Several mosques, palaces, arcades and a fine bazaar, left among its narrow lanes and wooden huts, bear witness to its former prosperity, and there are some good modern barracks and public buildings.

The old name of Travnik, *Lašva*, was last used in the 18th century. It is likely, from the number of Roman remains, that Travnik stands near the site of a Roman colony. It was a stronghold of the Bogomili during the 15th century, but its period of greatness dated from 1686, when the downfall of the Turks in Hungary caused the removal of the Bosnian government from Banjaluka, which was dangerously near the Hungarian frontier, and the Turkish governors, officially styled "valis of Hungary," ruled in Travnik from 1686 to 1850.

Several interesting villages, none containing more than a few hundred inhabitants, are grouped together, near Travnik. Prozor, with its ruined citadel, which withstood the Turkish advance until the beginning of the 16th century, when almost the whole of Bosnia had been enslaved, was then the capital of the princes of Rama, a district lying north-west of the Narenta. The thermal station of Kiseljak, where the Fojnica and Lepenica rivers meet, is a cluster of old-fashioned Turkish villas, with a casino, baths, barracks, hotels and park. In 1396, Tvrtko I. of Bosnia granted the privilege of silver-mining here to the Ragusans. Remains of old workings may still be seen. Kreševo, 5 m N N.E., is likewise rich in iron, cinnabar, quicksilver and the argentiferous load which was worked by the Saxons in the middle ages. The citadel of Zahor, or Gradina, now a ruin, guarded the mines. Bugojno, on the Vrbas, is a picturesque place, with a large cattle and horse trade. The Franciscan monastery of Fojnica, 18 m. east, is the largest and wealthiest foundation in Bosnia. Its Byzantine church is full of ancient ornaments and relics. The archives contain many valuable manuscripts, including a charter bestowed on the monks, in 1463 by the Sultan Mahomet II.

TRAWLING, SEINING AND NETTING. The innumerable kinds of fishing nets which may be distinguished, if all nets differing in details of structure or use be placed in separate classes, fall naturally into two main groups, namely stationary nets and nets used in motion. The former group contains the most primitive nets, though nets of great complexity are now included in it; and the simplest fixed nets, themselves derived probably from dams of rushes or stones so placed as to lead fish in to a "pound" or enclosure, may with some confidence be considered as the ancestors of the great otter trawls now shot and towed daily from powerful steamers on fishing grounds more than a thousand miles from the market they work to supply The more primitive fixed nets are of far less importance than movable nets (except in the capture of certain particular species), owing to the fact that they are necessarily confined to very shallow water The main types of movable nets may therefore be treated first.

All nets are constructed in accordance with what is known of the habits of the fish they are designed to capture, and as fishes may be roughly divided into those spending at least the greater part of their lives on or near the sea-bottom and those spending a great portion of their lives near the surface, two lines have been followed in the development of nets, some being designed to work on the bottom, others to work near the surface. The most important nets used in the capture of "demersal" or bottom-living fishes are trawls, the most important pelagic nets are drift-nets. The word trawling[1] was at one time applied to more than one method of fishing, but has, at all events in Europe, now become restricted to the operation of a flattened conical net or trawl, dragged along the sea-bottom There are two trawls in common use, the beam trawl and the otter trawl They differ in the method adopted for extending the mouth of the net. The original form is the beam trawl.

The Beam Trawl.

The beam trawl may be described as a flattened conical net whose mouth is kept open when in use by a long beam supported at the ends by iron runners, the trawl-heads. Elm is generally preferred for the beam, selected if possible from timber grown just to the proper thickness, that the natural strength of the wood may not be lessened by more trimming or chipping than is absolutely necessary. If the required length and thickness cannot be obtained in one piece, two or even three pieces are scarfed together, and the joints secured by iron bands. The trawl-heads differ somewhat in form in different countries and in different localities. The usual form is heart-shaped, the "shoe" or part actually in contact with the ground when in use being straight, the after-side straight and sloping upwards from the hindmost point or "heel," and then curving down in a single unbroken arc, which forms the front of the head, to join the shoe In the Barking pattern the head is stirrup-shaped; but this is now unusual A square socket is bolted to the top of the head (taking the head to be in the position of use) to receive the end of the beam, and ring-bolts are put in at the extreme front of each head, to hold the ropes or wires by which the trawl is towed, and, within the point of the heel, for the purpose of allowing the mouth of the net to be seized or lashed to the trawl-head at a point close to the ground. The shoe of the trawl-head is in the full-sized trawls made of double thickness, to resist wear.

The Net.

When the net is spread out in the position it would take up when working, the upper part or back has its straight front edge fastened to the beam, but the corresponding lower part or belly is cut away in such a manner that the front margin forms a deep curve extending from the shoe of one trawl-head to that of the other, the centre of the curve or "bosom," as it is called, being at a considerable distance behind the beam. The usual rule in English trawls is for the distance between the beam and the centre of the bosom to be about the same as the length of the beam. In French trawls this distance is generally much less; but in all cases the beam and back of the net must pass over a considerable space of ground when the trawl is at work before the fish are disturbed by much of the lower margin of the net. This lower edge of the mouth of the trawl is fastened to and protected by the "ground-rope," which is made of an old hawser "rounded" or covered with small rope to keep it from chafing, and to make it heavier. The ends of the ground-rope are fastened at each side by a few turns round the back of the trawl-heads, just above the shoe, and the rope itself rests on the ground throughout its entire curve. The fish which may be disturbed by it have therefore no chance of escape at either the sides or top of the net unless they can pass through the meshes, and as the outlet under the beam is a long way past them, and is steadily moving on, sooner or later they mostly pass over the ground-rope and find their way into the funnel-shaped end of the net, from which a small valve of netting prevents their return.

It must not be supposed, of course, that all fishes entering a trawl are retained in it. Numerous investigations have been made into the size and number of the various species of fish which get through the meshes of the trawl, by lacing small-meshed netting over the ordinary net, and examining the fish remaining in this outer net. Fish are found to escape all parts of the net, but chiefly the "batings," *i.e.* the part of the net where it is narrowing to the "cod end"; and as the chance of escape depends on the size and shape of the fish, and the mesh of the net, it is naturally found that the maximum size of the individuals which can escape in any numbers differs in different species. If small fish are on the ground, the total number escaping is, however, in all cases very large, frequently greatly exceeding the number caught. This is for the most part desirable, the fish being of a size to render them of but little value to the fishermen or to the public. It is in any case inevitable, since a full-sized trawl made entirely of small-mesh would offer so great a resistance to the water as to be unworkable.

The ground-rope bears directly on the ground, and to prevent the possibility of the fish passing under it, the rope should have some weight in it so as to "bite" well, or press the ground closely. It is, however, always made of old material, so that it may break in case of getting foul of rocks or such other chance obstruction as may be met with on the generally smooth ground where the trawl can only be worked with advantage. If in such a contingency the rope were so strong and good as not to break, there would be serious danger of the tow-rope snapping, and then the whole apparatus might be lost; but the ground-rope giving way enables the net to be cleared and hauled up with probably no more damage to it than the broken rope and perhaps some torn netting The remaining part of the trawl, extending from the bosom to the extreme end, forms a complete bag gradually diminishing in breadth to within about the last 10 ft., which part is called the "cod or purse," and is closed by a draw-rope or "cod-line" at the extremity when the net is being used. To avoid the abrasion of the under part of the cod-end pressed by the weight of fish against the stones and shells of the sea-bottom, stout pieces of old net are laced across beneath it in parallel strips. These strips thus trail beneath the trawl and protect it. They constitute the "rubbers" or "false belly." The cod-end is the general receptacle for the various fishes which enter the net; and when the trawl is hauled up and got on board the vessel, the draw-rope is cast off and the fish all fall out on the deck.

Pockets.

It has been mentioned that the body of the net tapers away to the entrance to the purse. It is at this point the opening of the pockets are placed; and they are so arranged that the fish having passed into the purse, and then seeking to escape by returning along its sides, are pretty sure to go into the pockets, which extend for a length of about 15 or 16 ft. along the inner side of the body of the net, and there, the more they try to press forward, the more tightly they become packed, as the pockets gradually narrow away to nothing at their upper or front extremity. These pockets are not separate parts of the trawl, but are made by merely lacing together the back and belly of the net, beginning close to the margin or side nearly on a level with the bosom, and then being carried on with slowly increasing breadth backward as far as the entrance to the purse. At this point the breadth of the net is divided into three nearly equal spaces, the central one being the opening from the main body of the net into the purse, or general receptacle for the fish, which must all pass through it, and those on each side being the mouths of the pockets facing the opposite direction. The central passage has a valve or veil of netting called the "flapper," which only opens when the fish press against it on their way into the purse. To understand clearly the facilities offered to the fish to enter the pockets, it is necessary to remember that the trawl, when at work, is towed along, with just sufficient force to expand the net by the resistance of the water. But this resistance directly acts only on the interior of the body of the net between the pockets and then on the purse; it does not at first expand the pockets, but tends rather to flatten them, because they are virtually outside the general cavity of the trawl and their openings face the father end of it. The water, however, which has expanded the body of the net, then passes under or through the flapper or valve, and enters the purse, which, being with a much smaller mesh than the rest of the net, offers so much resistance that it cannot readily escape in that direction; return currents are consequently formed along the sides, and those currents open the mouths of the pockets, which, as before mentioned, are facing them; and the fish, in their endeavours to escape, and finding these openings, follow the course of the pockets until they can go no farther. The whole of the net is therefore well expanded, but it is so by the pressure of the water in one direction through the middle, and in the opposite direction at the sides or pockets.

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[1] "Trawl" is from O Fr *trauler*, to go hither and thither; "troll," now used of drawing a line along the surface of the water from a boat, is from the variant O. Fr. *troller*, mod. *trôler*, to lead, drag about.

Size and Mesh.

The dimensions of a full-sized beam trawl, such as has been described above are from 45 to 50 ft. along the beam and about 100 ft. in length. Trawls of practically all smaller sizes down to some 30 ft. are to be found, but except for shrimp trawls the large sizes predominate almost to the exclusion of smaller nets. The trawl-heads support the beam at about 3 or 3½ ft. above the ground. The meshes of the net behind the beam (the square) are about 5 in. from knot to knot, when drawn out taut. In the batings, the part of the net in which the narrowing mostly occurs, they decrease gradually from 4 to about 3 in.; in cod end they are 2½ in. In the hope of protecting the small fish from capture some local authorities enforce within their jurisdiction a minimum size of mesh for trawls, as for other nets. According to certain recent by-laws of the Lancashire and Western Sea Fisheries District Committee, for instance, every trawl used in their waters, except for the capture of shrimps and certain specified fish, must allow a square wooden gauge of a certain size to pass easily through its meshes when these are wet. The difficulties in the way of the efficacy of such restriction are that a mesh which would allow the escape of fish of but little value of one species might allow the escape of very valuable individuals of another kind; and that both local and national authorities alike have powers of jurisdiction over such narrow strips of coastal water, that in the absence of an international agreement on the matter, the ground affected by the regulations is exceedingly small in comparison with the ground untouched. The same remarks apply to the similar regulations as to length of beam and circumference of nets.

Working the Net.

Considerable skill is needed to work a beam trawl successfully. A knowledge of the ground and of the direction and time of the tide is essential; for the trawl is towed with the stream, a little faster than it is running, so that there may be just sufficient resistance to expand the net. The regulation of speed, seeing that beam trawls are worked only from sailing vessels, is a matter of difficulty; when, however, there is a sufficiency of wind much can be done by an adjustment of the length of tow rope. Lowering the trawl is also a matter of difficulty especially when wind and tide are contrary, as in that case the vessel tends to drift over the net: the apparatus is first got into position by paying out the rope attached to the trawl-heads in such proportions that the beam takes its proper position while close to the surface. These ropes, called "bridles," are some 15 fathoms long: they meet and are shackled to the trawl warp, a manilla rope of 6 in. circumference, of which 150 fathoms are generally carried. The trawl being in proper position, the warp is allowed to run out and the trawl lowered to the bottom, the vessel slowly moving on meanwhile; usually the length of warp which is below the surface in towing is a few fathoms over three times the depth of water. The art of shooting the trawl lies in causing it to alight on its runners or shoes, with the net freely trailing behind. should the net be twisted, or the trawl alight on its beam, the trawl has been shot "foul," and must be hauled and shot again. While towing, an experienced fisherman can tell by pressing his hand firmly on the warp outside the ship's bulwark whether the progress of the trawl over the bottom is satisfactory, any irregular progress over rough ground revealing itself in the character of the vibration of the warp.

The trawl usually remains on the bottom for a whole tide, or six hours, and will in this time have passed over some 15 m. of ground. Hauling, a most lengthy and laborious process if carried out by hand-windlass, is in practically all modern fishing smacks carried out by a small steam capstan, the "steam man" as it is frequently called, a most efficient instrument with very compact engine housed under a small iron cover on the capstan's top. When the trawl comes alongside the heavy beam is secured by its two heads, the net is hauled over the side bit by bit, by hand, until the cod end is reached, when a rope is passed round it above the bulging end which contains the catch, and then over a "tackle" or pulley, and so the cod end is hoisted inboard. The knot of the codline is untied, and the fish, mixed with various invertebrate animals, star-fish and rooted forms (confounded in the one term "scruff"), falls to the deck.

Shrimp Trawls.

A small trawl is often used from an open boat for shrimping. It closely resembles a beam trawl, but has no pockets. The usual dimensions of this net are about 15 ft. beam and 20 total length, of which about 4 ft. are taken by the cod end. The mesh is about half an inch square, but where no restrictions are enforced it decreases to a considerably smaller size as the cod end is approached. The beam when in use is about a foot and a half above the ground.

Shank Nets.

Shank nets are also similar to beam trawls in general shape, but differ in that the mouth is kept open by a rectangle of wood. Frequently the lower margin of the trawl's mouth is not in contact with the ground, being attached to a bar of wood which is fixed parallel to the bottom of the wooden rectangle and a few inches above it. A fish or prawn is thus disturbed by the bottom bar of the wood, and either jumps over it and *below* the net and so escapes, or over both bottom bar and middle bar *into* the net. The theory of the net's action is that the fish tends most frequently to take the former course, the crustacean the latter; and there is some evidence that this is partially realized in practice. Shank nets are sometimes worked from carts, when they are known as "Trollopers."

Owing to their fine netting and the very shallow water in which they work, shrimp trawls are exceedingly destructive to very small fish. Johnstone[1] has found for instance that in a two mile haul of a shrimp trawl on the Lancashire coast 567 small plaice are caught on an average, beside great numbers of whiting, dabs, soles and other fish. In most parts of the English coast regulations are in force as to the mesh, size of beam and length of haul of shrimp nets, and shrimpers working on the beach are ordered to sort their catch at the water's edge, returning as many young fish alive as possible. The proportion saved by these means is not known with accuracy; it is much greater in the case of short hauls than in longer ones. A shrimp trawl is usually kept down from half an hour to an hour, or when not subject to regulation rather longer. It is seldom towed for a longer period than 2 hours, the speed being somewhat under two miles per hour on an average, though subject to variation.

Decay of Beam Trawling and rise of other Trawling from Steamers.

The beam trawl has been described at some length because its structure is somewhat more simple than that of the trawl now in more general use; the importance of the net as an engine of capture has undoubtedly declined greatly within the past generation. Some interesting figures collected by the British Board of Agriculture and Fisheries prove this incontestably. In 1893 the number of first-class British sailing trawlers was 2037, and their average net tonnage 57·4; in 1900 they numbered 925, with a net tonnage of 41·1, and from that year up to 1906 (the last year quoted in these returns) they never again reached a thousand in number or a tonnage of 40 tons net; on the other hand, there were in no one of the years quoted as few as 800 first-class sailing trawlers registered, nor did the average tonnage sink below 37, about which figure it remained constant. It is obvious therefore that about 1894 beam trawling began to decline, and that after a time this decline lost most of its power, the number of boats and size of boats having sunk to a condition in which they fulfilled a certain function, which for some years has remained fixed. The new factors which brought about this change went hand in hand. They were the invention of the otter trawl and the increasing use of steam in fishing vessels. The otter trawl has no rigid and heavy beam, but relies on the force with which it is towed through the water to keep it open, and it is a far more efficient instrument for the capture of all but small flat fish than the beam trawl. Owing to the second of these facts its employment inevitably spread, and owing to the first a sailing vessel needing at least a moderate breeze to give it the requisite speed for keeping a large net open was unsuitable for working it. Thus the introduction of the otter trawl undoubtedly hastened the replacement of sails by steam as motive power for the great fishing fleets. That the adoption of steam would have occurred in any case is almost certain. The conversion of drift-net fishing vessels from sail to steam has gone on rapidly, though no radical change of gear has taken place, and presumably the same would have occurred in the case of trawlers had the otter trawl never have introduced. There were, for instance, nearly 200 steam fishing vessels of various descriptions working from English and Welsh ports in 1883; and the desire to exploit new and more distant grounds had undoubtedly become powerful by 1894, and accounted to some extent for the increase of steam trawling about that time. Nevertheless this increase is so sudden, that its occurrence at the time of the adoption of the otter trawl can scarcely be a coincidence. In 1893 there were 480 steam trawlers working from English and Welsh ports: in 1899 there were over a thousand.

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[1] Johnstone, *British Fisheries*, p. 283 (London, 1905).

The subsequent history of British trawling is dominated by the steamers. Garstang has calculated from a study of market statistics that a steamer (between the years 1889 and 1898) caught on the average between four and seven times as much in a year as a sailing smack. Against this competition the smacks could not succeed; if it was profitable for the steamers to fish they could gradually eliminate the smacks, as has occurred at Grimsby. The line fishery also decreased owing to the increasing transfer of the haddock and some other fisheries to the trawlers. The change from masts and sails to steam has, however, never been complete. The increased cost of building and running steamers made the handling of large catches a necessary condition of their profitable employment. A sailing trawler costs from £500 to £1200 to build. £1000 would probably be a fair average. A first-class steam trawler of the present day costs £10,000 or more, quite ten times as much, and about £5000 a year to run; and although the cost was less in the early years of steam trawling there was always an approach to these proportions. On the other hand their rapidity and independence of wind made distance between fishing ground and port of landing a matter of minor consequence. These causes, combined with a very general belief in the exhaustion of the home-grounds—there seems no doubt that at all events the catch per vessel declined—led to the growth in size and power of the steamers, which were used for distant waters and the exploitation of new grounds. Thus in 1906 there were only 200 more steam trawlers than in 1899, but the average tonnage in the same period increased from 54 to nearly 62. To this increase in power and range of action of the steamers must be attributed the great increase in the quantity of trawled fish landed, since the engine of capture, the trawl, has changed but little since 1894: but another result occurred, namely a partial division of the area trawled between sail and steam. The grounds within easy reach of the English ports were left chiefly in the hands of the "smacks," the catches never being really very great, though possessing a high proportion of "prime" (*i.e.* valuable species of) fish. The persistence of Lowestoft and Ramsgate as smack ports speak for this. The longer voyages of the smacks, on the other hand, were gradually discontinued, and the distant grounds besides a multitude of new grounds were opened up by the steamers. Grimsby, Hull, Aberdeen, Milford, increased enormously in importance, and now send vessels to the north of Russia, to the coast of Africa and far into the Atlantic. Steam trawling died at Yarmouth, the place of its birth; sailing trawlers disappeared from Grimsby, one of their greatest strongholds, but a port near cheap coal, deep water, and a market for fish from more distant grounds.

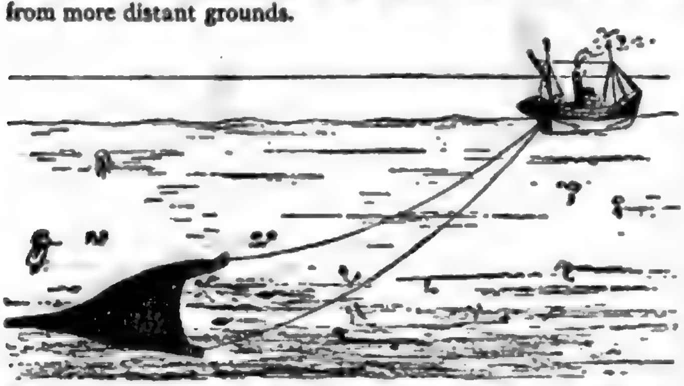


FIG. 1.—Diagrammatic; showing an Otter trawl in use. (For the sake of clearness, the size of the otter-boards is exaggerated, and the length of the warps and size of the ship diminished.)

The Otter Trawl. Principle of Action.

The essential features of the otter trawl are that the mouth is kept open by two large wooden boards, whose position when in use corresponds to that of the trawl heads in a beam trawl no beam being used. The action of these boards resembles that of a kite. A kite dragged through still air, owing to the position of the point of attachment of the string, takes up an oblique position, in which it is acted on by forces in two directions, viz. that exerted through the string, pulling forward, and that exerted by the resistance of the air in front of the kite, which, being perpendicular to the kite's surface, acts in an upward and backward direction. The resultant of these two forces necessarily acts in a direction between them, and the kite accordingly ascends. Constrain the kite to move in a horizontal plane, and the same forces would cause it to move not upwards, but to the side. A trawl board is practically a kite made to move on its side.

The trawl boards resemble massive wooden doors strengthened by iron bands. In action they move with their short edges vertical and their long edges horizontal, one in each case in contact with the sea bottom: the front bottom corner of each board is rounded off, so that the board resembles a sleigh runner. Four strong chains, which meet in one iron ring, are attached to each board by ringbolts, and to each ring a wire warp, by which the trawl is towed, is shackled. The ringbolts are about the same distance from the centre of the board, but the two chains attached to the after-ringbolts of the board are longer than the two fore-chains. The trawl board when towed thus takes up an oblique position as regards the line in which it is towed, though remaining vertical to the ground. The force with which it is towed urges it forward, the resistance of the water urges it in a direction perpendicular to its surface, viz. backwards and to the side; it accordingly moves in an intermediate direction, going forward by tending to diverge from the line of towing. Meanwhile the other trawl-board is diverging in a similar manner but in the opposite direction, and the mouth of the net, being attached to the hinder end of the boards, is thus pulled both right and left until stretched to its utmost, and the net is thus held open. The margin of the net which forms its upper lip is lashed to a rope called the headline: and the resistance of the water to the net's progress causes this to assume an arched form, the centre of the headline being probably some 10 or 15 ft. from the ground.

It has been calculated by Fulton, who experimented on the subject, that the distance between the boards of an otter trawl of 90 ft. headline is about 60 ft., owing to this arching upwards and backwards of the upper margin of the net. The loss in the spread of the net is, however, compensated for very largely, as far as certain round fish are concerned, by the increase in height of the mouth, the fish which are swimming near but not actually on the bottom tending to "strike upward" when disturbed. Indeed, the raising of the headline is accentuated occasionally by glass spheres or other buoyant objects to its centre; corks are still used in this way, but otherwise the practice has not been generally adopted in commercial trawling.

The earliest use of the otter board appears to have been due to Hearder, an electrician and inventor who designed it about 1860. It was little used except by amateurs working by steam yachts (to whom doubtless the ease with which it could be stowed away recommended it), until the late 'eighties, when Danish fishermen used otter boards to spread their plaice seines. In 1894 a patent was taken out by Scott of Granton for an otter trawl which differed from the most modern forms chiefly in possessing rigid bars or brackets instead of chains. Chains replaced the bars in the form used by Nielsen, a Dane, in 1895. Although numerous variants have since arisen, no essential difference in the trawl has been generally adopted.

Details of Structure. The Boards.

The trawl boards, or as they are frequently called "doors," are of deal, 8 to 9 ft. long, and 4 to 5 ft. high; they are liberally shod and strengthened with iron, and are about 3 in. thick. The net is fastened to eyes placed at the top and bottom of the after-end of the board but not to any intermediate point. This is to allow the part of the water swirling past the board to escape: the entry of the whole of the water upon which the net's mouth advances would cause too great a resistance.

The Warps.

Two warps are used, one to each trawl board. These are composed of wire rope 2½ in. round, and when the trawl is inboard lie coiled up on the separate drums of a steam winch. As wire can be run off or wound in on either drum separately, the adjustment of the lengths is much simplified. In the larger trawlers a thousand fathoms of warp is carried on each drum, and the warp is designed to stand a breaking strain of 23 tons.

The Net.

The main form of net is that of the beam trawl. We have, as in that net, a coarse meshed netting used near the mouth, a decrease in size of mesh as the net narrows, and a bag or cod end whose end is fastened by a cod line passed through its final meshes. The only essential difference lies in the net behind the headline. This has not, as in the beam trawl, a straight margin, but a curved one, the pointed sides of the net being termed the "top wings" of the trawl, the corresponding parts of the bottom being in both trawls the bottom wings. The ground rope resembles that in the beam-trawl, but is in some cases furnished with chains or "dangles" or with "bobbins." Bobbins are heavy cylindrical wooden rollers, threaded on the wire warp which forms the core of the ground rope. they are of two sizes (the larger a foot through) placed alternately to ensure freedom of rotation. Their object is to surmount or crush obstacles which, by catching the ground rope, might capsize the trawl boards and destroy the success of the haul, they are accordingly used only on rough ground The chains are fastened to the ground rope in loops, to give it weight, and are used on very soft ground to ensure the trawl's effectually dislodging the fish. The headline is a rope some 3 in. in circumference.

The meshes are, from knot to knot when drawn taut, from 5½ to nearly 6 in. in the square and wings, 5 to 4½ in. above, and 5 to rather over 3 in. below in the extreme back of the under batings called the "belly," about 2½ in. in the cod end.

Working the Net.

The successful shooting of the net is a matter of great skill. The paying out of the net, the lowering of the boards, the running out of unequal lengths of the two warps to square the trawl into proper position and the subsequent lowering of the whole to the bottom, resemble the corresponding operations with the beam trawl. The fore warp is then drawn close to the quarter of the vessel and shackled to the after-warp close to the vessel's side, and the vessel proceeds on her course at a speed of some 2¼ or 2½ m. per hour The length of haul made varies enormously On a ground where fish is very abundant, as in the early days of Iceland fishing, it may be half an hour or less: on the Eastern Grounds, off Denmark, where the great English fleets usually work, it is about 3 hours. When about to haul, the fore warp is released from the shackle and the vessel is immediately steered towards the side from which the trawl has been towed, while the warps are rapidly wound in; the warps thus speedily come to stand at right angles to the vessel. If this were not the case they might probably foul the vessel's propeller, with very serious and possibly fatal consequences to her safety The trawl boards, having been drawn right up to their powerful iron supports or gallows, remain suspended there if the trawl is to be re-shot while the net is emptied; they are otherwise lowered between the gallows and the bulwark, and secured. The hauling in of the catch occurs as in the beam-trawl. Trawlers carry a trawl on each side of the deck, and in continuous trawling these are worked alternately. On each side of the deck a square enclosure called a pound is made for the reception of the fish falling from the cod end, by fitting planks turned on their sides into stanchions grooved for their reception. The fish is sorted into baskets in the pound, cleaned and packed in trunks in ice in the hold or fish-room.

Fleet Fishing.

A noteworthy method of trawling is the custom of 50 or 60 boats fishing together in a fleet All these vessels will trawl as directed by an "admiral," in proximity to a "mark-boat," whose position is known to the owners from day to day, and the fish is daily fetched to market by fast "carriers." There are four such fleets of British vessels working in the North Sea. It is also worthy of mention that wireless telegraphy has recently been fitted to several German trawlers and drifters, which can thus communicate with the fishery protection cruisers, who pass on information concerning the fishery, and with the shore. The practice will doubtless spread, although as yet the distance over which a message can be sent by these vessels is very small.

Depths worked.

The use of steam has not only increased the radius of action of the vessel, but by facilitating the process of hauling enables trawling to be carried out in greater depths. The sailing vessels rarely work in greater depths than 30 fathoms. The steam vessels work frequently (*e.g.* south of Ireland) in over 200 fathoms. Commercial trawling in 500 fathoms is not unknown, and the Irish research vessel "Helga" works in as much as 800 fathoms.

Seines.

The movable nets resembling trawls are seines, from which trawls were in all probability developed. The seine is an extremely ancient net, used by Phoenicians, Greeks and other Mediterranean peoples, the word seine being derived from the Greek name (σαγήνη) for the appliance. In essence it is a long strip of netting with a buoyed headline and weighted ground rope. It is taken out in a boat some little distance from the shore, paid out during the boat's progress, and the lines attached to the ends being then brought back to the shore, the net is hauled up on the beach. From this simple form, which is still in use for the capture of smelts and other small fish, numerous developments have occurred Before mentioning the details of a few of the chief of these it may be said that the changes mainly consist in the formation of a purse or pocket in the middle of the net, somewhat resembling the cod end of a trawl, and in the working of the net from boats or ships instead of from the sea. The boat is anchored during the hauling, the net being drawn to it A net with a wide spread, furnished with a purse, drawn over the sea bottom to a boat, is obviously very near a trawl in its action. When in the late 'eighties Danish fishermen fastened otter boards to their plaice-seines, and allowed the boat to drift, the seine was dragged *by*, not *to* the boat, and when Petersen used a similar arrangement, presently to be described, dragged like a trawl, the evolution of a trawl from a seine was practically complete. Some such process, with the use of a beam instead of otter boards, probably occurred in the past and resulted in the beam trawl.

Pilchard Seines.

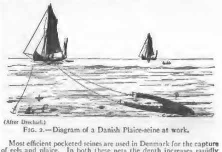
Pilchard seines, as the most elaborate forms of simple seines, may be briefly described. The pilchards approach certain parts of the Cornish coast, notably St Ives and Penzance, in shoals which are eagerly awaited; and when they are sufficiently near two boats start out on the fishery. One carries a short seine, the stop net, which has previously been joined to the large seine, and shoots this net as it rows towards shore The other rows along the shore, shooting its net as it goes. Ultimately the boats turn to meet each other, and when they do so the ends of the long seine are joined, the stop net removed, and the circle of netting towed to the beach until its ground rope touches the bottom. The pilchards are then removed at leisure by a smaller seine called a tuck-net—seine being a word which in the west of England is confined to nets worked from the beach. This net is very deep in the middle, and as the foot rope is drawn well in in hauling, a floor is formed for it as it approaches the boat from which it is worked, a simple form of purse or bag resulting The pilchards are dipped out in large baskets. In a good catch this process of "tucking" out the fish may be carried on for some days. The long seine used may be 200 fathoms long, and is about 6 fathoms deep at the ends and 8 fathoms in the middle. The tuck-net is about 80 fathoms long, 8 deep at the ends and 10 fathoms in the middle. The meshes are larger at the ends or wings than in the middle, as in the trawl, bringing a tuck-net from 30 down to 42 the yard

Purse Seines.

The seine is far more used in the United States than in the British Islands, its operations being so successful that complaints have in some cases been made that local fisheries for certain species have been entirely destroyed owing to the diminution of the fish which it has brought about. It is used in water of any depth, for the purpose of catching mackerel. Rings are fastened to the ground rope, and by means of a rope passed through these rings the lower margin of the net is drawn together, converting the circle of netting into a complete basin-shaped purse. The slack of the net is then gradually drawn in, the fish collecting in the last of the net (the fullness or "bunt") to be reached. Purse seines are also used in Japan, where there is also in use a net which is a combination of seine and pound-net A long wall of netting forms a "leader" to the fish, and ends in an oval enclosure formed by a purse seine with incompletely closed ends. Two anchored boats, to which the seine is lashed, keep it extended. On hauling, the opening is closed and the slack of the net hauled into one boat, which approaches the other, until the final portion containing the fish is brought to the surface.

"Seines with Pockets."

The pockets of seines, though answering the same purpose as those of trawls in preventing the escape of the fish, resemble not the pockets but the cod end of the latter net In the *filets de bœuf* of the Mediterranean the pocket is a very long bag, trailing behind the arms of the seine, and constricted for some distance before joining it. It is without "flapper" or other valve.



(After Drechsel.)

FIG. 2.—Diagram of a Danish Plaice-seine at work.

Most efficient pocketed seines are used in Denmark for the capture of eels and plaice. In both these nets the depth increases rapidly as soon as the extreme wings are left, and is very great in the middle. Thus when in action but little of the net is vertical; the ground and head ropes, though not parallel, tend to become so, and the net trails in a curve behind them. Seen from above, the whole front margin of the net is semicircular, but the net itself is shaped like the hinder part of a trawl: in fact, did the headline of a trawl lie not in front but exactly over the ground rope, the two nets would be almost identical.

Danish Seines.

Eel Drag-seine.

The eel drag-seine is worked from a boat, in shallow water. The extreme ends or wings are attached to two short spars, which in use are upright, and each of these is furnished with a line top and bottom which meet and are attached to the ropes by which the net is hauled in. The total length of the net is about 140 ft. from wing to wing, the length of the bag 30 ft., the depth at mouth is 20 ft. opening, the depth at the ends 6 or 8 ft.

Eel Drift-net.

The eel drift-net resembles the preceding, but is not drawn to an anchored boat, but drifts with the boat; it has accordingly to be made much smaller, its arms being each about 24 ft.—or a total length of 50. The wings were sometimes kept apart by the use of a floating spar, to the ends of which the seine was attached by short ropes, the spar itself being towed. A funnel-shaped valve leads into the bag.

Petersen's Trawl.

Petersen's trawl was designed by Dr Petersen for use in deep water, and for the capture of rapidly moving animals. It is essentially a drift-seine of the preceding pattern, worked with two small otter boards instead of a beam, and furnished with but a single warp, to which the otter boards are attached by shorter ropes or bridles. When used in very deep water these are prevented from twisting by attaching at the point of their junction with the warp a glass float and a leaden weight. This net is undoubtedly highly suitable for great depths. It is probably the "trawl" which it has been reported has been repeatedly used in the great depth of 2900 fathoms from the Norwegian research vessel "Michael Sars," in the course of the cruise in the Atlantic carried out in 1910 by Sir John Murray and Dr Hjort. It is practically a small otter trawl with the square cut out, leaving only wings, back part of batings and cod end, which last is entered by a funnel of netting. The meshes, in the net first constructed by Dr Petersen, were about a centimetre square in the wings and 8 millimetres square in the bag. The arms were each 24 ft. long, the bag about 16 ft. The boards were 29 in. by 32 in., and ¾ in. thick. Glass floats are frequently used with this trawl, to keep up the headline.

Danish Plaice-seine.

The Danish plaice-seine resembles the eel-seine in form, but is much larger, each arm being about 180 ft. long; the bag is 20 ft. long. The drag lines are also much longer, sometimes reaching to 1200 fathoms. These nets are worked from a very large number of boats, Esbjerg being the chief North Sea port engaged in the fishery. The vessels are yawl rigged, of the size of all but the largest smacks, and each is now furnished with a motor-boat. The boat takes the net to a considerable distance from the parent vessel, which is anchored, and shoots it in a wide curve. The drag lines are then brought back to the smack for hauling. By this method plaice are captured alive, and are kept in large floating fish-boxes until required.

Drift Nets.

Next in importance to trawling among the English fisheries is the use of drift-nets for mackerel, herrings and pilchards. It is undoubtedly the most common method of net-fishing on the coasts of the British islands, but nowhere is it so general as in Scotland. There are, however, great drift fisheries on the eastern and southern coasts of England, and an important mackerel fishery mainly at the western end of the channel, though owing to a high import duty on mackerel levied by France this is now of far less importance. The value of the mode of fishing technically known as "drifting or driving" will be understood when it is remembered that it is the only method by which such fishes as herrings, mackerel and pilchards, which generally swim at or near the surface, can be readily caught in the open sea, at any distance from land, and in any depth of water, so long as there is sufficient for the floating of the nets in the proper position. The term "drift-net" is derived from the manner in which the nets are worked. They are neither fixed nor towed within any precise limits of water, but are cast out or "shot" at any distance from the land where there are signs of fish, and are allowed to drift in whichever direction the tide may happen to take them, until it is thought desirable to haul them in. The essential principle of the working of the drift-net is that it forms a long wall or barrier of netting hanging for a few fathoms perpendicularly in the water, but extending for a great length horizontally, and that the fish, meeting these nets and trying to pass them, become meshed; they force their heads and gill-covers through the meshes, but can go no farther; and as the gill-covers catch in the sides of the mesh, the fish are unable to withdraw and escape. Whether it be mackerel, herring or pilchard, the manner in which the net works is the same; the variations which exist relate only to the differences in habits and size of the fish sought after.

The nets used are light cotton nets, each about 30 yards long and 10 or 12 deep, and when designed for herring have a mesh of about an inch square, pilchard nets being smaller and mackerel nets larger in mesh. These nets are laced end to end in a long row, the whole row, called a "fleet" or "train" of nets being, in the case of the large herring boats, as much as 3½ miles long. One of the long edges of the net is fastened to a rope corked at regular intervals, whose purpose is to keep that part uppermost. This edge is called the "back" of the net. The corks are, however, not sufficient to keep the whole net from sinking, and this is done by buoys called "bowls," which are attached to the back rope at intervals. It is always a matter of uncertainty at what depth the fish may be found, and a deal of judgment is needed in deciding what length of rope should be used in attaching the buoys. In the herring fishery of the English east coast the British boats usually work in somewhat shallower water than the foreign drifters, and set their nets at about 4 fathoms from the surface, the foreigners, lying outside them, using deeper-set nets. It is found convenient to colour certain of the bowls distinctively to indicate their position in the "fleet." Otherwise they are coloured to show ownership.

Drift-net fishing is with rare exceptions only carried on at night. The time for beginning is just before sunset, and the nets are then got into the water by the time it is dark. A likely place to fish is known (though there is much uncertainty in the matter) by signs recognizable only to the practised eye. An obvious one is the presence of many sea-birds, or of the fish themselves. But besides these the appearance and even the smell of the water furnishes a guide. In the case of the mackerel these signs have been shown by G. E. Bullen (*Journ. Marine Biol. Assoc.* viii. 269) to be due to the character of the microscopic organisms in the water, some of which furnish the food of the mackerel, others of which it avoids. If fish is believed to be present the vessel is sailed slowly before the wind and if possible across the tide; then the net is shot or thrown out over the vessel's quarter, the men being distributed at regular stations, some hauling up the net from below, others throwing it over and taking care that it falls so that the foot is clear of the corked back; others, again, looking after the warp which has to be paid out at the same time, and seeing that the seizings are made fast to it in their proper places. When it is all overboard, and about 15 or 20 fathoms of extra warp, called the "swing-rope," given out, the vessel is brought round head to wind by the warp being carried to the bow; the sails are then taken in, the mast lowered, a small mizen set to keep the vessel with her head to the wind, and the regulation lights are hoisted to show that she is fishing. A few of the hands remain on deck to keep a look out, and the vessel and nets are left to drift wherever the wind and tide may take them. It is very rarely that there is an absolute calm at sea; and if there is the faintest breath of air stirring the fishing boat will of course feel it more than the buoys supporting the nets; she will consequently drift faster, and being at the end of the train, extend the whole fleet of nets. In rough weather, as the strain may be greater, more rope is used. The first net in the train is often hauled after an hour to enable the men to judge whether the position is a good one. When the whole are hauled, the nets are taken in and the fish shaken out in the same orderly way as in shooting, each man having his own proper duty.

The sailing drifter is fast disappearing, giving place to the steam drifter. These vessels, though costing far more (£2500 to £3000 against £400 only) catch more fish, have a greater radius of action, reach market more quickly and are independent of weather. It has been calculated that a thousand square feet of herring netting used by a steamer catch 43½ cwt. of herring, while a sailing vessel catches 20 cwt. with the same area of netting; and the steamer-caught fish, being more quickly delivered, fetches a better price. It may be noted that of recent years herring have been caught at the bottom in considerable quantities by the trawl. The fishing of herring is thus increasing in variety of method, as well as in intensity. Such sailing boats as tend to remain are long shore boats, and such drifters as have been fitted with petrol motors.

Stationary Nets.

Stationary nets, being of very small importance relatively to the preceding, must be dismissed more shortly. They are of four main kinds, viz.: stake nets, pound and kettle nets, stow and bag nets, trammel-nets and hose nets.

Stake Nets.

Stake nets are usually set between tide-marks, or in shallow water, and, as their name implies, are kept up by stakes placed at intervals. They are generally set across the direction of the tide. They act as gill nets, and are chiefly used in America. In some cases a conical bag instead of a flat net occupies the space between every two stakes, forming a series of simple bag nets. This form is used on the German shores of the North Sea.

Pound and Kettle Nets.

In another modification the net is supported on the stakes, which is some 200 ft. long, does not act as a gill net but as a "leader," and one of its ends passes through a narrow opening into a circular enclosure surrounded by a similar wall of staked netting. The bag net and fly net for the capture of the salmon are merely elaborated forms of this type. The pound is roofed by netting, in the fly net, and in the bag net, which is floated—not staked—floored also. It is wedge-shaped, narrowing gradually from the entrance end, and divided incompletely by oblique internal walls or valves of netting into side compartments.

Stow Nets.

The bag net just described is practically a floating stake net. A simpler form is used in the Elbe, consisting of a pyramidal net whose mouth is held open by its sides being attached to spars, weighted at one end and buoyed at the other. This is the simplest form of stow net. The stow net is used in the Thames and Wash; it is specially designed for the capture of sprats, although many young herrings are sometimes caught, and it is worked most extensively at the entrance of the Thames. The stow net is a gigantic funnel-shaped bag having nearly a square mouth, 30 ft. from the upper to the lower side, and 21 ft. wide. It tapers for a length of about 90 ft. to a diameter of 5 or 6 ft., and further diminishes to about half that size for another 90 ft. to the end of the net. The whole net is therefore about 180 ft. or 60 yards long. The upper and lower sides of the square mouth are kept extended by two horizontal wooden spars called "balks," and the lower one is weighted so as to open the mouth of the net in a perpendicular direction when it is at work. The size of the meshes varies from 1¼ in. near the mouth to ½ in. towards the end, where, however, it is again slightly enlarged to allow for the greater pressure of the water at that part. The mode of working the net is very simple. Oyster smacks are commonly used in this fishery, although shrimping boats are also employed in it in the Thames. The smack takes up a position at the first of the tide where there are signs of fish, or in such parts of the estuary as are frequented by the sprats during that part of the season; she then anchors, and at the same moment the net is put overboard and so handled that it at once takes its proper position, which is under the vessel. It is kept there by a very simple arrangement. Four ropes leading, one from each end of the two balks, and therefore from the four corners of the mouth of the net, are united at some little distance in front, forming a double bridle, and a single mooring rope leads from this point of union to the vessel's anchor; so that the same anchor holds both the vessel and the net. The net is kept at any desired distance from the bottom by means of two ropes, one from each end of the upper balk to the corresponding side of the smack, where it is made fast. The open mouth of the net is thus kept suspended below the vessel, and the long mass of netting streams away astern with the tide. The strain of this immense bag-net by the force of the tide is often very great, but if the vessel drags her anchor, the net being made fast to the same mooring, both keep their relative positions. Here they remain for several hours till the tide slackens, the vessel's sails being all taken in and only one hand being left on deck to keep watch. The way in which the fish are caught hardly requires explanation. The sprats, swimming in immense shoals, are carried by the tide into the open mouth of the net and then on to the small end, where they are collected in enormous numbers; from this there is no escape, as the crowd is constantly increasing, and they cannot stem the strong tide setting into the net. The first thing to be done in taking in the net is to close the mouth, and this is effected by means of a chain leading from the bow of the vessel through an iron loop in the middle of the upper balk down to the centre of the lower one, and by heaving in this chain the two balks are brought together and ultimately hoisted out of the water under the vessel's bowsprit. The net is then brought alongside and overhauled till the end is reached, and this is hoisted on board. The rope by which it is closed having been cast off, the sprats are then measured into the hold of the vessel by about three bushels at a time, until the net has been emptied. The quantity of sprats taken in this manner by many scores of fishing craft during the season, which lasts from November to February, is in some years simply enormous; the markets at Billingsgate and elsewhere are inundated with them, and at last in many years they can only be disposed of at a nominal price for manure; and in this way many hundreds of tons are got rid of. The stow boats do not generally take their fish on shore, but market boats come off to them and buy the fish out of the vessel's hold, and carry it away. The mode of working is the same in the Solent and the Wash as that we have described in the Thames and large quantities of sprats are landed by the Southampton boats.

"Whitebait," or young sprats, mixed with some young herring and other small fish, are caught in the Thames by a net which is practically nothing else but a very small stow net, and it is worked in essentially the same manner. An interesting form of stow net is used in the Channels of the Frisian Island, chiefly during the rush of the ebb-tide, for the capture of rays (principally *Raja clavata*, the Thornback) which are highly valued by the Dutch. It consists of a net shaped like an otter trawl, furnished with otter boards, which are attached to ropes passed to the ends of long booms which project from the sides of the vessel using the net, and also to the two anchors by which the former is anchored.

Trammel Nets.

The remaining stationary nets to be mentioned partake of the nature of traps. The trammel net consists of three nets joined together at the top, bottom and sides. The whole system of nets hangs vertical, the head line being buoyed and the ground line weighted. The two outer nets are much smaller than the inner net, but of wide-meshed netting, whereas the inner net is of very small mesh. Consequently, a fish meeting an outer net passes through it, strikes the fine-meshed net and forces it before it through one of the meshes of the farther wide-meshed net; it is thus in a small pocket from which it cannot escape.

Hose Net.

The hose net is a long cylindrical net from which trap-like pockets open. The main cavity is kept open by rigid rings. The hose nets are set between tide marks, at low water, so that the tide runs through them; and they are emptied at next low tide.

While unimportant compared with the huge quantity of fish landed from sea-going vessels, the catch of the in-shore nets described is of importance in respect of the kinds of fish taken, whitebait and pilchards, for instance, being not otherwise obtained, while salmon, though taken in rivers as well as in estuaries and along the coast, is very rarely captured at sea.

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TRAY, a flat receptacle with a raised edge used for a variety of purposes, chiefly domestic. The tray takes many forms—oblong, circular, oval, square—and is made in a vast number of materials, from papier mâché to the precious metals. Duke Charles of Lorraine had a pen-tray of rock crystal standing on golden feet; Marie Antoinette possessed a wonderful oval tray, silver gilt and enamelled, set with 144 cameos engraved with the heads of sovereigns and princes of the house of Austria, and their heraldic devices. The tea-tray is the most familiar form; next to it comes the small round tray, usually of silver or electroplate, chiefly used for handing letters or a glass of wine. When thus employed it is usually called a "waiter." The English tea-trays of the latter part of the 18th century were usually oval in shape and sometimes had handles; mahogany and rosewood were the favourite materials. Sheraton and Shearer, among other cabinet-makers of the great English period, are credited with trays of this type. These were succeeded in the early and mid-Victorian period by trays of japanned iron, which possessed no charm but had the virtue of durability. Sheffield plate snuffer-trays of satisfying simplicity were made in large numbers, and are now much sought after.

TRAZ-OS-MONTES (*i.e.* across the Mountains), an ancient frontier province in the extreme N.E. of Portugal, bounded on the N. and E. by Spain, S. by the river Douro which separates it from Beira, and W. by the Gerez, Cabreira and Marão Mountains, which separate it from Entre-Minho-e-Douto. Pop. (1900), 427,358; area, 4,163 sq. m. For administrative purposes Traz-os-Montes was divided in 1833 into the districts of Braganza (*q.v.*) and Villa Real (*q.v.*). The surface is generally mountainous, although there are tracts of level land in the *veigas* or cultivated plains of Chaves and Miranda do Douro, and in the *cimas* or plateau region of Mogadouro. The highest peak is Marão (4642 ft.). The province belongs to the basin of the Douro and is chiefly drained by its tributaries the Tua, Tamega and Sabor. Its inhabitants belong to the old Portuguese stock, and resemble the Spaniards of Galicia in physical type, dialect and character. The Paiz do Vinho (see OPORTO) is the chief wine-growing district in Portugal; other products are silk, maize, wheat, rye, hemp, olive oil and honey. There are important mineral springs and baths at Vidago and Pedras

Salgadas. The principal towns are Braganza, Chaves and Villa Real.

TREACLE, the thick viscid syrup obtained in the early processes of refining sugar, the uncrystallizable fluid obtained in the process of procuring refined crystallized sugar being known as "golden syrup" and the drainings from the crude sugar as "molasses" (see SUGAR: *Manufacture*). The word was properly and first used for a medical compound of varying ingredients which was supposed to be a sovereign remedy against snake bites or poison generally. A well-known specific was Venice treacle, *Theriaca Andromachi*, a compound of a large number of drugs reduced to an electuary,[1] a medicinal compound prepared with honey, which dissolves in the mouth. The old French *triacle*, of which "treacle," earlier "triacle," is an adaptation, is a corruption of *theriaque*, Latin *theriaca*, Greek *θηριακά* (*sc. φάρμακα*), literally drugs used as an antidote against the bite of poisonous or wild animals (*θηρίον*, dim. of *θήρ*, wild beast). The word "triacle" came to be used of any remedy or antidote. The composition of electuaries with honey or syrup naturally transferred the name to the most familiar syrup, that obtained from the drainings of sugar.

TREAD-MILL, a penal appliance introduced by Sir William Cubitt in 1818 and intended by him as a means of employing criminals usefully. It was a large hollow cylinder of wood on an iron frame, round the circumference of which were a series of steps about 7½ in. apart. The criminal, steadying himself by hand-rails on either side, trod on these, his weight causing the mill to revolve and compelling him to take each step in turn. In the brutalizing system formerly in vogue the necessary resistance was obtained by weights, thus condemning the offender to useless toil and defeating the inventor's object. The tread-mill, however, was subsequently utilized for grinding corn, pumping water and other prison purposes. The speed of the wheel was regulated by a brake. Usually it revolved at the rate of 32 ft. per minute. The prisoner worked for 6 hours each day, 3 hours at a time. He was on the wheel for 15 minutes and then rested for 5 minutes. Thus in the course of his day's labour he climbed 8640 ft. Isolation of prisoners at their work was obtained by screens of wood on each side of the mill, converting the working space into a separate compartment. Each prisoner was medically examined before going to the mill.

By the Prison Act 1865 every male prisoner over 16, sentenced to hard labour, had to spend three months at least of his sentence in labour of the first class. This consisted primarily of the tread-mill, or, as an alternative, the crank. The latter consisted of a small wheel, like the paddle-wheel of a steamer, and a handle turned by the prisoner made it revolve in a box partly filled with gravel. The amount of gravel regulated the hard labour; or the necessary resistance was obtained by a brake, by which a pressure, usually of 12 lb, was applied. The prisoner had to make 8000 or 10,000 revolutions during his 6 hours' work, according to his strength, the number being registered on a dial. The crank too, however, was subsequently made to serve useful purposes. Both tread-mill and crank have gradually been abolished; in 1895 there were 39 tread-mills and 29 cranks in use in English prisons, and these had dwindled down to 13 and 5 respectively in 1901. They are now disused.

The fundamental idea of Cubitt's invention, *i.e.* procuring rotary motion for industrial purposes by the weight of men or animals, is very old. "Tread-wheels," of this type, usually consist of hollow cylinders, round the inner surface of which a horse, dog or man walks, foothold being kept by slabs of wood nailed across at short intervals.

TREASON (Fr. *trahison*, Lat. *traditio*), a general term for the crime of attacking the safety of a sovereign state or its head. The law which punishes treason is a necessary consequence of the idea of a state, and is essential to the existence of the state. Most, if not all, nations have accordingly, at an early period of their history, made provision by legislation or otherwise for its punishment. The principle is universal, though its application has led to differences of opinion. What would have been a capital crime at Rome under Tiberius may be no offence at all in England. It is to the advantage of the state and the citizen that what is treason and what is not should be clearly defined, so that as little as possible discretionary power, apt to be strained in times of popular excitement, should be left to the judicial or executive authorities. The importance of this was seen by Montesquieu. Vagueness in the crime of treason, says he, is sufficient to make the government degenerate into despotism.[2] At the same time, it may be observed that despotic governments have not always left the crime undefined. The object of Henry VIII., for instance, was rather to define it as closely as possible by making certain acts treason which would not have been so without such definition. In both ancient and modern history treason has generally been a crime prosecuted by exceptional procedure, and visited with *afflictive* as distinguished from *simple* punishments (to use the terminology of Bentham).

Roman Law.—In Roman law the offences originally falling under the head of treason were almost exclusively those committed in military service, such as in England would be dealt with under the Army Act. The very name *perduellio*, the name of the crime in the older Roman law, is a proof of this. *Perduelles* were, strictly, public enemies who bore arms against the state; and traitors were regarded as having no more rights than public enemies. The Twelve Tables made it punishable with death to communicate with the enemy or to betray a citizen to the enemy. Other kinds of *perduellio* were punished by interdiction of fire and water. The crime was tried before a special tribunal, the *duumviri perduellionis*, perhaps the earliest permanent criminal court existing at Rome. At a later period the name of *perduellio* gave place to that of *laesa majestas*, *deminuta* or *minuta majestas*, or simply *majestas*. The *lex Julia majestatis*, to which the date of 48 B.C. has been conjecturally assigned, continued to be the basis of the Roman law of treason until the latest period of the empire, and is still, with the law of *perduellio*, the basis of the law of British South Africa as to treason. The original text of the law appears to have still dealt with what were chiefly military offences, such as sending letters or messages to the enemy, giving up a standard or fortress, and desertion. With the empire the law of *majestas* received an enormous development, mainly in the reign of Tiberius, and led to the rise of a class of professional informers, called *delatores*.[3] The conception of the emperor as divine[4] had much to do with this. It became a maxim that treason was next to sacrilege[5] in gravity. The law as it existed in the time of Justinian is contained chiefly in the titles of the *Digest*[6] and *Code*[7] "*Ad legem Juliam majestatis.*" The definition given in the *Digest* (taken from Ulpian) is this: "majestatis crimen illud est quod adversus populum Romanum vel adversus securitatem ejus committitur." Of treasons other than military offences, some of the more noticeable were the raising of an army or levying war without the command of the emperor, the questioning of the emperor's choice of a successor, the murder of (or conspiracy to murder) hostages or certain magistrates of high rank, the occupation of public places, the meeting within the city of persons hostile to the state with weapons or stones, incitement to sedition or administration of unlawful oaths, release of prisoners justly confined, falsification of public documents, and failure of a provincial governor to quit his province at the expiration of his office or to deliver his army to his successor. The intention (*voluntas*) was punishable as much as an overt act (*effectus*).[8] The reported opinions as to what was not treason show the lengths to which the theory of treason was carried. It was not treason to repair a statue of the emperor which had decayed from age, to hit such a statue with a stone thrown by chance, to melt down such a statue if unconsecrated, to use mere verbal insults against the emperor, to fail in keeping an oath sworn by the emperor or to decide a case contrary to an imperial constitution. Treason was one of the *publica judicia*, *i.e.* one of those crimes in which any citizen was entitled to prosecute. The law deprived the accused in a charge of treason of his ordinary remedy for malicious prosecution, and also took from him the privilege (which those accused of other crimes generally possessed) of immunity from accusation by women or infamous persons, from liability to be put to the torture, and from having his slaves tortured to make them testify against him (see TORTURE). The punishment from the time of Tiberius was death (usually by beheading)[1] and confiscation of property, coupled with complete civil disability. A traitor could not make a will or a gift or emancipate a slave. Even the death of the accused, if guilty of treason of the gravest kind, such as levying war against the state, did not extinguish the charge, but the memory of the deceased became infamous, and his property was forfeited as though he had been convicted in his lifetime.

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[1] Electuary (Lat. *electuarium*), is probably derived from Gr. *ἐκλεικτόν*, used in the same sense, from *ἐκλείχειν*, to lick out.

[2] *Esprit des lois*, bk. xii. c. 7.

[3] See Merivale, *History of the Romans under the Empire*, iii. 467, v. 141.

[4] "Principes instar deorum esse" are the words of Tacitus.

[5] This crime was called *laesa majestas divina* in later law.

[6] xlviii. 4.

[7] ix. 8.

[8] A similar provision was contained in the Golden Bull of Charles IV. c. 24. In English law, with the one exception of a statute of 1397 (21 Ric. II. c. 3) repealed in the first year of Henry IV.,

English Law.—The law of England as to treason corresponds to a considerable extent with Roman law; in fact, treason is treated by Blackstone as the equivalent of the *crimen laesae majestatis*. The history of the crime in the two systems agrees in this that in both the law was settled by legislation at a comparatively early period, and subsequently developed by judicial construction. In both, too, there were exceptional features distinguishing this crime from other offences.[2] For instance, at common law treason was not bailable (except by the king's bench) nor clergyable, could not be cleared by sanctuary, and did not admit of accessories before or after the fact, for all were principals, nor could a married woman plead coercion by her husband. To stand mute and refuse to plead did not save the lands of the accused, as it did in felony, so that the *peine forte et dure* (see TORTURE) was unnecessary in treason. These severities were due to the conception of treason as a breach of the oath of allegiance. Other differences introduced by statute will be mentioned later. In some cases a statute simply affirmed the common law, as did the Treason Act 1351 to a great extent, and as did an act of 1534, depriving those accused of treason of the benefit of sanctuary. How far the Roman law was consciously imitated in England it is impossible to determine. It was certainly not adopted to its full extent, for many acts were *majestas* which were never high treason, even in the most despotic periods. Treason was the subject of legislation in many of the pre-Conquest codes. The laws of Alfred[3] and Æthelred[4] punished with death any one plotting against the life of the king. The *Leges Henrici Primi*"[5] put anyone slaying the king's messenger in the king's mercy. The crime was shortly defined by Glanvill,[6] and at a greater length by Britton,[7] and by Bracton,[8] who follows Roman law closely.

The offence of high treason was not precisely defined by the common law (1 Hale, 76), and until the passing of the Treason Act 1351 depended much on the opinions of the king and his judges. That statute appears to be the answer to a petition of the Commons in 1348 (1 Hale, 87), praying for a definition of the offence of accroaching royal power, a charge on which several persons—notably Gaveston and the Despensers—had suffered. The offences made high treason by the statute which still remain are these: (1) to compass or imagine[9] the death of the king,[10] the queen or their eldest son and heir; (2) to violate the king's companion, or his eldest daughter unmarried, or the wife of his eldest son and heir; (3) to levy war against the king in his realm, or be adherent to the king's enemies in his realm, giving them aid and comfort in the realm or elsewhere (*perduellio*); (4) to slay the chancellor, treasurer, or the king's justices of the one bench or the other, justices in eyre, or justices of assize, and all other justices assigned to hear and determine, being in their places doing their offices. In all cases of treason not specified in the statute the justices before whom the case came are to tarry without going to judgment until the cause has been showed and declared before the king and his parliament whether it ought to be judged treason or felony. The statute, so far as it defines the offence of high treason, is still law.

The statute also treated as high treason forgery of the great or privy seal, counterfeiting the king's coin and importing counterfeits thereof. These offences are now felonies. It also defined petty treason (now merged in wilful murder) as the slaying of a master by his servant, a husband by his wife, or a prelate by a man secular or religious owing him allegiance. The act of 1351 protects only the king's life, and its insufficiency was supplemented in periods of danger by legislation, often of a temporary nature. Under Richard II. many new offences were made treason,[11] but the acts creating these new treasons were repealed at the earliest opportunity by the parliaments of his successors. The reign most prolific in statutory additions to the law of treason was that of Henry VIII. Legislation in this reign was little more than a register of the fluctuating opinions of the monarch. Thus, by one act of 1534 it was treason not to believe Mary illegitimate and Elizabeth legitimate; by another act of 1536 it was treason to believe either legitimate; by an act of 1543 it was treason not to believe both legitimate. Another act of this reign (1545) shows that a class of men like the Roman *delatores* must have been called into existence by all the new legislation. The act made it felony to make anonymous charges of treason without daring to appear in support of them before the king or council. These acts were repealed in 1553 (1 Mar. st. 1. c. 1. s. 1.) and the act of 1351 was made the standard of the offence.

Besides the acts of 1351 and 1553 the following statutes are still in force with respect to the substantive law of treason. By an obscurely penned statute of 1495 (11 Hen. VII. c. 1. s. 1) persons serving the king for the time being in war are not to be convicted or attainted of treason; see Steph., *Dig. Cr. Law* (6th ed.), article 56. This statute has been held not to apply in British South Africa.

By an act of 1571 (13 Eliz. c. 2) as a counterblast to papal attacks on the right of Elizabeth to the English crown, it was declared that persons using in England papal bulls offering absolution and reconciliation to persons forsaking their due obedience to the English crown should be punishable as traitors. The penalties were abolished in 1846, but the acts against which the statute was aimed were declared to be still unlawful (see Steph., *Dig. Cr. Law*, 6th ed., p. 45*n*.). By an act of 1702 (1 Anne st. 2. c. 21 s. 3) it is treason to endeavour to hinder the next successor to the crown from succeeding, and by the Succession to the Crown Act 1707 it is treason maliciously, advisedly and directly by writing or printing to maintain and affirm that any person has a right to the crown otherwise than according to the Acts of Settlement and Union, or that the crown and parliament cannot pass statutes for the limitation of the succession to the crown.

By an act of 1796, made perpetual in 1817, the definition of treason is extended so as to include plots within or without Great Britain to cause the death or destruction, or any bodily harm tending to the death, destruction, maiming, or wounding, imprisonment or restraint of the king, if such plots are expressed by publishing any printing or writing, or by any overt act or deed. Since that date no new forms of treason have been created. There are many instances of offences temporarily made treason at different times. A

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an overt act has always been necessary. The difficulty of proving a mere intention is obvious. In French and German law the overt act (*Attentat* or *Unternehmen*) is as indispensable as in English.

[1] To harbour a fugitive enemy was punishable only by deportation. *Dig.*, xlviii. 19, 40.

[2] The position of treason as a special crime prosecuted by special procedure is one common to most legal systems at some period of their existence. For instance, in Germany, by a constitution of Henry VII. the procedure was to be summary, *sine strepitu et figura judicii*.

[3] c. 4.
[4] v. 30.
[5] lxxix. 2.
[6] xiv. 1.
[7] cc. 20, 21, 22.
[8] de Corona 118*b*.

[9] These words, according to Luders (*Law Tracts*, note *ad fin.*), mean to attempt or contrive.

[10] This by act of 1553 includes a queen regnant.

[11] One reason for making offences treason rather than felony was no doubt to give the Crown rather than the lord of the fee the right to the real estate of the criminal on forfeiture. Had the offences been felony the king would have had only his year, day and waste on the estate escheating to the lord, as was the case in treason before the Statute of Treasons.

few of the more interesting may be briefly noticed. It was treason to attempt to appeal or annul judgments made by parliament against certain traitors (1398); to break a truce or safe-conduct (1414–1450); to hold castles, fortresses or munitions of war against the king (1552); to adhere to the United Provinces (1665); to return without licence if an adherent of the Pretender (1696); to correspond with the Pretender (1701); and to compass or imagine the death of the prince regent (1817). In addition to these, many acts of attainder were passed at different times. One of the most severe was that against Catherine Howard (1541), which went as far as to make it treasonable for any queen to conceal her ante-nuptial incontinence. Other acts were those against Archbishop Scrope, Owen Glendower, Jack Cade, Lord Seymour, Sir John Fenwick, James Stuart and Bishop Atterbury. In one case, that of Cromwell, Ireton and Bradshaw, an act of attainder was passed after the death of those guilty of the treason (1660), and their bodies were exhumed, beheaded and exposed. Acts of indemnity were passed to relieve those who had taken part in the suppression of rebellion from any possible liability for illegal proceedings. Three such acts were passed in the reign of William III. (1689–1690). Similar acts were passed after the Irish rebellion of 1798.

Punishment.

The punishment of treason at common law was barbarous in the extreme.[1] The sentence in the case of a man was that the offender be drawn on a hurdle to the place of execution, that there he be hanged by the neck but not till he be dead, and that while yet alive he be disembowelled and that then his body be divided into four quarters, the head and quarters to be at the disposal of the Crown.[2] Until 1790 at common law a woman was drawn to the place of execution and there burned. In that year hanging was substituted for burning in the case of female traitors. In 1814 the part of the sentence relating to hanging and to disembowelling was altered to hanging until death supervened. Drawing and beheading and quartering after hanging were abolished in 1870. There is no legislation authorizing the execution of traitors within the walls of a prison as in the case of murder (see CAPITAL PUNISHMENT). The act of 1814 in the case of men enables the Crown, by warrant under the sign manual, countersigned by a secretary of state, to change the sentence to beheading. Attainder and forfeiture for treason are abolished by the Forfeitures Act 1870, except where the offender has been outlawed.[3] The maximum penalty for a felony under the act of 1848 is penal servitude for life. In every pardon of treason the offence is to be particularly specified therein (see PARDON).

Trials for treason in Great Britain and Ireland were at one time frequent and occupy a large part of the numerous volumes of the *State Trials*. Some of the more interesting may be mentioned. Before the Statute of Treasons were those of Gaveston and the Despensers in the reign of Edward II. on charges of accroaching the royal power. After the statute were those (some before the peers by trial or impeachment, most before the ordinary criminal courts) of Empson and Dudley, Fisher, More, the earl of Surrey, the duke of Somerset, Anne Boleyn, Lady Jane Grey, Sir Thomas Wyatt, Cranmer, the queen of Scots, Sir Walter Raleigh, Strafford, Laud, Sir Henry Vane and other regicides, William Lord Russell, Algernon Sydney, the duke of Monmouth, and those implicated in the Pilgrimage of Grace, the Gunpowder, Popish, Rye House and other plots. Cases where the proceeding was by bill of attainder have been already mentioned. Occasionally the result of a trial was confirmed by statute. In some of these trials, as is well known, the law was considerably strained in order to insure a conviction. Since the Revolution there have been the cases of those who took part in the risings of 1715 and 1745, Lord George Gordon in 1780, Thomas Hardy and Horne Tooke in 1794, the Cato Street conspirators in 1820, Thomas Frost in 1840, Smith O'Brien in 1848, and in 1903 Arthur Lynch, for adhering to, aiding and comforting the king's enemies in the South African war.[4] The bulk of the treason trials are reported in Howell's *State Trials* and the *New Series of State Trials*. The statute of 1351 as interpreted by the judges in these cases is still the standard by which an act is determined to be treason or not. The judicial interpretation has been sometimes strained to meet cases scarcely within the contemplation of the framers of the statute: *e.g.* it became established doctrine that a conspiracy to levy war against the king's person or to imprison or depose him might be given in evidence as an overt act of compassing his death, and that spoken words, though they could not in themselves amount to treason, might constitute an overt act, and so be evidence. Besides decisions on particular cases, the judges at different times came to general resolutions which had an appreciable effect on the law. The principal resolutions were those of 1397 (confirmed 1398), of 1557, and those agreed to in the case of the regicides at the Restoration and reported by Sir John Kelyng. The effect of this legislation, according to Sir James Stephen, is that such of the judicial constructions as extend the imagining of the king's death to imagining his death, destruction or any bodily harm tending to death or destruction, maim or wounding, imprisonment or restraint, have been adopted, while such of the constructions as make the imagining of his deposition, conspiring to levy war against him, and instigating foreigners to invade the realm, have not been abolished, but are left to rest on the authority of decided cases. The legislation in force in 1878 as to treason and kindred offences was collected by the late Mr R. S. Wright and its substance embodied in a draft consolidation bill (Parl. Pap. 1878 H. L. 178), and in 1879 the existing law was incorporated in the draft criminal codes of 1879. The code draws a distinction between treason and treasonable crimes, the former including such acts (omitting those that are obviously obsolete) as by the Treason Act 1351 and subsequent legislation are regarded as treason proper, the latter including the crimes contained in the Treason Felony Act 1848.

In the words of the draft (§ 76) " treason is (*a*) the act of killing Her Majesty, or doing her any bodily harm tending to death or destruction, maim or wounding, and the act of imprisoning or restraining her; or (*b*) the forming and manifesting by an overt act an intention to kill Her Majesty, or to do her any bodily harm tending to death or destruction, maim or wounding, or to imprison or to restrain her; or (*c*) the act of killing the eldest son and heir-apparent of Her Majesty, or the queen consort of any king of the United Kingdom of Great Britain and Ireland; or (*d*) the forming and manifesting by an overt act an intention to kill the eldest son and heir-apparent of Her Majesty, or the queen consort of any king of the United Kingdom of Great Britain and Ireland; or (*e*) conspiring with any person to kill Her Majesty, or to do her any bodily harm tending to death or destruction, maim or wounding, or conspiring with any person to imprison or restrain her; or (*f*) levying war against Her Majesty either with intent to depose Her Majesty from the style, honour and royal name of the Imperial Crown of the United Kingdom of Great Britain and Ireland or of any other of Her Majesty's dominions or countries; or in order by force or constraint to compel Her Majesty to change her measures or counsels, or in order to intimidate or overawe both Houses or either House of Parliament; or (*g*) conspiring to levy war against Her Majesty with any such intent or for any such purpose as aforesaid; or (*h*) instigating any foreigner with force to invade this realm or any other of the dominions of Her Majesty; or (*i*) assisting any public enemy at war with Her Majesty in such war by any means whatsoever; or (*j*) violating, whether with her consent or not, a queen consort, or the wife of the eldest son and heir-apparent for the time being of the king or queen regnant."

No amount of residence abroad exempts a British subject from the penalty of treason if he bears arms against the king,[5] unless he has become naturalized as the subject of a foreign state before the outbreak of the war in which he bears arms. To become naturalized as the subject of an enemy during a war is in itself an act of treason. It is well established that an alien resident within British territory owes local allegiance to the Crown and may be indicted for high treason, and there are numerous instances of prosecution of foreigners for treason. Such are the cases of Leslie, bishop of Ross, ambassador to Elizabeth from the queen of Scots (1584), the marquis de Guiscard in Queen Anne's reign and Gyllenborg, the ambassador from Sweden to George I. (1717). Proceedings against ambassadors for treason have never gone beyond imprisonment, more for safe custody than as a punishment. In 1781 La Motte, a Frenchman resident in England, was convicted of holding treasonable communications with France, and in Canada American citizens were tried for treason for aiding in the rebellion of 1837–1838 (Forsyth, 200). Assistance by a resident alien to invaders of British territory is high treason even if the territory in question is in military occupation by the forces of the foreign power.[6]

Court and Place of Trial.

Of the modes of trying high treason two are obsolete, viz. (1) by appeal in the common law courts, which ceased by the effect of statutes between 1322 and 1399 and were finally abolished in 1819; (2) before the constable and marshal. The last instance of this mode of trial was an award of battle in 1631 in the case of Lord Reay.[1] Four modes of trying high treason still remain, viz. impeachment, trial of a peer by his peers, trial by court-martial and trial by jury on indictment before the High Court or a court of assize or a special commission. The offence is not triable at quarter sessions.

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[1] The exceptional character of the punishment, like that of the procedure, may be paralleled from Germany. The punishment of traitors by Frederick II. by wrapping them in lead and throwing them into a furnace is alluded to by Dante, *Inferno*, xxiii. 66.

[2] See the sentence in full in Latin in *R.* v. *Walcot*, 1696, 1 Eng. Rep. 87.

[3] Proceedings after the death of an alleged traitor might at one time have been taken, but only to a very limited extent as compared with what was allowed in Roman and Scots law. Coke (4 *Rep.* 57) states that there might have been forfeiture of the land or goods of one slain in rebellion on view of the body by the lord chief justice of England as supreme coroner.

[4] 1903, 1 K.B. 446. He was sentenced to death. The sentence was commuted to penal servitude for life. Lynch was released on licence after one year in prison and has since been pardoned.

[5] Aeneas Macdonald's case, 18 *St. Tr.* 857; *R.* v. *Lynch* (1903) 1 K.B. 446—see Mayne, *Ind. Cr. Law* (1896), pp. 459, 460.

[6] De Jager's case (1907) App. Cas. 326.

At common law and under the Great Charter a peer, and, by an act of 1442, a peeress in right of her husband, are triable for treason before the House of Lords, or, when parliament is not sitting, in the court of the lord high steward. The last trial of a peer for treason was that of Lord Lovat in 1746–1747 (18 Howell's *St. Tr.* 529).

In the reign of Edward IV., and perhaps later, treason was at times tried by martial law. The issue of commissions of martial law in time of peace was in 1628 declared illegal by the Petition of Right. But the prerogative of the Crown to deal by martial law with traitors in time of war or open rebellion within the realm or in a British possession still exists.[2]

Treasons committed within the admiralty jurisdiction or out of the realm were originally triable only by the admiral or the constable and marshal according to the civil law, but were made triable according to the courts of the common law by the Offences at Sea Act 1536, and by acts of 1543, 1552[3] and 1797. Provision is made for the trial in British possessions of treasons committed in the admiralty jurisdiction (Offences at Sea Act 1806).

Treasons committed within the realm are tried in the High Court, the central criminal court or another court of assize, or by special commission, except in the case of peers. In two acts dealing with Ireland (of 1809 and 1833) it was provided that nothing in the acts was to take away the undoubted prerogative of the Crown for the public safety to resort to the exercise of martial law against open enemies and traitors, while actual war or insurrection is raging (see Martial Law).[4] Treason by persons subject to military law is triable by court-martial under the Army Act (1881) ss. 4, 41 (*a*), where the offence cannot with reasonable convenience be tried in a civil court, and treason by persons subject to naval discipline by court-martial under the Naval Discipline Act (1866) s. 7. The procedure in such trials is regulated by the acts.

Procedure.

In certain cases of treason the procedure on the trial is the same as upon a charge of murder. Those cases, which are statutory exceptions from the statutory procedure prescribed for the trial of high treason and misprision thereof, are: (*a*) Assassination or killing of the king, or any heir or successor of the king, or any direct attempt against his life or any direct attempt against his person whereby his life may be endangered or his person may suffer bodily harm (1800, 1814); (*b*) attempts to injure in any manner the person of the king (1842).

In all other cases of treason the procedure is regulated by acts of 1695, 1708 and 1825. A copy of the indictment must be delivered to the accused ten days at least before his arraignment, with a list of the witnesses for the prosecution (1708) and a list of the petty jury, except in the High Court, where the petty jury list is to be delivered ten days before the trial (1825).[5] The accused is entitled to be defended by counsel, and on application to the court may have two counsel assigned to him (1695), a right extended in 1746 to impeachments for treason. Witnesses for the defence have since 1702 been examinable upon oath. The accused may by the Criminal Evidence Act 1898 consent to be called as witness for the defence. It is doubtful whether the wife or husband of the accused is a compellable witness for the Crown (*Archb. Crim. Pleading*, 23rd ed., 398).

Prosecutions for treason must be begun within three years of the offence, except in cases of attempts to assassinate the king. The rules as to the indictment are stricter than in the case of felony and misdemeanour, much of the modern statutory power of amendment not extending to indictments for the graver offence. No evidence may be given of any overt act (*voie de fait*) not expressly stated in the indictment. The accused is entitled to peremptory challenge of thirty-five of the jurors summoned for the petty jury; but they need not now be freeholders. The accused can be convicted only on his own confession in open court, or by the oath of two witnesses either both to the same overt act charged, or one to one overt act and the other to another overt act of the same treason. If two or more treasons of different kinds are charged on the same indictment, one witness to prove one treason and another to prove another are not sufficient for a lawful conviction. Persons charged with treason are not admitted to bail except by order of a secretary of state or by the High Court (k.b.d.) or a judge thereof in vacation (Indictable Offences Act 1848, s. 23). Witnesses for the defence are examined on oath and their attendance is secured in the same way as that of witnesses for the Crown (1695, 170).

Misprision of Treason.

Misprision of treason consists in the concealment or keeping secret of any high treason. (*a*) This offence was in 1552 declared to be high treason (5 and 6 Edw. VI. c. 11, s. 8), but the former law was restored in 1553–1554 (1 Mary st. i. c. 1 s.1; 1 & 2 Ph. and Mary c. 10, s.7). The definition is vague and the exact scope of the offence uncertain, but in strictness it does not include acts which in the case of felony would constitute an accessory after the fact. In the Queensland Code of 1899 (s. 38) every person is guilty of a crime who, knowing that any person intends to commit treason, does not give information thereof with all reasonable despatch to a justice or use other reasonable endeavours to prevent the commission of that crime. The procedure for the trial of misprision of treason is the same as in the case of high treason. The punishment is imprisonment for life and forfeiture of the offender's goods and of the profits of his lands during his life. (Steph. *Dig. Cr. Law*, 6th ed., 121, 401.) The forfeitures are not abolished by the Forfeitures Act 1870. There is no case of prosecution of this offence recorded during the last century.

Offences akin to Treason.

The necessity of prosecutions for treason has been greatly lessened by a series of statutes beginning in 1744 which provide for the punishment as felonies of certain acts which might fall within the definition of treason, *e.g.* piracies (1744, 18 Geo. II. c. 30), incitement to mutiny (1797), unlawful oaths, including oaths to commit treason (1797, 1812), and aiding the escape of prisoners of war (1812). By the Treason Act 1842 it is a high misdemeanour, punishable by penal servitude for seven years, wilfully to discharge, point, aim or present at the person of the king any gun or other arms, loaded or not, or to strike at or attempt to throw anything upon the king's person, or to produce any firearms or other arms, or any explosive or dangerous matter, near his person, with intent to injure or alarm him or to commit a breach of the peace.[6] The offence is one of the few for which flogging may be awarded.

By the Treason Felony Act 1848, s. 1., it was made a felony within or without the United Kingdom to plot (*a*) to deprive or depose the king from the style, &c., of the imperial crown of the United Kingdom, (*b*) to levy war against the king in any part of the United Kingdom in order by force or constraint to change his measures or counsels or to put force or constraint on or to intimidate or overawe either or both houses of parliament, (*c*) to move or stir any foreigner with force to invade the United Kingdom or any of the king's dominions. The plot to be within the act must be expressed by publishing in printing or writing or by an overt act or deed. "Open and advised speaking," originally included as an alternative, was removed from the act in 1891. For other offences more or less nearly connected with treason reference may be made to the articles: Libel; Oaths; Petition; Riot; Sedition.

The act of 1848 does not abrogate the Treason Act of 1351, but merely provides an alternative remedy. But with the exception of the case of Lynch in 1903, all prosecutions in England for offences of a treasonable character since 1848 have been for the felony created by the act of 1848. The trials under the act, mostly in Ireland, are collected in vols. 6, 7 and 8 of the *New Series of State Trials*. The procedure in the case of all the offences just noticed is governed by the ordinary rules as to the trial of indictable offences, and the accused may be convicted even though the evidence proves acts constituting high treason.

Scotland.—Treason included treason proper, or crimes against the Crown or the state, such as rebellion, and crimes which, though not technically treasonable, were by legislation punished as treason. Scottish procedure was as a rule less favourable to the accused than English. In one matter, however, the opposite was the case. Advocates compellable to act on behalf of the accused were allowed him by 1587, c. 57, more than a century before the concession of a similar indulgence in England. At one time trial in absence and even after death was allowed, as in Roman law. In the case of Robert Leslie, in 1540, a summons after death was held by the estates to be competent, and the bones of the deceased were exhumed and presented at the bar of the court.[7] The act of 1542, c. 13 (rep. 1906), confined this revolting procedure to certain treasons of the more heinous kind.

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[1] A case of treason out of the realm as to which alone the constable and marshal had jurisdiction (3 Howell's *St. Tr.* 1).

[2] See case of D. F. Marais (1902, App. Cas. 109).

[3] There is no trace of recourse to the act of 1552. In 1903 Arthur Lynch was tried under the act of 1543 for high treason in South Africa, and Lord Maguire in 1645 for treason in Ireland (4 *St. Tr.* 653).

[4] The decisions of courts of martial law appear not to be reviewable by ordinary civil courts (re Marais, 1907, App. Cas. 109).

[5] In these respects persons accused of treason are in a better position than those accused of felony.

[6] This act was passed in consequence of a series of assaults on Queen Victoria. See 4 *St. Tr. N. S.* 1382; 7 *St. Tr. N. S.* 1130, and 8 *St. Tr. N. S.* 1.

[7] In the one instance in England—that of Cromwell, Ireton and Bradshaw—where the bodies of alleged traitors were exhumed after death they were not brought to the bar of a court as in Scotland.

By the Treason Act 1708 trial in absence—the last instance of which had occurred in 1698—was abolished. The same act assimilates the law and practice of treason to that of England by enacting that no crime should be treason or misprision in Scotland but such as is treason or misprision in England. The act further provides for the finding of the indictment by a grand jury as in England and that the trial is to be by a jury of twelve, not fifteen as in other crimes, before the court of justiciary, or a commission of oyer and terminer containing at least three lords of justiciary. To slay a lord of justiciary or lord of session sitting in judgment, or to counterfeit the great seal, is made treason. The act also contains provisions as to forfeiture,[1] qualification of jurors and procedure, which are not affected by the Criminal Procedure (Scotland) Act 1887. The punishment is the same as it was in England before the Forfeitures Act 1870, which does not extend to Scotland; and attainder and forfeiture are still the effects of condemnation for treason in Scotland.

One or two other statutory provisions may be briefly noticed. By acts of 1706 and 1825 the trial of a peer of Great Britain or Scotland for treason committed in Scotland is to be by a commission from the Crown, on indictment found by a grand jury of twelve. Bail in treason-felony is only allowed by consent of the public prosecutor or warrant of the high or circuit court of justiciary (Treason Felony Act 1848, s. 9). The term *lese-majesty* was sometimes used for what was treason proper (*e.g.* in 1524, c. 4, making it lese-majesty to transport the king out of the realm, repealed in 1906), sometimes as a synonym of *leasing-making*. This crime (also called verbal sedition) consisted in the engendering discord between king and people by slander of the king.[2] The earliest act against leasing-making *eo nomine* was in 1524. The reign of James VI. was pre-eminently prolific in legislation against this crime. It is now of no practical interest, as prosecutions for leasing-making have long fallen into desuetude. At one time, however, the powers of the various acts were put into force with great severity, especially in the trial of the earl of Argyll in 1681. The punishment for leasing-making, once capital, is now, by acts of 1825 and 1837, fine or imprisonment or both.

Ireland.—The Treason Act 1351 was extended to Ireland by Poyning's law, but at the union there were considerable differences between the Irish and the English law. The law and practice of Ireland as to treason were assimilated to those of England by acts of 1821 (1 & 2 Geo. IV. c. 24), 1842 (5 & 6 Vict. c. 51), 1848 (11 & 12 Vict. c. 12, s. 2), and 1854 (17 & 18 Vict. c. 56).

Prior to 1854 the provisions as to procedure in the English treason acts did not apply to Ireland (Smith O'Brien's case, 1848, *7 St. Tr. N. S.* 1). A series of enactments called the "Whiteboy Acts" (passed by the Irish and the United Kingdom parliaments between 1775 and 1831) was intended to give additional facilities to the executive for the suppression of tumultuous risings, and powers for dealing with "dangerous associations" are given by the Criminal Law and Procedure (Ireland) Act 1887. Prosecutions for treason in Ireland were numerous in 1848. Since that date numerous prosecutions have taken place under the Treason Felony Act 1848.

British Possessions.—Numerous temporary acts were passed in India at the time of the Mutiny, one of the most characteristic being an act of 1858 making rebellious villages liable to confiscation. By the Indian Penal Code, s. 121, it is an offence punishable by death or transportation for life and by forfeiture of all property to wage or attempt to wage war against the king. By s. 125 it is an offence punishable by transportation for life (as a maximum) to wage or attempt to wage war against any Asiatic government in alliance or at peace with the king or to abet the waging of such war. By s. 121 A., added in 1870, it is an offence punishable by transportation for life (as a maximum) to conspire within or without British India to commit an offence against s. 121 or to deprive the king of the sovereignty of British India or of any part thereof, or to overawe by criminal force or the show of criminal force the government of India or any local government in India. Other cognate offences are included in the same chapter (vi.) of the Criminal Code.

The Penal Codes of Canada (1892, ss. 65–73) and New Zealand (1893, ss. 77–82) closely follow the provisions of the English draft code of 1879. Prosecutions for treason have been rare in Canada. Those of most note were in 1837, after the rebellion (see the Canadian Prisoners case, 1839, 9 Ad(olphus) El(les) [731]) and of Riel after the Red River rising in 1884 (see *Riel* v. *R.* 1885, 10 App. Cas. 675).

The Commonwealth parliament of Australia has not legislated on the subject of high treason, which is in Australia governed by the laws of the constituent states, *i.e.* by the law of England as it stood when they were colonized, subject to local legislation. In the codes of Queensland (1899) and West Australia (1902) the offence is defined in a form which is little more than a redrafting of the English statutes. The provisions of the Treason Felony Act 1848 have been adapted by legislation to New South Wales (1900), Queensland (1899), Western Australia (1902) and Tasmania (1868). In Victoria there is legislation as to procedure but none as to the substantive law of treason. In Mauritius the offence is regulated by the Penal Code of 1838, arts. 50–61 (*Mauritius Laws Revised*, 1903, i. 372).

In the Asiatic colonies treason is defined on the lines of the Indian Penal Code, *i.e.* Ceylon, Straits Settlements, and Hong-Kong.

In the West Indies the law of treason is defined by code in Jamaica and in British Guiana (the code superseding the Dutch Roman law).

In South Africa the law of treason is derived through Holland from the Roman law. It includes the *crimen perduellionis*, *i.e.* disturbing the security or independence of the state with hostile intent. This is spoken of as high treason, as distinct from the *crimen laesae majestatis*, in which the hostile intent need not be proved, and from *vis publica*, *i.e.* insurrection and riot involving danger to public peace and order. By a Cape law of 1853 passed during the Griqualand rebellion it is made treason to deliver arms or gunpowder to the king's enemies.

The Treason Felony Act 1848 was also adopted in Natal in 1868.

During the South African War of 1899–1902 many trials took place for treason, chiefly under martial law, including cases of British subjects who had joined the Boer forces. In some cases it was contended that the accused had been recognized by the British authorities as a belligerent (Louw, 1904, 21 Cape Supreme Court Reports, 36). The decisions of the ordinary courts are collected in Nathan, *Common Law of South Africa*, iv. 2425 (London, 1907). The decisions of courts-martial were not reviewable by the ordinary courts and are also protected by acts of indemnity. A striking feature of colonial legislation is the great number of such acts passed after rebellions and native risings. Instances of such acts occur in the legislation of Canada, Ceylon, the Cape of Good Hope, Natal, New Zealand, St Vincent and Jamaica. The most important in the history of law is the Jamaica Act of 1866, indemnifying Governor Eyre for any acts committed during the suppression of the rising in the previous year. It was finally held that this act protected Eyre from being civilly sued or criminally prosecuted in England for acts done during the outbreak (*Phillips* v. *Eyre*, 1871, *L. R.* 6 Q. B. 1). The validity of an act passed in 1906 after disturbances among the Kaffirs of Natal was unsuccessfully challenged in 1907 (Tilonko's case, 1907, App. Cas. 93).

United States.—The law is based upon that of England. By art. 3, s. 3 of the constitution "treason against the United States shall consist only in levying war against them, or in adhering to their enemies, giving them aid and comfort. No person shall be convicted of treason unless on the testimony of two witnesses to the same overt act, or on confession in open court. The Congress shall have power to declare the punishment of treason; but no attainder of treason shall work corruption of blood or forfeiture, except during the life of the person attainted." By art. 2, s. 4 impeachment for and conviction of treason is a ground for removing the president, vice-president and other civil officers. The punishment by an act of 1790 was declared to be death by hanging. But during the Civil War an act (July 17, 1862) was passed, providing that the punishment should be death, or, at the discretion of the court, imprisonment at hard labour for not less than five years, and a fine of not less than 10,000 dollars to be levied on the real and personal property of the offender, in addition to disability to hold any office under the United States. The act of 1862 and other acts also deal with the crimes of inciting or engaging in rebellion or insurrection, criminal correspondence with foreign governments in relation to any disputes or controversies with the United States, or to defeat the measures of the government of the United States, seditions, conspiracy, recruiting soldiers or sailors and enlistment to serve against the United States. The act of 1790 further provides for the delivery to the prisoner of a copy of the indictment and a list of the jurors, for defence by counsel, and for the finding of the indictment within three years after the commission of the treason (see Story, *Constitution of the United States*, Rev. Stat. U.S. p. 1041). Treason against the United States cannot be inquired into by any state court, but the states may, and some of them have, their own constitutions and legislation as to treasons committed against themselves, generally following the lines of the constitution and legislation of the United States. In some cases there are differences which are worth notice. Thus the constitution of Massachusetts, pt. 1, § 25, declares that no subject ought in any case or in any time to be declared guilty of treason by the legislature. The same provision is contained in the constitutions of Vermont, Connecticut, Pennsylvania, Alabama and others. In some states the crime of treason cannot be pardoned; in others, as in New York, it may be pardoned by the legislature, and the governor may suspend the sentence until the end of the session of the legislature next following conviction. In some states a person convicted of treason is disqualified for exercising the franchise. In New York conviction carries with it forfeiture of real estate for the life of the convict and of his goods and chattels.

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[1] The provisions in the act as to forfeiture (now repealed) were, according to Blackstone (*Comm.* iv. 384), the result of a compromise between the House of Lords, in favour of its continuance and the House of Commons, supported by the Scottish nation, struggling to secure a total immunity from this disability.

[2] It is called by Hallam "the old mystery of iniquity in Scots law."

France.—By the *Code Pénal* treason falls under the head of crimes against the safety of the state (bk. iii. tit. i. c. 1). It is a capital offence for a Frenchman to bear arms against France (s. 75) or to plot with a foreign power or its agents to commit hostilities or undertake war against France whether war follows or not (s. 76), or to intrigue with the enemies of the state for facilitating their entry into French territory, or to deliver to them French ships or fortresses, or to supply them with munitions of war, or aid the progress of their arms in French possessions or against French forces by sea or land (s. 78).

Germany.—The *Strafgesetzbuch* distinguishes between high treason (*Hochverrat*) and treason (*Landesverrat*). The offences denominated high treason are (1) murder or attempt to murder the emperor or a federal sovereign in his own state, or during the stay of the offender in the sovereign's state (s. 80); (2) undertaking to kill, take prisoner, or deliver into an enemy's power, or make incapable of government a federal sovereign; to change by violence the constitution of the empire or a state thereof or the successor to the throne therein; to incorporate by force the federal territory or the territory of any such state with a foreign or another federal state (s. 81). The code treats as treason, but does not punish by death, the offences included in the French code (ss. 87–89), and under certain circumstances punishes alien residents for these offences (s. 91). The code also punishes insults on the emperor and federal sovereigns (ss. 95, 97) under the name of *Majestätsbeleidigung.*

Italy.—Treason in the Penal Code 1888 (tit. i. c. 1) includes direct acts to subject Italy or any part thereof to foreign domination or to diminish its independence or break up its unity (s. 104), to bear arms against the state (s. 105)) or intrigue with foreign states with the object of their levying war against Italy or helping them in such war (s. 106), or to reveal political or military secrets affecting the national independence (s. 107).

Spain.—The Spanish code distinguishes between treason (*lesa majestad*) and rebellion (*rebelión*). Under the former are included assassination, or attempts on the life or personal liberty of the king (arts. 158, 159), or insults to the king (161, 162), and provisions are made as to attacks on the heir or consort of the sovereign (163, 164). Under rebellion are included violent attempts to dethrone the king or to interfere with the allegiance to him of his forces or any part of the realm (243). (W. F. C.)

TREASURE TROVE, the legal expression for coin, bullion, gold or silver articles, found (Fr. *trouvé*) hidden in the earth, for which no owner can be discovered. In Roman law it was called *thesaurus*, and defined as an ancient deposit of money (*vetus depositio pecuniae*) found accidentally. Under the emperors half went to the finder and half to the owner of the land, who might be the emperor, the public treasury (*fiscus*), or some other proprietor. Property found in the sea or on the earth has at no time been looked on as treasure trove. If the owner cannot be ascertained it becomes the property of the finder (see Lost Property). As the feudal system spread over Europe and the prince was looked on as the ultimate owner of all lands, his right to the treasure trove became, according to Grotius, *jus commune et quasi gentium*, in England, Germany, France, Spain and Denmark. In England for centuries the right to treasure trove has been in the Crown, who may grant it out as a franchise. It is the duty of the finder, and indeed of any one who acquires knowledge, to report the matter to the coroner, who must forthwith hold an inquest to find whether the discovery be treasure trove or no. Although the taking of the find is not larceny until this be done, the concealment is an indictable offence still punishable in practice, and formerly was held "akin both to treason and to larceny." In the statute *De officio coronatoris* 1276 (4 Edw. I. c. 2) the coroner is enjoined to inquire as to treasure trove both as to finders and suspected finders, "and that may be well perceived where one liveth riotously and have done so of long time." The Coroners Act of 1887 continues this power as heretofore. In Scotland the law is the same, but the concealment is not a criminal offence; it is there the duty of the king's and lord treasurer's remembrancer, with the aid of the local procurator fiscal, to secure any find for the Crown, whose rights in this respect have been pushed to some length. Thus in 1888 a prehistoric jet necklace and some other articles found in Forfarshire were claimed by the authorities, though they were neither gold nor silver. The matter was finally compromised by the deposit of the find in the National Museum. By a treasury order of 1886 provision is made for the preservation of suitable articles so found in the various national museums and payment to the finders of sums in respect of the same. Also if the things are not required for this purpose they are to be returned to the finder. In India the Treasure Trove Act (16 of 1878) makes elaborate provision on the subject. It defines treasure as "anything of value hidden in the soil." When treasure over Rs. 10 is discovered, the finder must inform the collector and deposit the treasure or give security for its custody. Concealment is a criminal offence. An inquiry is held upon notice; if declared ownerless the finder has three-fourths and the owner of the ground one-fourth. The government, however, has the right of pre-emption.

In the United States the common law, following English precedent, would seem to give treasure trove to the public treasury, but in practice the finder has been allowed to keep it. In Louisiana French codes have been followed, so that one-half goes to finder and one-half to owner of land. Modern French law is the same as this, as it is also in Germany, in Italy and in Spain. In the latter country formerly the state had three-quarters, whilst a quarter was given to the finder. In Austria a third goes to the finder, a third to the owner of the land, and a third to the state, and provision is made for the possible purchase of valuable antiquities by the state. In Denmark treasure trove is known as "treasure of Denmark," and is the property of the king alone. In Russia the usage varies. In one or two of the governments, in Poland and the Baltic provinces, the treasure is divided between the owner of the land and the finder, but throughout the rest of Russia it belongs exclusively to the owner of the land. This was also the law amongst the ancient Hebrews, or so Grotius infers from the parable of the treasure hid in a field (Matt. xiii. 44).

See Blackstone's *Commentaries*; Chitty's *Prerogatives of the Crown*; R. Henslowe Wellington, *The King's Coroner* (1905–1906); Rankine on *Landownership*; Murray, *Archaeological Survey of the United Kingdom* (1896), containing copious references to the literature of the subject. (F. Wa.)

TREASURY, a place for the storage of treasure (Fr. *trésor*, Lat. *thesaurus*, Gr. *θησαυρός*, store, hoard); also that department of a government which manages the public revenue. The head of the department was an important official in the early history of English institutions. He managed the king's hoard or treasury, and under the Med. Latin name of *thesaurarius*, *i.e.* treasurer, grew into increased importance in times when the main object of government seemed to be to fill the king's purse. He received the title of lord high treasurer (*q.v.*) and ranked as the third great officer of state. In course of time the English treasury grew into two departments of state (see Exchequer). Since 1714 the office of lord high treasurer has been in commission, and his duties have been administered by a board, consisting of a first lord, a chancellor and four or more junior lords. The board itself never meets, except on extraordinary occasions, although until the commencement of the 19th century it was its practice to meet almost daily to discuss matters of financial detail. There were originally separate treasury boards for England, Scotland and Ireland, but the English and Scottish were united by the act of union, and that of Ireland was joined with the English in 1816. The first lord of the treasury (see Ministry) takes practically no part in the duties of the board, the office being to all intents and purposes a sinecure, it is usually held by the prime minister of the day. Indeed from 1783 to 1885 it was invariably so held, but in the latter year there was a departure from the practice, and again in 1887, 1891 and 1895. The junior lords of the treasury are also political rather than financial officers, acting as assistant whips in the House of Commons. There are two joint secretaries to the treasury, one of whom, the patronage secretary, is merely a political officer, acting as chief whip, the other is termed financial secretary and is the chancellor of the exchequer's chief assistant. All the above officers are members of the House of Commons and of the government. The salaries of the first lord of the treasury and of the chancellor of the exchequer are £5000 per annum; of the joint secretaries £2000 per annum each, of three of the junior lords £1000 per annum each, the other junior lords being unpaid. The vast bulk of the work of the treasury department is performed by the permanent staff, at whose head is the permanent secretary and auditor of the civil list, with a salary of £2500 per annum. The chancellor of the exchequer (see MINISTRY), as finance minister of the Crown, is the officer who is responsible to parliament for the carrying out of the business of the treasury. He performs practically the ancient duties of under-treasurer and presents the annual budget of revenue and expenditure.

The treasury department of the United States is responsible for the finances of the government and the control of the currency. Its genesis was a treasury office of accounts established in 1776 for the purpose of examining and auditing accounts. In 1779 it was reorganized, but was abolished in 1781, on the election of Robert Morris as superintendent of finances, and in 1789 the present executive department of the treasury was established by act of Congress. Its scope is more varied and complex than that of any other United States government department. It is presided over by a secretary, who is a member of the cabinet and has a salary of $12,000 per annum. He is assisted by three assistant secretaries, two of them having salaries of $5000 and the third a salary of $4500. The treasury department looks after the revenue administration of the United States, and has for this purpose a customs service division and an internal revenue division. There is also the division of the treasury, in the strictest sense of the word; bureaus of auditing and accounting, of currency and of banking and certain miscellaneous bureaus, as the life-saving service, the public health and marine hospital service, the supervising architect and the bureau of engraving and printing.

TREATIES. A treaty is a contract between two or more states. The Latin term "tractatus," and its derivatives, though of occasional occurrence in this sense from the 13th century onwards, only began to be commonly so employed, in lieu of the older technical terms "conventio publica," or "foedus," from the end of the 17th century. In the language of modern diplomacy the term "treaty" is restricted to the more important international agreements, especially to those which are the work of a congress; while agreements dealing with subordinate questions are described by the more general term "convention." The present article will disregard this distinction.

The making and the observance of treaties is necessarily a very early phenomenon in the history of civilization, and the theory of treaties was one of the first departments of international law to attract attention. Treaties are recorded on the monuments of Egypt and Assyria; they occur in the Old Testament Scriptures; and questions arising under *συνθῆκαι* and *foedera* occupy much space in the Greek and Roman historians.[1]

Treaties have been classified on many principles, of which it will suffice to mention the more important. A "personal treaty," having reference to dynastic interests, is contrasted with a "real treaty," which binds the nation irrespectively of constitutional changes; treaties creating outstanding obligations are opposed to "transitory conventions," *e.g* for cession of territory, recognition of independence, and the like, which operate irrevocably once for all, leaving nothing more to be done by the contracting parties; and treaties in the nature of a definite transaction (*Rechtsgeschäft*) are opposed to those which aim at establishing a general rule of conduct (*Rechtssatz*). With reference to their objects, treaties may perhaps be conveniently classified as (1) political, including treaties of peace, of alliance, of cession, of boundary, for creation of international servitudes, of neutralization, of guarantee, for the submission of a controversy to arbitration; (2) commercial, including consular and fishery conventions, and slave trade and navigation treaties; (3) confederations for special social objects, such as the Zollverein, the Latin monetary union, and the still wider unions with reference to posts, telegraphs, submarine cables and weights and measures; (4) relating to criminal justice, *e.g.* to extradition and arrest of fugitive seamen; (5) relating to civil justice, *e.g.* to the protection of trade-mark and copyright, to the execution of foreign judgments, to the reception of evidence, and to actions by and against foreigners; (6) promulgating written rules of international law, upon topics previously governed, if at all, only by unwritten custom, with reference *e.g.* to the peaceful settlement of international disputes, or to the conduct of warfare.

Classification.

It must be remarked that it is not always possible to assign a treaty wholly to one or other of the above classes, since many treaties contain in combination clauses referable to several of them.

The analogy between treaty-making and legislation is striking when a congress agrees upon general principles which are afterwards accepted by a large number of states, as, for instance, in the case of the Geneva conventions for improving the treatment of the wounded. Many political treaties containing "transitory conventions," with reference to recognition, boundary or cession, become, as it were, the title-deeds of the nations to which they relate.[1] But the closest analogy of a treaty is to a contract in private law.

Requisites.

The making of a valid treaty implies several requisites. (1) It must be made between competent parties, *i.e.* sovereign states. A "concordat," to which the pope, as a spiritual authority, is one of the parties, is therefore not a treaty, nor is a convention between a state and an individual, nor a convention between the rulers of two states with reference to their private affairs. Semi-sovereign states, such as San Marino or Egypt, may make conventions upon topics within their limited competence. It was formally alleged that an infidel state could not be a party to a treaty. The question where the treaty-making power resides in a given state is answered by the municipal law of that state. In Great Britain it resides in the executive (see the parliamentary debates upon the cession of Heligoland in 1890), sometimes, however, it is shared for all purposes, as in the United States, or for certain purposes only, as in many countries of the European continent, by the legislature, or by a branch of it. (2) There must be an expression of agreement. This is not (as in private law) rendered voidable by duress; *e.g.* the cession of a province, though extorted by overwhelming force, is nevertheless unimpeachable. Duress to the individual negotiator would, however, vitiate the effect of his signature. (3) From the nature of the case, the agreement of states, other than those the government of which is autocratic, must be signified by means of agents, whose authority is either express, as in the case of plenipotentiaries, or implied, as in the case of *e.g.* military and naval commanders, for matters, such as truces, capitulations and cartels, which are necessarily confided to their discretion. When an agent acts in excess of his implied authority, he is said to make no treaty, but a mere "sponsion," which, unless adopted by his government, does not bind it, *e.g.* the affair of the Caudine Forks

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[1] For the celebrated treaty of 509 B.C. between Rome and Carthage, see Polybius iii. 22; and, on the subject generally, Barbeyrac's full but very uncritical *Histoire des anciens traités*, (1739); Müller-Jochmus, *Geschichte des Völkerrechts im Alterthum* (1848); E. Egger, *Études historiques sur les traités publics chez les grecs et chez les romains* (new ed., 1866).

[1] Cf. Sir Edward Hertslet's very useful collections entitled: *The Map of Europe by Treaty* (4 vols., 1875–1891), and *The Map of Africa by Treaty* (2 vols., 1894).

(Livy ix. 5) and the convention of Closter Seven in 1757. (4) Unlike a contract in private law, a treaty, even though made in pursuance of a full power, is, according to modern views, of no effect till it is ratified. It may be remarked that ratification, though hitherto not thought to be required for "declarations," such as the Declaration of Paris of 1856, was expressly stipulated for in the case of those signed at the peace conferences of 1899 and 1907. (5) No special form is necessary for a treaty, which in theory may be made without writing. It need not even appear on the face of it to be a contract between the parties, but may take the form of a joint declaration, or of an exchange of notes. Latin was at one time the language usually employed in treaties, and it continued to be so employed to a late date by the emperor and the pope. Treaties to which several European powers of different nationalities are parties are now usually drawn up in French (the use of which became general in the time of Louis XIV), but the treaties of Aix-la-Chapelle of 1748 and 1784 contain, as does the final act of the congress of Vienna, a protest against the use of this language being considered obligatory. French is, however, exclusively used in the treaties constituting the great "international unions"; and bilingual treaties are sometimes accompanied by a third version in French, to be decisive in case of alleged variances between the other two. A great European treaty has usually commenced "In the name of the Most Holy and Indivisible Trinity," or, when the Porte is a party, "In the name of Almighty God." (6) It is sometimes said that a treaty must have a lawful object, but the danger of accepting such a statement is apparent from the use which has been made of it by writers who deny the validity of any cession of national territory, or even go so far as to lay down, with Fiore, that "all should be regarded as void which are in any way opposed to the development of the free activity of a nation, or which hinder the exercise of its natural rights." (7) The making of a treaty is sometimes accompanied by acts intended to secure its better performance. The taking of oaths, the assigning of "conservatores pacis" and the giving of hostages are now obsolete, but revenue is mortgaged, territory is pledged, and treaties of guarantee are entered into for this purpose.

Duration.

A "transitory convention" operates at once, leaving no duties to be subsequently performed, but with reference to conventions of other kinds questions arise as to the duration of the obligation created by them; in other words, as to the moment at which those obligations come to an end. This may occur by the dissolution of one of the contracting states, by the object-matter of the agreement ceasing to exist, by full performance, by performance becoming impossible, by lapse of the time for which the agreement was made, by *contrarius consensus* or mutual release, by "denunciation" by one party under a power reserved in the treaty. By a breach on either side the treaty usually becomes, not void, but voidable. A further cause of the termination of treaty obligations is a total change of circumstances, since a clause "rebus sic stantibus" is said to be a tacit condition in every treaty.[1] Such a contention can only be very cautiously admitted. It has been put forward by Russia in justification of her repudiation of the clauses of the Treaty of Paris neutralizing the Black Sea, and of her engagements as to Batoum contained in the Treaty of Berlin. The London protocol of 1871, with a view to prevent such abuses, lays down, perhaps a little too broadly, "that it is an essential principle of the law of nations that no power can liberate itself from the engagements of a treaty, nor modify the stipulations thereof, unless with the consent of the contracting powers, by means of an amicable arrangement." Treaties are in most cases suspended, if not terminated, by the outbreak of a war between the contracting parties (though the Spanish decree of the 23rd of April 1898 went too far when it asserted that the war with the United States had terminated "all conventions that have been in force up to the present between the two countries"), and are therefore usually revived in express terms in the treaty of peace.

The rules for the interpretation of treaties are not so different from those applicable to contracts in private law as to need here a separate discussion.

Collections.

Collections of treaties are either (i.) general or (ii.) national.

i. The first to publish a general collection of treaties was Leibnitz, whose *Codex juris gentium*, containing documents from 1097 to 1497, "ea quae sola inter liberos populos legum sunt loco" appeared in 1693, and was followed in 1700 by the *Mantissa*. The *Corps universel diplomatique du droit des gens* of J. Dumont, continued by J. Barbeyrac and Rousset in thirteen folio volumes, containing treaties from A.D. 315 to 1730, was published in 1726–1739. Wenck's *Corpus juris gentium recentissimi* (3 vols. 8vo, 1781–1795) contains treaties from 1735 to 1772. The 8vo *Recueil* of G. F. de Martens, continued by C. de Martens, Saalfeld, Murhard, K. F. Samwer, K. Hopf, F. Stoerk and H. Triepel, commenced in 1791 with treaties of 1761, and is still in progress. The series in 1910 extended to eighty-eight volumes; that for 1910 being the third of the *Nouveau recueil général* (23me série). See also the *Recueil international des traités de xxe siècle* (1904, sqq.), by Descamps en Renault, and the following periodical publications. *Das Staatsarchiv, Sammlung der officiellen Actenstucke zur Geschichte der Gegenwart* (Leipzig, commencing in 1861); *Archives diplomatiques* (Stuttgart, since 1821); *Archives diplomatiques, recueil mensuel de diplomatie et d'histoire* (Paris, since 1861), and Hertslet's *British and Foreign State Papers, from the Termination of the War of 1814 to the Latest Period, compiled at the Foreign Office by the Librarian and Keeper of the Papers* (London, since 1819, and still in progress).

ii. The more important collections of national treaties are those of MM. Neumann and de Plasson from 1855, and of the commission for modern history from 1903, for Austria; Beutner for the German Empire, 1883; C. Calvo for "l'Amérique latine," 1862–1869; de Clercq for France, 1864–1908; De Garcia de la Vega for Belgium, 1850, &c., Lagemans and Breukelman for the Netherlands, 1858, &c.; Soutzo for Greece, 1858; Count Solar de la Marguerite for Sardinia, 1836–1861; Olivart for Spain, 1890, &c.; Da Castro for Portugal, 1856–1879, Rydberg for Sweden, 1877; Kaiser, 1861, and Eichmann, 1885, for Switzerland; Baron de Testa, 1864, &c., Aristarchi Bey 1873–1874, and Effendi Noradounghian, 1897–1903, for Turkey; F. de Martens for Russia (the 9 vols. published 1874–1907 contain the treaties made by Russia with Austria, Germany, Great Britain and France respectively); W. F. Mayers for China, 1877. The official publication for Italy begins in 1864 (see also the collection by Luigi Palma, 1879, &c.), for Spain in 1843, for Denmark in 1874. The treaties of Japan were published by authority in 1899. Those of the United States are contained in the *Statutes at Large* of the United States, and in the *Treaties, Conventions, etc., between the United States of America and Other Powers, 1776–1909* (Washington, 1910); also in the collections of J. Elliott (1834) and H. Minot (1844–1850); see also Mr Bancroft Davis's *Notes upon the Treaties of the United States with other Powers, preceded by a list of the Treaties and Conventions with Foreign Powers, chronologically arranged and followed by an Analytical Index and a Synoptical Index of the Treaties* (1873). In England no treaties were published before the 17th century, such matters being thought "not fit to be made vulgar." The treaty of 1604 with Spain was, however, published by authority, as were many of the treaties of the Stuart kings. Rymer's *Foedera* was published, under the orders of the government, in twenty volumes, from 1704 to 1732; but for methodical collections of the earlier British treaties we are indebted to private enterprise, which produced three volumes in 1710–1713, republished with a fourth volume in 1732. Other three volumes appeared in 1772–1781, the collection commonly known as that of C. Jenkinson (3 vols.) in 1785 and that of G. Chalmers (2 vols.) in 1795. The recent treaties made by Great Britain, previously dispersed through the numbers of the *London Gazette* or embedded in masses of diplomatic correspondence presented to parliament at irregular intervals, are now officially published as soon as ratified in a special 8vo. "Treaty Series" of parliamentary papers commenced in 1902. J. Macgregor published (1841–1844) eight volumes of commercial treaties, but the great collection of the commercial treaties of Great Britain is that of L. Hertslet, librarian of the foreign office, continued by his son, Sir Edward Hertslet, and later holders of the same office, entitled *A Complete Collection of the Treaties and Conventions and Reciprocal Regulations at present subsisting between Great Britain and Foreign Powers, and of the Laws and Orders in Council concerning the same, so far as they relate to Commerce and Navigation, the Slave Trade, Post Office, &c., and to the Privileges and Interests of the Subjects of the Contracting Parties* (24 vols., 1820–1907). Sir Edward Hertslet also commenced in 1875 a series of volumes containing *Treaties and Tariffs regulating the Trade between Britain and Foreign Nations, and Extracts of Treaties between Foreign Powers, containing the Most Favoured Nation Clauses applicable to Great Britain*. Both of these publications are still continued. He also published, in 1891, *Treaties, &c., concluded between Great Britain and Persia, and between Persia and Foreign Powers*, and, in 1896, a similar work on treaties with China. The treaties affecting British India are officially set out, with historical notes, in *A Collection of Treaties,*

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[1] Cf. Bynkershoek, *Quest. sur pub.* vol. ii. ch. 10.

Engagements and Sannuds relating to India and Neighbouring Countries, by C. V. Aitchison. This work, with the index, extends to eight volumes, which appeared at Calcutta in 1862–1866. A continuation by A. C. Talbot was published in 1876, and it was brought up to date by the government of India in 1909. Useful lists of national collections of treaties will be found in the *Revue de droit international* for 1886, pp. 169–187, and in the Marquis Olivart's *Catalogue de ma bibliothèque* (1899–1910).

List of Important Treaties.

It may be worth while to add a list of some of the more important treaties, now wholly or partially in force, some of which are discussed under separate headings, especially those to which Great Britain is a party, classified according to their objects, in the order suggested above.

i. The principal treaties affecting the distribution of territory between the various states of Central Europe are those of Westphalia (Osnabrück and Münster), 1648; Utrecht, 1713; Paris and Hubertusburg, 1763; for the partition of Poland, 1772, 1793; Vienna, 1815; London, for the separation of Belgium from the Netherlands, 1831, 1839; Zürich, for the cession of a portion of Lombardy to Sardinia, 1859; Vienna, as to Schleswig-Holstein, 1864; Prague, whereby the German Confederation was dissolved, Austria recognizing the new North German Confederation, transferring to Prussia her rights over Schleswig-Holstein, and ceding the remainder of Lombardy to Italy, 1866; Frankfort, between France and the new German Empire, 1871. The disintegration of the Ottoman Empire has been regulated by the Great Powers, or some of them, in the treaties of London, 1832, 1863, 1864, and of Constantinople, 1881, with reference to Greece, and by the treaties of Paris, 1856; London, 1871; Berlin, 1878; London, 1883, with reference to Montenegro, Rumania, Servia, Bulgaria and the navigation of the Danube. The encroachments of Russia upon Turkey, previous to the Crimean War, are registered in a series of treaties beginning with that of Kuchuk-Kainarji, 1774, and ending with that of Adrianople in 1829. The independence of the United States of America was acknowledged by Great Britain in the treaty of peace signed at Paris in 1783. The boundary between the United States and the British possessions is regulated in detail by the treaties of Washington of 1842, 1846, 1871, 1903 and 1908. The territorial results of the war of 1898 between the United States and Spain are registered in the treaty of 1899, and those of the Russo-Japanese War in the treaty of Portsmouth of 1905 Various causes of possible misunderstanding between Great Britain and France were removed by the convention of 1904; and a similar treaty was concluded with Russia in 1908. The navigation of the Suez Canal is regulated by a treaty of 1888, and that of the future Panama Canal by one of 1901. The boundaries of the territories, protectorates and spheres of influence in Africa of Great Britain, Germany, France, Italy, Belgium and Portugal have been readjusted by a series of treaties, especially between the years 1885 and 1894. Switzerland, Belgium, Corfu and Paxo and Luxemburg are respectively neutralized by the treaties of Vienna, 1815, and of London, 1839, 1864, 1867. A list of treaties of guarantee supposed to be then in force, to which Great Britain is a party, beginning with a treaty made with Portugal in 1373, was presented to parliament in 1859 Treaties of alliance were made between Great Britain and Japan in 1902 and 1905.

ii. For the innumerable conventions, to which Great Britain is a party, as to commerce, consular jurisdiction, fisheries and the slave trade, it must suffice to refer to the exhaustive and skilfully devised index to vols. 1–21 of Hertslet's *Commercial Treaties*, published in 1905 as vol. 22 of the series.

iii. The social intercourse of the world is facilitated by conventions, such as those establishing the Latin monetary union, 1865; the international telegraphic union, 1865; the universal postal union, 1874; the international bureau of weights and measures, 1875; providing for the protection of submarine cables in time of peace, 1884; the railway traffic union, 1890. Such treaties, now very numerous, are somewhat misleadingly spoken of by recent writers (L. von Stein and F de Martens) as constituting a "droit administratif international"

iv. For the now operative treaties of extradition to which Great Britain is a party, it will be sufficient to refer to the article EXTRADITION. It may be observed that all of them, except the treaty of 1842, now, however, varied by one of 1889, with the United States, are subsequent to, and governed by, the provisions of 33 & 34 Vict. c. 52, The Extradition Act 1870. Before the passing of this general act it had been necessary to pass a special act for giving effect to each treaty of extradition. The most complete collection of treaties of extradition is that of F. J. Kirchner, *L'Extradition, Recueil, &c.* (London, 1883).

v. General conventions, to which most of the European states are parties, were signed in 1883 at Paris for the protection of industrial, and in 1886 at Bern for the protection of literary and artistic, property, and, from 1899 onwards, a series of general treaties, to none of which is Great Britain a party, have been signed at the Hague, as the result of conferences, invited by the government of the Netherlands, for solving some of the more pressing questions arising out of "the conflict of laws."

vi. Quasi-legislation by treaty has been directed mainly to encouraging the settlement of international disputes by peaceful methods, and to regulating the conduct of warfare.

The first peace conference, held at the Hague in 1899, devoted much time to producing the generally accepted "Convention for the Pacific Settlement of International Disputes." An important achievement of this convention was the establishment at the Hague of an international tribunal, always ready to arbitrate upon cases submitted to it; and the convention recommended recourse not only to arbitration, but also to good offices and mediation, and to international commissions of inquiry. This convention has now been superseded by the revised and amplified edition of it adopted by the second peace conference in 1907. The provisions of neither convention are obligatory, but merely "facultative," amounting only to recommendations. Great efforts were made, especially in 1907, but without success, to draft a generally acceptable convention, making resort to arbitration compulsory, at any rate with reference to certain classes of questions. In the meantime, however, agreements of this nature between one power and another have multiplied rapidly within the last few years (see ARBITRATION).

Certain bodies of rules intended to mitigate the horrors of war have received the adhesion of most civilized states. Thus the declaration of Paris, 1856 (to which, however, the United States, Venezuela and Bolivia have not yet formally acceded), prohibits the use of privateers and protects the commerce of neutrals; the Geneva conventions, 1864 and 1906, give protection to the wounded and to those in attendance upon them; the St Petersburg declaration, 1868, prohibits the employment of explosive bullets weighing less than 400 grammes; and the three Hague declarations of 1899 prohibit respectively (1) the launching of projectiles from balloons, (2) the use of projectiles for spreading harmful gases, and (3) the use of expanding bullets. The second Hague conference, of 1907, besides revising the convention made by the first conference, of 1899, as to the laws of war on land, produced new conventions, dealing respectively with the opening of hostilities, neutral rights and duties in land warfare; the status of enemy merchant ships at the outbreak of war; the conversion of merchant ships into ships of war; submarine mines; bombardment by naval forces; the application of the Geneva principles to naval warfare; the rights of maritime capture; the establishment of an international prize court, and neutral rights and duties in maritime warfare. These conventions, as well as a republication of the first Hague declaration, which had in 1907 expired by efflux of time, have been already largely ratified.

It were greatly to be wished that the official publication of treaties could be rendered more speedy and more methodical than it now is. The labours of the publicist would also be much lightened were it possible to consolidate the various general collections of diplomatic acts into a new *Corps diplomatique universel*, well furnished with cross references, and with brief annotations showing how far each treaty is supposed to be still in force.

Literature.—In addition to the works already cited in the course of this article the following are for various reasons important

Joh. Lupus, *De confederatione principum* (Strassburg, 1511, the first published monograph upon the subject); Bodinus, *Dissertatio de contractibus summarum potestatum* (Halle, 1696), Neyron, *De vi foederum inter gentes* (Göttingen, 1778), Neyron, *Essai historique et politique sur les garanties, &c.* (Gottingen, 1797), Wachter, *De modis tollendi pacta inter gentes* (Stuttgart, 1780), Dresch, *Ueber die Dauer der Volkervertrage* (Landshut, 1808), C. Bergbohm, *Staatsverträge und Gesetze als Quellen des Volkerrechts* (Dorpat, 1877); Jellinek, *Die rechtliche Natur der Statenvertrage* (Vienna, 1880); D. Donati, *Trattati internazionali nel diritto costituzionale* (1907); Holzendorff, *Handbuch des Volkerrechts* (1887) vol. iii., Fleischmann, *Völkerrechtsquellen in Auswahl herausgegeben* (1905), de Lapradelle, *Recueil des arbitrages internationaux* (1905); J. B. Moore, *History and Digest of the International Arbitrations to which the United States has been a Party* (1898) 6 vols. For a list of the principal "concordats," see Calvo, *Droit international théorique et pratique* t. i On the history of the great European treaties generally, see the *Histoire abrégée des traités de paix entre les puissances de l'Europe*, by Koch, as recast and continued by Scholl (1817 and 1818), and again by Count de Garden in 1848–1859, as also the *Recueil manuel* of De Martens and Cussy, continued by Geffcken. For the peace of Westphalia, Putter's *Geist des westphalischen Friedens* (1795) is useful; for the congress of Vienna Klüber's *Acten des Wiener Congresses* (1815–1819) and *Le Congrés de Vienne et les traités de 1815 précédé des conférences de Dresde, de Prague et de Chatillon, suivi des Congres d'Aix-la-Chapelle, Troppau, Laybach et Vérone*, by Count Angeberg. The last-mentioned writer has also published collections of treaties relating to Poland, 1762–1862; to the Italian question, 1859; to the Congress of Paris, 1856 and the revision of its work by the Conference of London, 1871; and to the Franco-German War of 1870–71. For the treaties regulating the Eastern question see *The European Concert in the Eastern Question*, by T. E. Holland (1885) and *La Turquie et le Tanzimat*, by E. Engelhardt (1882–1884). (T. E. H.)

TREATISE, a written composition, dealing fully and systematically with the principles of some subject of serious importance. The M. Eng. *tretis*, O. Fr. *tretis*, or *treitis*, is a doublet of "treaty," which also meant a discourse or account. Both words are to be referred to Lat. *tractare*, to treat, handle, frequentative of *trahere*, *tractus*, to draw. "Treatise" thus would mean, by etymology, something well handled, nicely made.

TREBIA (mod. *Trebbia*), a river of Cisalpine Gaul, a tributary of the Padus (Po) into which it falls some 4 m. west of Placentia (Piacenza). It is remarkable for the victory gained on its banks by Hannibal over the Romans in 218 B.C. The latest investigations make it clear that Polybius's account, according to which the battle took place on the left bank of the river, is to be preferred to that of Livy (see W. J. Kromayer in *Anzeiger der phil. hist. Klasse der k. Akademie der Wissenschaften*, Vienna, October 14, 1908). Its valley is followed past Bobbio by the modern highroad from Piacenza to Genoa (88 m.).

TREBINJE, a town of Herzegovina, situated 9 m. N.E. of Ragusa, on the small river Trebinjčica, and on a branch of the railway from Metkovic to Castelnuovo, near Cattaro. Pop. (1895), about 1700. Trebinje is built in a low-lying oasis among the desolate limestone mountains, close to the Dalmatian and Montenegrin frontiers. Its half-ruined wall and citadel testify to its former strategic importance. Trebinje was built by the Slavs, probably on the site of a Roman town laid waste by the Saracens in 840. In the tenth century Constantine Porphyrogenitus mentions it as *Terbunia*. It commanded the road from Ragusa to Constantinople, traversed, in 1096, by Raymond of Toulouse and his crusaders. Under the name of Tribunia or Travunja (the *Trebigne* of the Ragusans), it belonged to the Servian Empire until 1355. In 1483 it was captured by the Turks.

TREBIZOND (Gr. *Trapezus*), a city of Asia Minor, situated on the Black Sea, near its south-eastern angle. From the time of its foundation as a Greek colony to the present day it has always been a considerable emporium of commerce, and it was for two centuries and a half the capital of an empire. Its importance is due to its command of the point where the chief trade route from Persia and Central Asia to Europe, over the table-land of Armenia by Bayezid and Erzerum, descends to the sea. Its safety also was secured by the barrier of rugged mountains (7000 to 8000 ft.) which separates its district from the rest of Asia Minor. So complete is the watershed that no streams pass through these ranges, and there is hardly any communication in this direction between the interior of Asia Minor and the coast. For the same reason, together with its northern aspect, the climate is humid and temperate, unlike that of the inland regions, which are exposed to great extremes of heat in summer and cold in winter. The position which was occupied by the Hellenic and medieval city is a sloping table of ground (whence the original name of the place, Trapezus, the "Table-land"), which falls in steep rocky precipices on the two sides, where two deep valleys, descending from the interior, run parallel at no great distance from one another down to the sea. The whole is still enclosed by the Byzantine walls, which follow the line of the cliffs and are carried along the sea-face, and the upper part of the level, which is separated from the lower by an inner cross wall, forms the castle; while at the highest point, where a sort of neck is formed between the two valleys, is the keep which crowns the whole. On each side, about half-way between the keep and the sea, these ravines are crossed by massive bridges, and on the farther side of the westernmost of these, away from the city, a large tower and other fortifications remain. The area of the ancient city is now called the Kaleh, and is inhabited by the Turks; eastward of this is the extensive Christian quarter, and beyond this again a low promontory juts northward into the sea, partly covered with the houses of a well-built suburb, which is the principal centre of commerce. The harbour lies on the eastern side of this promontory, but it is an unsafe roadstead, being unprotected towards the north-east and having been much silted up, so that vessels cannot approach within a considerable distance of the shore. From here the caravans start for Persia, and at certain periods of the year long trains of camels may be seen, and Persian merchants conspicuous by their high black caps and long robes. The route which these caravans follow is a *chaussée* as far as Erzerum, but this in places is too much broken to admit of the transit of wheeled vehicles. The railway by Batoum to Baku by way of Tiflis has tended greatly to turn the channel of commerce from Trebizond into Russian territory, since it helps to open the route to Erivan, Tabriz and the whole of Persia. The total population of the place amounts to about 40,000, of whom 22,000 are Moslems and 18,000 Christians. Great Britain and all the larger European states have consulates there.

The vilayet, of which Trebizond is the chief town, consists of a long irregular strip of coast country, the eastern half of which is deeply indented and mountainous.

History.—The city of Trapezus was a colony of Sinope, but it first comes into notice at the time of the Retreat of the Ten Thousand, who found repose there. Notwithstanding its commercial importance, the remoteness of its position prevented it from being much known to fame either in the Hellenic or the early medieval period; its greatness dates from the time of the fourth crusade (1204), when the Byzantine Empire was dismembered and its capital occupied by the Latins. During the confusion that followed that event Alexius Comnenus escaped into Asia, and, having collected an army of Iberian mercenaries, entered Trebizond, where he was acknowledged as the legitimate sovereign, and assumed the title of Grand Comnenus. Though only twenty-two years of age, Alexius was a man of ability and resolute will, and he succeeded without difficulty in making himself master of the greater part of the southern coast of the Black Sea. The empire thus founded continued to exist until 1461, when the city was taken by Mahommed II. The cause of this long duration, and at the same time the secret of its history, is to be found in the isolated position of Trebizond and its district, between the mountains and the sea, which has already been described. By this means it was able to defy both the Seljuks and the Ottomans, and to maintain its independence against the emperors of Nicaea and Constantinople. But for the same reason its policy was always narrow, so that it never exercised any beneficial influence on the world at large. It was chiefly in the way of matrimonial alliances that it was brought into contact with other states. The imperial family were renowned for their beauty, and the princesses of this race were sought as brides by Byzantine emperors of the dynasty of the Palaeologi, by Western nobles, and by Mahommedan princes; and the connexions thus formed originated a variety of diplomatic relations and friendly or offensive alliances. The palace of Trebizond was famed for its magnificence, the court for its luxury and elaborate ceremonial, while at the same time it was frequently a hotbed of intrigue and immorality. The Grand Comneni were also patrons of art and learning, and in consequence of this Trebizond was resorted to by many eminent men, by whose agency the library of the palace was provided with valuable manuscripts and the city was adorned with splendid buildings. The writers of the time speak with enthusiasm of its lofty towers, of the churches and monasteries in the suburbs, and especially of the gardens, orchards and olive groves. It excited the admiration of Gonzales Clavijo, the Spanish envoy, when he passed through it on his way to visit the court of Timur at Samarkand (Clavijo, *Historia del gran Tamorlan*, p. 84); and Cardinal Bessarion, who was a native of the place, in the latter part of his life, when the city had passed into the hands of the Mahommedans, and he was himself a dignitary of the Roman Church, so little forgot the impression it had made upon him that he wrote a work entitled "The Praise of Trebizond" (Ἐγκώμιον Τραπεζοῦντος), which exists in manuscript at Venice. Little was known of the history of the empire of Trebizond until the subject was taken in hand by Professor Fallmerayer of Munich, who discovered the chronicle of Michael Panaretus among the books of Cardinal Bessarion, and from that work, and other sources of information which were chiefly unknown up to that time, compiled his *Geschichte des Kaiserthums von Trapezunt* (Munich, 1827). From time to time the emperors of Trebizond paid tribute to the Seljuk sultans of Iconium, to the grand khans of the Mongols, to Timur the Tatar, to the Turkoman chieftains, and to the Ottomans; but by means of skilful negotiations they were enabled practically to secure their independence. We find them also at war with many of these powers, and with the Genoese, who endeavoured to monopolize the commerce of the Black Sea. The city was several times besieged, the most formidable attack being that which occurred in the reign of Andronicus I., the second emperor, when the Seljuks, under the command of Melik, the son of the great sultan Ala-ed-din, first assaulted the northern wall in the direction of the sea, and afterwards endeavoured to storm the upper citadel by night. They failed, however, in both attempts; and in the latter, owing to the darkness, and to the occurrence of a violent storm which suddenly swelled the torrents in the ravines, their force was thrown into inextricable confusion, and they were compelled to abandon their camp and make the best of their escape from the country. So great was the strength of the fortifications that Mahommed II. might have experienced much difficulty in reducing it, had it not been for the pusillanimous conduct of David, the last emperor, who surrendered the place almost unconditionally.

Ancient Memorials.—Several interesting monuments of this period remain at Trebizond in the form of churches in the Byzantine style of architecture. One of these is within the area of the old city, viz. the church of the Panaghia Chrysokephalos, or Virgin of the Golden Head, a large and massive but excessively plain building, which is now the Orta-hissar mosque. On the farther side of the eastern ravine stands a smaller but very well proportioned structure, the church of St Eugenius, the patron saint of Trebizond, now the Yeni Djuma djami, or New Friday mosque. Still more important is the church of Haghia Sophia, which occupies a conspicuous position overlooking the sea, about 2 m. west of the city. The porches of this are handsomely ornamented, and about 100 ft. from it rises a tall campanile, the inner walls of which have been covered in parts with frescoes of religious subjects, though these are now much defaced. But the most remarkable memorial of the middle ages that exists in all this district is the monastery of Sumelas, which is situated about 25 m. from Trebizond, at the side of a rocky glen, at a height of 4000 ft. above the sea. Its position is most extraordinary, for it occupies a cavern in the middle of the face of a perpendicular cliff 1000 ft. high, where the white buildings offer a marked contrast to the brown rock which forms their setting. It is approached by a zigzag path at the side of the cliff, from which a flight of stone steps and a wooden staircase give access to the monastery. The valley below is filled with the richest vegetation, the undergrowth being largely composed of azaleas and rhododendrons. An antiquity of 1500 years is claimed for the foundation of the monastery, but it is certain that the first person who raised it to importance was the emperor Alexius Comnenus III. of Trebizond; he rebuilt it in 1360, and richly endowed it. The golden bull of that emperor, which became thenceforth the charter of its foundation, is still preserved; it is one of the finest specimens of such documents, and contains portraits of Alexius himself and his queen. The monastery also possesses the firman of Mahommed II. by which he accorded his protection to the monks when he became master of the country.

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TREBLE (a doublet of "triple," three-fold, from Lat. *triplus*, triple; cf. "double" from *duplus*), the term applied, in music, to the high or acute part of the musical system, as opposed to and distinguished from the "bass," the lower or grave part. The middle C is the practical division between the parts. The word is also used as equivalent to the "soprano" voice, the highest pitch or range of the human voice, but generally it is confined to a boy's voice of this quality, "soprano" being used of the corresponding female voice. The treble-clef is the G-clef on the second line. The origin of this application of the term "treble," *triplus*, threefold, to the highest voice or part is due to the fact that in the early plain-song the chief melody was given to the tenor, the second part to the alto (*discantus*) and where a third part (*triplum*) was added it was assigned to the highest voice, the soprano or treble.

TRÉBUCHET, a medieval siege engine, employed either to batter masonry or to throw projectiles over walls. It was developed from the post-classical Roman *onager* (wild ass), which derived its name from the kicking action of the machine. It consisted of a frame placed on the ground to which a vertical frame of solid timber was rigidly fixed at its front end; through the vertical frame ran an axle, which had a single stout spoke. On the extremity of the spoke was a cup to receive the projectile. In action the spoke was forced down, against the tension of twisted ropes or other springs, by a windlass, and then suddenly released. The spoke thus kicked the crosspiece of the vertical frame, and the projectile at its extreme end was shot forward. In the trébuchet the means of propulsion was a counter-weight. The axle which was near the top of a high strutted vertical frame served as the bridge of a balance, the shorter arm of which carried the counter-weight and the longer arm the carrier for the shot. An alternative name for the trébuchet is the mangonel (*mangonneau*).

TREBULA, the name of five ancient towns in Italy. (1) TREBULA in Samnium, a town of the Caraceni, on the left bank of the Sangro, some 20 m. below Castel di Sangro; the church of the Madonna degli Spineti near Quadri marks the site. It appears to have been a *municipium*, but we only know of its existence in Hadrian's time. (2) TREBULA in Campania, between Saticula and Suessula. The site is probably identical with the hills bearing the modern name Tripaola (about 1000 ft. above sea level) above the entrance to the valley of Maddaloni. It is possibly this Trebula the citizens of which received Latin rights in 303 B.C. Its territory extended as far as the Via Appia, and its place was taken in imperial times by the Vicus Novanensis, on the road itself, near Suessula. (3) TREBULA BALLIENSIS (mod. Treglia), also in Campania, 22 m. north of Capua, in the mountains, about 1000 ft. above sea-level. It revolted to Hannibal and was reduced to obedience by Fabius. Remains of walls, aqueduct and tombs exist. Its territory was mentioned in the projected distributions of land in Cicero's time; and its wine was well thought of under Nero. It was a *municipium*. (4) TREBULA MUTUESCA in the Sabine country, 2 m.

east of the point where the Via Caecilia diverges from the Via Salaria. It lies about 1 m. south-west of the modern Monteleone, and an amphitheatre and other remains are visible. In a dedication made there by the consul Mummius in 146 B.C. it is spoken of as a *vicus*, but when the *praefecturae* were abolished it became a *municipium*. The post station of Vicus Novus on the Via Salaria (mod. Osteria Li Massacci) belonged to its territory (see N. Persichetti in *Römische Mitteilungen*, 1898, p. 193). (5) Trebula Suffenas is generally placed 6 m. south of Reate (mod. *Rieti*) on the Via Quinctia, but is with considerable probability identified with Ciciliano, 10 m. east of Tivoli, 2030 ft. above sea-level, by Q. Cuntz (*Jahreshefte des oesterr. arch. Instituts*, 1899, ii. 89), who combines the evidence of inscriptions and of the description in Martial (v. 71), with a new interpretation of the *Itineraries*. There are remains of an ancient road, with substructures in rough polygonal work ascending to it in zigzags. (T. As.)

TREDEGAR, an urban district in the western parliamentary division of Monmouthshire, England, on the Sirhowy river, 24 m. north of Cardiff, on a joint line of the London & North-Western and the Rhymney railways. Pop. (1901), 18,497. It stands at an elevation of about 1000 ft., and owes its existence to the establishment in the beginning of the 19th century of the works of the Tredegar Iron and Coal Company, which employ most of the large industrial population. The place gave the title of Baron Tredegar (*c.* 1859) to Sir Charles Morgan Robinson Morgan, Bart. (1792–1875), whose grandfather, Sir Charles Gould, Bart., married the heiress of John Morgan of Tredegar and changed his name to Morgan. He was M.P. for Brecknock in 1835–1847. He married a granddaughter of the 1st Lord Rodney. His son Godfrey (b. 1830), who succeeded to the barony, was created Viscount Tredegar in 1905; he had served in the Crimea and taken part in the famous Balaclava charge.

TREDGOLD, THOMAS (1788–1829), English engineer, was born at Brandon, near Durham, on the 22nd of August 1788, and at the age of fourteen was apprenticed to a carpenter. In 1808 he went to Scotland, and after working there as a journeyman for five years, obtained employment in London with an architect. He began to practice as a civil engineer on his own account in 1823, but much of his time was devoted to the preparation of his engineering text-books, which gained a wide reputation. They included *Elementary Principles of Carpentry* (1820), almost the first book of its kind in English; *Practical Treatise on the Strength of Cast Iron and other Metals* (1824); *Principles of Warming and Ventilating Public Buildings* (1824); *Practical Treatise on Railroads and Carriages* (1825); and *The Steam Engine* (1827). He died in London on the 28th of January 1829.

TREE, SIR HERBERT BEERBOHM (1853–), English actor and manager, was born in London, on the 17th of December 1853, the son of Julius Beerbohm, a London merchant of German parentage; his half-brother, Max Beerbohm (b. 1872), became well known as a dramatic critic, a miscellaneous writer and caricaturist. Taking the stage name of Beerbohm Tree he made his first professional appearance in London in 1876. After some years of varied experience he made a striking success in 1884 as the curate in *The Private Secretary*, but he was making himself well known meanwhile in dramatic circles as an admirable actor in many rôles. In September 1887 he became lessee and manager of the Haymarket theatre, London, where his representations of melodramatic "character" parts, as in *Jim the Penman*, *The Red Lamp*, and *A Man's Shadow*, were highly successful. His varied talents as an actor were displayed, however, not only in a number of modern dramas, such as H. A. Jones's *Dancing Girl*, but also in romantic parts such as Gringoire, and in the production of so essentially a literary play as Henley's *Beau Austin*; and in classic parts his ability as a comedian was shown in *The Merry Wives of Windsor*, in which he played Falstaff, and as a tragedian in *Hamlet*; his presentations of Shakespeare were notable too as carrying forward the methods of realistic staging inaugurated at the Lyceum under Irving. In 1897 Mr Tree moved to the new Her Majesty's (afterwards His Majesty's) theatre, opening with Gilbert Parker's *Seats of the Mighty*; but his chief successes were in Stephen Phillips's poetical dramas, and in his splendid revivals of Shakespeare (especially *Richard II.* and the *Merchant of Venice*). The magnificence of the mounting, the originality and research shown in the "business" of his productions, and his own versatility in so many different types of character, made his management memorable in the history of the London stage; and on the death of Sir Henry Irving he was generally recognized as the leader in his profession. His wife (Maud Holt), an accomplished actress, and their daughter Viola, were also prominently associated with him. In 1907 he took his company to Berlin at the invitation of the German emperor, and gave a selection from his *répertoire* with great success. In the same year he established a school of dramatic art, for the training of actors, in London; and in this and other ways he was prominent in forwarding the interests of the stage. He was knighted in 1909.

TREE (O. Eng. *trēo*, *treow*, cf. Dan. *trae*, Swed. *träd*, tree, *trä*, timber; allied forms are found in Russ. *drevo*, Gr. δρῦς, oak, and δόρυ, spear, Welsh *derw*, Irish *darog*, oak, and Skr. *dāru*, wood), the term, applied in a wide sense, to all plants which grow with a permanent single woody stem or trunk of some height, branching out at some distance from the ground. There is a somewhat vague dividing line, in popular nomenclature, between "shrubs" and "trees," the former term being usually applied to plants with several stems, of lower height, and bushy in growth. The various species to which the name "tree" can be given are treated under their individual titles, *e.g.* oak, ash, elm, &c.; the articles Fir and Pine treat of two large groups of conifers; general information is provided by the articles Plants and Gymnosperms; tree cultivation will be found under Forests and Forestry and Horticulture; and the various types of tree whose wood is useful for practical purposes under Timber. Apart from this general meaning of the word, the chief transferred use is that for a piece of wood used for various specific purposes, as a framework, bar, &c., such as the tree of a saddle, axle-tree, cross-tree, &c.

TREE-CREEPER, one of the smallest of British birds, and, regard being had to its requirements, one very generally distributed. It is the *Certhia familiaris* of ornithology, and is remarkable for the stiffened shafts of its long and pointed tail-feathers, aided by which, and by its comparatively large feet, it climbs the trunks or branches of trees, invariably proceeding upwards or outwards and generally in a spiral direction, as it seeks the small insects that are hidden in the bark and form its chief food. When in the course of its search it nears the end of a branch or the top of a trunk, it flits to another, always alighting lower down than the place it has left, and so continues its work. Inconspicuous in colour—for its upper plumage is mostly of various shades of brown mottled with white, buff and tawny, and beneath it is of a silvery white—the tree-creeper is far more common than the incurious suppose; but, attention once drawn to it, it can be frequently seen and at times heard, for though a shy singer its song is loud and sweet. The nest is neat, generally placed in a chink formed by a half-detached piece of bark, which secures it from observation, and a considerable mass of material is commonly used to stuff up the opening and give a sure foundation for the tiny cup, in which are laid from six to nine eggs of a translucent white, spotted or blotched with rust-colour.

The tree-creeper inhabits almost the whole of Europe as well as Algeria and has been traced across Asia to Japan. It is now recognized as an inhabitant of the greater part of North America, though for a time examples from that part of the world, which differed slightly in the tinge of the plumage, were accounted a distinct species (*C. americana*) and even those from Mexico and Guatemala (*C. mexicana*) have lately been referred to the same. It therefore occupies an area not exceeded in extent by that of many passerine birds and is one of the strongest witnesses to the close alliance of the so-called Nearctic and Palaearctic regions.

Allied to the tree-creeper, but without its lengthened and stiff tail-feathers, is the genus *Tichodroma*, the single member of which is the wall-creeper (*T. muraria*) of the Alps and some other mountainous parts of Europe and Asia. It is occasionally seen in Switzerland, fluttering like a big butterfly against the face of a rock conspicuous from the scarlet-crimson of its wing-coverts and its white spotted primaries. Its bright hue is hardly visible when the bird is at rest, and it then presents a dingy appearance of grey and black. It is a species of wide range, extending from Spain to China; and, though but seldom leaving its cliffs, it has wandered even so far as England. Merrett (*Pinax*, p. 177) in 1667 included it as a British bird, and the correspondence between Marsham and Gilbert White (*Proc. Norf. and Norw. Nat. Society*, ii. 180) proves that an example was shot in Norfolk, on the 30th of October 1792; while another is reported (*Zoologist*, 2nd series, p. 4839) to have been killed in Lancashire on the 8th of May 1872.

The passerine family Certhiidae contains a number of genera of birds to which the general name "creeper" is applied; they occur in North America, Europe and Asia, the greater part of Africa, and Australia and New Guinea. (A. N.)

TREE-FERN. In old and well-grown specimens of some of the familiar ferns of temperate climates the wide-spreading crown of fronds may be observed to rise at a distance often of a good many inches above the ground, and from a stem of considerable thickness. The common male fern *Lastraea* (*Filix-mas*) affords the commonest instance of this; higher and thicker trunks are, however, occasionally presented by the royal fern (*Osmunda regalis*), in which a height of 2 ft. may be attained, and this with very considerable apparent thickness, due, however, to the origin and descent of a new series of adventitious roots from the bases of each annual set of fronds. Some tropical members and allies of these genera become more distinctly tree-like, *e.g. Todea*; *Pteris* also has some sub-arboreal forms. *Oleandra* is branched and shrub-like, while *Angiopteris* and *Marattia* may also rise to 2 ft. or more. But the tree-ferns proper are practically included within the family Cyatheaceae. This includes seven genera (*Cyathea, Alsophila, Hemitelia, Dicksonia, Thyrsopteris, Cibotium* and *Balantium*) and nearly 300 species, of which a few are herbaceous, but the majority arboreal and palm-like, reaching frequently a height of 50 ft. or more, *Alsophila excelsa* of Norfolk Island having sometimes measured 60 to 80 ft. The fronds are rarely simple or simply pinnate, but usually tripinnate or decompound, and may attain a length of 20 ft., thus forming a splendid crown of foliage. The stem may occasionally branch into many crowns.

The genera are of wide geographical range, mostly within the tropics; but South Australia, New Zealand, and the southern Pacific islands all possess their tree-ferns. In Tasmania *Alsophila australis* has been found up to the snow-level, and in the humid and mountainous regions of the tropics tree-ferns are also found to range up to a considerable altitude. The fronds may either contribute to the apparent thickness of the stem by leaving more or less of their bases, which become hardened and persistent, or they may be articulated to the stem and fall off, leaving characteristic scars in spiral series upon the stem. The stem is frequently much increased in apparent thickness by the downgrowth of aerial roots, forming a black coating several inches or even a foot in thickness, but its essential structure differs little in principle from that familiar in the rhizome of the common bracken (*Pteris*). To the ring or rather netted cylinder of fibrovascular bundles characteristic of all fernstems scattered internal as well as external bundles arising from these are superadded and in a tree-fern the outer bundles give off branches to the descending roots from the region where they pass into the leaves.

Tree-ferns are cultivated for their beauty alone; a few, however, are of some economic applications, chiefly as sources of starch. Thus the beautiful *Alsophila excelsa* of Norfolk Island is said to be threatened with extinction for the sake of its sago-like pith, which is greedily eaten by hogs; *Cyathea medullaris* also furnishes a kind of sago to the natives of New Zealand, Queensland and the Pacific islands. A Javanese species of *Dicksonia* (*D. chrysotricha*) furnishes silky hairs, which have been imported as a styptic, and the long silky or rather woolly hairs, so abundant on the stem and frond-leaves in the various species of *Cibotium* have not only been put to a similar use, but in the Sandwich Islands furnish wool for stuffing mattresses and cushions, which was formerly an article of export. The "Tartarian lamb," or *Agnus scythicus* of old travellers' tales in China and Tartary, is simply the woolly stock of *Cibotium Barometz*, which, when dried and inverted, with all save four of its frond-stalks cut away, has a droll resemblance to a toy sheep.

TREE FROG. Many different groups of tailless Batrachians (see FROG) are adapted to arboreal life, which is indicated by expansions of the tips of the fingers and toes, adhesive disks which assist the animal in climbing on vertical smooth surfaces. These disks do not act as suckers, but adhere by rapid and intense pressure of the distal phalanx and special muscles upon the lower surface, which is also provided with numerous glands producing a viscous secretion.

The best-known tree frog is the little *Hyla arborea* of continental Europe, *rainette* of the French, *Laubfrosch* of the Germans, often kept in glass cylinders provided with a ladder, which the frog is supposed to ascend or descend in prevision of the weather. But recent experiments conducted on scientific principles show that not much reliance can be placed on its prophecies. This frog is one of the smallest of European Batrachians, rarely reaching 2 in. in length; its upper parts are smooth and shiny, normally of a bright grass-green, which may change rapidly to yellow, brown, olive or black; some specimens, deprived of the yellow pigment which contributes to form the green colour, are sky-blue or turquoise blue; the lower parts are granulate and white.

The family Hylidae, of which the European tree frog is the type, is closely related to the Bufonidae or true roads, being distinguished from them by the presence of teeth in the upper jaw and by the claw-like shape of the terminal phalanx of the digits. It is a large family, represented by about three hundred species, two hundred and fifty of which belong to the genus *Hyla*, distributed over Europe, temperate Asia, North Africa, North and South America, Papua and Australia. Close allies of *Hyla* are the *Nototrema* of Central and South America, in which the female develops a dorsal broad pouch in which the young undergo part or the whole of their metamorphoses. The genus *Phyllomedusa*, also from Central and South America, are quadrumanous; the inner finger and the toe being opposable to the others, and the foot being very similar to the hand. These frogs deposit their spawn between the leaves of branches overhanging water, into which the tadpoles drop and spend their larval life.

TREE KANGAROO, any individual of the diprotodont marsupial genus *Dendrolagus* (see MARSUPIALIA). Three species are inhabitants of New Guinea and the fourth is found in North Queensland. They differ greatly from all other members of the family (Macropodidae), being chiefly arboreal in their habits, and feeding on bark, leaves and fruit. Their hinder limbs are shorter than in the true kangaroos, and their fore limbs are longer and more robust, and have very strong curved and pointed claws. The best-known species, Lumholtz' tree kangaroo (*Dendrolagus lumholtzi*), is found in North Queensland. It was named by Professor Collett in honour of its discoverer, who described it as living on the highest parts of the mountains, in the densest scrub and most inaccessible places. It is hunted by the blacks with trained dingoes; the flesh is much prized by the blacks, but the presence of a worm between the muscles and the skin renders it less inviting to Europeans.

TREE-SHREW, any of the arboreal insectivorous mammals of the genus *Tupaia*. There are about a dozen species, widely distributed over the east. There is a general resemblance to squirrels. The species differ chiefly in the size and in colour and length of the fur. Nearly all have long bushy tails. Their food consists of insects and fruit, which they usually seek for in the trees. When feeding they often sit on their haunches, holding the food, after the manner of squirrels, between their fore paws. The pen-tailed tree-shrew (*Ptilocercus lowi*), from Borneo, Sumatra and the Malay Peninsula, is the second generic representative of the family Tupaiidae. The head and body, clothed in blackish-brown fur, are about 6 in. long; the tail, still longer, is black, scaled and sparsely haired for the upper two-thirds, while the lower third is fringed on each side with long hairs, mostly white. One shrew from Borneo and a second from the Philippines have been referred to a separate genus under the name *Urogale everetti* and *U. cylindrura*, on account of their uniformly short-haired, in place of varied, tails. (See INSECTIVORA.)

TREE-WORSHIP. Primitive man, observing the growth and death of trees, the elasticity of their branches, the sensitiveness and the annual decay and revival of their foliage, anticipated in his own way the tendency of modern science to lessen the gulf between the animal and the vegetable world. When sober Greek philosophers (Aristotle, Plutarch) thought that trees had perceptions, passions and reason, less profound thinkers may be excused for ascribing to them human conceptions and supernatural powers, and for entertaining beliefs which were entirely rational and logical from primitive points of view. These beliefs were part of a small stock of fundamental ideas into which scientific knowledge of causation did not enter, ideas which persist in one form or another over a large portion of the world, and have even found a place in the higher religions, inevitably conditioned as these positive faiths are by the soil upon which they flourish.[1] In fact, the evidence for tree-worship is almost unmanageably large, and since comparative studies do not as yet permit a concise and conclusive synopsis of the subject, this article will confine itself to some of the more prominent characteristics.

Trees and Human Life.

Numerous popular stories reflect a firmly rooted belief in an intimate connexion between a human being and a tree, plant or flower. Sometimes a man's life depends upon the tree and suffers when it withers or is injured, and we encounter the idea of the *external soul*, already found in the Egyptian "Tale of the Two Brothers" of at least 3000 years ago. Here one of the brothers leaves his heart on the top of the flower of the acacia and falls dead when it is cut down. Sometimes, however, the tree is an *index*, a mysterious token which shows its sympathy with an absent hero by weakening or dying, as the man becomes ill or loses his life. These two features very easily combine, and they agree in representing a—to us—mysterious sympathy between tree- and human-life, which, as a matter of fact, frequently manifests itself in recorded beliefs and customs of historical times.[2] Thus, sometimes the new-born child is associated with a newly planted tree with which its life is supposed to be bound up; or, on ceremonial occasions (betrothal, marriage, ascent to the throne), a personal relationship of this kind is instituted by planting trees, upon the fortunes of which the career of the individual depends. Sometimes, moreover, boughs or plants are selected and the individual draws omens of life and death from the fate of his or her choice. Again, a man will put himself into relationship with a tree by depositing upon it something which has been in the closest contact with himself (hair, clothing, &c.). This is not so unusual as might appear; there are numerous examples of the conviction that a sympathetic relationship continues to subsist between things which have once been connected (*e.g.* a man and his hair), and this may be illustrated especially in magical practices upon material objects which are supposed to affect the former owner.[3] We have to start then with the recognition that the notion of a real inter-connexion between human life and trees has never presented any difficulty to primitive minds.

The custom of transferring disease or sickness from men to trees is well known.[4] Sometimes the hair, nails, clothing, &c., of a sickly person are fixed to a tree, or they are forcibly inserted in a hole in the trunk, or the tree is split and the patient passes through the aperture. Where the tree has been thus injured, its recovery and that of the patient are often associated. Different explanations may be found of such customs which naturally take rather different forms among peoples in different grades of civilization. Much depends upon the theory of illness. In India, for example, when the patient is supposed to be tormented by a demon, ceremonies are performed to provide it with a tree where it will dwell peacefully without molesting the patient so long as the tree is left unharmed.[5] Such ideas do not enter, of course, when the rite merely removes the illness and selfishly endangers the health of those who may approach the tree.[6] Again, sometimes it is clearly felt that the man's personality has been mystically united with some healthy and sturdy tree, and in this case we may often presume that such trees already possessed some peculiar reputation. The custom finds an analogy when hair, nail-clippings, &c., are hung upon a tree for safety's sake lest they fall into the hands of an enemy who might injure the owner by means of them.

Veneration of Trees.

In almost every part of the world travellers have observed the custom of hanging objects upon trees in order to establish some sort of a relationship between the offerer and the tree. Such trees not infrequently adjoin a well or are accompanied by sacred buildings, pillars, &c. Throughout Europe, also, a mass of evidence has been collected testifying to the lengthy persistence of "superstitious" practices and beliefs concerning them. The trees are known as the scenes of pilgrimages, ritual ambulation, and the recital of (Christian) prayers. Wreaths, ribbons or rags are suspended to win favour for sick men or cattle, or merely for "good luck." Popular belief associates the sites with healing, bewitching, or mere "wishing"; and though now perhaps the tree is the object only of some vague respect, there are abundant allusions to the earlier vitality of coherent and systematic cults.[7] Decayed or fragmentary though the features may be in Europe, modern observers have found in other parts of the world more organic examples which enable us, not necessarily to reconstruct the fragments which have survived in the higher religions and civilizations, but at least to understand their earlier significance. In India, for example, the Korwas hang rags on the trees which form the shrines of the village-gods. In Nebraska the object of the custom was to propitiate the supernatural beings and to procure good weather and hunting. In South America Darwin recorded a tree honoured by numerous offerings (rags, meat, cigars, &c.); libations were made to it, and horses were sacrificed.[8] If, in this instance, the Gauchos regarded the tree, not as the embodiment or abode of Walleechu, but as the very god himself, this is a subtle but very important transference of thought, the failure to realize which has not been confined to those who have venerated trees.

Embody Spirits.

Among the Arabs the sacred trees are haunted by angels or by *jinn*; sacrifices are made, and the sick who sleep beneath them receive prescriptions in their dreams. Here, as frequently elsewhere, it is dangerous to pull a bough. This dread of damaging special trees is familiar: Cato instructed the woodman to sacrifice to the male or female deity before thinning a grove (*De re rustica*, 139), while in the Homeric poem to Aphrodite the tree nymph is wounded when the tree is injured, and dies when the trunk falls.[9] Early Buddhism decided that trees had neither mind nor feeling and might lawfully be cut; but it recognized that certain spirits might reside in them, and this the modern natives of India firmly believe. Propitiation is made before the sacrilegious axe is laid to the holy trees; loss of life or of wealth and the failure of rain are feared should they be wantonly cut; and there are even trees which it is dangerous to climb.[10] The Talein of Burma prays to the tree before he cuts it down, and the African woodman will place a fresh sprig upon the stump as a new home for the spirit. In the Gold Coast the silk-cotton and odum (poison) trees are especially sacred as the abode of the two deities, who are honoured by sacrifices—even of human victims; these indwelt trees must not be cut, and, since all trees of these species are under their protection, they can be felled only after certain purificatory ceremonies.[1] In general the evidence shows that sacred trees must not be injured unless they (*i.e.* their spirits) have been appeased, or means taken to provide the occupant with another abode. That the difference between the sacred *object* and the sacred *occupant* was not always clearly drawn is quite intelligible from those beliefs of much less rudimentary religions which confuse the unessential with the essential.

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[1] In this as in other subjects of comparative religion (see SERPENT-WORSHIP), the comparative and historical aspects of the problems should not be severed from psychology, which investigates the actual mental processes themselves. A naive rationalism or intellectualism which would ridicule or deplore the modern retention of "primitive" ideas has to reckon with the psychology of the modern average mental constitution; a more critical and more sympathetic attitude may recognize in religious and in other forms of belief and custom the necessary consequences of a continuous development linking together the highest and the lowest conceptions of life.

[2] See the evidence collected by E. S. Hartland, *The Legend of Perseus* (1894–1896), ii.; J. G. Frazer, *The Golden Bough* (1900), iii. 351 sqq., 391; and in general, A. E. Crawley, *The Idea of the Soul* (1909).

[3] There appears to be a fundamental confusion of association, likeness and identity, which on psychological grounds is quite intelligible. It is appropriate to notice the custom of injuring an enemy by simply beating a tree-stump over which his *name* had previously been pronounced (A.B. Ellis, *The Ewe-speaking Peoples of the Slave Coast of West Africa*, 1890, p. 98). The folk-lore of the "*name*" is widespread and of great antiquity, and certain features of it show that a thing (individual or object) and its name were not easily disconnected, and that what affected the one affected the other. In this case, by pronouncing the name the tree-stump for all intents and purposes became the enemy.

[4] Hartland ii. 142 sqq.; Frazer, iii. 26 sqq.

[5] W. Crooke, *The Popular Religion and Folk-lore of Northern India* (1896), ii. 92 sqq.; cf. p. 96, where the demon, the cause of sterility, is removed to trees.

[6] Cf. E. B. Tylor, *Primitive Culture* (1903), ii. 149 seq., G. L. Gomme, *Ethnology in Folk-lore* (1892), 141 seq.

[7] Hartland ii. 175 sqq.; Gomme, pp. 85, 94 seq., 102 sqq., and the literature at the end of this article.

[8] Tylor ii. 223 seq.

[9] See generally Frazer i. 170 sqq., Tylor i. 475 sqq., ii. 219 seq. For the survival of the idea of modern Greece, see J. C. Lawson, *Modern Greek Folk-lore* (1910), p. 158 seq.

[10] Crooke ii. 77, 87, 99 sqq.

Again, when the jungle-races of India clear the forests, they leave behind certain trees which are carefully protected lest the sylvan gods should abandon the locality (Crooke ii. 90). These trees embody the local deities much in the same way as the north European homestead had a tree or a small grove for the guardian-spirit or "lord of the home," and they resemble the tree tutelary genius of old German villages and the Japanese trees which are the terrestrial dwelling-places of the guardian of the hamlets.[2] Such beliefs as these are more significant when trees are associated with the spirits of the dead. Trees were planted around graves in Greece, and in Roman thought groves were associated with the *manes* of the pious. The Baduyas of the central provinces of India worship the souls of their ancestors in groves of Sāj trees, and this may be supplemented by various modern burial usages where the dead are buried in trees, or where the sacred tree of the village enshrines the souls of the dead forefathers. Thus among the natives of South Nigeria each village has a big tree into which the spirits of the dead are supposed to enter; when a woman wants a child or when a man is sick, sacrifice is made to it, and if the "Big God" Osòwo who lives in the sky is favourable the request is granted.[3]

Forms of Cult.

Often the tree is famous for oracles. Best known, perhaps, is the oak of Dodona tended by priests who slept on the ground. The tall oaks of the old Prussians were inhabited by gods who gave responses, and so numerous are the examples that the old Hebrew "terebinth of the teacher" (Gen. xii. 6), and the "terebinth of the diviners" (Judg. ix. 37) may reasonably be placed in this category. Important sacred trees are also the object of pilgrimage, one of the most noteworthy being the branch of the Bo tree at Ceylon brought thither before the Christian era.[4] The tree-spirits will hold sway over the surrounding forest or district, and the animals in the locality are often sacred and must not be harmed. Thus, the pigeons at the grove of Dodona, and the beasts around the north European tree-sanctuaries, were left untouched, even as the modern Dyak would allow no interference with the snake by the side of the bush which enshrined a dead kinsman.[5] Sacred fires burned before the Lithuanian Perkuno and the Roman Jupiter; both deities were closely associated with the oak, and, indeed, the oak seems to have been very commonly used for the perpetual holy fires of the Aryans.[6] The powers of the tree-deities, though often especially connected with the elements, are not necessarily restricted, and the sacred trees can form the centre of religious, and sometimes, also, of national life. Such deities are not abstract beings, but are potent and immediate, and the cultus is primarily as utilitarian as the duties of life itself. They may have their proper ministrants· (*a*) the chief sanctuary of the old Prussians was a holy oak around which lived priests and a high priest known as "God's mouth"; (*b*) in Africa there are sacred groves into which the priest alone may enter, and (*c*) among the Kissil-Bashi (or Kizilbashes) of the Upper Tigris and Euphrates, the holy tree of the village stands in an enclosure to which only the father-priest has access.[7] The trees may be the scene of religious festivals, and—what sometimes goes with these—of periodical fairs and markets. Among the Lousiade group in British New Guinea the religious feasts are held under the sacred tree and a portion is laid aside for the spirit-occupants. That the invisible spirit naturally enjoyed only the *spiritual* part of the offerings is a belief which may have been shared by others than the African negro.[8] Human sacrifice is known on the Slave Coast and in the Punjab; it was practised among the Druids, and at Odin's grave at Upsala. It is also said that the pollution of old Prussian sacred groves and springs by the intrusion of Christians was atoned for by human victims. Indeed, to judge from later popular custom and tradition, and from the allusion in ancient writers, various grisly rites and acts of licentiousness (such as the more advanced Hebrew prophets denounced) were by no means unusual features in the cults of trees and vegetation.[9]

Forms of Development.

Although trees have played so prominent a part in the history of religions, the utmost caution is necessary in any attempt to estimate the significance of isolated evidence and its relation to the contemporary thought. Let it suffice to notice that in West Equatorial Africa the death of the sacred tree near the temples leads to the abandonment of the village, that in Rome the withering of the sacred fig-tree of Romulus in the Forum caused the greatest consternation. One can now understand in some measure why so much importance should be attached to a venerated tree, but these examples will illustrate the different historical and religious conditions which require study in any investigation of tree-worship. Unfortunately one constantly reaches the point where the ancient writer or the modern observer has failed to record the required information. Moreover, we do not encounter tree-cults at their rise: in every case we arrest the evidence at a certain stage of development. It is often impossible to determine why certain trees are sacred; sometimes it may be that the solitary tree is the survivor of a forest or grove, or it has attracted attention from its curious or uncanny form, or again it stands on a spot which has an immemorial reputation for sanctity. The persistence of sacred localities is often to be observed in the East, where more rudimentary forms of tree-cults stand by the side of or outlive higher types of religion.[10] The evolution of sacred trees and of religious beliefs and practices associated therewith have not always proceeded along parallel lines. As ideas advanced, the spirits associated with trees were represented by posts, idols, or masks; altars were added, and the trunk was roughly shaped to represent the superhuman occupant. There is reason to believe that the last-mentioned transformation has frequently happened in the development of iconography. Indeed, the natives of the Antilles suppose that certain trees instructed sorcerers to shape their trunks into idols, and to instal them in temple-huts where they could be worshipped and could inspire their priests with oracles.[11]

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[1] A. B. Ellis, *op. cit.* pp. 49 sqq.; cf. further Frazer i. 180, 182 sqq.

[2] Tylor ii. 225; H. M. Chadwick, "The Oak and the Thunder-god," *Journ. of the Anthrop. Inst.* (1900), pp. 30, 32, 43.

[3] C. Partridge, *The Cross River Natives* (1904), p. 273, cf. further Crooke ii. 85, 91; Tylor ii. 10 seq.; Frazer i. 178 sqq.; J. G. Forlong, *Faiths of Man*, iii. 446.

[4] Tylor ii. 218, and for other examples, pp. 224, 226; W. R. Smith, *Religion of the Semites* (1894), p. 185.

[5] Frazer i. 179, cf. 230.

[6] Ibid. 168; see his *Lectures on the Early History of the Kingship* (1905), pp. 209, 281.

[7] (*a*) Chadwick 32; (*b*) Tylor ii. 224; (*c*) *The Standard*, Sept. 19, 1904. For an African tree-god with priesthood and "wives," see Ellis, *op. cit.* p. 50.

[8] Tylor ii. 216 (citing Waitz, *Anthrop.* ii. 188).

[9] See *Golden Bough*, i. 171 seq.; Lucan, *Phar.* iii. 405; P. H. Mallet, *Northern Antiquities*, i. 113. Chadwick 32; and, for the survivals, *Golden Bough* iii. 345.

[10] So in Asia Minor where a tree hung with rags stands by a rock with an ancient "Hittite" representation of the god of vegetation (W. M. Ramsay, *The Expositor*, Nov., 1906, p. 461 seq.). "Hittite" religion has long passed away, but the locality preserves its sacred character and presents a form of cult older than the "Hittite" civilization itself (cf also the persistence of the veneration of trees in Palestine in spite of some four thousand years of history). There has not been a reversion to ancient forms of cult in their organic entirety, but with the weakening and loss of the positive influences in the course of history, there has been no progression, and the communities live in simpler conditions and at a simpler stage of mental evolution and they are "childlike" rather than "senile" or "decadent."

[11] Tylor, ii. 216. Here one may observe: (*a*) the virtues of the tree as a whole will be retained—as in the case of the relic of a medieval saint—in any part of it (cf. ibid. 217; the offshoots of the oak of

The development of the beliefs relating to the spirit-occupants themselves would take us along quite another line of inquiry. When the tree-spirit was conceived to be of human shape the numerous stories which associate trees with men or deities of flesh and blood would easily arise; and just as Indian natives have gods which are supposed to dwell in trees, so in higher religions we find a Zeus or a Dionysus *Endendros*, gods, "occupants of trees," who have been identified with one or other of the leading members of a recognized pantheon.[1]

Later Vicissitudes.

The vicissitudes of the old tree-spirits are influenced by the circumstances of history. Syrian writers speak of a "king of the forest" and of a tall olive tree to the worship of which Satan seduced the people. But these "trees of the demons" were hewn down by zealous Syrian Christians. So also the caliph Omar cut down the tree at Ḥodaibaya visited by pilgrims, lest it should be worshipped, and the Council of Nantes (A.D. 895) expressly enjoined the destruction of trees which were consecrated to demons. Tradition has preserved some recollections of the overthrow of tree-cult in Europe. Bonifacius destroyed the great oak of Jupiter at Geismar in Hesse, and built of the wood a chapel to St Peter. (A similar continuity was maintained near Hebron when Constantine destroyed the idols and altars beneath the oak or terebinth of Abraham at Mamre and replaced them by a basilica.) On the Heinzenberg near Zell the Chapel of Our Lady stands where the old tree uttered its complaint as the woodman cut it down; and at Kildare (*cilldara*, church of the oak), "Saint" Brigit or Bridget built her church under an oak tree.[2] On the other hand, at Samosata, the sacred tree worshipped in Christian times, was honoured as the wood of Christ's cross, and this growth of a new tradition to justify or at least to modify an old survival recurs in Palestine where the holy trees, whether adjoining a venerated tomb or not, are often connected with the names of saints or prophets and sometimes with appropriate traditions.

It is impossible to do more than indicate the outlines of an intricate subject which concerns the course of certain fundamental ideas, their particular development so far as trees are concerned, and the more accidental factors which have influenced these two lines within historical times. Several important aspects have been inevitably ignored, *e.g.* the marriage of trees and tree-spirits, the annual festivals at the growth and decay of vegetation, and the evidence for the association of prominent deities with tree-spirits. For these features and for other general information see especially the works of J. G. Frazer (*Golden Bough*; *Lectures on Kingship*; *Adonis, Attis and Osiris*; *Totemism and Exogamy*), other literature cited in the course of this article, and the numerous works dealing with primitive religious and other customs. Among the most useful monographs are those of C. Boetticher, *Der Baumkultus d. Hellenen* (1856); W. Mannhardt, *Der Baumkultus der Germanen und ihrer Nachbarstämme* (1875), *Antike Wald- und Feldkulte* (1877), and, for introductory study, Mrs J. H. Philpot, *The Sacred Tree, or the Tree in Religion and Myth* (1897). (S. A. C.)

TREFOIL (Lat. *trifolium*, three-leaved plant, Fr. *trèfle*, Ger. *Dreiblatt* and *Dreiblattbogen*), the term in Gothic architecture given to the ornamental foliation or cusping introduced in the heads of window-lights, tracery, panellings, &c., in which the centre takes the form of a three-lobed leaf, one of the earliest examples being in the plate tracery at Winchester (1222–1235); see QUATREFOIL.

TREGELLES, SAMUEL PRIDEAUX (1813–1875), English theologian, was born at Wodehouse Place, near Falmouth, on the 30th of January 1813. His parents were Quakers, and he himself for many years was in communion with the (Darbyite) Plymouth Brethren, but afterwards became a Presbyterian. For a while he worked at the ironworks, Neath Abbey Glamorgan, and then set up as a private tutor in Falmouth, finally devoting himself to a laborious student life, until he was incapacitated by paralysis in 1870. He received the LL.D. degree from St Andrews and a pension of £200 from the civil list. He died at Plymouth on the 24th of April 1875.

Most of his numerous publications had reference to his great critical edition of the New Testament (1857–1872; see BIBLE; *New Testament, Textual Criticism*). They include an *Account of the Printed Text of the Greek New Testament* (1854), a new edition of T. H. Horne's *Introduction* (1860), and *Canon Muratorianus; Earliest Catalogue of Books of the New Testament* (1868). As early as 1844 he published an edition of the Book of the Revelation, with the Greek text so revised as to rest almost entirely upon ancient evidence. Tregelles wrote *Heads of Hebrew Grammar* (1852), translated Gesenius's *Hebrew Lexicon*, and was the author of a little work on the *Jansenists* (1851) and of various works in exposition of his special eschatological views (*Remarks on the Prophetic Visions of Daniel*, 1852, new ed., 1864).

TRÉGUIER, a port of western France, in the department of Côtes-du-Nord, 36 m. N.W. of St Brieuc by road. Pop. (1906). 2605. The port is situated about 5½ m. from the English Channel at the confluence of two streams that form the Tréguier river; it carries on fishing and a coasting and small foreign trade. The cathedral, remarkable in having three towers over the transept, one of which is surmounted by a fine spire, dates from the 14th and 15th centuries. It contains the sumptuous modern mausoleum of St Yves (d. 1303), a canon of the cathedral, the building of which was largely due to him. To the south of the church there is a cloister (latter half of the 15th century) with graceful arcades. There is a statue of Ernest Renan, a native of the town. Saw-milling, boat-building and flax-stripping are carried on, together with trade in cereals, cloth, potatoes, &c.

Tréguier (*Trecorum*), which dates from the 6th century, grew up round a monastery founded by St Tugdual. In the 9th century it became the seat of a bishopric, suppressed in 1790.

TREILHARD, JEAN BAPTISTE (1742–1810), French revolutionist, was born at Brives (Corrèze). In Paris he gained reputation as an avocat at the parlement, and was a deputy to the states-general in 1789. In the Constituent Assembly he showed great capacity in dealing with the reorganization of the Church and the nationalization of ecclesiastical property. Ineligible, like all the members of the Constituent Assembly, for the Legislative Assembly, he became president of the criminal tribunal of Paris, but failed through lack of firmness. The department of Seine-et-Oise elected him to the Convention, where he attached himself to the group known as the Mountain (*q.v.*) and voted for the death of Louis XVI. He was a member of the committee of public safety, and became president of the Convention on the 27th of December 1792. Under the Directory he entered the Council of the Five Hundred (of which he was president during the month of Nivose, year IV.), was a member of the Tribunal of Cassation, plenipotentiary at the Congress of Rastatt, and became a director in the year VI. After the *coup d'état* of 18 Brumaire he became president of the tribunal of appeal and councillor of state. He took an important part in drafting the civil code, the criminal code, the code of civil procedure and the commercial code. He died on the 1st of December 1810, a senator and count of the empire.

See Bonnal de Ganges, "Représentants du peuple dignitaires par Napoléon . . . Treilhard," in the *Revue du monde catholique* (7th series, vol. iii., 1900); Guyot d'Amfreville, *Vie de J. B. Treilhard* (Limoges, 1879).

TREITSCHKE, HEINRICH VON (1834–1896), German historian and political writer, was born at Dresden on the 15th of September 1834. He was the son of an officer in the Saxon army who rose to be governor of Königstein and military governor of Dresden. Young Treitschke was prevented by deafness from entering the public service. After studying at Leipzig and Bonn, where he was a pupil of Dahlmann, he established himself as a *privatdozent* at Leipzig, lecturing on history and politics. He at once became very popular with the students, but his political opinions made it impossible for the Saxon government to appoint him to a professorship. He was at that

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Dodona; the sacred oak of which the Argo was built); also (*b*) it was believed that the divine essence could be made to enter—transubstantiated as it were—into an image (cf. Rameses II. and his idols; see Breasted, *Egypt. Hist. Doc.* iii. 179, note; and for analogies see *Folk-Lore*, viii. 325).

[1] Even the Hebrews knew of the good-will of "Him who dwelt in the bush" (Deut. xxxiii. 16). For ideas associating Yahweh (Jehovah) with trees, see J. G. Frazer, *Anthrop. Essays to E. B. Tylor* (1907), p. 125 seq.

[2] See Chadwick 33, 35; Frazer, *Lectures*, 225; and Hartland ii. 181, 184 (who refers to the tree-worship taken over by St Maree and St Etto). Even the temples of Dodona and of Jupiter Capitolinus stood on the sites of older tree-worship.

time a strong Liberal; he hoped to see Germany united into a single state with a parliamentary government, and that all the smaller states would be swept away. In 1863 he was appointed professor at Freiburg; in 1866, at the outbreak of war, his sympathies with Prussia were so strong that he went to Berlin, became a Prussian subject, and was appointed editor of the *Preussische Jahrbücher*. A violent article, in which he demanded the annexation of Hanover and Saxony, and attacked with great bitterness the Saxon royal house, led to an estrangement from his father, who enjoyed the warm friendship of the king. It was only equalled in its ill humour by his attacks on Bavaria in 1870. After holding appointments at Kiel and Heidelberg, he was in 1874 made professor at Berlin; he had already in 1871 become a member of the Reichstag, and from that time till his death in 1896 he was one of the most prominent figures in the city. On Sybel's death he succeeded him as editor of the *Historische Zeitschrift*. He had outgrown his early Liberalism and become the chief panegyrist of the house of Hohenzollern. He did more than any one to mould the minds of the rising generation, and he carried them with him even in his violent attacks on all opinions and all parties which appeared in any way to be injurious to the rising power of Germany. He supported the government in its attempts to subdue by legislation the Socialists, Poles and Catholics; and he was one of the few men of eminence who gave the sanction of his name to the attacks on the Jews which began in 1878. As a strong advocate of colonial expansion he was also a bitter enemy of Great Britain, and he was to a large extent responsible for the anti-British feeling of German Chauvinism during the last years of the 19th century. In the Reichstag he had originally been a member of the National Liberal party, but in 1879 he was the first to accept the new commercial policy of Bismarck, and in his later years he joined the Moderate Conservatives, but his deafness prevented him from taking a prominent part in debate. He died at Berlin on the 28th of April 1896.

As an historian Treitschke holds a very high place. He approached history as a politician and confined himself to those periods and characters in which great political problems were being worked out: above all, he was a patriotic historian, and he never wandered far from Prussia. His great achievement was the *History of Germany in the Nineteenth Century*. The first volume was published in 1879, and during the next sixteen years four more volumes appeared, but at his death he had only advanced to the year 1847. The work shows extreme diligence, and scrupulous care in the use of authorities. It is discursive and badly arranged, but it is marked by a power of style, a vigour of narrative, and a skill in delineation of character which give life to the most unattractive period of German history; notwithstanding the extreme spirit of partisanship and some faults of taste, it will remain a remarkable monument of literary ability. Besides this he wrote a number of biographical and historical essays, as well as numerous articles and papers on contemporary politics, of which some are valuable contributions to political thought.

The most important of the essays have been collected under the title *Historische und politische Aufsätze* (4 vols., Leipzig, 1896); a selection from his more controversial writings was made under the title *Zehn Jahre deutscher Kämpfe*; in 1896 a new volume appeared, called *Deutsche Kämpfe, neue Folge*. After his death his lectures on political subjects were published under the title *Politik*. He brought out also in 1856 a short volume of poems called *Vaterländische Gedichte*, and another volume in the following year. The only works translated into English are two pamphlets on the war of 1870, *What we demand from France* (London, 1870), and *The Firetest of the North German Confederation* (1870).

See Schiemann, *Heinrich v. Treitschkes Lehr- und Wanderjahre, 1836–1866* (Munich, 1896); *Gustav Freitag und Heinrich v. Treitschke im Briefwechsel* (Leipzig, 1900); *Deutsche Rundschau* (Oct. 1896); and article by J. W. Headlam, *Hist. Rev.* (Dec. 1897). (J. W. He.)

TRELAWNY, EDWARD JOHN (1792–1881), English sailor and friend of Shelley and Byron, was born in London on the 13th of November 1792, the son of an army officer. After a short term in the navy and a naval school, he shipped for India, but deserted at Bombay. For several years he led an adventurous life in India, but about 1813 returned to England, married and settled down. In was early in 1822 that he met Shelley and Byron at Pisa and passed nearly every day with one or both of them until the drowning of Shelley (*q.v.*) and Williams on the 8th of July. He it was who superintended the recovery and cremation of the bodies, snatching Shelley's heart from the flames, and who added the lines from the *Tempest* to Leigh Hunt's "Cor Cordium"; and, finally, who supplied the funds for Mrs Shelley's return to England. In 1823 he set out with Byron for Greece, to aid in the struggle for independence. Distressed by his companion's dilatoriness, Trelawny left him and joined the insurgent chief Odysseus and afterwards married his sister Tersitza. While in charge of the former's fortress on Parnassus he was assaulted by two Englishmen and nearly killed. Returning to England, he lived for a time in Cornwall with his mother and afterwards in London, where his romantic associations, picturesque person and agreeable manners made him a great social favourite. Permission having been refused him to write the life of Shelley, he began an account of his own life in the *Adventures of a Younger Son* (1835), followed much later by a second part: *Recollections of Shelley and Byron* (1858). This gives an admirable portrait of Shelley, and a less truthful one of Byron. He married a third time, but the irregularity of his life estranged him from his wife, and he died at Sompting, near Worthing, on the 13th of August 1881. His ashes were buried in Rome by the side of those of Shelley. The old seaman in Millais's picture, "The North-West Passage," in the Tate Gallery, London, gives a portrait of him.

See the *Letters of Edward J. Trelawny*, edited with Introduction by H. Buxton Forman, C.B. (1910).

TRELAWNY, SIR JONATHAN, Bart. (1650–1721), English prelate, was a younger son of Sir Jonathan Trelawny, bart. (1624–1685), a member of a very old Cornish family, and was born at Pelynt in Cornwall on the 24th of March 1650. Educated at Westminster School and at Christ Church, Oxford, Trelawny took holy orders in 1673, and in 1685, his elder brother having died in 1680, became third baronet in succession to his father. Having rendered good service to James II. during Monmouth's rebellion, Trelawny was consecrated bishop of Bristol on the 8th of November 1685. He was loyal to King James until the first declaration of indulgence in April 1687, when, as a bishop, he used his influence with his clergy against the king, and, as a Cornish landowner, resisted the attempt to assemble a packed parliament. In May 1688 Trelawny signed the petition against the second declaration of indulgence, and in the following month was imprisoned in the Tower of London with Archbishop Sancroft and five other bishops, sharing their triumphant acquittal. In spite of Burnet's assertion, it is probable that Trelawny did not sign the invitation to William of Orange, although he certainly welcomed his army into Bristol. Before this James II., anxious to regain the bishop's support, had nominated him to the see of Exeter; but Trelawny lost nothing, as this appointment was almost at once confirmed by William III. Unlike five of his colleagues among the "seven bishops," Trelawny took the oaths of allegiance to William and Mary; but he was soon estranged from the new king and sided with the princess Anne, who showed him some favour after she became queen. In 1707 Trelawny was appointed bishop of Winchester and became prelate of the Order of the Garter, but henceforward he took very little part in politics. He died at his residence at Chelsea on the 19th of July 1721, and was buried at Pelynt. His wife was Rebecca (d. 1710), daughter of Thomas Hele of Bascombe, Devon, by whom he had a family of six sons and six daughters. His eldest son, John, the 4th baronet, died without sons in 1756, and the present baronet is descended from the bishop's brother, Henry (d. 1702). Another of his sons was Edward Trelawny (1699–1754), governor of Jamaica from 1738 to 1752. When bishop of Exeter, Trelawny, as visitor of Exeter College, Oxford, deprived the rector of his office, a sentence which was upheld on appeal by the House of Lords; and when bishop of Winchester he completed the rebuilding of Wolvesey Palace. Trelawny is the hero, or one of the heroes, of the refrain:—

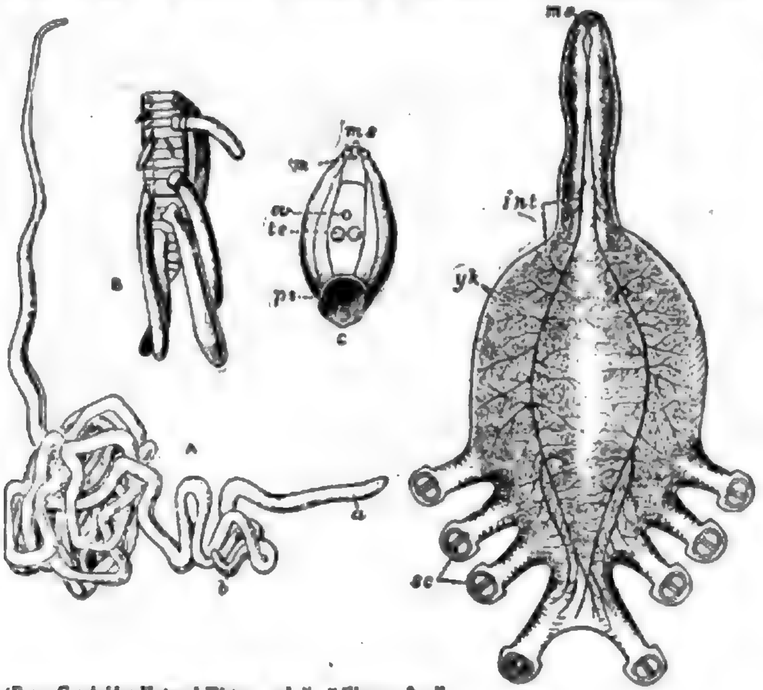
> "And shall Trelawny die,
> Here's twenty thousand Cornishmen
> Will know the reason why."

These words were sung by the men of Cornwall, who seem to have assembled during the bishop's short imprisonment in 1688. It is probable, however, that a similar threat was heard in 1628, when John Trelawny (1592–1665), grandfather of the bishop, was imprisoned by the House of Commons for opposing the election of Sir John Eliot to parliament. The "Song of the Western Men," which contains the above refrain, was composed in 1825 by R. S. Hawker.

TREMATODES, or flukes (as they are called from their fish-like shape), one of the three classes that compose the phylum Platyelmia (*q.v.*). They are flattened organisms provided with two or more suckers, hence their name (τρηματώδης, pierced with holes), and are exclusively parasitic both in their earlier and mature stages of life. Their structure has undergone little degeneration in connexion with this habit, and may be compared organ for organ with that of the Planarians (*q.v.*). The chief peculiarities that distinguish Trematodes from their free-living allies, the Turbellaria, are the development of adhering organs for attachment to the tissues of the host; the replacement of the primitively ciliated epidermis by a thick cuticular layer and deeply sunk cells to ensure protection against the solvent action of the host, and (in one large order) a prolonged and peculiar life-history. The only organs that exhibit any sign of degeneration are those of sense, but in the ectoparasitic Trematodes simple eye-like structures are present and perhaps serve as organs of temperature. The class as a whole is linked to the Turbellaria not only by its similarity of structure, but by the intermediation of the singular class the Temnocephaloidea (see PLANARIANS), which in habit and in organization form an almost ideal annectant group.

External Characters.—The body, which varies in length from a few millimetres to a couple of feet, is usually oval and flattened. In certain genera the margins are infolded either along their whole length (the male of *Schistostomum haematobium*; fig. 9, A) or anteriorly only (Holostomidae). The anterior third of the body is attenuated and sharply marked off from the bulbous trunk in *Didymozoon*. Trematodes never exhibit segmentation, though a superficial annulation may occur, *e.g.* in *Udonella*.

The ventral surface is characterized by one or more suckers and apertures. The mouth lies usually in the centre of the anterior and sub-terminal sucker or between two adoral suckers, but in *Gasterostomum* and its allies it is mid-ventral. A second sucker of variable size and shape lies behind the oral one. In the ectoparasitic Trematodes this post-oral sucker is a complex disk placed near the hinder end and provided with suckerlets, hooks and a musculature arising from a special skeleton. In the majority of endoparasitic forms it is merely a muscular disk just behind the mouth; but in the Aspidocotylea this sucker forms a muscular ribbed sole extending over the greater part of the ventral surface (fig. 7).



(From *Cambridge Natural History*, vol. ii. "Worms, &c.," by permission of Macmillan & Co., Ltd.)

FIG. 1.—A Group of Trematodes.

A, *Nematobothrium filarina*, two specimens (*a* and *b*) from the Tunny. *B*, *Udonella caligorum*, attached to the ova of the copepod *Caligus*. C, *Epibdella hippoglossi* (from Halibut); *ms*, the two adoral suckers with the mouth (*m*) between them; *ps*, ventral sucker; *ov*, ovary, *te* testes. D, *Octobothrium merlangi*; *ms*, oral sucker; *int.* intestine; *sc*; posterior suckers; *yk*, yolk-glands.

The anterior and posterior ends of the body are well defined. The former is specially modified in a few genera in a manner analogous to the "proboscis" of certain Rhabdocoel Turbellaria. Thus in the recently discovered arctic genus *Prosorhynchus* the muscular and glandular extremity is protrusible, but in the allied *Gasterostomum* this organ is represented by a sucker with fimbriated or tentacular margins. Another form, *Rhopalophorus*, has two cephalic tentacles that are retractile and covered with hooks. The chief genital pore is placed anteriorly between the oral sucker and the ventral one, and is posterior only in Holostomidae, Gasterostomidae and a few Distomidae. Usually this aperture is median, but occasionally asymmetrical. Both male and female gonoducts open through a common atrium to the exterior by this pore, but in three bisexual genera the male and female ducts are developed in separate individuals (*Bilharzia*, *Didymozoon*, *Koellikeria*). A single or paired accessory gonopore is met with in many Trematodes just as in certain Turbellaria (*e.g. Cylindrostomum*, *Trigonoporus*). This accessory pore is not of uniform significance. In ectoparasitic Trematodes it is paired and usually ventral (fig. 4 B, *v*), but the two apertures may run into one, and may also open dorsally (*Hexacotyle*). In this group, the accessory gonopore is the opening of the "vagina," in contradistinction to the median and atrial opening of the uterus which is a "birth-pore." In most endoparasitic Trematodes the accessory gonopore is a median and dorsal structure. It is the opening of Laurer's canal and is homologous not with that of the "vagina", just mentioned, but with a totally distinct structure—the "yolk-receptacle"—which in ectoparasitic forms discharges into the gut instead of to the exterior (see fig. 3).

The excretory pore is terminal and posterior in endoparasitic forms: paired, anterior and dorsal in the ectoparasitic class.

Parasitic Habits.—The Trematodes with few exceptions select a vertebrate for their host. Speaking generally each species of parasite has a particular host, upon the blood of which it nourishes itself and matures its reproductive organs. This strange partiality is now to some extent intelligible. It has been shown in the mammals that blood-relationship, in the strict and literal sense, holds good. The blood of most species behaves differentially towards precipitants, and it is therefore conceivable that when blood is used as food and is elaborated into special compounds for the nutrition of the reproductive organs of a parasite, these specific or larger differences in the blood of animal hosts may prevent the ripening of the gonads of a widely diffused parasite and only one particular kind of blood prove suitable. It would seem that the Trematodes present various degrees of such adaptation, for whilst some—*e.g.* the common liver-fluke (*Distomum hepaticum*)—mature equally well in the bile-ducts of a man as in those of a sheep or rabbit, others and in fact the majority are restricted apparently to one host. It must, however, be borne in mind that a Trematode may develop in an "aberrant" manner in one host and "normally" in another; and unless we knew the initial stock, the two forms would be regarded as distinct species, each with its own host.

The position of the Trematode on its host is of far-reaching importance. If ectoparasitic and attached to the skin, apertures or gills, the Trematode adopts more elaborate adhesive organs and undergoes a less complex development than are required for the endoparasitic members of the class. The latter are almost invariably swallowed by their host in an immature state with its food, and from the stomach or intestine they work their way into the lungs, liver, body-cavity or blood vessels. These endoparasites have a peculiar larval development, the results of which are to increase their numbers and enhance the opportunity of their gaining the necessarily remote station in some fresh individual host. It is usual to consider the ectoparasitic habit as leading up to the endoparasitic one. From what we know of the Platyelmia, however, it is more probable that the two are quite independent and have been evolved separately.

The influence of Trematodes on their hosts is a varied one. Probably all of them secrete an active poison by the aid of their glands, but the effects of these substances are not readily perceptible. In addition to this, they constitute a drain upon the blood which may result in anaemia. If present in large numbers they may give rise to obstruction of the liver-ducts or to inflammation of other tissues. The most important of the Trematodes in its effect on man is *Schistostomum* (*Bilharzia*). This parasite is one of the plagues of Africa. In Egypt 30% of the natives are affected by haematuria which arises from congestion of the bladder consequent upon the attacks of this animal. The noxious influence of Trematodes is, moreover, not confined to their mature phase of life. The rapid multiplication that takes place in the larval stage of nearly all endoparasitic forms affects the tissues of the "intermediate" host in which they live. In most cases this is a mollusc, and the larvae bore their way into the most diverse organs, often accumulating to such an extent as to give a distinctly orange colour to an otherwise colourless tissue, and to cause the demolition of particular structures *e.g.* the liver and gonad. Perhaps the most remarkable of these effects is that produced by the larvae of *Gasterostomum*. These organisms live in cockles, oysters and other lamellibranchs and they so affect the gonads of these molluscs as to castrate and sterilize their host. A different but still more interesting result is produced by these Trematode larvae on certain lamellibranchs. The production of pearls by oysters and mussels is common knowledge, but it is only recently that the origin of pearls has been traced and admitted to be due to inflammation set up by a parasite. In the case of the pearl oyster this parasite is a cestode larva, but in the less valuable but no less genuine pearl produced by *Mytilus*, &c., the nucleus is a Trematode-larva (Jameson).

Structure.—The anatomical structure of the Trematodes is fairly uniform (Braun). The body is enveloped by a thick striated protective cuticle which is frequently raised into hooks or spines. In *Distomum acanthocephalum* the cuticle forms circlets of large and small hooks at the anterior end, somewhat as in Cestodes. The epidermis has lost its connected epithelial character and its cilia, and the isolated cells have become sunk inwards retaining their attachment to the innermost cuticular layer by slender processes. This layer also forms the attachment for the muscles, of which there are two enveloping coats, a circular and a longitudinal layer and also dorso-ventral fibres. The muscles are remarkable for two reasons. They occasionally exhibit striation and originate from large branched cells, the nucleus and unmodified part of which form conspicuous elements. The digestive system consists of a simple or bifurcated sac, opening through the mouth by means of a "pharynx bulbosus," adapted to act primarily as a sucker, and secondarily, when drawing blood, as an aspirator. Between the blind gut and the cuticle is a reticular branched tissue which forms the chief substance of the body. This is the mesenchyma. As in other Platyelmia the elements of this tissue undergo the most varied differentiation. The main mass of it forms a spongy vacuolated matrix, but some of the cells become glandular and open by pores on the surface of the cuticle, others become "flame-cells" (fig. 2, D) and canaliculi of the excretory system as in Turbellaria, others again muscle-cells. Embedded in the matrix lies the complex genital apparatus composed usually of both male and female reproductive organs (fig. 2, B). The former consist of one pair or more of vesicular testes communicating by fine ducts with a vesicula seminalis. From this point a glandular tube runs to the genital atrium and during the last part of its course is converted into an eversible hooked "cirrus" or penis. The female organs consist of distinct ovaries and yolk-glands, the ducts of which unite in the neighbourhood of a "shell-gland" or "ootype." Here the two elements, ovum and yolk-cells, are surrounded by a shell of operculate or of spindle-capped types. Coincidently, to allow of fertilization and the escape of excess of yolk, and of spermatozoa, other accessory ducts open at this point. Thus in ectoparasitic Trematodes, the paired vagina transmits spermatozoa to the egg: and a canal carries off yolk from this point of junction either to the gut for resorption or to the exterior for exudation. This duct (Laurer's canal) is sometimes rudimentary and ends blindly beneath the skin. The fertilized ova, provided with yolk and a shell, are next transferred to the "uterus" along which they travel to the exterior. In the endoparasitic trematodes the uterus is the only passage by which fertilization can be effected, and in cases of cross and self-impregnation this duct is physiologically a vagina. Lastly the nervous system is well developed and consists of a pair of well-marked and interconnected ganglia placed near the anterior end and dorsal to the oesophagus. From these ganglia, nerve-tracts provided with ganglion-cells are given off. Of these there are three on each side of the body: a large ventral tract, smaller lateral strands and dorsal ones. From these tracts a plexus of nerve-fibres is developed in connexion with the musculature and cuticle.

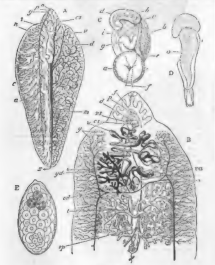


FIG. 2.

A, *Fasciola hepatica*, from the ventral surface; the alimentary and nervous systems only shown on the left side of the figure, the excretory only on the right; *a*, right main branch of the intestine; *c*, a diverticulum; *g*, lateral ganglion; *n*, lateral nerve; *o*, mouth; *p*, pharynx; *s*, ventral sucker; *cs*, cirrus sac; *d*, left anterior dorsal exeretory vessel; *m*, main vessel; *v*, left anterior ventral trunk; *x*, excretory pore.

B, anterior portion more highly magnified (from Marshall and Hurst, after Sommer); *cs*, cirrus sac; *d*, ductus ejaculatorius; *f*, female aperture; *o*, ovary; *od*, oviduct; *p*, penis; *s*, shell-gland; *t*, anterior testis; *u*, uterus; *va*, *vp*, vasa deferentia; *vs*, vesicula seminalis; *y*, yolk-gland; *yd*, its duct.

C, genital sinus and neighbouring parts (from Sommer); *a*, ventral sucker; *b*, cirrus sac; *c*, genital pore; *d*, evaginated cirrus sac; *e*, end of vagina; *f*, vasa deferentia; *g*, vesicula seminalis; *h*, ductus ejaculatorius; *i*, accessory gland.

D, a flame-cell from the excretory apparatus, highly magnified (from Fraipont).

E, egg of *Fasciola hepatica*. (from Thomas).

The Trematodes are divided into three orders, primarily distinguished by the character of their suckers, viz.: Heterocotylea, Aspidocotylea and Malacocotylea.

Order 1. *Heterocotylea.*—Ectoparasitic Trematodes, in which a large posterior adhesive apparatus is present and is usually accompanied by a pair of suckers placed anteriorly in relation to the mouth. The large posterior organ of attachment is usually wheel-shaped and provided with hooks; but the ridges may become separated

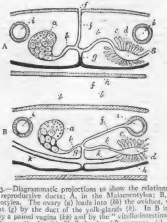
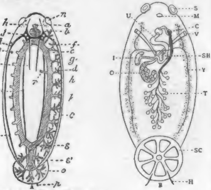


FIG. 3.—Diagrammatic projections to show the relations of the female reproductive ducts: A, in the Malacocotylea; B, in the Heterocotylea. The ovary (*a*) leads into (*bb*) the oviduct, which is joined at (*g*) by the duct of the yolk-glands (*h*). In B it is also joined by a paired vagina (*kk*) and by the "vitello-intestinal duct" (Laurer's canal). *f.* (*c*) Shell-glands; (*d*) ootype; (*e*) uterus; (*g*) median-vitello-duct; (*i*, *i*) intestine.

into a number of independent suckers set on a disc or "cotylophore." Eye-spots are general and the nervous system maintains a primitive diffused condition. The excretory system opens to the exterior by a pair of dorsal pores at the level of the pharynx. The eggs are comparatively few, and development is direct, the embryo after reaching its host remaining attached to it for life.

All the members of this order are parasitic on aquatic vertebrates and in rare cases derive their food from a vertebrate host indirectly by means of another invertebrate parasite (*e.g. Udonella* occurs on parasitic Crustacea). They are transparent leaf-like organisms and may often be found attached to the skin, mouth, nostrils or gills of fish; on the skin and bladder of Amphibia; and on those of certain Reptilia. *Polystomum integerrimum* (fig. 5) occurs commonly in the "bladder" of frogs and toads; *Diplozoon* on the skin of the minnow; *Gyrodactylus* (figs. 5, 6) on the gills of various fresh-water fish; and a large number of genera occur on the skin, cloaca and gills of Elasmobranchs and other marine fish. They ingest the mucus and, to some extent, the blood of their host by the aid of a sucking pharynx through which the food passes into the bifurcated alimentary sac and its branched caeca.

The life-history of this order offers many points of interest. The eggs are stalked and provided with chitinoid often operculate shell. Each shell contains a single ovum and a mass of yolk-cells. In most cases the eggs are attached to the host, but in *Polystomum* the eggs are laid in water. The egg of *Gyrodactylus* develops in the body of the parent.



(From Lankester's *Treatise on Zoology*, pt. iv.)

FIG. 4.—Schematic figures of a Heterocotylean Trematode to illustrate its structure (after Benham).

A, Dorsal view showing the nervous system and digestive system; *a*, mouth; *b*, pharynx; *c*, *d*, *e*, gut; *i*, post-genital union of two limbs of gut; *f*, excretory pore; *g*, vaginal pore; *h*, *j*, *k*, brain and nerves; *l*, dorsal nerves; *m*, ventral nerves; *n*, adoral sucker; *o*, posterior sucker; *p*, hooks on posterior sucker; *r*, vitello-intestinal duct.

B, Ventral view showing the reproductive system; C, Cirrus; H, hooks on the ventral sucker; I, small piece of the intestine to show its connexion with the reproductive organs by the narrow duct that passes from it to the union of the vaginae; M, mouth; O, ovary; S, oral sucker; SC, sucker; SH, shell-gland; T, Testis; U, uterus; V, vaginal pore; Y, yolk-gland.

The further history of the animal is only known in a few cases. *Polystomum* hatches out six weeks after ovi-position as a minute (·3 mm. long) larva capable of swimming freely for a short time by the aid of five girdles of ciliated cells. If in the course of the first twenty-four hours this larva meet with a tadpole it attaches itself at once and undergoes further development. If unsuccessful it dies. In the former case the larva creeps along the tadpole until it reaches the branchial opening into which it darts, fixes its sucker, and then throws off its cilia. Its further development takes place partly in the branchial chamber and partly in the bladder, which it reaches by travelling the whole length of the alimentary canal. In the former position the suckers are developed and growth proceeds for 8 to 10 weeks until the metamorphosis of its host. In the bladder it remains for three years before attaining maturity. Sometimes the *Polystomum*-larva attaches itself to a young tadpole, and in that case grows so rapidly as to become mature in five weeks. These *Polystomum* deposit their eggs in the branchial chamber and die at the metamorphosis of their host. They differ structurally from the normal form in being capable of self-fertilization only, and in the shape and details of their spermatozoa

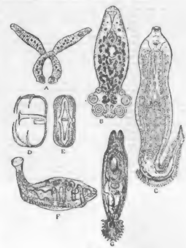


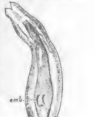
FIG. 5.

A, *Diplozoon paradoxum*; two united specimens.
B, *Polystomum integerrimum*. (×about 100; after Zeller.)
C, *Microcotyle mormyri.*
D, E, Two views of the chitinous framework of a sucker of *Axine belones*; highly magnified (after Lorenz).
F, *Aspidogaster conchicola*. (×about 25; after Aubert)
G, *Gyrodactylus elegans*. (×about 80; after Wagener.)

The life-history of *Diplozoon* (fig. 5) is remarkable in that two larvae (the so-called *Diporpae*) unite and fuse permanently into an X-shaped organism. Unless this occurs, the development of the larvae is soon arrested. The ciliated stage is only capable of free life for five or six hours, and if at the end of that time it has not encountered and attached itself to a minnow, it dies. If successful, the larva throws off its cilia and develops a dorsal papilla, a median ventral sucker and an additional pair of lateral suckers. Then the *Diporpa* stage is attained. This stage is capable of isolated existence for two or three months but remains immature. Should it, however, encounter another *Diporpa*, the mid-ventral sucker of either is applied to the dorsal papilla of the other, and complete fusion takes place across the junction. The compound organism now develops two sets of inter-connected genitalia and becomes a *Diplozoon*.

Gyrodactylus produces only one large egg at a time and this develops *in situ* into an embryo: but within this embryo another appears before the first leaves the parent. This anomalous phenomenon is still obscure, for we do not yet know whether the second embryo is developed sexually or asexually from the first. Von Linstow has indeed suggested that *Gyrodactylus* is a larval form capable of reproduction by an asexual method.

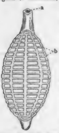
Order 2. *Aspidocotylea.*—Endoparasitic Trematodes provided with a large ventral sucker which is almost co-extensive with the lower surface of the body and is divided into rectangular compartments. The alimentary sac is simple and devoid of caeca. The development is direct.



(After v. Nordmann. From *Cambridge Natural History*, vol. ii. "Worms, &c." by permission of Macmillan & Co., Ltd.)

FIG. 6.—*Gyrodactylus elegans* from the fins of the Stickleback; *emb.* embryo.

These Trematodes occur in the alimentary canal and adjacent organs of Mollusca, the gall-bladder of *Chimaera*, and the intestine of Chelonia and of certain fish. *Aspidogaster conchicola* is a form not uncommon in *Anodon*, *Unio* and certain fresh-water Gastropods. When young it is found in the intestine, but becomes mature in "Keber's organ" and the pericardium. An allied form (*A. margaritiferae*) occurs in the pericardium of the Ceylon pearl-oyster (9).



(After Monticelli From Lankester's *Treatise on Zoology*, part iv.)

FIG. 7.—*Aspidogaster conchicola*; ventral aspect; *a*, mouth; *b*, marginal sense organs.

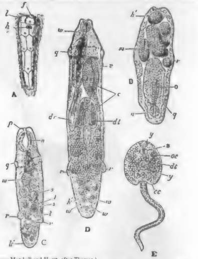
This order differs in several points from the preceding one. The excretory system is highly developed and opens at the posterior extremity by a paired muscular bladder. The testis is a single compact organ. From the oviduct a long duct full of yolk passes backwards almost to the hinder end of the body and ends blindly in a globular dilatation just below the skin. This structure is regarded as the homologue of a canal (Laurer's canal) which in the Heterocotylea opens into the intestine and so gets rid of the excess of yolk. The life-history of the order is almost unknown, but at the time of hatching the young Aspidocotylean has an oral sucker at the anterior extremity and an equally simple post-oral one at the other, thus resembling the members of the next order. Subsequently the body grows backwards and the ventral sucker comes to occupy a relatively more anterior position. Concomitantly its cavity is sub-divided by transverse ridges into a single row and later on into paired rows of compartments. A curious form (*Stichocotyle*) described in an immature condition by Cunningham from the lobster and Norway lobster probably belongs to this order.

Order 3. *Malacocotylea* (Distomae, Leuck: Digenea v. Ben.). Endoparasitic Trematodes with a variable adhesive apparatus. The oral sucker may alone be present (Monostomidae), more usually a second is developed on the under surface, but may be mid-ventral (Distomidae) or terminal. It is posterior (Amphistomidae), or anterior (Gasterostomidae). In addition to these suckers the sides of the anterior region may become infolded and give rise to an accessory adhesive organ (Holostomidae). In all these families spines and glandular papillae may be super-added. The intestinal sac has become bifid and is usually devoid of branches. The excretory system is highly developed; the larger collecting ducts are elaborately looped and open posteriorly by a single terminal aperture. A canal (Laurer's canal) leads from the oviduct or yolk-duct to the dorsal surface. The development is indirect. From the egg a larva arises. This enters a temporary host. Here it gives rise by a peculiar process to numerous individuals of a second larval form, and these usually produce a third form from which the minute immature Trematode is developed. In this manner a single egg may give rise to a large number of sexual individuals. The larvae usually live in Molluscs, the mature worm in vertebrates, and the immature but metamorphosed Trematode in either host and also in pelagic and littoral marine and fresh-water invertebrates.

The Malacocotylea occur in all classes of vertebrates. They are usually found in the alimentary canal or its appendages but occasionally work their way into the serous cavities, nervous system and blood vessels. Fourteen species belonging to five genera have been found in man, but only one [*Schistostomum* (*Bilharzia*) *haematobium*] is of serious medical importance, the others being rare and occasioned by want of cleanliness and close association with infected domestic animals. Domestic animals suffer periodically to a much greater extent. The liver-fluke (*Distomum hepaticum*) unlike most Trematodes flourishes in a wide range of hosts and infects man, horse, deer, oxen, sheep, pig, rabbit and kangaroo. Sheep, however, suffer most from this parasite and from the allied *D. magnum*. The former fluke is found in Europe, North Africa, Abyssinia, North Asia, South America, Australia and the Hawaiian Islands; the latter in the United States. Wet summers are followed by an acute outbreak of liver-rot amongst sheep and this, together with the effects of other diseases that accompany wet seasons, cause the death of vast numbers of sheep, the numbers from both sources being estimated in bad years at from 1½ to 3 millions in England alone. The anatomy of *Distomum hepaticum* is fully described in many accessible memoirs [Sommer (10), Marshall and Hurst, Braun (3)]. It has been shown that this parasite feeds upon the blood, not the bile of its host, though it occurs mainly in the bile ducts.

The life-histories of the Malacocotylea form the most interesting feature of the order. The majority of species are hermaphrodite and many are capable of self-impregnation. In these, the male organs ripen before the ova and spermatozoa may pass into the uterus before the external pore is formed (Looss). A few species, however, are bisexual, *e.g.* *Schistostomum* (*Bilharzia*) *haematobium* in which the male is larger than the female and encloses the latter in a ventral canal; *Koelikeria filicolle* Rud (*Distomum okenii*, Köll) which also occurs in pairs, a large female and a small male being found together encysted in the branchial chamber of *Brama raji*: and *Didymozoon thynni* (*Monostomum bipartitum*) which occurs in pairs fused for the greater part of their length and only free anteriorly; the larger individual is the female.

The egg consists of a fertilized ovum and a mass of yolk-cells. Segmentation takes place during its passage down the uterus. The result of this process is a minute ovoid embryo consisting of a solid mass of cells surrounded by a follicle of flattened yolk-cells. The central mass soon becomes differentiated into an outer epidermal and a dermal layer of flat-cells. Some of the central cells remain in clumps as "germ-balls," others form a mesenchyma in which "flame-cells" arise; others again give rise to muscles; and at the thicker end of the body, rudiments of the brain and digestive system are observable. A pair of "eye-spots" develops immediately over the brain. If the egg with its contained embryo falls into water with the faeces of the host the larva hatches out and swims freely for a time. In dry localities or in the absence of the intermediate host (usually a mollusc) this larva soon dies. If, however, it encounters the host the larva bores its way in, and attacks the liver, mouth or gonad in which it comes to rest. In all Malacocotylea except the Holostomidae the ensuing change is a degenerative one. The cilia are lost, the eye-spots disappear, the digestive sac vanishes and the larva becomes a sac or "sporocyst" full of germ-cells. The origin of these cells is a moot point. According to some writers (Leuckart) they are derived from undifferentiated blastomeres, other authorities (Thomas, Biehringer, Heckert) trace them to the parietal cells of the larva. These cells aggregated in masses become the bodies of another generation of larvae within the sporocyst. By a series of changes similar to those by which the primary larva arose from a segmented egg, so do these secondary larvae or "rediae" arise from the germ-cells or germ-balls within the sporocyst. The structure of a redia, however, is an advance on that of its parent. Though not possessing eyes or cilia, it has a pharynx and short straight digestive sac: and its mesenchymatous cavities are filled with germ-balls in various stages of development.



(All from Marshall and Hurst, after Thomas.)

FIG. 8.—Five stages in the life-history of *Fasciola hepatica*; all highly magnified.

A, The free-swimming embryo. B, A sporocyst containing young rediae. C, A young redia, the digestive tract shaded. D, An adult redia, containing a daughter-redia, two almost mature cercariae, and germs. E, A free cercaria. The letters have the same significance throughout.

c, Nearly ripe cercariae; *cc*, cystogenous cells; *dr*, daughter-redia; *dl*, limbs of the digestive tract; *f*, head-papilla; *h*, eye-spots; *h'*, same degenerating; *k'*, germinal cell; *l*, cells of the anterior row; *m*, embryo in optical section, gastrula stage; *n*, pharynx of redia; *o*, digestive sac; *oe*, oesophagus.

p, Lips of redia; *q*, collar; *r*, processes serving as rudimentary feet; *s*, embryos; *t*, trabecula crossing body-cavity of redia; *u*, glandular cells; *v*, birth-opening; *w*, *w'*, morulae; *y*, oral sucker; *y'*, ventral sucker; *z*, pharynx.

The movements and activity of the redia cause it to burst the wall of the sporocyst. It escapes into the adjacent tissue and there gives rise either to one or more generations of rediae or at once to a new type of organism—the cercaria. What determines the origin of the cercaria rather than a new generation of rediae is unknown. It originates from germ-balls by a differentiation similar in general to that already described, though profoundly different in detail. The cercaria is just visible to the naked eye and has an oval or discoidal body and usually a long tail of variable form. The tail may be a simple hollow muscular process or provided with stiff bristles set in transverse rows, or divided into two equally long processes, or finally it may form a large vesicular structure The body contains in miniature all the organs of the adult fluke, including the gonads and in addition "eye-spots," a stylet, rod-cells and cystogenous cells. The latter structures are only employed for an interval before the final host is entered.

The number of cercariae produced by the pullulating rediae in a single water-snail is immense, and as they are emitted at a given period or a few successive periods, the snail at these times appears enclosed in a cloud of whitish flocculent matter. The cercaria swims freely for a time and either encysts directly on grass or weeds or it enters a second host which may be another mollusc, an insect, crustacean or fish, and then encysts. In this process it is aided by the stylet with which it actively bores its way, throws off its tail and then, surrounding itself with the secretion of its cystogenous cells, comes to rest. The further development of the cercaria is dependent on the weed or animal in which it lies being eaten by the final host which is usually a predaceous fish or one of the higher vertebrates. When that occurs, the cyst is dissolved and the minute fluke works its way down the alimentary canal into some part of which it inserts its suckers and commences to feed on the blood of its host. Occasionally the fluke migrates into the blood vessels and may reach the lungs, kidneys, urethra and bladder. In the course of a few months it attains full size and maturity and probably in most cases dies in the course of a year after having given rise to another generation of larvae.

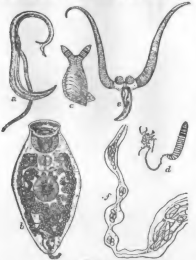


FIG. 9.

A, *Schistostomum (Bilharzia) haematobium*, the thin female in the gynaecophoric canal of the stouter male. (after Leuckart).
B, *Distomum macrostomum*, showing the digestive and the greater part of the genital apparatus with the cirrus protruded.
C, Snail (*Succinea*), the tentacles deformed by *Leucochloridium*. (Natural size.)
D, *Leucochloridium* removed from the tentacle. (Natural size; after Zeller.)
E, *Bucephalus polymorphus*. (Highly magnified; after Ziegler.)
F, Portion of a sporocyst containing *Bucephali* in process of development. (× about 50; after Lacaze-Duthiers.)

A few special cases of this general description of the life-history may be mentioned. The liver-fluke (*Distomum hepaticum*) passes through its larval stages in the water snail *Limnaea truncatula* in Europe; in *L. oahuensis* in the Hawaiian Islands; in *L. viator* in South America and in *L. humilis* in North America; and is eaten by sheep during its encysted stage attached to herbage. *Distomum macrostomum*, which occurs in various birds, produces a very curious sporocyst in the body of the snail *Succinea putris*. This sporocyst assumes a branched structure and penetrates into the tentacles of the snail (fig. 9, *c*, *d*). In this situation it becomes much swollen and banded with colours, and produces a large number of ecaudate cercariae. The attention of birds is speedily attracted to the snail by this appearance and by the peculiar movements which the worm executes, and the passage of the parasite into its final host is advantageously effected. In many cases it appears that only the brilliantly coloured tentacle is pecked off by the bird, and as the snail can easily regenerate a new one, this in turn becomes infected by a fresh branch of the sporocyst ramifying through the snail and thus a new supply of larvae is speedily provided (Heckert).

The life-history of *Schistostomum haematobium* is still unknown, but the difficulty in obtaining developmental stages in any of the numerous intermediate hosts that have been tried suggests that the ciliated larvae may develop directly in man and either gain access to him by the use of impure water for drinking or may perforate his skin when bathing. Experiments on monkeys have, however, given negative results.

The life-history of the Holostomidae differs from that of the Distomidae in an important regard. These Trematodes live chiefly in the intestine of aquatic birds or reptiles. The ciliated larva escapes from the egg into the water and enters an intermediate host (leech, mollusc, arthropod, batrachian or fish) where it undergoes a metamorphosis into a second stage in which most of the adult organs are present. In this condition they remain encysted as immature flukes until eaten by their final host.

The cycle of development taken by the Malacocotylea has been generally regarded as an alternation of one or more asexual generations with a sexual one. The question, however, is complicated by the uncertain nature of the germ-cells in the sporocysts and rediae. Some authors looking upon these as parthenogenetic ova regard the developmental cycle as one composed of an alternation of parthenogenetic and of sexual generations. Others again consider that the whole cycle is a metamorphosis which, beginning in the Heterocotylea as a direct development, has become complicated in the Holostomidae by a larval history, and finally in the Malacocotylea has acquired additional complexity by the intercalation of two larval forms, and is thus spread over several generations.

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(F. W. GA.)

TREMOLITE, a member of the amphibole group of rock-forming minerals (see AMPHIBOLE). It is a calcium and magnesium metasilicate, $CaMg_3(SiO_3)_4$, crystallizing in the monoclinic system with an angle of 55° 49′ between the perfect prismatic cleavages. It occurs sometimes as distinct crystals, but more usually as long bladed and fibrous forms. The colour is white or grey, but when iron is present it is green, then forming a passage to actinolite. The hardness is 5½ and the specific gravity 3·0. Tremolite is a characteristic mineral of crystalline limestones, especially dolomitic limestones, but also occurs as an alteration-product of olivine in basic igneous rocks. Typical specimens have long been known from the white crystalline dolomite of Campolongo in the St Gotthard region, Switzerland, near to which is the Tremola Valley, after which the mineral was named in 1796. Fine crystals are found in crystalline limestone at Gouverneur, Pierrepont and other places in New York, and at several localities in Sweden. (L. J. S.)

TRENCH, RICHARD CHENEVIX (1807–1886), Anglican archbishop and poet, was born at Dublin on the 9th of September 1807. He went to school at Harrow, and graduated at Trinity College, Cambridge, in 1829. In 1830 he visited Spain. While incumbent of Curdridge Chapel near Bishops Waltham in Hampshire, he published (1835) *The Story of Justin Martyr and Other*

Poems, which was favourably received, and was followed in 1838 by *Sabbation, Honor Neale, and other Poems*, and in 1842 by *Poems from Eastern Sources*. These volumes revealed the author as the most gifted of the immediate disciples of Wordsworth, with a warmer colouring and more pronounced ecclesiastical sympathies than the master, and strong affinities to Tennyson, Keble and Monckton Milnes. In 1841 he resigned his living to become curate to Samuel Wilberforce, then rector of Alverstoke, and upon Wilberforce's promotion to the deanery of Westminster in 1845 he was presented to the rectory of Itchenstoke. In 1845 and 1846 he preached the Hulsean lecture, and in the former year was made examining chaplain to Wilberforce, now bishop of Oxford. He was shortly afterwards appointed to a theological chair at King's College, London. In 1851 he established his fame as a philologist by *The Study of Words*, originally delivered as lectures to the pupils of the Diocesan Training School, Winchester. His purpose, as stated by himself, was to show that in words, even taken singly, "there are boundless stores of moral and historic truth, and no less of passion and imagination laid up"—a truth enforced by a number of most apposite illustrations. It was followed by two little volumes of similar character—*English Past and Present* (1855) and *A Select Glossary of English Words* (1859). All have gone through numerous editions and have contributed much to promote the historical study of the English tongue. Another great service to English philology was rendered by his paper, read before the Philological Society, "On some Deficiencies in our English Dictionaries" (1857), which gave the first impulse to the great Oxford *New English Dictionary*. His advocacy of a revised translation of the New Testament (1858) aided to promote another great national undertaking. In 1856 he published a valuable essay on Calderon, with a translation of a portion of *Life is a Dream* in the original metre. In 1841 he had published his *Notes on the Parables*, and in 1846 his *Notes on the Miracles*, popular works which are treasuries of erudite and acute illustration.

In 1856 Trench was raised to the deanery of Westminster, probably the position which suited him best. Here he instituted evening nave services. In January 1864 he was advanced to the more dignified but less congenial post of archbishop of Dublin. A. P. Stanley had been named, but rejected by the Irish Church, and, according to Bishop Wilberforce's correspondence, Trench's appointment was favoured neither by the prime minister nor the lord-lieutenant. It was, moreover, unpopular in Ireland, and a blow to English literature; yet the course of events soon proved it to have been most fortunate. Trench could do nothing to prevent the disestablishment of the Irish Church, though he resisted with dignity. But, when the disestablished communion had to be reconstituted under the greatest difficulties, it was found of the highest importance that the occupant of his position should be a man of a liberal and genial spirit. This was the work of the remainder of Trench's life; it exposed him at times to considerable misconstruction and obloquy, but he came to be appreciated, and, when in November 1884 he resigned his archbishopric from infirmity, clergy and laity unanimously recorded their sense of his "wisdom, learning, diligence, and munificence." He had found time for *Lectures on Medieval Church History* (1878); his poetical works were rearranged and collected in two volumes (last edition, 1885). He died in London, after a lingering illness, on the 28th of March 1886.

See his *Letters and Memorials* (2 vols., 1886).

TRENCHARD, SIR JOHN (1640–1695), English politician, belonged to an old Dorset family, his father being Thomas Trenchard (1615–1671), of Wolverton, and his grandfather Sir Thomas Trenchard (1582–1657), also of Wolverton, who was knighted by James I. in 1613. Born at Lytchett Matravers, near Poole, on the 30th of March 1640, and educated at New College, Oxford, John Trenchard entered parliament as member for Taunton in 1679, and associated himself with those who proposed to exclude the duke of York from the throne. He attended some of the meetings held by these malcontents and was possibly concerned in the Rye House plot; at all events he was arrested in July 1683, but no definite evidence was brought against him and he was released. When Monmouth landed in the west of England in June 1685 Trenchard fled from England, but was pardoned through the good offices of William Penn and returned home two years later. Again he entered parliament, but he took no active part in the Revolution of 1688, although he managed to secure the good will of William III. He was knighted by the king and made chief justice of Chester, and in 1692 he was appointed a secretary of state. He and the government incurred much ridicule through their failure to prove the existence of a great Jacobite plot in Lancashire and Cheshire in which they had been led to believe. Sir John died on the 27th of April 1695. His wife was Philippa (d. 1743), daughter of George Speke (d. 1690) of White Lackington, Somerset.

Another member of the Trenchard family was the writer, John Trenchard (1662–1723), erroneously referred to by Macaulay as a son of Sir John Trenchard. Educated at Trinity College, Dublin, Trenchard inherited considerable wealth and was thus able to devote the greater part of his life to writing on political subjects, his point of view being that of a Whig and an opponent of the High Church party. His chief works are *A Short History of Standing Armies in England* (1698 and 1731) and *The Natural History of Superstition* (1709). With Thomas Gordon (d. 1750) he produced a weekly periodical, *The Independent Whig*, and with the same colleague he wrote a number of letters to the *London Journal* and to the *British Journal* under the pseudonym of Cato. These letters were published in four volumes in 1724 and the collection has often been reprinted. Trenchard died on the 17th of December 1723.

TRENCHER (M. Eng. *trenchour, trenchere*, &c., O. Fr. *trencheoir trenchoier*, a place on which to cut up food, from *trencher*, mod. *trancher*, to cut, probably from Lat. *truncare*, lop, cut off, or from *transecare*, to cut across), a platter, being a flat piece of wood, in its earliest form square, later circular, on which food was carved or cut up and served. These wooden "trenchers" took the place of earlier ones which were thick slices of coarse bread; these, after being soaked with the gravy and juices from the meat and other food were eaten or thrown to the alms basket for the poor. The wooden trencher went out of use on the introduction of pottery and later of porcelain plates. At Winchester College, the old square beechwood trenchers are still in use. The potters of the 18th century made earthenware plates very flat and with a shallow rim; these were known as "trencher plates." "Trencher salt-cellars" were the small salts placed near each person for use, as opposed to the ornamental "standing" salts.

For "trench," a ditch, and "entrenchment," see Fortification and Siegecraft.

TRENCK, FRANZ, Freiherr von der (1711–1749), Austrian soldier, was born on the 1st of January 1711, of a military family. Educated by the Jesuits at Oedenburg, he entered the Imperial army in 1728 but resigned in disgrace three years later. He then married and lived on his estates for some years. Upon the death of his wife in 1737 he offered to raise an irregular corps of "Pandours" for service against the Turks, but this offer was refused and he then entered the Russian army. But after serving against the Turks for a short time as captain and major of cavalry he was accused of bad conduct, brutality and disobedience and condemned to death, the sentence being commuted by Field Marschal Münnich to degradation and imprisonment. After a time he returned to Austria, where his father was governor of a small fortress, but there too he came into conflict with every one and actually "took sanctuary" in a convent in Vienna. But Prince Charles of Lorraine, interesting himself in this strange man, obtained for him an amnesty and a commission in a corps of irregulars. In this command, besides his usual truculence and robber manners, he displayed conspicuous personal bravery, and in spite of the general dislike into which his vices brought him his services were so valuable that he was promoted lieutenant-colonel (1743) and colonel (1744). But at the battle of Soor he and his irregulars plundered when they should have been fighting and Trenck was accused (probably falsely) of having allowed the king of Prussia himself to escape. After a time he was brought before a court-martial in Vienna, which convicted him of having sold and withdrawn commissions to his officers without the queen's leave, punished his men without heed to the military code, and drawn pay and allowance for fictitious men. Much was allowed to an irregular officer in all these respects, but Trenck had far outrun the admitted limits, and above all his brutalities and robberies had made him detested throughout Austria and Silesia. A death sentence followed, but the composition of the court-martial and its proceedings were thought to have been such as from the first forbade a fair trial, and the sentence was commuted by the queen into one of cashiering and imprisonment. The rest of his life was spent in mild captivity in the fortress of Spielberg, where he died on the 4th of October 1749.

His cousin, **Friedrich, Freiherr von der Trenck** (1726–1794), the writer of the celebrated autobiography, was born on the 16th of February 1726 at Königsberg, his father being a Prussian general. After distinguishing himself for his quickness and imagination at the university of Königsberg, he entered the Prussian army in 1742, and soon became an orderly officer on Frederick's own staff. But within a year he fell into disgrace because of a love affair—whether real or imaginary—with the king's sister Princess Amalie, and when in 1743 his Austrian cousin presented him with a horse and opened a correspondence, Frederick had him arrested, a few days after the battle of Soor, and confined in the fortress of Glatz, whence in 1746 he escaped. Making his way home and thence to Vienna, in the vain hope of finding employment under his now disgraced cousin, he finally met a Russian general, who took him into the Russian service But, receiving news that owing to his cousin's death he had become the owner of the family estates, he returned to Germany almost immediately He was made a captain of Austrian cavalry, but never served, as his time was fully taken up with litigation connected with the inherited estates. In 1754 he visited Prussia, but was there arrested and confined in Magdeburg for ten years, making frequent attempts, of incredible audacity, to escape from the harshness of his gaolers. But after the close of the Seven Years' War, Maria Theresa requested that he should, as being a captain in her service, be at once released. Trenck then spent some years in Aix-la-Chapelle, managing an agency for Hungarian wines and publishing a newspaper, and on the failure of these enterprises he returned to his Hungarian estates. Here he composed his celebrated autobiography and many other writings. He visited England and France in 1774–1777, and was afterwards employed by the government in diplomatic or secret service missions. After the death of Frederick the Great he was allowed to enter Prussia, and stayed in Berlin for two years. In 1788 he visited Paris, where he was the hero of society for a moment; next year he returned to Hungary in order to collect his writings in a uniform edition, but in 1791 he returned to Paris to be a spectator of the Revolution, and after living in safety throughout the Terror he was at last denounced as an Austrian spy and guillotined on the 25th of July 1794.

His autobiography, which has been translated into several languages, first appeared in German at Berlin and Vienna (13 vols.) in 1787. Shortly afterwards a French version, by his own hand, was published at Strassburg. His other published works are in eight volumes and appeared shortly after the autobiography at Leipzig. A reprint of the autobiography appeared in 1910 in "Reclam's Universal Series."

See Wahrmann, *Leben und Thaten des Franz, Freiherr von der Trenck* and *Friedrich Freiherrn von der Trencks Leben, Kerker und Tod* (both published at Leipzig in 1837).

TRENDELENBURG, FRIEDRICH ADOLF (1802–1872), German philosopher and philologist, was born on the 30th of November 1802 at Eutin, near Lübeck. He was educated at the universities of Kiel, Leipzig and Berlin. He became more and more attracted to the study of Plato and Aristotle, and his doctor's dissertation (1826) was an attempt to reach through Aristotle's criticisms a more accurate knowledge of the Platonic philosophy (*Platonis de ideis et numeris doctrina ex Aristotele illustrata*). He declined the offer of a classical chair at Kiel, and accepted a post as tutor to the son of an intimate friend of Altenstein, the Prussian minister of education. He held this position for seven years (1826–1833), occupying his leisure time with the preparation of a critical edition of Aristotle's *De anima* (1833; 2nd ed. by C. Belger, 1877). In 1833 Altenstein appointed Trendelenburg extraordinary professor in Berlin, and four years later he was advanced to an ordinary professorship. For nearly forty years he proved himself markedly successful as an academical teacher, during the greater part of which time he had to examine in philosophy and pedagogics all candidates for the scholastic profession in Prussia. In 1865 he became involved in an acrimonious controversy on the interpretation of Kant's doctrine of Space with Kuno Fischer, whom he attacked in *Kuno Fischer und sein Kant* (1869), which drew forth the reply *Anti-Trendelenburg* (1870). He died on the 24th of January 1872.

Trendelenburg's philosophizing is conditioned throughout by his loving study of Plato and Aristotle, whom he regards not as opponents but as building jointly on the broad basis of idealism. His own standpoint may almost be called a modern version of Aristotle thus interpreted. While denying the possibility of an absolute method and an absolute philosophy, as contended for by Hegel and others, Trendelenburg was emphatically an idealist in the ancient or Platonic sense; his whole work was devoted to the demonstration of the ideal in the real. But he maintained that the procedure of philosophy must be analytic, rising from the particular facts to the universal in which we find them explained. We divine the system of the whole from the part we know, but the process of reconstruction must remain approximative. Our position forbids the possibility of a final system. Instead, therefore, of constantly beginning afresh in speculation, it should be our duty to attach ourselves to what may be considered the permanent results of historic developments. The classical expression of these results Trendelenburg finds mainly in the Platonico-Aristotelian system. The philosophical question is stated thus: How are thought and being united in knowledge? how does thought get at being? and how does being enter into thought? Proceeding on the principle that like can only be known by like, Trendelenburg next reaches a doctrine peculiar to himself (though based upon Aristotle) which plays a central part in his speculations. Motion is the fundamental fact common to being and thought; the actual motion of the external world has its counterpart in the constructive motion which is involved in every instance of perception or thought. From motion he proceeds to deduce time, space and the categories of mechanics and natural science. These, being thus derived, are at once subjective and objective in their scope. It is true matter can never be completely resolved into motion, but the irreducible remainder may be treated like the πρώτη ὕλη of Aristotle as an abstraction which we asymptotically approach but never reach. The facts of existence, however, are not adequately explained by the mechanical categories. The ultimate interpretation of the universe can only be found in the higher category of End or final cause. Here Trendelenburg finds the dividing line between philosophical systems. On the one side stand those which acknowledge none but efficient causes—which make force prior to thought, and explain the universe, as it were, *a tergo*. This may be called, typically, Democritism. On the other side stands the "organic" or teleological view of the world, which interprets the parts through the idea of the whole, and sees in the efficient causes only the vehicle of ideal ends. This may be called in a wide sense Platonism. Systems like Spinozism, which seem to form a third class, neither sacrificing force to thought nor thought to force, yet by their denial of final causes inevitably fall back into the Democritic or essentially materialistic standpoint, leaving us with the great antagonism of the mechanical and the organic systems of philosophy. The latter view, which receives its first support in the facts of life, or organic nature as such, finds its culmination and ultimate verification in the ethical world, which essentially consists in the realization of ends. Trendelenburg's *Naturrecht* may, therefore, be taken as in a manner the completion of his system, his working out of the ideal as present in the real. The ethical end is taken to be the idea of humanity, not in the abstract as formulated by Kant, but in the context of the state and of history. Law is treated throughout as the vehicle of ethical requirements. In Trendelenburg's treatment of the state, as the ethical organism in which the individual (the potential man) may be said first to emerge into actuality, we may trace his nurture on the best ideas of Hellenic antiquity.

Trendelenburg was also the author of the following: *Elementa logices Aristotelicae* (1836; 9th ed., 1892; Eng. trans., 1881), a selection of passages from the *Organon* with Latin translation and notes, containing the substance of Aristotle's logical doctrine, supplemented by *Erläuterungen zu den Elementen der Aristotelischen Logik* (1842; 3rd ed. 1876); *Logische Untersuchungen* (1840; 3rd ed. 1870), and *Die logische Frage in Hegels System* (1843), important factors in the reaction against Hegel; *Historische Beiträge zur Philosophie*

(1846-1867), in three volumes, the first of which contains a history of the doctrine of the Categories; *Das Naturrecht auf dem Grunde der Ethik* (1860); *Lücken im Volkerrecht* (1870), a treatise on the defects of international law, occasioned by the war of 1870. A number of his papers dealing with non-philosophical, chiefly national and educational subjects, are collected in his *Kleine Schriften* (1871).

On Trendelenburg's life and work see H. Bonitz, *Zur Erinnerung an F.A.T.* (Berlin, 1872); P. Kleinert, *Grabrede* (Berlin, 1872); E. Bratuschek, *Adolf Trendelenburg* (Berlin, 1873); C. von Prantl, *Gedachtnissrede* (Munich, 1873); G. S. Morris in the *New Englander* (1874), xxxii.

TRENT (Lat. *Tridentum*; Ital. *Trento*; Ger. *Trient*), the capital of the south or Italian-speaking portion of the Austrian province of Tirol. It stands on the left bank of the Adige where this river is joined by the Fersina, and is a station on the Brenner railway, 35 m. S. of Botzen and 56½ m. N. of Verona. It has a very picturesque appearance, especially when approached from the north, with its embattled walls and towers filling the whole breadth of the valley. A conspicuous feature in the view is the isolated rocky citadel of Doss Trento (the Roman *Verruca*), that rises on the right bank of the Adige to a height of 308 ft. above the city and is now very strongly fortified, as are various other positions near Trent giving access to Trent from the east (Val Sugana) or the west (valley of the Sarca). With its numerous palaces, substantial houses, broad streets, and spacious squares, Trent presents the aspect of a thoroughly Italian city, and its inhabitants (24,868 in 1900, including a garrison of over 2000 men) speak Italian only—it is the centre of the region called *Italia Irredenta* by fervent Italian patriots. The Duomo or cathedral church (dedicated to San Vigilio, the first bishop) was built in four instalments between the 11th and 15th centuries, and was restored in 1882–1889. More interesting historically is the church of Santa Maria Maggiore, built in 1514–1539, and the scene of the sessions of the famous Ecumenical Council (as to which, see below) which lasted, with several breaks, from 1545 to 1563; near it, in the open, a column was erected in 1845, on the occasion of the three hundredth anniversary of the opening of the Council. To the east of the city rises the Castello del Buon Consiglio, for centuries the residence of the prince-bishops, but now used as barracks. There is a huge town hall, which also houses the museum and the very extensive town library. Trent lives rather on its historical souvenirs than on its industries, which are not very extensive, viticulture, silk-spinning and the preparation of salami (a strongly spiced kind of Italian sausage) being the chief. Ecclesiastically Trent is a suffragan see of the archbishopric of Salzburg. Opposite the railway station a statue of Dante was erected in 1896, for he is believed to have visited this region about 1304.

Trent was originally the capital of the Tridentini, and is mentioned in the *Antonine Itinerary* as a station on the great road from Verona to Veldidena (Innsbruck) over the Brenner. It was later ruled by the Ostrogoths (5th century) and the Lombards (6th century) after the conquest of whom by the Franks (774) Trent became part of the kingdom of Italy. But in 1027 the emperor Conrad II. bestowed all temporal rights in the region on the bishop (the see dates from the 4th century) and transferred it to Germany, an event which fixed all its later history. The Venetian attacks were finally repulsed in 1487, and the bishop retained his temporal powers till 1803 when they passed to Austria, to which (save 1805–1814, when first the Bavarians and then Napoleon held the region) they have ever since belonged, the Trentino being annexed formally to Tirol in 1814. (W. A. B. C.)

TRENT, COUNCIL OF. The Council of Trent (1545–1563) has a long antecedent history of great significance for the fortunes of the Catholic Church. During the 15th and the earlier half of the 16th century, the conception of an "ecumenical council" remained an ideal of which the realization was expected to provide a solution for the serious ecclesiastical difficulties which were then prevalent. True, the councils of Constance and Basel had fallen short of the desired goal; but confidence in the unknown quantity persisted and took deeper root as the popes of the Renaissance showed themselves less and less inclined to undertake the reforms considered necessary in wide circles of the Church. The papacy indeed did not recognize the jurisdiction of the ecumenical council, and in 1459 Pius II. had prohibited any appeal to such a tribunal under penalty of excommunication. This, however, had no effect on public opinion, and the council continued to be invoked as the supreme court of Christianity. So in 1518, for instance, the university of Paris demanded the convocation of a general council, to which it referred its solemn protest against the papal encroachments on the privileges of the French Church. Thus, when Luther took this very step in the same year, and repeated it later, his action was not devoid of precedent. Again in 1529 the evangelical estates of Germany made a formal appeal in the Diet of Spires, and, in the preface to the Augsburg Confession of 1530, requested a "general, unfettered council of Christendom." The same demand was formulated by Charles V. The emperor indeed—though, as a statesman, he had found himself in frequent opposition to the papal policy of his day—had never entertained the slightest doubt as to the truth of Catholic doctrine, and had rendered inestimable services to the Church in the perilous years which followed the emergence of Protestantism. Still he could not blind himself to the fact that ecclesiastical life stood in urgent need of reform; and the only method of effecting an alteration in the existing régime was by means of a council. Consequently he declared himself in favour of convening a general assembly of the church—a project which he pursued with the greatest energy. True, the passive resistance of the Curia was so stubborn that the decisive step was postponed time and again. But the goal was finally attained, and this result was essentially the work of Charles. Actually, the meeting came too late: the Evangelical Church had gathered strength in the interim, and the council failed to exercise the decisive influence anticipated on the relations between Catholicism and Protestantism. In 1536 its convocation seemed imminent. Pope Paul III., who in the conclave had already admitted the necessity of a council, convened it on the 2nd of June 1536, for the 23rd of May 1537, at Mantua. He then altered the date to the 1st of November of the same year. Later it was summoned to meet at Vicenza on the 1st of May 1538, only to be postponed till the Easter of 1539. Finally, he adjourned the execution of the project *sine die*. Charles met this dilatory policy by arranging colloquies between Protestant and Catholic at Worms and Regensburg, the result being that the Curia became afraid that the emperor might take the settlement of the religious question into his own hands. This consideration forced Paul III. to compliance, and fresh writs were issued convoking the council, first for Whitsuntide, 1542, then for the 1st of November of the same year. In consequence, however, of the hostilities between Charles and the French king Francis I., the conference was so scantily attended that it was once more prorogued to the 6th of July 1543, before it had come into active existence. Not till the peace of Crespy, 1544, when the emperor showed some disposition to attempt an accommodation of the ecclesiastical feud in a German Diet, did the pope resolve to translate his numerous promises into deeds. The bull *Laetare Hierusalem* (November 19, 1544) fixed the meeting of the council for the 15th of March 1545, in Trent, and assigned it three tasks: (1) the pacification of the religious dispute by doctrinal decisions, (2) the reform of ecclesiastical abuses, (3) the discussion of a crusade against the infidels. The selection of the town of Trent, the capital of the Italian Tirol, and part of the empire had a twofold motive: on the one hand it was a token of concession to the emperor, who wished the synod to be held in his dominions; on the other, there was no occasion to fear that an assembly, meeting on the southern border of Germany, would fall under the imperial influence.

The opening of the council was deferred once again. Towards the end of May 1545, twenty bishops were collected at Trent; but there was no sign of action, and the papal legates—Del Monte, Corvinus and Reginald Pole—delayed the inauguration. The cause of this procrastinating policy was that the emperor and the pope were at cross purposes with regard to the mode of procedure. In the eyes of Paul III. the council was simply the means by which he expected to secure a condemnation of the Protestant heresy, in hopes that he would then be in a position to impose the sentence of the Church upon them by force. For him the question of ecclesiastical reform possessed no interest whatever. In contrast to this, Charles demanded that these very reforms should be given precedence, and the decisions on points of dogma postponed till he should have compelled the Protestants to send representatives to the council. The pope, however, alarmed by the threat of a colloquy in Germany, recognized the inadvisability of his dilatory tactics, and at last ordered the synod to be opened (December 13, 1545).

Since there was no definite method by which the deliberations of ecumenical councils were conducted, special regulations were necessary; and those adopted were of such a nature as to assure the predominance of the Roman chair from the first. As the voting was not to be by nations, as at Constance, but by individuals, the last word remained with the Italians, who were in the majority. In order to enhance this superiority the legates as a rule denied the suffrage to those foreign bishops who desired to be represented by procurators; and a number of Italian prelates were enabled to make their appearance at Trent, thanks to special allowances from the pope. The dispute as to the order of precedence among the subjects for deliberation was settled by a compromise, and the questions of dogma and ecclesiastical abuses were taken simultaneously, the consequence being that in the decisions of the council the doctrinal and reformatory decrees rank side by side. In pursuance of a precedent established by the last Lateran Council, the sessions were divided into two classes: those devoted to discussion (*congregationes generales*), and those in which the results of the discussion were put to the vote and formally enacted (*sessiones publicae*). To ensure a thorough consideration of every proposition, and also to facilitate the exercise of the papal influence on the proceedings, the delegates were split into three groups (*congregationes*), each group debating the same question at the same time. This arrangement, however, only endured till 1546. Since these sections were only brought into conjunction by the legates, and met under their presidency, the pontifical envoys in effect regulated the whole course of the deliberations. They claimed, moreover, the right of determining the proposals submitted, and were throughout in active and constant communication with Rome—a circumstance which provoked the *bon mot* of the French deputy (1563), that when the rivers were flooded and the Roman post delayed the Holy Ghost postponed his descent. These precautions nullified any possible disposition on the part of the council to enter on dangerous paths; and in addition the clause "under reservation of the papal authority" was affixed to all enactments dealing with ecclesiastical irregularities—thus leaving the pope a free hand with regard to the practical execution of any measures proposed. Contrary to the emperor's wish, the council began its labours in the region of dogma by defining the doctrines of the Church with reference to the most important controversial points—a procedure which frustrated all his projects for a reconciliation with the Protestants. On the 8th of April 1546 the doctrine of the Holy Scriptures and tradition (*sessio* iv.) was proclaimed; on the 17th of June 1546, the doctrine of original sin (*sessio* v.); on the 13th of January 1547, the doctrine of justification (*sessio* vi.); and on the 3rd of March 1547, the decree concerning the sacraments in general, and baptism and confirmation in particular (*sessio* vii.). On the 11th of March, however, the council was transferred to Bologna on the pretext that an epidemic was raging in Trent (*sessio* viii.), though, at the imperial command, part of the bishops remained behind. But on the 2nd of June the council of Bologna resolved (*sessio* x.) to adjourn its labours. The emperor's demands that the council should again be removed to Trent were vain, till on the 24th of April 1547, the battle of Mühlberg decided the struggle with the Schmalkaldic league, formed by the Evangelical princes of Germany, in his favour. His hands were now free, and he utilized his military successes to balance his account with the Church. At the Diet of Augsburg he secured the enactment of a *modus vivendi*, leavened by the Catholic spirit, between the adherents of either religion; and this provisory settlement—the so-called *Interim* of Augsburg—was promulgated as a law of the empire (June 3, 1548), and declared binding till the council should reassemble. The Protestants, it is true, received certain concessions—the non-celibacy of the priesthood and the lay chalice—but the Roman hierarchy, the old ceremonial, the feast-days and the fasts, were reinstated. Since the bishops who had remained in Trent abstained, at the emperor's request, from any display of activity *qua* synod, the outbreak of a schism was avoided. But the confusion of ecclesiastical affairs had grown worse confounded through the refusal of the pope to continue the council, when the death of Paul III. (November 10, 1549) gave a new turn to events.

Pope Julius III., the former legate Del Monte, could not elude the necessity of convening the council again, and, though personally he took no greater interest in the scheme than his predecessor in office, caused it to resume its labours on the 1st of May 1551 (*sessio* xi.), under the presidency of the legate, Cardinal Crescentio. The personnel of the synod was, for the most part, different; and the new members included the Jesuits, Laynez and Salmeron. More than this, the general character of the second period of the council was markedly distinct from that of its earlier stages. The French clergy had not a single delegate, while the Spanish bishops maintained an independent attitude under the aegis of the emperor, and Protestant deputies were on this occasion required to appear at Trent. The German Protestants who, in the first phase of the council, had held aloof from its proceedings, since to have sent representatives to this assemblage would have served no good purpose, had now no choice but to obey the imperial will. Charles V. was anxious to assure them not merely of a safe conduct, but also of a certain hearing. But in this he ran counter to the established facts: the Catholic Church had already defined its attitude to the dogmas above mentioned, and the Curia showed no inclination to question these results by reopening the debate. Thus the participation of the Protestants was essentially superfluous, for the object they had at heart—the discussion of these doctrines on the gound of Holy Writ—was from the Catholic standpoint an impossible aspiration. The Württemberg deputies had already submitted a creed, composed by the Swabian reformer Johann Brenz, to the council, and Melanchthon was under way with a *confessio saxonica*, when there came the revolt of the Elector Maurice of Saxony (March 20, 1552), which compelled the emperor to a speedy flight from Innsbruck, and dissolved the conclave. Its dogmatic labours were confined to doctrinal decrees on the Lord's Supper (*sessio* xiii. October 11, 1551), and on the sacraments of penance and extreme unction (November 25, 1551, *sessio* xiv.). On the 28th of April 1552, the sittings were suspended on the news of the elector's approach.

Ten years had elapsed before the council reassembled for the third time in Trent; and on this occasion the circumstances were totally changed. During the intervening period, the religious problem in Germany had received such a solution as the times admitted by the peace of Augsburg (1555); and the equality there guaranteed between the Protestant estates and the Catholic estates had left the former nothing to hope from a council. Thus the motive which till then had governed the emperor's policy was now nullified, as there was no necessity for seeking a reconciliation of the two parties by means of a conference. The incitement to continue the council came from another quarter. It was no longer anxiety with regard to Protestantism that exercised the pressure, but a growing conviction of the imperative need of more stringent reforms within the Catholic Church itself. Pope Paul IV. (1551–1559), the protector of the Inquisition, and the opponent of Philip II. of Spain as well as of the emperor Ferdinand, turned a deaf ear to all requests for a revival of the synod. The regime of Pius IV. (1559–1566) was signalized by an absolute reversal of the papal policy: and it was high time. For in France and Spain—

the very countries where the Protestant heresy had been most vigorously combated—a great mass of discontent had accumulated; and France already showed a strong inclination to attempt an independent settlement of her ecclesiastical difficulties in a national council. Pius IV. saw himself constrained to take these circumstances into account. On the 29th of November 1560 he announced the convocation of the council; and on the 18th of January 1562 it was actually reopened (*sessio* xvii.). The presidency was entrusted to Cardinal Gonzaga, assisted by Cardinals Hosius, bishop of Ermeland, Seripando, Simonetta, and Marc de Altemps, bishop of Constance. The Protestants indeed were also invited but the Evangelical princes, assembled in Naumburg, withheld their assent—a result which was only to be expected. In order to enhance the synod's freedom of action, France and the emperor Ferdinand required that it should rank as a new council, and were able to adduce in support of their claim the fact that the resolutions of the two former periods had not yet been formally recognized. Pius IV., however, designated it a continuation of the earlier meetings. Ferdinand, in addition to regulations for the amendment of the clergy and the monastic system, demanded above all the legalization of the marriage of the priesthood and the concession of the "lay chalice," as he feared further defections to Protestantism. France and Spain laid stress on the recognition of the divine right of the episcopate, and its independence with regard to the pope. These episcopal tendencies were backed by a request that the bishops should reside in their sees—a position which Pius IV. acknowledged to be *de iure divino*; though, as it would have implied the annihilation of the Roman Curia, he refused to declare it as such. In consequence of these reformatory aspirations, the position of the pope and the council was for a while full of peril. But the papal diplomacy was quite competent to shatter an opposition which at no time presented an absolutely unbroken front, and by concessions, threats and the utilization of political and politico-ecclesiastical dissensions, to break the force of the attack. In the third period of the council, which, as a result of these feuds, witnessed no session from September 1562 to July 1563, doctrinal resolutions were also passed concerning the Lord's Supper *sub utraque specie* (*sessio* xxi., July 16, 1562), the sacrifice of the Mass (*sessio* xxii., September 27, 1562), the sacrament of ordination (*sessio* xxiii., July 15, 1563), the sacrament of marriage (*sessio* xxiv., November 11, 1563), and Purgatory, the worship of saints, relics and images (December 3, 1563). On the 4th of December 1563 the synod closed.

The dogmatic decisions of the Council of Trent make no attempt at embracing the whole doctrinal system of the Roman Catholic Church, but present a selection of the most vital doctrines, partly chosen as a counterblast to Protestantism, and formulated throughout with a view to that creed and its objections. From the discussions of the council it is evident that pronounced differences of opinion existed within it even on most important subjects, and that these differences were not reconciled. Hence came the necessity for reticences, equivocations and temporizing formulae. Since, moreover, the council issued its pronouncements without any reference to the decisions of earlier councils, and omitted to emphasize its relation to these, it in fact suppressed these earlier decisions, and posed not as continuing, but as superseding them.

The reformatory enactments touch on numerous phases of ecclesiastical life—administration, discipline, appointment to spiritual offices, the marriage law (*decretum de reformatione matrimonii "Tametsi," sessio* xxiv.), the duties of the clergy, and so forth. The resolutions include many that marked an advance; but the opportunity for a comprehensive and thorough reformation of the life of the Church—the necessity of which was recognized in the Catholic Church itself—was not embraced. No alteration of the abuses which obtained in the Curia was effected, and no annulment of the customs, so lucrative to that body and deleterious to others, was attempted. The question of the annates, for instance, was not so much as broached.

The Council of Trent in fact enjoyed only a certain appearance of independence. For the freedom of speech which had been accorded was exercised under the supervision of papal legates, who maintained a decisive influence over the proceedings and could count on a certain majority in consequence of the overwhelming number of Italians. That the synod figured as the responsible author of its own decrees (*sancta oecumenica et generalis tridentina synodus in spiritu sancto legitime congregata*) proves very little, since the following clause reads *praesidentibus apostolicae sedis legatis*; while the legates and the pope expresaly refused to sanction an application of the words of the Council of Constance—*universalem ecclesiam repraesentans*. The whole course of the council was determined by the presupposition that it had no autonomous standing, and that its labours were simply transacted under the commission and guidance of the pope. This was not merely a claim put forward by the Roman see at the time: it was acknowledged by the attitude of the synod throughout. The legates confined the right of discussion to the subjects propounded by the pope, and their position was that he was in no way bound by the vote of the majority. In difficult cases the synod itself left the decision to him, as in the question of clandestine marriages and the administration of the Lord's Supper *sub utraque specie*. Further, at the close of the sessions a resolution was adopted, by the terms of which all the enactments of the council *de morum reformatione atque ecclesiastica disciplina* were subject to the limitation that the papal authority should not be prejudiced thereby (*sessio* xxv. *cap*. 21). Finally, every doubt as to the papal supremacy is removed when we consider that the Tridentine Fathers sought for all their enactments and decisions the ratification (*confirmatio*) of the pope, which was conferred by Pius IV. in the bull *Benedictus Deus* (January 26, 1564). Again, in its last meeting (*sessio* xxv.), the synod transferred to the pope a number of tasks for which their own time had proved inadequate. These comprised the compilation of a catalogue of forbidden books, a catechism, and an edition of the missal and the breviary. Thus the council presented the Holy See with a further opportunity of extending its influence and diffusing its views. The ten rules *de libris prohibitis*, published by Pius IV. in the bull *Dominici gregis custodiae* (March 24, 1564), became of great importance for the whole spiritual life of the Roman Catholic Church: for they were an attempt to exclude pernicious influences, and, in practice, led to a censorship which has been more potent for evil than good. These regulations were modified by Leo XIII. in his Constitution *Officiorum ac munerum* (January 24, 1897). Acting on a suggestion of the council (*sessio* xxiv. *c.* 2; *sessio* xxv. *c.* 2), Pius IV. published a short conspectus of the articles of faith, as determined at Trent, in the bull *Injunctum nobis* (November 13, 1564). This so-called *Professio fidei tridentinae*, however, goes beyond the doctrinal resolutions of the synod, as it contains a number of clauses dealing with the Church and the position of the pope within the Church—subjects which were deliberately ignored in the discussions at Trent. In 1877 this confession—binding on every Roman Catholic priest—was supplemented by a pronouncement on the dogma of papal infallibility.

The great and increasing need of a manual for the instruction of the people gave rise in the first half of the 16th century to numerous catechisms. At the period of the council, that composed by the Jesuit Peter Canisius, father-confessor of the emperor Ferdinand, enjoyed the widest vogue. It failed, however, to receive the sanction of the synod, which preferred to undertake the task itself; and, as that body left its labours unfinished, the pope was entrusted with the compilation of a textbook. Pius V. appointed a commission (Leonardo Marini, Egidio Foscarari, Francisco Fureiro and Murio Calini) under the presidency of three cardinals, among them Charles Borromeo; and this commission discharged its duties with such rapidity that the *Catechismus a decreto concilii tridentini ad parochos* was published in Rome as early as the year 1568. The book is designed for the use of the cleric, not the layman. The *Missale romanum*, moreover, underwent revision: also the *Breviarium romanum*, the daily devotional work of the Roman priest. The necessity of still further improvements in the latter was forcibly urged in the Vatican Council.

The numerical representation of the Council of Trent was marked by considerable fluctuations. In the first session (December 13, 1545) the spiritual dignitaries present—omitting the 3 presiding cardinals—consisted of one other cardinal, 4 archbishops, 21 bishops and 5 generals of orders. On the other hand, the resolutions of the synod were signed at its close by the 4 presidents, then by 2 cardinals, 3 patriarchs, 25 archbishops, 166 bishops, 7 abbots, 7 generals of orders and 19 procurators of archbishops and bishops. In this council—as later in the Vatican—Italy was the dominant nation, sending two-thirds of the delegates; while Spain was responsible for about 30, France for about 20, and Germany for no more than 8 members. In spite of the paucity of its numbers at the opening and the unequal representation of the Church, which continued to the last, the oecumenical character of the council was never seriously questioned. On the motion of the legates, the resolutions were submitted to the ambassadors of the secular powers for signature, the French and Spanish envoys alone withholding their assent. The recognition of the council's enactments was, none the less, beset with difficulties. So far as the doctrinal decisions were concerned no obstacles existed; but the reformatory edicts—adhesion to which was equally required by the synod—stood on a different footing. In their character of resolutions claiming to rank as ecclesiastical law they came into conflict with outside interests, and their acceptance by no means implied that the rights of the sovereign, or the needs and circumstances of the respective countries, were treated with sufficient consideration. The consequence was that there arose an active and, in some cases, a tenacious opposition to an indiscriminate acquiescence in all the Tridentine decrees. Under Charles IX. and Henry IV. the situation was hotly debated in France: but these monarchs showed as little complaisance to the representations and protests of the Curia as did the French *parlement* itself; and only those regulations were recognized which came into collision neither with the rights of the king nor with the liberties of the Gallican Church. In Spain, Philip II. allowed, indeed, the publication of the *Tridentinum*, as also in the Netherlands and Naples, but always with the reservation that the privileges of the king, his vassals and his subjects, should not thereby be infringed. The empire, as such, never recognized the *Tridentinum*. Still it was published at provincial and diocesan synods in the territories of the spiritual princes, and also in the Austrian hereditary states.

In his official confirmation Pius IV. had already strictly prohibited any commentary on the enactments of the council unless undertaken with his approval, and had claimed for himself the sole right of interpretation. In order to supervise the practical working of these enactments, Pius created (1564) a special department of the Curia, the *Congregatio cardinalium concilii tridentini interpretum*; and to this body Sixtus V. entrusted the further task of determining the sense of the conciliar decisions in all dubious cases. The *resolutiones* of the congregation—on disputed points—and their *declarationes*—on legal questions—exercised a powerful influence on the subsequent development of ecclesiastical law.

The Council of Trent attained a quite extraordinary significance for the Roman Catholic Church; and its pre-eminence was unassailed till the *Vaticanum* subordinated all the labours of the Church in the past—whether in the region of doctrine or in that of law—to an infallible pope. On the theological side it fixed the results of medieval scholasticism and gleaned from it all that could be of service to the Church. Further, by pronouncing on a series of doctrinal points till then undecided it elaborated the Catholic creed; and, finally, the bold front which it offered to Protestantism in its presentation of the orthodox faith gave to its members the practical lead they so much needed in their resistance to the Evangelical assault. The regulations dealing with ecclesiastical life, in the widest sense of the words, came, for the most part, to actual fruition, so that, in this direction also, the council had not laboured in vain. For the whole Roman Catholic Church of the 16th century its consequences are of an importance which can scarcely be exaggerated: it showed that Church as a living institution, capable of work and achievement; it strengthened the confidence both of her members and herself, and it was a powerful factor in heightening her efficiency as a competitor with Protestantism and in restoring and reinforcing her imperilled unity. Indeed, its sphere of influence was still more extensive, for its labours in the field of dogma and ecclesiastical law conditioned the future evolution of the Roman Catholic Church. As regards the position of the papacy, it is of epoch-making significance—not merely in its actual pronouncements on the papal see, but also in its tacit subordination to that see, and the opportunities of increased influence accorded to it.

There were three periods of the council, separated by not inconsiderable intervals, each of an individual character, conducted by different popes, but forming a single unity—an indivisible whole, so that it is strictly correct to speak of one Council of Trent, not of three distinct synods.

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TRENT, the chief river in the midlands of England, the third in length in the country, exceeded only by the Thames and Severn. It rises in the north of Staffordshire, and discharges through the Humber into the North Sea, having a course of about 170 m., and a drainage area of 4052 sq. m. The source is on Biddulph Moor, which rises to a height of 1100 ft. The course of the river is at first southerly, and it skirts the manufacturing district of the Potteries, passing Stoke-upon-Trent. Immediately below this town the valley widens, and the fall of the river, from a point 15 m. from the source to the mouth, is only 338 ft. Passing Stone, the course becomes south-easterly, and the united waters of the Sow and the Penk are received on the right. Near Rugeley the direction becomes easterly, and near Alrewas the Trent receives the Tame on the right, and turns to the north-east. Much of the valley above this point is well wooded and picturesque, though the flanking hills are gently sloping, and of no great elevation. The river now passes

Burton-upon-Trent, in this part of its course forming the boundary between Staffordshire and Derbyshire. The fall from Burton to the mouth, a distance of 109 m., is 148 ft. The valley opens out as the stream, dividing into several channels at Burton and receiving on the left the Dove, enters Derbyshire. It then separates that county from Leicestershire and Nottinghamshire, receives in quick succession the Derwent (left), Soar (right) and Erewash (left), enters Nottinghamshire, and passes Nottingham, 81½ m. from the mouth. The next important town is Newark, which, however, the main channel of the river passes at a considerable distance to the west; the Devon joins here on the right, and the fall from this point to the mouth, a distance of 57½ m., is only 18 ft. The valley becomes flat, though the river is rather deeply entrenched in some parts. Forming the boundary between Nottingham and Lincolnshire, the Trent passes Gainsborough (26½ m. from the mouth), receives the Idle on the left, and, entering Lincolnshire and skirting the Isle of Axholme, joins the Yorkshire Ouse near Faxfleet. The lower part of the valley resembles the Fens in character, and is drained by many artificial channels. The northward turn at Newark is of interest inasmuch as it is considered that the river from this point formerly flowed towards Lincoln, and, following a depression in the escarpment there, passed down the valley at present occupied by the Witham to the Wash. It is suggested that the waters were diverted to the Humber by a stream within that system cutting back southward and tapping the Trent in the vicinity of Newark; and in high flood the Trent has been known to send water across the low parting to the Witham (see Avebury, *Scenery of England*, ch. xi.). The highest tides are felt about 40 m. up river, and the phenomenon of an "eagre" (bore or tidal wave) is seen rising on spring tides to a height of 4 or 5 ft., 15 m. above the mouth of the river.

The Trent is navigable for a distance of 94½ m. from its junction with the Ouse, to a point a short distance above the junction of the Derwent, the Trent Navigation Company having a general control of the navigation down to Gainsborough, the line of which passes through Nottingham by canals. On the river itself there are eight locks. Below Gainsborough the navigation is open, and vessels drawing 9 ft. can reach this point on spring tides. From the Derwent mouth the Trent and Mersey Canal follows the Trent valley upward, and gives connexion with the entire inland navigation system of the midlands and west of England. Short canals give access to Derby and the Erewash valley; the Leicester Navigation, following the Scar, connects with the Grand Junction canal; and the Grantham Canal carries a little traffic between that town and Nottingham. The Fossdyke, distinguished as the oldest navigable waterway still in use in England, as it was originally of Roman construction, connects the Trent with Lincoln and the Witham, and lower down the Sheffield and South Yorkshire canal joins the river from the west at Keadby. There is also a canal, little used, to Chesterfield.

TRENTE ET QUARANTE (called also *Rouge et Noir*), a game of French origin played with cards and a special table. It is one of the two games played in the gambling rooms at Monte Carlo, roulette being the other. The diagram illustrates one half of the table, the other half precisely corresponding to it. Two croupiers sit on each side, one of them being the dealer; behind the two on the side opposite to the dealer a supervisor of the game has his seat. Six packs of fifty-two cards each are used; these are well shuffled, and the croupier asks any of the players to cut, handing him a blank card with which to divide the mixed packs. There are only four chances at trente et quarante: *rouge* or *noir*, known as the *grand tableau*; *couleur* or *inverse*, known as the *petit tableau*. At Monte Carlo the stakes are placed on the divisions indicated on the table, the maximum being 12,000 francs and the minimum 20 francs which must be staked in gold. The dealer, who has placed all the cards before him, separates a few with the blank card, takes them in his left hand and invites the players to stake with the formula, "Messieurs, faites votre jeu!" After a pause he exclaims "Le jeu est fait, rien ne va plus!" after which no stake can be made. He then deals the cards in a row until the aggregate number of pips is something more than thirty, upon which he deals a second row, and that which comes nearest to thirty wins, the top row being always distinguished as *noir*, and the lower as *rouge*. In announcing the result the word *trente* is always omitted, the dealer merely announcing *un*, *trois*, *quatre*, as the case may be, though when forty is turned up it is described as *quarante*. The words *noir* and *inverse* are also never used, the announcement being *rouge gagne* or *rouge perd*, *couleur gagne* or *couleur perd*. Gain or loss over *couleur* and *inverse* depends upon the colour of the first card dealt. If this should be also the colour of the winning row, the player wins. Assuming, for example, that the first card dealt is red, and that the lower row of the cards dealt is nearest to thirty, the dealer will announce "Rouge gagne et le couleur." If the first card dealt is red, but the black or top row of cards is nearest to thirty, the dealer announces "Rouge perd et le couleur." It frequently happens that both rows of cards when added together give the same number. Should they both, for instance, add up to thirty-three, the dealer will announce "Trois après," and the deal goes for nothing except in the event of their adding up to thirty-one. *Un après* (*i.e.* thirty-one) is known as a *refait*; the stakes are put in prison to be left for the decision of the next deal, or if the player prefers it he can withdraw half his stake, leaving the other half for the bank. Assurance against a *refait* can be made by paying 1% on the value of the stake with a minimum of five francs. When thus insured against a *refait* the player is at liberty to withdraw his whole stake. It has been calculated that on an average a *refait* occurs once in thirty-eight coups. After each deal the cards are pushed into a metal bowl let into the table in front of the dealer. When he has not enough left to complete the two rows, he remarks "Les cartes passent"; they are taken from the bowl, reshuffled, and another deal begins.

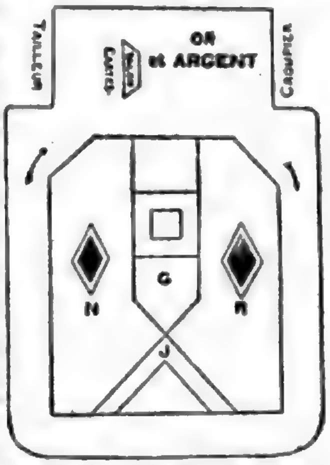

Diagram of Half of Trente et Quarante Table.
N, Noir. G, Grand tableau.
R, Rouge. J, Inverse.

TRENTON, a city and the county-seat of Grundy county, Missouri, U.S.A., on the E. fork of the Grand River, in the north central part of the state, about 100 m. N.E. of Leavenworth. Pop. (1890), 5039; (1900), 5396, including 192 foreign-born and 200 negroes; (1910), 5656. It is served by the Chicago, Rock Island & Pacific (which has repair shops here) and the Quincy, Omaha & Kansas City railways. It has a picturesque situation, and is laid out over a high uneven bluff. The city is a trading centre for a prosperous farming region, and coal is mined in the vicinity. Trenton was platted in 1841, became the county-seat in the same year, and was incorporated as a town in 1857. In 1893 it received a city charter under a general state law. In 1900–1903 it was the seat of Ruskin College, an institution founded by Walter Vrooman (b. 1869), a native of Missouri, and the organizer of the Ruskin Hall Workingmen's College, Oxford, England. The college was removed to Glen Ellyn, Illinois, in 1903 and after 1906 to Ruskin, Florida.

TRENTON, the capital of New Jersey, U.S.A., and the county-seat of Mercer county, on the eastern bank of the Delaware river, about 33 m. N.E. of Philadelphia, and about 59 m. S.W. of New York. Pop. (1890), 57,458; (1900), 73,307, of whom 16,793 were foreign-born (including 4114 Germans, 3621 English, 3292 Irish, and 1494 Hungarians), and 32,879 were of foreign parentage (both parents foreign-born), including 8873 of German parentage, 8324 of Irish parentage, 5513 of English parentage, and 2243 of Hungarian parentage; (1910 census), 96,815. Area, 9 sq. m. Trenton is served by the Pennsylvania (main line and Belvidere division) and the Philadelphia & Reading railway systems, by inter-urban electric railways, and by small freight and passenger steamers on the Delaware river; the Delaware & Raritan Canal connects with the Raritan river at New Brunswick. Trenton is at the head of navigation on the Delaware river, which falls 8 ft. here. Riverside park extends along its water front for about 3 m., and on the outskirts of the city lies Cadwalader park (100 acres), containing a zoological garden. In the centre of the city, marking the spot where Washington planted his guns at the battle of Trenton, stands the Battle monument, a Roman-Doric column of granite, 150 ft. high, hollow and fluted, its cap forming an observatory, with a statue of Washington by William R. O'Donovan (b. 1844). In Perry Street, mounted on a granite pedestal, is the "Swamp Angel," the great gun used by Federal troops in the marshes near Charleston, South Carolina, during their attack on that city in August 1863. There are many buildings in the city which are rich in historic associations. Chief among these is the barracks, erected by the colony in 1758 to mitigate the evils of billeting, and occupied by British troops during the Seven Years' War, and at different times by British, Hessian and American troops during the War of Independence. Other interesting landmarks are "Woodland" (formerly called "Bloomsbury Court"), built early in the 18th century by William Trent, and said to have sheltered, at various times, Washington, Lafayette and Rochambeau; the "Hermitage," erected some time before the War of Independence; and "Bow Hill," in the suburbs of the city, a quaint old colonial mansion which for some time before 1822 was a home of Joseph Bonaparte. Among the public buildings are the state capitol, the post office building, the county court house, the city hall, the second regiment armoury, public library (containing about 42,000 volumes in 1909), and the building (1910) given by Henry C. Kelsey to the city for the school of industrial arts (founded in 1898). Here also are the state normal and model schools (1855), the state library, housed in the capitol, the state school for deaf mutes, the state home for girls, one of the two state hospitals for the insane (opened in 1848), the state arsenal—the building being the old state prison—the state prison (1836), St Francis hospital (1874), Mercer hospital (1892), the William McKinley memorial hospital (1887), the city hospital, two children's day nurseries, the Friends' home, the Union industrial home (for destitute children), the Florence Crittenton home (1895), the indigent widows' and single women's home (1854), the Har Sinai charity society, the home for friendless children, and the society of St Vincent de Paul. Trenton is the see of Protestant Episcopal and Roman Catholic bishops.

Trenton is an important industrial centre. Its proximity to the coal fields of Pennsylvania and to the great markets of New York and Philadelphia, and its excellent transportation facilities by rail and by water, have promoted the development of its manufactures. The city is the greatest centre for the pottery industry in the United States. In 1905 there were 40 establishments for the manufacture of pottery and terra-cotta, employing 4571 labourers; and their total product was valued at $5,882,701—or 9·2% of the value of the pottery product of the United States, and 18% of the value of all the city's factory products, in this year. The chief varieties of this ware are vitrified china, belleck china, semi-porcelain, white granite and c. c. ware, vitrified porcelain for electrical supplies, porcelain bath tubs and tiles, and terra-cotta. Clay for the "saggers," or cases in which the wares are fired, is mined in the vicinity, but the raw materials for the fine grades of pottery are obtained elsewhere. Some pottery was made in Trenton by crude and primitive methods near the beginning of the 19th century, but the modern methods were not introduced until 1852, when yellow and Rockingham wares were first made here. In 1859 the manufacture of white granite and cream-coloured ware was successfully established. The fine exhibits from the Trenton potteries at the Centennial Exhibition in Philadelphia in 1876 greatly stimulated the demand for these wares and increased the competition among the manufacturers; and since that date there has been a marked development in both the quantity and the quality of the product. In Trenton, also, are manufactured iron, steel and copper wire, rope, cables and rods—the John A. Roebling's Sons Company has an immense wire and cable manufactory here—iron and steel bridge building materials and other structural work, plumbers' supplies (manufactured by the J. L. Mott Company), and machinery of almost every character, much of it being exported to foreign countries. Much rubber ware is also manufactured. In 1905 Trenton contained 312 factories, employing 14,252 labourers, and the total value of the factory products was $32,719,945.

The charter, as amended, provides for a mayor elected for two years and a common council of two members from each ward elected for two years. Other elected officers are: city clerk, comptroller, treasurer, counsel, receiver of taxes, engineer, inspector of buildings, overseer of poor, street commissioner and sealer of weights and measures. The municipality owns the water works and the sewer system; the water supply is obtained from the Delaware and is stored in a reservoir having a capacity of about 110,000,000 gallons.

The settlement of Trenton began in 1680 with the erection by Mahlon Stacy, a Quaker colonist of Burlington, of a mill at the junction of the Assanpink creek[1] with the Delaware river. By 1685 a number of colonists had settled at this point, which became known as "The Falls" on account of the rapids in the Delaware here. In 1714 Stacy sold his plantation at "The Falls" to William Trent (*c.* 1655–1724), speaker of the New Jersey Assembly (1723) and chief justice of the colony (1723–1724), in whose honour the place came to be called Trent-town or Trenton. In 1745 Trenton received a royal charter incorporating it as a borough, but in 1750 the inhabitants voluntarily surrendered this privilege, deeming it "very prejudicial to the interest and trade" of the community. In 1783 the New Jersey delegates in Congress proposed that Trenton be made the seat of the general government, but as this measure was opposed by the Southern delegates, it was agreed that Congress, pending a final decision, should sit alternately at Annapolis and Trenton. Congress accordingly met in Trenton in November 1784, but soon afterwards removed to New York, where better accommodation could be obtained. Trenton became the capital of the state in 1790, was chartered as a city in 1792, and received new charters in 1837, 1866, and 1874. The borough of South Trenton was annexed in 1850; the borough of Chambersburg and the township of Millham in 1888; the borough of Wilbur in 1898; and parts of the townships of Ewing and Hamilton in 1900.

See *The City of Trenton, N.J., a Bibliography* (1909), prepared by the Trenton Free Library; John O. Raum, *History of the City of Trenton* (Trenton, 1871); George A. Wolf, *Industrial Trenton* (Wilmington, Del., 1900); F. B. Lee, *History of Trenton* (Trenton, 1895).

TRENTON AND PRINCETON, BATTLES OF (1776–1777). These battles in the War of American Independence are noted as the first successes won by Washington in the open field. Following close upon a series of defeats, their effect upon his troops and the population at large was marked. After the capture of Fort Washington on Manhattan Island, on the 16th of November 1776, the British general, Sir William Howe, forced the Americans to retreat through New Jersey and across the Delaware into Pennsylvania. Howe then went into winter quarters, leaving the Hessian general, Rahl, at Trenton on the river with a brigade of 1200 men. Although Washington's army had dwindled to a mere handful and was discouraged by the year's disasters, it could still be trusted for a promising exploit. Ascertaining that the Hessians at Trenton were practically unsupported, the American general determined to attempt their capture. On the night of the 25th of December 1776 he recrossed the Delaware through floating ice to a point 9 m. above the enemy, whom he expected to reach at dawn of the following day, the 26th. Dividing his force of 2500 men into two divisions under Generals Sullivan and Greene, he approached the town by two roads, surprised the Hessian outposts, and then rushed upon the main body before it could form effectively. The charge of the American troops and the fire of their artillery and musketry completely disconcerted the enemy. All avenues of retreat being closed and their general mortally wounded, the latter to the number of 950 quickly surrendered and were marched back into Pennsylvania on the same day. The American loss was five or six wounded.

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[1] The name Assanpink is a corruption of an Indian word said to mean "place of stone implements." In gravel deposits in and near Trenton many stone implements, human skulls and remains of extinct animals have been found, and according to some scientists they are evidences of Glacial man, a conclusion disputed by others. (See America, vol. i. p. 817.)

Elated by this success and eager to beat up the enemy's advanced posts at other points, Washington again crossed the Delaware on the 30th of December and occupied Trenton. Hearing of this move Lord Cornwallis at Princeton, 10 m. north of Trenton, marched down with about 7000 troops upon the Americans on the 2nd of January 1777, and drove them across the Assanpink, a stream running east of the town. The Americans, who encamped on its banks that night, were placed in a precarious position, as the Delaware, with no boats at their disposal at that point, prevented their recrossing into Pennsylvania, and all other roads led towards the British lines to the northward. Washington accordingly undertook a bold manœuvre. Fearing an attack by Cornwallis on the next morning, he held a council of war, which confirmed his plan of quietly breaking camp that night and taking a by-road to Princeton, then cutting through any resistance that might be offered there and pushing on to the hills of northern New Jersey, thus placing his army on the flank of the British posts. His tactics succeeded. At Princeton (*q.v.*) he came upon three British regiments which for a time held him at bay. The 17th foot especially, under Colonel Mawhood, twice routed the American advanced troops, inflicting severe loss, but were eventually driven back toward Trenton. The other regiments retreated north toward New Brunswick, and Washington continued his march to Morristown, New Jersey. He had broken through Howe's lines and placed himself in an advantageous position for recruiting his army and maintaining a strong defensive in the next campaign. These two affairs of Trenton and Princeton put new life into the American cause, and established Washington in the confidence of his troops and the country at large.

See W. S. Stryker, *The Battles of Trenton and Princeton* (Boston, 1898).

TREPIDATION (from Lat. *trepidare*, to tremble), a term meaning, in general, fear or trembling, but used technically in astronomy for an imagined slow oscillation of the ecliptic, having a period of 7000 years, introduced by the Arabian astronomers to explain a supposed variation in the precession of the equinoxes. It figured in astronomical tables until the time of Copernicus, but is now known to have no foundation in fact, being based on an error in Ptolemy's determination of precession.

TRESCOT, WILLIAM HENRY (1822–1898), American diplomatist, was born in Charleston, South Carolina, on the 10th of November 1822. He graduated at Charleston College in 1840, studied law at Harvard, and was admitted to the bar in 1843. In 1852–1854 he was secretary of the U.S. legation in London. In June 1860 he was appointed assistant secretary of state, and he was acting secretary of state in June–October, during General Lewis Cass's absence from Washington, and for a few days in December after Cass's resignation. His position was important, as the only South Carolinian holding anything like official rank, because of his intimacy with President Buchanan, and his close relations with the secession leaders in South Carolina. He opposed[1] the re-enforcement of Fort Sumter, used his influence to prevent any attack on the fort by South Carolina before the meeting of the state's convention called to consider the question of secession, and became the special agent of South Carolina in Washington after his resignation from the state department in December. He returned to Charleston in February 1861; was a member of the state legislature in 1862–1866, and served as colonel on the staff of General Roswell S. Ripley during the Civil War; and later returned to Washington. He was counsel for the United States before the Halifax Fishery Commission in 1877; was commissioner for the revision of the treaty with China in 1880; was minister to Chile in 1881–1882; in 1882 with General U.S. Grant negotiated a commercial treaty with Mexico; and in 1889–1890 was a delegate to the Pan-American Congress in Washington. He died at Pendleton, South Carolina, his country place, on the 4th of May 1898.

His writings include *The Diplomacy of the Revolution* (1852), *An American View of the Eastern Question* (1854) and *The Diplomatic History of the Administrations of Washington and Adams* (1857).

TRESHAM, FRANCIS (*c.* 1567–1605), English Gunpowder Plot conspirator, eldest son of Sir Thomas Tresham of Rushton, Northamptonshire (a descendant of Sir Thomas Tresham, Speaker of the House of Commons, executed by Edward IV. in 1471), and of Muriel, daughter of Sir Thomas Throckmorton of Coughton, was born about 1567, and educated at Oxford. He was, like his father, a Roman Catholic, and his family had already suffered for their religion and politics. He is described as "a wild and unstayed man," was connected intimately with many of those afterwards known as the Gunpowder Plot conspirators, being cousin to Catesby and to the two Winters, and was implicated in a series of seditious intrigues in Elizabeth's reign. In 1596 he was arrested on suspicion together with Catesby and the two Wrights during an illness of Queen Elizabeth. In 1601 he took part in Essex's rebellion and was one of those who confined the Lord Keeper Egerton in Essex House on the 8th of February. He was imprisoned and only suffered to go free on condition of a fine of 3000 marks paid by his father. He was one of the promoters of the mission of Thomas Winter in 1602 to Madrid to persuade the king of Spain to invade England. On the death of Elizabeth, however, he, with several other Roman Catholics, joined Southampton in securing the Tower for James I.

Tresham was the last of the conspirators to be initiated into the Gunpowder Plot. According to his own account, which receives general support from Thomas Winter's confession, it was revealed to him on the 14th of October 1605. Inferior in zeal and character to the rest of the conspirators, he had lately by the death of his father, on the 11th of September 1605, inherited a large property and it was probably his financial support that was now sought. But Tresham, as the possessor of an estate, was probably less inclined than before to embark on rash and hazardous schemes. Moreover, he had two brothers-in-law, Lords Stourton and Monteagle, among the peers destined for assassination. He expressed his dislike of the plan from the first, and, according to his own account, he endeavoured to dissuade Catesby from the whole project, urging that the Romanist cause would derive no benefit, even in case of success, from the attempt. His representations were in vain and he consented to supply money, but afterwards discovered that no warning was to be given to the Roman Catholic peers. All the evidence now points to Tresham as the betrayer of the plot, and it is known that he was in London within 24 hours of the despatch of the famous letter to Lord Monteagle which revealed the plot (see GUNPOWDER PLOT). In all probability he had betrayed the secret to Monteagle previously, and the method of discovery had been settled between them, for it bears the marks of a prearranged affair, and the whole plan was admirably conceived so as to save Monteagle's life and inform the government, at the same time allowing the conspirators, by timely warning, opportunity to escape (see MONTEAGLE, WILLIAM PARKER, 4th baron). Tresham avoided meeting any of the conspirators as he had agreed to do at Barnet, on the 29th of October, but on the 31st he was visited by Winter in London, and summoned to Barnet on the following day. There he met Catesby and Winter, who were prepared to stab him for his betrayal, but were dissuaded by his protestations that he knew nothing of the letter. His entreaties that they would give up the whole project and escape to Flanders were unavailing. After the arrest of Fawkes on the night of the 4th Tresham did not fly with the rest of the conspirators, but remained at court and offered his services for apprehending them. For some days he was not suspected, but he was arrested on the 12th. On the 13th he confessed his share in the plot, and on the 29th his participation and that of Father Garnet in the mission to Spain. Shortly afterwards he fell ill with a complaint from which he had long suffered. On the 5th of December a copy of the *Treatise of Equivocation*, in which the Jesuit doctrine on that subject was treated, was found amongst his papers by Sir Edward Coke (see GARNET, HENRY). From the lessons learnt here he had evidently profited. On the 9th of December he declared he knew nothing about the book, and shortly before his death, with the desire of saving his friend, he withdrew his statement concerning Garnet's complicity in the Spanish negotiations, and denied that he had seen him or communicated with him for 16 years. His death took place on the 22nd. His last transparent falsehoods had removed any thoughts of leniency in the government. He was now classed with the other conspirators, and though he had never been convicted of any crime or received sentence, his corpse was decapitated and he was attainted by act of parliament. Tresham had married Anne, daughter of Sir John Tufton of Holtfield in Kent, by whom he had two daughters. His estates passed, notwithstanding the attainder, to his brother, afterwards Sir Lewis Tresham, Bart.

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[1] His "Narrative...concerning the Negotiations between South Carolina and President Buchanan in December 1860," written in February 1861, edited by Gaillard Hunt, appeared in the *American Historical Review*, xiii. 528–556 (1908).

TRESPASS (O. Fr. *trespas*, a crime, properly a stepping across, from Lat. *trans*, across, and *passus*, step, cf. "transgression," from *transgredi*, to step across), in law, any transgression of the law less than treason, felony or misprision of either. The term includes a great variety of torts committed to land, goods or person, distinguished generally by names drawn from the writs once used as appropriate to the particular transgression, such as *vi et armis*, *quare clausum fregit de bonis asportatis*, *de uxore abducta cum bonis viri*, *quare filium et heredem rapuit*, &c. Up to 1694 the trespasser was regarded, nominally at any rate, as a criminal, and was liable to a fine for the breach of the peace, commuted for a small sum of money, for which 5 Will. and Mar. c. 12 (1693) substituted a fee of 6s. 8d. recoverable as costs against the defendant. Trespass is not now criminal except by special statutory enactment, *e.g.* the old statutes against forcible entry, the game acts, and the private acts of many railway companies. When, however, trespass is carried sufficiently far it may become criminal, and be prosecuted as assault if to the person, as nuisance if to the land. At one time an important distinction was drawn between trespass general and trespass special or trespass on the case, for which see TORT. The difference between trespass and case was sometimes a very narrow one: the general rule was that where the injury was directly caused by the act of the defendant the proper remedy was trespass, where indirectly case. The difference is illustrated by the action for false imprisonment: if the defendant himself imprisoned the plaintiff the action was trespass; if a third person did so on the information of the defendant it was case. A close parallel is found in Roman law in the *actio directa* under the lex Aquilia for injury caused directly, the *actio utilis* for that caused indirectly. One of the reasons for the rapid extension of the action on the case, especially that form of it called *assumpsit*, was no doubt the fact that in the action on the case the defendant was not allowed to wage his law (see WAGER).

In its more restricted sense trespass is generally used for entry on land without lawful authority by either a man, his servants or his cattle. To maintain an action for such trespass the plaintiff must have possession of the premises. The quantum of possession necessary to enable him to bring the action is often a question difficult to decide. In most instances the tenant can bring trespass, the reversioner only case. Remedies for trespass are either judicial or extra-judicial. The most minute invasion of private right is trespass, though the damages may be nominal if the injury was trivial. On the other hand, they may be exemplary if circumstances of aggravation were present. Pleading in the old action of trespass was of a very technical nature, but the old-fashioned terms *alia enormia*, replication *de injuria*, new assignment, &c., once of such frequent occurrence in the reports, are of merely historical interest since the introduction of a simpler system of pleading, unless in those American states where the old pleading has not been reformed. The venue in trespass was formerly local, in case transitory. In addition to damages for trespass, an injunction may be granted by the court. The principal instances of extra-judicial remedies are distress damage feasant of cattle trespassing, and removal of a trespasser without unnecessary violence, expressed in the terms of Latin pleading by *molliter manus imposuit*.

Trespass may be justified by exercise of a legal right, as to serve the process of the law, or by invitation or license of the owner, or may be excused by accident or inevitable necessity, as deviation from a highway out of repair. Where a man abuses an authority given by the law, his wrongful act relates back to his entry, and he becomes a trespasser *ab initio*, that is, liable to be treated as a trespasser for the whole time of his being on the land. Mere breach of contract, such as refusal to pay for wine in a tavern which a person has lawfully entered, does not constitute him a trespasser *ab initio*. A trespass of a permanent nature is called a continuing trespass; such would be the permitting of one's cattle to feed on another's land without authority.

In Scots law trespass is used only for torts to land. By the Trespass (Scotland) Act 1865 trespassers are liable on summary conviction to fine and imprisonment for encamping, lighting fires, &c., on land without the consent and permission of the owner.

TRES TABERNAE (Three Taverns), an ancient village of Latium, Italy, a post station on the Via Appia, at the point where the main road was crossed by a branch from Antium. It is by some fixed some 3 m. S.E. of the modern village of Cisterna just before the Via Appia enters the Pontine marshes, at a point where the modern road to Ninfa and Norba diverges to the north-east, where a few ruins still exist (Grotte di Nottola), 33 m. from Rome. It is, however, more probable that it stood at Cisterna itself, where a branch road running from Antium by way of Satricum actually joins the Via Appia. Ulubrae, mentioned as a typical desert village by Roman writers, lay in the plain between Cisterna and Sermoneta. Tres Tabernae is best known as the point to which St Paul's friends came to meet him on his journey to Rome (Acts xxviii. 15) It became an episcopal see, but this was united with that of Velletri in 592 owing to the desertion of the place.

The name occurs twice in other parts of Italy as the name of post stations.

TRESVIRI, or TRIUMVIRI, in Roman antiquities, a board of three, either ordinary magistrates or extraordinary commissioners.

1. *Tresviri capitales*, whose duty it was to assist the higher officials in their judicial functions, especially criminal, were first appointed about 289 B.C., unless they are to be identified with the *tresviri nocturni* (Livy ix. 46, 3), who were in existence in 304. They possessed no criminal jurisdiction or *jus prensionis* (right of arrest) in their own right, but acted as the representatives of others. They kept watch over prisoners and carried out the death sentence (*e.g.* the Catilinarian conspirators were strangled by them in the *Carcer Tullianum*); took accused or suspected persons into custody; and exercised general control over the city police. They went the rounds by night to maintain order, and had to be present at outbreaks of fire. Amongst other things they assisted the aediles in burning forbidden books. It is possible that they were entrusted by the praetor with the settlement of certain civil processes of a semi-criminal nature, in which private citizens acted as prosecutors (see G. Götz in *Rheinisches Museum*, xxx. 162). They also had to collect the *sacramenta* (deposit forfeited by the losing party in a suit) and examined the plea of exemption put forward by those who refused to act as jurymen. Caesar increased their number to four, but Augustus reverted to three. In imperial times most of their functions passed into the hands of the *praefectus vigilum*.

2. *Tresviri epulones*, a priestly body (open from its first institution to the plebeians), assisted at public banquets. Their number was subsequently increased to seven, and by Caesar to ten, although they continued to be called *septemviri*, a name which was still in use at the end of the 4th century A.D. They were first created in 196 B.C. to superintend the *epulum Jovis* on the Capitol, but their services were also requisitioned on the occasion of triumphs, imperial birthdays, the dedication of temples, games given by private individuals, and so forth, when entertainments were provided for the people, while the senate dined on the Capitol.

3. *Tresviri monetales* were superintendents of the mint. Up to the Social War they were nominated from time to time, but afterwards became permanent officials. Their number was increased by Caesar to four, but again reduced by Augustus. As they acted for the senate they only coined copper money under the empire, the gold and silver coinage being under the exclusive control of the emperor. The official title was "tresviri aere argento auro flando feriundo."

4. *Tresviri reipublicae constituendae* was the title bestowed upon Octavianus, Lepidus and Antony for five years by the lex Titia, 43 B.C. The coalition of Julius Caesar, Pompey and Crassus has also been wrongly called a "triumvirate," but they never had the title *tresviri*, and held no office under that name.

See T. Mommsen, *Römisches Staatsrecht* (1888), ii. 594–601, 638, 601, 718; J. Marquardt, *Römische Staatsverwaltung* (1885), iii. 347.

TREVELYAN, SIR GEORGE OTTO, Bart. (1838–   ), British author and statesman, only son of Sir Charles Trevelyan, was born on the 20th of July 1838 at Rothley Temple, Leicestershire. His mother was Lord Macaulay's sister. He was educated at Harrow and at Trinity College, Cambridge, where he was second in the classical tripos. In 1861 he wrote his *Horace at the University of Athens*, a topical drama in verse, parts of which are said to have offended Whewell and lost Trevelyan a fellowship. The following year he went out as a civil servant to India, where he spent several years. During his stay he contributed "Letters of a Competition Wallah" to *Macmillan's Magazine* (republished 1864). *Cawnpore*, an account of that terrible tragedy, was published in 1865. During the same year he was elected to parliament for Tynemouth in the Liberal interest. In 1867 he wrote *The Ladies in Parliament*, a humorous political brochure in verse. At the general election of 1868 he was returned for the Hawick burghs, which he continued to represent until 1886. When the first Gladstone ministry was formed, in December 1868, Trevelyan was appointed civil lord of the Admiralty, but resigned in July 1870 on a point of conscience connected with the government Education Bill. He advocated a sweeping reform of the army, including the abolition of the purchase of commissions, and both in and out of parliament he was the foremost supporter for many years of the extension of the county franchise. In the session of 1874 he brought forward his Household Franchise (Counties) Bill, which was lost on the second reading; it was not till ten years later that the agricultural labourer was enfranchized. Among other causes which he warmly supported were women's suffrage, a thorough reform of metropolitan local government, and the drastic reform or abolition of the House of Lords. He was also in favour of the direct veto and other temperance legislation. In 1876 he published *The Life and Letters of Lord Macaulay*, one of the most admirable and most delightful of modern biographies; and in 1880 he published *The Early History of Charles James Fox*. In the latter year he was appointed parliamentary secretary to the Admiralty. This office he held until May 1882, when, after the assassination of Lord Frederick Cavendish, he became for two years chief secretary for Ireland. From November 1884 to June 1885 he was chancellor of the duchy of Lancaster. In February 1886 he became secretary for Scotland, but resigned on the 26th of March on account of his disagreement with some of Mr Gladstone's Irish Home Rule proposals. The same year he succeeded his father in the baronetcy. At the general election of 1886 Sir George Trevelyan lost his seat for Hawick. As a representative of the Unionist party he took part in the Round Table Conference, and, being satisfied with the modifications made by Mr Gladstone in his Home Rule scheme, he formally rejoined the Liberal party. In August 1887 he re-entered the House of Commons as member for the Bridgeton division of Glasgow; and from 1892 to 1895 he was secretary for Scotland. Early in 1897 he resigned his seat in parliament and retired into private life. In 1899 he published the first volume of a *History of the American Revolution*, which was completed (3 vols.) in 1905; in the latter year, as *Interludes in Prose and Verse*, he republished his early classical *jeux d'esprit* and Indian pieces. He had married in 1869 Caroline Philips, whose father was M.P. for Bury. His eldest son, Charles Philips Trevelyan (b. 1870), became Liberal M.P. for the Elland division of Yorkshire in 1899, and in 1908 was appointed parliamentary secretary to the Board of Education. The third son, George Macaulay Trevelyan (b. 1876), became well known as a brilliant historical writer, notably with two books on Garibaldi (1907 and 1909).

TREVET (or Trivet), **NICHOLAS** (*c.* 1258–*c.* 1328), English chronicler, was the son of Sir Thomas Trevet (d. 1283), a judge, and became a Dominican friar. After studying at Oxford and in Paris, he spent most of his subsequent years in writing and teaching, and died about 1328. His chief work is his *Annales sex regum Angliae*, a chronicle of English history covering the period between 1135 and 1307; this is valuable for the later part of the reign of Henry III. and especially for that of Edward I., who was the author's contemporary. A member of the same family was Sir Thomas Trivit (d. 1383), a soldier of repute, who saw a good deal of service in France, and died in October 1383.

The *Annales* were published in Paris in 1668, in Oxford in 1719, and were edited by Thomas Hog for the English Historical Society in 1845. Manuscripts are at Oxford and in the British Museum. Trevet's other historical works are *Catalogus regum anglo-saxonum durante heptarchia*, and *Les Cronicles qe frere N. Trevet escript a dame Marie* ("Marie" was Edward I.'s daughter Mary). From the latter Chaucer is believed to have obtained his *Man of Law's Tale*. Trevet also wrote a number of works of a theological and philological character.

TREVI (anc. *Trebiae*), a town of the province of Perugia, Italy, 30 m. S.E. of Perugia and 5 m. S. of Foligno by rail. Pop. (1901), 5708. The town stands on a steep hill 1355 ft. above sea-level. Several of its churches are architecturally interesting, especially the Madonna delle Lacrime (1487) outside the town, the elegant early Renaissance architecture of which resembles that of the Madonna del Calcinaio at Cortona, and most of them (and also the municipal picture gallery) contain paintings by artists of the Umbrian school—notably Lo Spagna, a pupil of Perugino. S. Emiliano has a group of three altars decorated with fine sculptures by Rocco da Vicenza (1521). The ancient town is believed to have been situated 1½ m. to the north-west, but little is known of it, and no remains save inscriptions exist.

TREVIGLIO, a town of Lombardy, Italy, in the province of Bergamo, 14 m. by rail S. by W. of that town, 410 ft. above sea-level. Pop. (1901), 5899 (town); 14,897 (commune). It has a fine church (S. Martino) containing pictures by Butinone and Zenale (1436–1526), both natives of the town, and having a lofty campanile of the 13th and 14th centuries. It has important silk works, wool-spinning, and other manufactories. It is a junction for Verona, Cremona and Bergamo, and steam tramways run to Monza, Lodi, &c.

TREVIRANUS, GOTTFRIED REINHOLD (1776–1837), German naturalist, was born at Bremen on the 4th of February 1776. He studied medicine at Göttingen, where he took his doctor's degree in 1796, and a year later he was appointed professor of medicine and mathematics in the Bremen lyceum. He died at Bremen on the 16th of February 1837.

In the first of his larger works, *Biologie; oder die Philosophie der lebenden Natur*, which appeared from 1802–1805, Treviranus gave clear expression to the theory of "descent with modification." He believed that simple forms (Protists), which he termed "zoophytes," were "the primitive types from which all the organisms of the higher classes had arisen by gradual development," and he laid down as a fundamental proposition "that all living forms are the results of physical influences which are still in operation, and vary only in degree and direction." Like many after him, he directed attention to the influence of the male elements in fertilization as a source of variation, but laid emphasis only on the intra-organismal power of adaptation to surroundings. Whatever opinion be entertained in regard to the priority and the importance of the contribution made by Treviranus to the theory of evolution, it is at least certain that he was a learned naturalist and an acute thinker. His most important later work of a synthetic nature was entitled *Erscheinungen und Gesetze des organischen Lebens* (1831).

His younger brother, **LUDOLPH CHRISTIAN TREVIRANUS** (1779–1864), studied medicine at Jena, and was successively professor of medicine at Bremen lyceum (1807), professor of natural history at Rostock (1812), professor of botany and director of the botanical garden at Breslau (1816), and professor of botany at Bonn (1830).

TREVISO (anc. *Tarvisium*), a town and episcopal see of Venetia, Italy, capital of the province of Treviso, 49 ft. above sea-level. Pop. (1901), 16,933 (town); 36,433 (commune). It is situated on the plain between the Gulf of Venice and the Alps, 18 m. by rail N. of Venice, at the confluence of the Sile with the Botteniga. The former flows partly round its walls, the latter through the town; and it has canal communication with the lagoons. It is an old town, with narrow irregular colonnaded streets and some interesting old frescoed houses. The cathedral of San Pietro, dating from 1141 and restored and enlarged in the 15th century by Pietro Lombardo, with a classical façade of 1836, has five domes. It contains a fine "Annunciation" by Titian (1519), an important "Adoration of the Shepherds" by Paris Bordone (born at Treviso in 1500), and frescoes by Pordenone. There are also sculptures by Lorenzo and Battista Bregno and others. The Gothic church of San Niccolò (1310–1352) contains a fine tomb by Tullio Lombardo, and a large altarpiece by Fra Marco Pensabene and others; in the church and adjoining chapter-house are frescoes by Tommaso da Modena (1352), some frescoes by whom (life of S. Ursula) are also in the Museo Civico. The Monte de Pietà contains an "Entombment" by an artist of the school of Pordenone (wrongly attributed to Giorgione). The churches of S. Leonardo, S. Andrea, S. Maria Maggiore, and S. Maria Maddalena also contain art treasures. The Piazza dei Signori contains picturesque brick battlemented palaces—the Salone del Gran Consiglio (1184) and the Palazzo del Commune (1268). Treviso is the seat of various manufactures—ironworks and pottery, macaroni, cotton-spinning and rice-husking, paper, printing, brushes, brickyards, flourmills—and is the centre of a fertile district.

The ancient Tarvisium was a *municipium*. It lay off the main roads, and is hardly mentioned by ancient writers, though Pliny speaks of the Silis as flowing "ex montibus Tarvisanis." In the 6th century it appears as an important place and was the seat of a Lombard duke. Charlemagne made it the capital of a marquisate. It joined the Lombard league, and was independent after the peace of Constance (1183) until in 1339 it came under the Venetian sway. From 1318 it was for a short time the seat of a university. In the 15th century its walls and ramparts (still extant) were renewed under the direction of Fra Giocondo, two of the gates being built by the Lombardi. Treviso was taken in 1797 by the French under Mortier (duke of Treviso). In March 1848 the Austrian garrison was driven from the town by the revolutionary party, but in the following June the town was bombarded and compelled to capitulate.

TREVITHICK, RICHARD (1771–1833), English engineer and inventor, was born on the 13th of April in the parish of Illogan, Cornwall, and was the only son of Richard Trevithick (1735–1797), manager of the Dolcoath and other important Cornish mines. He attended his first and only school at Camborne, and was in general a slow and obstinate scholar, though he showed considerable aptitude for figures. He inherited more than the average strength for which his family was famous; he stood 6 ft. 2 in. in height, and his feats in wrestling and in lifting and throwing weights were unexampled in the district. At the age of eighteen he began to assist his father, and, manifesting great fertility of mechanical invention, was soon recognized as the great rival of James Watt in improvements on the steam-engine (*q.v.*). His earliest invention of importance was his improved plunger pole pump (1797) for deep mining, and in 1798 he applied the principle of the plunger pole pump to the construction of a water-pressure engine, which he subsequently improved in various ways. Two years later he built a high-pressure non-condensing steam-engine, which became a successful rival of the low-pressure steam-vacuum engine of Watt. He was a precursor of George Stephenson in the construction of locomotive engines. On Christmas Eve 1801 his common road locomotive carried the first load of passengers ever conveyed by steam, and on the 24th of March 1802 he and Andrew Vivian applied for a patent for steam-engines in propelling carriages. In 1803 another steam vehicle made by him was run in the streets of London, from Leather Lane along Oxford Street to Paddington, the return journey being made by Islington. He next directed his attention to the construction of a steam locomotive for tramways, with such success that in February 1804 at Pen-y-darran in Wales he worked a tramroad locomotive which was able to haul twenty tons of iron; a similar engine was supplied to the Wylam colliery (Newcastle) in the following year. In 1808 he constructed a circular railway in London near Euston Square, on which the public were carried at the rate of twelve or fifteen miles an hour round curves of 50 or 100 ft. radius. Trevithick applied his high-pressure engine with great success to rock boring and breaking, as well as to dredging. In 1806 he entered into an engagement with the board of Trinity House, London, to lift ballast from the bottom of the Thames, at the rate of 500,000 tons a year, for a payment of 6d. a ton. A little later he was appointed to execute a driftway under the Thames, but the work was abandoned owing to the water breaking in. He then set up workshops at Limehouse, for the construction of iron tanks and buoys. He was the first to recognize the importance of iron in the construction of large ships, and in various ways his ideas also influenced the construction of steamboats. In the application of steam to agriculture his name occupies one of the chief places. A high-pressure steam threshing engine was erected by him in 1812 at Trewithen, while in the same year, in a letter to the Board of Agriculture, he stated his belief that every part of agriculture might be performed by steam, and that such a use of the steam-engine would "double the population of the kingdom and make our markets the cheapest in the world." In 1814 he entered on an agreement for the construction of engines for mines in Peru, and to superintend their working removed to Peru in 1816. Thence he went in 1822 to Costa Rica. He returned to England in 1827, and in 1828 petitioned parliament for a reward for his inventions, but without success. He died, penniless, at Dartford on the 22nd of April 1833.

A *Life of Richard Trevithick, with an account of his Inventions* was published in 1872 by his third son, Francis Trevithick (1812–1877).

TREVOR, SIR JOHN (1626–1672), English politician, was a son of Sir John Trevor (d. 1673) of Trevelyn, Denbighshire. His father was a member of parliament under James I. and Charles I., and sat also in the parliaments of Oliver and of Richard Cromwell, and was a member of the council of state during the Commonwealth. One of his uncles was Sir Sackvill Trevor (d. *c.* 1640), a naval officer, who was knighted in 1604; and another was Sir Thomas Trevor (1586–1656), the judge who decided in favour of the Crown in the famous case about the legality of ship-money, and was afterwards impeached and fined. Sir John Trevor was returned to parliament in 1646 as member for Flintshire. After filling several public positions under the Commonwealth and Protectorate he was a member of the council of state appointed in February 1660 and under Charles II. he rose to a high position. Having purchased the office of secretary of state he was knighted and entered upon its duties towards the end of 1668, just after he had helped to arrange an important treaty between England and France. He married Ruth, daughter of the great John Hampden, and died on the 28th of May 1672.

His second son, Thomas, Baron Trevor (1658–1730), was knighted in 1692 as solicitor-general and in 1695 became attorney-general. In 1701 he was appointed chief justice of the common pleas, and in 1712 he was created a peer as Baron Trevor of Bromham. On the accession of George I. in 1714 he was deprived of the justiceship, but from 1726 to 1730 he was lord privy seal. Three of his sons succeeded in turn to his barony, and a fourth son, Richard Trevor (1707–1771), was bishop of St Davids from 1744 to 1752, and then bishop of Durham. Robert, 4th Baron Trevor and 1st Viscount Hampden (1706–1783), represented his country at the Hague from 1739 to 1746, during which time he maintained a regular correspondence with Horace Walpole. He took the additional name of Hampden in 1754, on succeeding to the estates of that family, and in 1776, twelve years after he had become Baron Trevor, he was created Viscount Hampden. From 1759 to 1765 he was joint post-master-general. He wrote some Latin poems which were published at Parma in 1792 as *Poemata Hampdeniana.* His second son, John Hampden-Trevor (1749–1824), British minister at Munich from 1780 to 1783 and at Turin from 1783 to 1798, died only three weeks after he had succeeded his brother Thomas as 3rd Viscount Hampden, the titles becoming extinct.

Another member of this family was Sir John Trevor (1637–1717), Speaker of the House of Commons (1685). A partisan of James II., he was deprived of his office on the accession of William III., but in 1690 he was again a member of parliament, becoming Speaker for the second time in 1690 and master of the rolls in 1693. In 1695 he was found guilty of accepting a bribe and was expelled from the House of Commons, but he retained his judicial position until his death on the 20th of May 1717. Through his daughter Anne Sir John was the ancestor of the Hills, marquesses of Downshire, and of the family of Hill-Trevor, Viscounts Dungannon from 1766 to 1862.

TRÉVOUX, a town of eastern France, chief town of an arrondissement in the department of Ain, 16 m. N. of Lyons on the Paris-Lyons railway. Pop. (1906), 1934. The town is situated on the slope of the left bank of the Saône, which is here crossed by a suspension bridge and is dominated by two towers, remains of a feudal castle of the 12th century. The fortifications date from the 14th century, and the church from the same period. The law-court is a building of the 17th century, and was once the seat of the parlement of Dombes. Trévoux has a sub-prefecture and a tribunal of first instance. Gold and silver wire-drawing, introduced into the town by Jews in the 14th century, and the manufacture of apparatus for wire-drawing, are its chief industries.

Trévoux (Trevos) was hardly known before the 11th century, after which it was included in the domain of the lords of Thoire-Villars, from whom it acquired its freedom. It was bought by the Bourbons in 1402, became the capital of the Dombes, and had its own mint. In 1603 a well-known printing works was established there, from which in the 18th century the *Journal de Trévoux* and a universal dictionary known as the *Dictionnaire de Trévoux* were issued by the Jesuits.

TRIAL, in English law, the hearing by a court of first instance of the issues of fact and law involved in a civil or criminal cause. The term is inappropriate to rehearing by an appellate court. Trial follows upon the completion of the steps necessary to bring the parties before the court and to adjust the issues upon which the court is to adjudicate, which may be summed up in the term pleading (*q.v.*). In England the trial is usually in open court, and it is rare to try cases *in camera,* or to attempt to exclude the public from the hearing. The essential part of the trial is that there should be full opportunity to both sides for evidence and argument on the questions in dispute. At present in England, as distinguished from the rest of Europe, the evidence is ordinarily taken viva voce in court, and affidavits and depositions are sparingly accepted, whereas under the continental system the bulk of the proofs in civil cases are reduced to writing before the hearing.

The modes of trial have altered with legal development in English as in Roman law (see Action). Many forms of trial, notably those by ordeal, by wager of battle or of law (see Ordeal and Wager), and by grand assize, have become obsolete, and new forms have been created by legislation in order to meet altered circumstances of society. Up to a very recent date the tendency of the Roman and English systems was in opposite directions. In the former and in systems founded on it, such as the Scottish and French, trial by the judge became the rule, in the latter trial by judge and jury. In England the method of trial of issues of fact arising under the common law was by jury and a bench of judges. In truth the trials were the sittings of commissioners sent to inquire and report with the aid of the neighbourhood on questions of crime and civil wrongs in a county; the practice is summed up in the old phrase *ad quaestionem juris judices respondeant, ad quaestionem facti juratores.* In courts which administered equity or derived their law or procedure from the civil or canon law no jury was used, and the judges determined both law and fact. The system of trial before a full bench of judges even with a jury is now used on the European continent, but has been superseded in England by trial before a single judge with a jury except in the rare cases of *trial at bar.* This latter mode of trial is a survival of the mode universal in the superior courts before the writ of *nisi prius,* and is now only used in the king's bench division, when claimed by the Crown as of right or in cases of unusual importance and difficulty. Recent instances are the trial in 1904 of Arthur Lynch for treason in South Africa, and in 1905 of questions raised on a petition of right in respect of a claim to make the Crown responsible on the conquest of the Transvaal for acts of the Transvaal government before or during the war.

The necessity for trial by jury has been removed in many cases by legislation and rules of court (see Jury; Summary Jurisdiction), and the present English practice is summarized in the following statement.

In the High Court of Justice in England and Ireland several modes of trial are now used:—

1. Trial by judge with a jury used in the king's bench division and in probate and matrimonial cases. There is a right to have a jury as a matter of course in actions of defamation, false imprisonment, malicious prosecution, seduction and breach of promise of marriage. In other cases, subject to exceptions to be noted, a jury can be obtained on the application of either party.

2. Trial by a judge without a jury is invariable in the chancery division and now common in the other divisions. Cases in the chancery division are not tried with a jury unless a special order is made (Ord. 36, r. 3); and the High Court in cases in which trial without jury could be ordered without consent (1875) still retains the power of so trying them, and has also acquired power to direct trial without a jury of any issue requiring prolonged examination of documents or accounts or scientific or local investigation.

3. Trial with assessors, usual in admiralty cases (the assessors being nautical) but rare in other divisions.

4. Trial by an official referee in certain cases involving much detail (R.S.C.O. 36). In the county court the ordinary mode of trial is by the judge alone, but a jury of eight is allowed in certain cases on application, and in the admiralty jurisdiction marine assessors can be called in. In other local civil courts the trial is often by jury, as in the mayor's court of London, sometimes without, as in the vice-chancellor's court of the university of Oxford. In all civil cases the parties can by a proper submission have a trial before an arbitrator selected by or for them. As regards criminal cases the right to trial by due process of law before condemnation is given by art. 29 of Magna Carta; and the trial must be by jury unless a statute otherwise provides (see Court-Martial; Summary Jurisdiction).

The parties may be represented by lawyers, solicitor or counsel or both, according to the court, in county courts by accredited lay agents, or may conduct their case in person. The trial is carried on by stating to the court the pleadings if any and by opening the plaintiff's case. This is followed by the evidence of the witnesses, who are sworn and examined and cross-examined. On the completion of the plaintiff's case and evidence, the defendant's case is stated and evidence adduced in support of it. The plaintiff or his lawyer has as a rule the reply or last word, though in some courts, described as single speech courts, no reply is given. At the conclusion the judge sums up the law and facts of the case to the jury, if there is one, and their verdict is returned, or if there is no jury gives judgment, stating his conclusions on the law and facts involved.

There remain certain modes of trial not obsolete but rarely used. Such are impeachment of the House of Commons before the House of Lords; and in the case of a charge of treason or felony by a person having privilege of peerage, trial on indictment before the House of Lords, or in vacation before the court of the lord high steward. Trials by certificate, by inspection and by record, are obsolete.

The decisions on a trial at first instance are reviewed by appeal (*q.v.*), or in trial cases heard before a jury by application for a new trial, where the judge has not directed the jury correctly as to the law or has permitted them to consider inadmissible evidence, or the jurors have in their verdict acted without evidence or against the weight, *i.e.* the quality not the quantity of the evidence. Under the Criminal Appeal Act 1907 the decisions in criminal trials on indictment, whether on matters of law or of fact or on mixed questions of law or fact, are reviewable by the court of criminal appeal; but that court has no power to order a retrial of the case before a jury.

Scotland.—Jury trial was introduced into Scotland for certain classes of civil cases in the 19th century but is not much used. In criminal cases it is used where summary jurisdiction has not been conferred.

Ireland.—The law of Ireland as to trials is in substance the same as in England, except as to appeals in criminal cases.

United States.—In the United States the system of trial is that of the English common law as varied by Federal and state legislation. (W. F. C.)

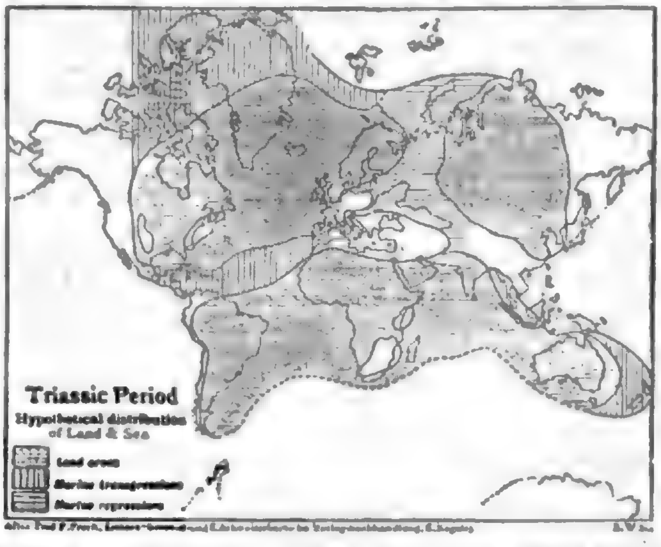
TRIANGLE, in geometry, a figure enclosed by three lines; if the lines be straight the figure is called a plane triangle; but if the figure be enclosed by lines on the surface of a sphere it is a spherical triangle. The latter are treated in TRIGONOMETRY; here we summarize the more important properties of plane triangles. In a plane triangle any one of the angular points can be regarded as the *vertex*; and the opposite side is called the *base*. The three sides and angles constitute the six elements of a triangle; it is customary to denote the angular points by capital letters and refer to the angles by these symbols; the sides are usually denoted by the lower case letter corresponding to that of the opposite angular point. Triangles can be classified according to the relative sizes of the sides or angles. An equilateral triangle has its three sides equal; an isosceles triangle has only two sides equal; whilst a scalene triangle has all its sides unequal. Also a right-angled triangle has one angle a right angle, the side opposite this angle being called the hypothenuse; an obtuse-angled triangle has one angle obtuse, or greater than a right angle; an acute-angled triangle has three acute angles, *i.e.* angles less than right angles. The triangle takes a prominent place in book i. of Euclid; whilst the relation of the triangle to certain circles is treated in book iv. (See GEOMETRY: § *Euclidean.*)

The following is a summary of the Euclidean results. The angles at the base of an isosceles triangle are equal and conversely; hence it follows that an equilateral triangle is also equiangular and conversely (i. 5, 6). If one side of a triangle be produced then the exterior angle is greater than either of the two interior opposite angles (i. 16), and equal to their sum (i. 32); hence the sum of the three interior angles equals two right angles. (In i. 17 it is shown that any two angles are less than two right angles.) The greatest angle in a triangle is opposite the greatest side (i. 18, 19). On the identical equality of triangles Euclid proves that two triangles are equal in all respects when the following parts are equal each to each (*a*) two sides, and the included angle (i. 4), three sides (i. 8, cor.), two angles and the adjacent side, and two angles and the side opposite one of them (i. 26). The mensuration is next treated. Triangles on the same base and between the same parallels, *i.e.* having the same altitude, are equal in area (i. 37); similarly triangles on equal bases and between the same parallels are equal in area (i. 38). If a parallelogram and triangle be on the same base and between the same parallels then the area of the parallelogram is double that of the triangle (i. 41). These propositions lead to the result that the area of a triangle is one half the product of the base into the altitude. The penultimate proposition (i. 47) establishes the beautiful theorem, named after Pythagoras, that in a right-angled triangle the square on the hypothenuse equals the sum of the squares on the other two sides. Two important propositions occur in book ii. viz. 12 and 13; these may be stated in the following forms: If ABC is an obtuse-angled triangle with the obtuse angle at C and a perpendicular be drawn from the angular point A cutting the base BC produced in D, then AB^2 (*i.e.* square on the side subtending the obtuse angle) $= BC^2 + CA^2 + 2BC\cdot CD$ (ii. 12); in any triangle (with the same construction but with the side AC subtending an acute angle B, we have $AC^2 = AB^2 + BC^2 - 2CB\cdot BD$ (see TRIGONOMETRY).

Book iv. deals with the circles of a triangle. To inscribe a circle in a given triangle is treated in iv. 4; to circumscribe a circle to a given triangle in iv. 5. The centre of the first circle is the intersection of the bisectors of the interior angles; if the meet of the bisectors of two exterior angles be taken, a circle can be drawn with this point as centre to touch two sides produced and the third side; three such circles are possible and are called the escribed circles. The centre of the circum circle is the intersection of the perpendiculars from the middle points of the sides. Concerning the circum circle we observe that the feet of the perpendiculars drawn from any point on its circumference to the sides are collinear, the line being called Simson's line. We may here notice that the perpendiculars from the vertices of a triangle to the opposite sides are concurrent; their meet is called the orthocentre, and the triangle obtained by joining the feet of the perpendiculars is called the pedal triangle. Also the lines joining the middle point of the sides to the opposite vertices, or medians, are concurrent in the centroid or centre of gravity of the triangle. There are several other circles, points and lines of interest in connexion with the triangle. The most important is the "nine point circle," so called because it passes through (*a*) the middle points of the sides; (*b*) the feet of the perpendiculars from the vertices to the opposite sides; and (*c*) the middle points of the lines joining the orthocentre to the angular points. This circle touches the inscribed and escribed circles. For the Brocard points and circle, Tucker's circles—with the particular forms cosine circle, triplicate ratio (T.R.) circle, Taylor's circle, McCay's circles, &c., see W. J. M'Clelland, *Geometry of the Circle*; or Casey, *Sequel to Euclid.*

TRIANGLE, in music (Fr. *triangle*, Ger. *Triangel*, Ital. *triangolo*), an instrument of percussion of indefinite musical pitch, consisting of a triangular rod of steel, open and slightly curved at one corner. The triangle, suspended by a loop, is played by means of a steel stick with a wooden handle. Varied rhythmical effects and different grades of forte and piano can be obtained. A sort of tremolo or roll can be produced by striking each end of the triangle alternately in rapid succession. When the triangle is scored for on a separate staff, the treble clef is used, but it is more often included with the bass drum on the bass stave. The tone of the triangle is clear and ringing, but it should have no definite pitch. The small triangles are the best. Beethoven, Mozart, Weber and other great masters employed the instrument.

TRIASSIC SYSTEM, in geology, the lowest or youngest system of the Mesozoic era; it occupies a position above the Permian and below the Jurassic system of rocks. The principal formations of the type region, Germany, are the Bunter, Muschelkalk and Keuper; these were for the first time grouped together under the systematic name "Trias" by F. von Alberti (1834). A description of the rocks in these formations will be found under their respective headings. For a long time this German development of the strata was regarded as typical of the period; later, however, the discovery of another more fossiliferous phase in the Alps and Mediterranean region, and subsequently in Asia and elsewhere, led geologists to take a different view of the system as a whole. It was clearly seen that there existed two distinct phases of Triassic rock-building, the one continental (terrestrial and lagoonal), the other marine (pelagic).



The original Trias of the "Germanic" area (including Great Britain) must be understood as a special local expression of the continental Trias, while the thoroughly marine type represents the normal aspect of sedimentation. Similarly, the fauna of the marine Trias is the standard for comparison with the life of other geological systems. The term Trias—indicative of the threefold grouping in Germany—thus loses its original significance when applied to the world-wide deposits of the period; its use, however, is continued by general consent.

Continental Trias.—The records of the terrestrial and lagoonal conditions during this period are to be found in the coarse conglomerates, red and mottled sandstones, marls and clays with their accompanying beds of dolomite and limestone, and layers of gypsum, anhydrite, rock-salt and coal. The coarser breccias and conglomerates appear to represent ancient screes and shore deposits, and in part at least their formation may have been due to torrential action. The remarkable oblique bedding in many of the sandstones, coupled with the fact that the sand grains are often very perfectly rounded, points to the transporting action of wind. Even the pebbles occasionally exhibit the *dreikanter* form, familiar in our modern deserts. But the marls, muds and many sandy beds were certainly deposited in sheets of water, which were evidently shallow and subject to frequent periods of desiccation. Of this we have evidence in the great abundance of reptilian foot-prints, of rain pits, ripple marks, and sun cracks upon what were once surface muds and sands. That the drying up of the water sheets repeatedly produced a highly saline condition is shown by the common occurrence of rock-salt, gypsum and anhydrite. In short, the physical conditions under which the continental Trias was formed appear to have been similar to those obtaining at the present day in the Caspian region.

In Europe the earlier deposits of the continental Trias occupy a compact area covering nearly the whole of Germany, whence they may be followed into central and northern England, Heligoland, Upper Silesia and the Vosges. Another tract lay over what are now the western Alps and south-east France; also in the Pyrenees, Balearic Islands, Sardinia, Sicily and southern Spain, and on to the north coast of Africa. In the Carpathians the same rocks appear, and they cover a large area in north-east Russia (Tartarian), and north-west Siberia. Later, the Muschelkalk limestones point to a temporary influx of the sea involving most of the above regions except Britain and Russia. Three encroachments of the sea are indicated, each followed by a period of excessive evaporation and contraction; these happened in the time of the Röth, the Lower and the Upper Muschelkalk. Finally the last influx, that of the Rhaetic Sea, not only spread much beyond the limits of the earlier incursions but remained as the forerunner of the succeeding Jurassic waters. In North America the continental Trias appears with a close resemblance to that of western Europe along the Atlantic coastal strip from Prince Edward's Island, through New Brunswick, Nova Scotia, Connecticut, New York, Pennsylvania, Virginia, to North Carolina. These are the rocks of the Newark series. Southwards it may be traced in Honduras, the Andes, Brazil, Argentina and Chile. Another large area in the western interior, Wyoming and New Mexico, is occupied by "red beds" (600–2000 ft., in part Permian) with gypsum and rock-salt. In southern Africa the upper part of the Karoo formation appears to represent Triassic time—the Stormberg beds (Permo-Trias) and the Beaufort beds (Rhaetic). In India the Panchet beds of the Gondwana system and in New South Wales the Hawkesbury series (Wianametta shales with coals and iron-stone, Hawkesbury sandstone, and at the base the Narraburra beds) belong to about the same horizon. In New Zealand the Otapiri, Wairoa and Oreti series appear to contain fossils indicating a transition from Permian to Rhaetic.

The Marine or Open-sea Trias.—This type of Triassic deposit is frequently referred to under the titles "Alpine," "Mediterranean" or "Pelagic." It first came into notice through the discovery of fossils in the neighbourhood of Recoaro and St Cassian on the southern side of the Alps, and these rocks were subsequently correlated with those at Hallstatt on the northern side. On both sides of the Alps rocks of this age flank the central core, but they are better developed, thicker and less altered towards the east than towards the west. In the western Alps Triassic beds can be only dimly recognized amongst the masses of schists called the *Schistes-lustrés* and *Bundnerschiefer*. In the eastern Alps, however, although there are sandy and conglomeratic members, such as the Werfen beds and Lunz sandstone, yet the most striking feature, in contrast with the continental Trias, is the prevalence of calcareous and dolomitic strata, to which must be added the enormously greater abundance of organic remains. The Alpine Trias varies in lithological character so rapidly from point to point, and has furthermore been subjected to so much dislocation, that great difficulty has been experienced in correlating the beds in different areas and in placing them in their proper order of sequence. The result of this difficulty has been the production of a nomenclature so unwieldy that no attempt at a detailed exposition is possible in the space here available. The principal members of the Alpine Trias will be found in their correct relative positions in the table. One of the most striking aspects of the Alpine Trias, on both the northern and southern sides, is the great development of dolomite which is so prominent a feature in the scenery of southern Tirol (Drei Zinnern, &c.). Some of these rocks contain the remains of corals, still more bear the fossils of calcareous algae, and although the view originally advanced by F. v. Richthofen that they represent Triassic coral reefs has been strongly opposed, it still seems to be the most reasonable explanation of their origin. The rocks of the marine Trias generally are argillaceous beds and dark limestones; in the Alpine regions many of the latter have been marmorized. The well-known white marble of Carrara in the Apuan Mountains is a metamorphosed Triassic limestone. The same type of Trias occurs also in south Italy (Longobardian), in Sicily, Barcelona, Balearic Islands, Crete, Bosnia, East Hungary, and the Carpathian Mountains by Bukovina and Dobrudja.

The Alpine-Mediterranean Trias sea evidently had a prolongation into Western Asia, for in Asia Minor, Armenia and Bokhara rocks with closely related fossils have been found. In Central Asia Triassic rocks are known in Afghanistan (sandstones with coal), Russian Turkestan, and in the Pamir. In India the lower Trias of the Salt Range presents the most typical example of the marine deposits of this stage. The Himalayan Trias more perfectly represents the upper portion of the system. Triassic limestones are found also in Kashmir and Hazara, and shales in Baluchistan. The marine Trias is known in Burma, Tongking, China and north-east Tibet; also in Japan, Siberia and in the arctic regions of Spitsbergen and Bear Island. In the Australasiatic region the marine Trias is found in the Sunda Islands, Sumatra, Roth and Timor and in New Caledonia.

Climate, Vulcanism.—There seems little room for doubt that the climate of Triassic times was, over large tracts of the northern continental region, dry and arid in character, certain features in the flora tending to support this view. On the other hand, the southern continental deposits, with *Glossopteris* and its allies, is more suggestive of a moist climate. There is no evidence of the glacial condition of the preceding Permian period. The Triassic period was one of rest so far as crustal movements were concerned. Volcanic activity, however, was exhibited on a large scale in the north-western part of North America, the great batholith of the Coast Range being nearly 1000 m. long; in British Columbia and Alaska large bodies of igneous rock are supposed to belong to this period. On the eastern side of the continent the diabase and dolerite lava flows, veins and sills of the famous Palisades of the Hudson valley belong to the Newark system. In Europe and Asia igneous rocks are scarce, but tuffs, porphyrites, &c., occur in the Schlern district (Upper Cassian age) and at Falzarego Strasse, Trarenanzes (Wengen horizon), in the Alpine region.

Life of the Triassic Period.—The plant life of this period exhibits on the whole a closer relationship with the Jurassic than with the preceding Palaeozoic formations. Flowering plants are unknown in the Triassic deposits and the dominant forms are all gymnosperms, the prevailing types being ferns and fern-like plants, cycadeans, conifers and equisetums. The Palaeozoic calamites, sigillarias and lepidodendrons became extinct early in this period; but in the southern hemisphere the *Glossopteris* flora still held on in considerable force. Amongst the ferns were *Lepidopteris*, *Sagenopteris*, *Danaeopteris*, with the Carboniferous genera *Sphenopteris*, *Pecopteris* and others. *Equisetites* and *Schizoneura* became common. Characteristic conifers were *Voltzia*, *Araucarites*, *Brachyphyllum*. The Cycadeans were represented by *Pterophyllum*, *Cycadites*, *Podozamites*, &c. *Baiera* was the representative of the ginkgos. Calcareous algae were important rock builders in some of the Triassic seas (*Gyroporella*, *Diplopora*). Fish remains are not generally common in the Trias; teeth and scales are crowded together in the "bone beds" in the Rhaetic and between the Keuper and Muschelkalk; in the marine Trias of the Alpine region skeletons are much more common. They are abundant also in the bituminous shales of the Connecticut Valley and in the Hawkesbury series of New South Wales. Selachians are represented by species of *Hybodus*, *Acrodus* and *Palaeobates*; dipnoids by *Ceratodus* and *Gosfordia*. The ganoids, with Palaeozoic as well as younger forms, include *Gyrolepis*, *Semionotus*, *Dictyopyge*, *Graphiurus*, *Belonorhynchus* and *Pholidopleuras*. Bony fish were very feebly represented. The amphibian labyrinthodonts (*Stegocephalia*) were numerous, their bones being found in the "bone beds" and in the Bunter and Keuper sandstones and their equivalents in North America, South Africa and India (*Labyrinthodont*, *Mastodonsaurus*, *Trematosaurus*, *Capitosaurus*). Their footprints are often very abundant, *e.g.* *Cheirotherium*. The reptiles of the Triassic deposits, unlike the amphibians, which are Permian in character, show a closer relationship with Jurassic forms; one of the most interesting facts in the life-history of the group is the development during this period of sea-going forms such as at a later geological period played so prominent a part. Early crocodilian reptiles are represented by *Belodon*, *Mystriosuchus*, *Stagonolepis*, *Parasuchus*; and *Rhyncocephalia* by *Telerpeton* and *Hyperodapedon*. Ichthyopterygians were represented by *Mixosaurus*, *Nothosaurus*, *Cymatosaurus*; early dinosaurs (carnivorous) by *Zanclodon*, *Anchisaurus*, *Thecodontosaurus*, *Palaeosaurus*; the remarkable theromorphs (anomodonts), by *Elginia*, *Dicynodon*, *Geikia*, *Gordonia*, Turtles became well established during this period (*Psammochelys, Chelyzoon*). Of great interest is the discovery of the earliest traces of mammals in the Trias of Europe, South Africa and North America. The imperfect remains (teeth and jaw-bones) do not admit of any certainty in deciphering their relationships. *Microlestes* from the Rhaetic of England and Württemberg and *Dromatherium* from North America are perhaps the best known; *Tritylodon* from South Africa may also be added. Among the lower forms of marine life foraminifera and sponges play a subordinate part. Corals, which with the calcareous algae built considerable reefs in some regions, at this time began to assume a modern aspect, and henceforth the Hexacorallids took the place of the Palaeozoic Tetracorallid forms (*Stylophyllum, Pinacophyllum, Thecosmilia*). Crinoids were locally very numerous individually (*Encrinus liliiformis, Dadocrinus gracilis*). Urchins were not very common, but an important change from the Palaeozoic to the Mesozoic type of shell took place about this time. Brachiopods were important; rostrate forms like *Terebratula* and *Rhynchonella* from this time onward became more prevalent than broad hinged genera. Pelecypods were abundant, *Myophoria, Halobia, Daonella, Pseudomonotis, Avicula, Gervillia* and many others. Gasteropods also were numerous; at the beginning of the period, as in other groups, many Palaeozoic forms lingered on, but one of the main changes about this time was the development and expansion of siphonostomous forms with canaliculate shells. Quite the most important Mollusca were the Cephalopods. In the early Trias there still remained a few of the Palaeozoic genera, *Orthoceras, Hungarites*, and forms which linked up the goniatites with the ammonites, which henceforth took the lead in numbers and variety. *Prionolobus, Aspidites, Celtites, Meekoceras, Tirolites, Ptychites, Tropites, Ceratites, Arcestes, Psiloceras* and *Flemingites* are a few of the prominent Triassic genera. The nautiloids were fairly well represented, but they exhibit no such marked development from Palaeozoic to Mesozoic types as is shown among the ammonoids.

In the tabulated synopsis of the Triassic system given below it has been impossible to include many of the names of groups and subordinate divisions. Some of these, such as the term "Noric" (Norian), have been used in a variety of ways. A clear account of the history of the study of the Trias will be found in K. A. von Zittel's *History of Geology and Palaeontology* (Eng. trans., London 1901).

REFERENCES.—The literature of the Trias is very voluminous. A full account, with full references as to date of publication, in *Lethaea Geognostica*, ed. by F. Frech, Theil II.; *Das Mesozoicum*, Bd. i. "Einleitung des Mesozoicum und der Trias" (F. Frech); "Continentale Trias" (E. Philippi and J. Wysogorski), 1903; 2nd Lieferung, "Die asiatische Trias" (F. Noetling), 1905; 3rd Lieferung, "Die Alpine Trias des Mediterran-Gebietes" (G. von Hathaber), Stuttgart, 1905. (J. A. H.)

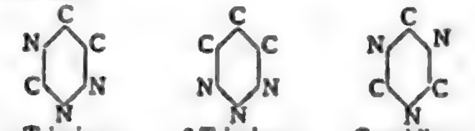
CONTINENTAL TRIAS.

		German Trias.	England.	
Keuper	Rhaetic	Sandstones and Clays with *Avicula contorta* Bone bed	Rhaetic or Penarth beds White Lias, black paper-shales, marls Bone bed	"Newark Series" of Eastern North America and "Red beds" (in part) of western interior states, North America. Hawkesbury Series of New South Wales. Panchet Series of India. Stormberg and Beaufort beds (part) of the Karoo Series, South Africa. Tartarian group of N.E. Russia (Urals).
	Gypskeuper	Stubensandstein Schilfsandstein	Red and mottled marls with rock-salt and gypsum Variously coloured sandstones and marls (with "Water-stones")	
	Kohlenkeuper	Grenz dolomite Lettenkohlensandstein Dolomitic limestones and marls	Conglomerate and breccia	
Muschelkalk		Haupt-Muschelkalk Anhydrite group, dolomite and marls with rock-salt and gypsum Zellendolomit Wellenkalk and dolomite	Absent	
Bunter		Upper division or Röth Middle division or Hauptsandstein and (Vogesensandstein) Lower division sandstones with occasional oolite (Rogenstein)	Upper mottled sandstone Pebble beds Lower mottled sandstone	

MARINE TRIAS OF THE ALPINE AND INDIAN TYPES.

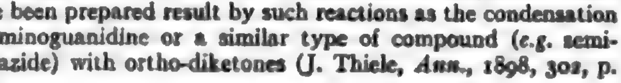
		North Alpine Region.	South Alpine Region.	Alpine Zone Fossils.	India.		America.
Upper Trias	Rhaetic	Kossen beds Lithodendron Kalk Rhaetic Dachstein Kalk and Dolomite	Kossen beds (Azzarola beds)	*Avicula contorta*	*Magalodon* limestone and "Hochgebergskalk" in part *Aulacothyris* limestone	Indian Upper Trias	Star Peak beds Sandstones with dinosaurs of Connecticut
	Norian	Dachstein Kalk and Coral limestones Main dolomite	Main dolomite Dachstein Kalk and Coral limestones	*Turbo* (*Worthenia*) *solitarius*	*Sagenites* beds Coral limestone *Halorites* beds		
	Carnian	Opponitz limestone and dolomite Reingrabner beds and Lunz sandstone Cardita beds	Raibl beds Schlern dolomite, Esino limestone, Marmolata limestone and "Ore-bearing" dolomite	*Tropites subbullatus* *Trachyceras aonides*	*Hauerites* beds Spiti dolomite *Daonella* beds		Taylorville beds of California Sandstones with plants, Richmond, Virginia
Middle Trias	Ladinian	Reifling limestone and Partnach beds Wetterstein dolomite and limestone	Cassian beds Wengen beds Buchenstein beds Dolomite or Coral limestone Mendola dolomite	*Trachyceras aon* *Daonella lommeli* *Protrachyceras reitzi*	*Daonella* beds		
	Anisian	"Alpine Muschelkalk" (part) Guttenstein beds Ramsau (Lower) dolomite	Trinodosus beds (Prezzo limestone) (Brachiopod limestone) Recoaro limestone Virgloria limestone Tuffs of Kaltwasser near Raibl	*Ceratites trinodosus* *Rhynchonella decussata*	*Ptychites* beds Niti limestone	Indian Middle Trias	Koipato beds
Lower Trias	Scythian Wengen beds	Campil beds Seis beds	Campil beds Seis beds	*Natiria costata* *Pseudomonotis clarai*	*Hedenstroemia* beds *Prionolobus* beds *Otoceras* beds (Permian) *Ceratite* beds of Salt Range	Indian Lower Trias	*Meekoceras* beds, Idaho

TRIAZINES, in organic chemistry, a series of cyclic compounds, containing a ring system composed of three carbon and three nitrogen atoms. Three series are possible, the positions of the various units of the ring system being illustrated in the annexed formulae:—

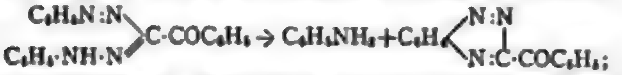


α-Triazines, β-Triazines, Cyanidines.

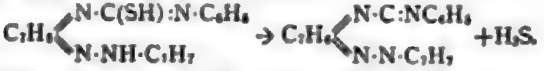
Few simple derivatives of the α-series are known, those which have been prepared result by such reactions as the condensation of aminoguanidine or a similar type of compound (*e.g.* semicarbazide) with ortho-diketones (J. Thiele, *Ann.*, 1898, 302, p. 299):



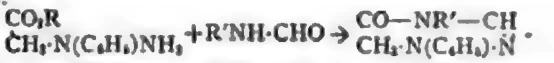
Wolff has obtained a chloro-derivative by the action of potassium cyanide on diazoacetophenone and subsequent treatment with acid. The phen-α-triazines are more numerous, and are obtained either by the action of concentrated acids on the formazyl compounds (E. Bamberger, *Ber.*, 1893, 26, p. 2786):—



by the reduction of symmetrical acyl-ortho-nitrophenyl hydrazines (*e.g.* $NO_2 \cdot C_6H_4 \cdot NH \cdot NH \cdot CHO$); or in the form of dihydro derivatives by the condensation of aldehydes with ortho-aminoazo compounds (H. Goldschmidt and Y. Rosell, *Ber.*, 1890, 23, p. 487), or from the aminoazo compound and a mustard oil, the resulting thiocarbanilido derivative being heated with acetic acid (M. Busch, *Ber.*, 1899, 32, p. 2960):—

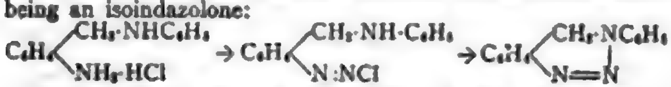


C. Harries (*Ber.*, 1895, 28, p. 1223) has also shown that *as*-phenylhydrazino-acetic esters, when heated with formamide and substituted formamides under pressure, yield dihydrotriazines:—

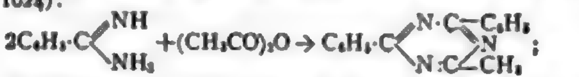


The phen-α-triazines are yellow-coloured crystalline compounds of a somewhat basic character.

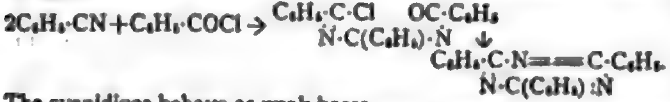
Derivatives of β-triazines are formed by the action of nitrous acid on ortho-aminobenzylamines (M. Busch, *Ber.*, 1892, 25, p. 445), or in small quantity by the action of nitrous acid on ortho-aminobenzoylphenylhydrazines (A. Konig and A. Reissert, *Ber.*, 1899, 32, p. 782), the chief product in this latter reaction being an isoindazolone:



The best drawn series of the triazines is the symmetrical or cyanidine series, members of which result from the condensation of acid anhydrides with aromatic amidines (A. Pinner, *Ber.*, 1892, 25, p. 1624):

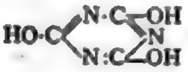


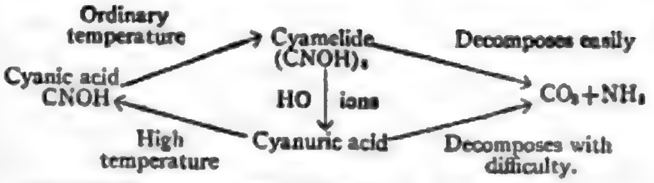
or by the condensation of aromatic nitriles with acid chlorides in the presence of aluminium chloride (Eitner and Krafft, *Ber.*, 1892, 25, p. 2263). In using benzoyl chloride in this reaction the condensation is found to proceed better if a little ammonium chloride be added:



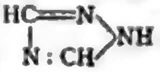
The cyanidines behave as weak bases.

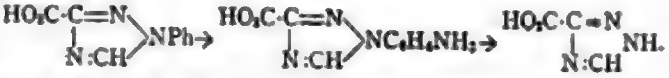
Mention may be made here of cyanuric acid, $H_3C_3N_3O_3$, which contains the same ring system as the cyanidines. It was first prepared by C. Scheele and is formed when urea is strongly heated or when cyanuric chloride is treated with water. It is usually represented by the inset formula and is closely related to cyanic acid and cyamelide, the relationships existing between the three compounds being shown in the diagram (see also A. Hantzsch, *Ber.*, 1906, 39, p. 139):





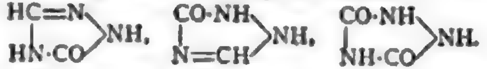
TRIAZOLES (pyrro-α and β′-diazoles), in organic chemistry, a series of heterocyclic compounds containing the ring complex (annexed formula). Derivatives were obtained by J. A. Bladin (*Ber.*, 1892, 25, p. 183) by the action of acetic anhydride on dicyanophenylhydrazine (formed from cyanogen and phenylhydrazine), the resulting acetyl derivative losing water and yielding phenylmethylcyanotriazole, which, on hydrolysis, gives the free acid. By eliminating carbon dioxide, phenylmethyltriazole results. In a similar manner, formic acid and dicyanophenylhydrazine yields a phenyl-triazole carboxylic acid, in which the phenyl group may be nitrated, the nitro group reduced to the amino group, and the product oxidized to a triazole carboxylic acid, which, by elimination of carbon dioxide, yields the free triazole:





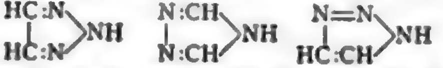
They also result when the acidylthiosemicarbazides are strongly heated, the mercapto-triazoles so formed being converted into triazoles on oxidation with hydrogen peroxide (M. Freund, *Ber.*, 1896, 29, p. 2483); by the condensation of hydrazides with acid amides; and by the distillation of the triazolones (see below) with phosphorus pentasulphide. The triazoles behave as weak bases, the imido-hydrogen being replaceable by metal.

The keto-dihydrotriazoles or triazolones are obtained by the action of hydrazines on acetyl urethane (A. Andreocci, *Ber.*, 1892, 25, p. 225). These compounds may be considered as 5-triazolones, a series of isomeric 3-triazolones resulting from the condensation of phenylsemicarbazide with aromatic aldehydes in the presence of an oxidant. The diketotetrahydrotriazoles, or urazoles, are formed by condensing urea derivatives with hydrazine salts, urazole itself resulting by the action of urea or biuret on hydrazine or its salts. It behaves as a strong acid and on treatment with phosphorus pentachloride at high temperatures gives triazole.



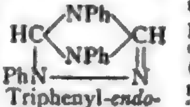
5-Triazolone. 3-Triazolone. Urazole.

Isomeric triazoles of the following constitutions are known:—



Osotriazole (αα′). Iminotriazole (ββ′). αβ-Triazole.

The osotriazoles are obtained by heating the osazones of orthodiketones with mineral acids; by the action of acetic anhydride on the hydrazoximes of orthodiketones, or by condensing diazo-methane with cyanogen derivatives (A. Peratones and E. Azzarello, *R. Acad. Lincei*, 1907 [v.], 16, pp. 237, 318). They are feeble bases which distil unchanged. The ring is very stable to most reagents. The iminobiazoles are formed by conversion of diacylhydrazines into iminochlorides which with ammonia or bases yield the required triazoles (R. Stollé, *Journ. prak. Chem.*, 1906 [ii.], 74, pp. 1, 13). M. Busch (*Ber.*, 1905, 38, pp. 856, 4049) has isolated a series of bridged ring compounds which he describes as *endo*-iminodihydrotriazoles, the triphenyl derivative (annexed formula) being prepared by condensing triphenylaminoguanidine with formic acid. The nitrate of this base (known as *nitron*) is so insoluble that nitrates may be gravimetrically estimated with its help. These bases combine with the alkyl iodides to yield quaternary ammonium salts.



Triphenyl-*endo*-iminodihydrotriazole.

TRIBALLI, in ancient geography, a Thracian people whose earliest home was near the junction of the Angrus and Brongus (the east and west Morava), and included towards the south "the Triballian plain" (Herodotus iv. 49), which corresponds to the plain of Kossovo in Turkey. In 424 B.C. they were attacked by Sitalces, king of the Odrysae, who was defeated and lost his life in the engagement. On the other hand, they were overcome by the Autariatae, an Illyrian tribe; the date of this event is uncertain (Strabo vii. 317). In 376 a large band of Triballi crossed Mt Haemus and advanced as far as Abdera; they were preparing to besiege the city, when Chabrias appeared off the coast with the Athenian fleet and compelled them to retire. In 339, when Philip II. of Macedon was returning from his expedition against the Scythians, the Triballi refused to allow him to pass the Haemus unless they received a share of the booty. Hostilities took place, in which Philip was defeated and nearly lost his life (Justin ix. 3), but the Triballi appear to have been subsequently subdued by him. After the death of Philip, the Triballi having taken up arms again, Alexander the Great in 334 crossed the Haemus and drove them to the junction of the Lyginus with the Danube. Their king Syrmus took refuge in Peuce (Peukē, an island in the Danube), whither Alexander was unable to follow him. The punishment inflicted by him upon the Getae, however, induced the Triballi to sue for peace (Arrian, *Anabasis*, i. 1, 4; 2, 2–4; 4, 6). About 280 a host of Gauls under Cerethrius defeated the Getae and Triballi (Justin xxv. 1; Pausanias x. 19, 7). Nevertheless, the latter for some fifty years (135–84) caused trouble to the Roman governors of Macedonia. In the time of Ptolemy their territory is limited to the district between the Ciabrus (Tzibritza) and Utus (Vid), in the modern Bulgaria, their chief town being Oescus (*Οἶσκος Τριβαλλῶν*). Under Tiberius mention is made of Treballia in Moesia, and the Emperor Maximin (235–237) had been commander of a squadron of Triballi. The name occurs for the last time during the reign of Diocletian, who dates a letter from Triballis. The Triballi are described as a wild and warlike people (Isocrates, *Panathenaicus*, 227), and in Aristophanes (*Birds*, 1565–1693) a Triballian is introduced as a specimen of an uncivilized barbarian.

See W. Tomaschek, "Die alten Thraker" in *Sitzungsberichte der k. Akad. der Wissenschaften*, cxxviii. (Vienna, 1893).

TRIBE (Lat. *tribus*, from *tres*, three), a word which is believed to have originally meant a "third part" of the people, in reference to the three patrician orders or political divisions of the people of Ancient Rome, the Ramnes, Tities and Luceres, representing the Latin, Sabine and Etruscan settlements. Its ethnological meaning has come to be any aggregate of families or small communities which are grouped together under one chief or leader, observing similar customs and social rules, and tracing their descent from one common ancestor. Examples of such "enlarged families" are the twelve tribes of Israel. In general the tribe is the earliest form of political organization, nations being gradually constituted by tribal amalgamation. (See FAMILY.)

TRIBERG, a town and health resort of Germany, in the grand duchy of Baden, in the Black Forest, pleasantly situated on the Gutach and surrounded by well-wooded hills, 2250 ft. above the sea, 35 m. by rail S.E. of Offenburg. Pop. (1905), 3717. It has four churches, one of them Anglican. Triberg is one of the chief centres of the Black Forest clock-making industry. Straw-plaiting, saw-milling, brewing, and the manufacture of wooden wares are also carried on, and the town has a permanent industrial exhibition. Triberg is what is called a *Luftkurort*, a place to which convalescents resort after a course of baths elsewhere. Near the town is the fine waterfall formed by the Gutach. Triberg came into the possession of Austria in 1654 and into that of Baden in 1806.

TRIBONIAN, the famous jurist and minister of Justinian, was born in Pamphylia in the latter part of the 5th century. Adopting the profession of an advocate, he came to Constantinople and practised in the prefectural courts there, reaching such eminence as to attract the notice of the emperor Justinian, who appointed him in 528 one of the ten commissioners directed to prepare the first *Codex* of imperial constitutions. In the edict creating this commission (known as *Haec quae*) Tribonian is named sixth, and is called "virum magnificum, magisteria dignitate inter agentes decoratum" (see *Haec quae* and *Summa reipublicae*, prefixed to the *Codex*.) When the commission of sixteen eminent lawyers was created in 530 for the far more laborious and difficult duty of compiling a collection of extracts from the writings of the great jurists of the earlier empire, Tribonian was made president and no doubt general director of this board. He had already been raised to the office of quaestor, which at that time was a sort of ministry of law and justice, its holder being the assessor of the emperor and his organ for judicial purposes, something like the English lord chancellor of the later middle ages. The instructions given to these sixteen commissioners may be found in the constitution *Deo auctore* (*Cod.* i. 17, 1), and the method in which the work was dealt with in the constitution *Tanta* (*Cod.* i. 17, 2), great praise being awarded to Tribonian, who is therein called ex-quaestor and ex-consul, and also as magister officiorum. This last constitution was issued in December 533, when the *Digest* was promulgated as a law-book. During the progress of the work, in January 532, there broke out in Constantinople a disturbance in the hippodrome, which speedily turned to a terrible insurrection, that which goes in history by the name of Nika, the watchword of the insurgents. Tribonian was accused of having prostituted his office for the purposes of gain, and the mob searched for him to put him to death (Procop. *Pers.* i. 24–26). Justinian, yielding for the moment, removed him from office, and appointed a certain Basilides in his place. After the suppression of the insurrection the work of codification was resumed. A little earlier than the publication of the *Digest*, or *Pandects*, there had been published another but much smaller law-book, the *Institutes*, prepared under Justinian's orders by Tribonian, with Theophilus and Dorotheus, professors of law (see Preface to *Institutes*). About the same time the emperor placed Tribonian at the head of a fourth commission, consisting of himself as chief and four others—Dorotheus, professor at Beyrut, and three practising advocates, who were directed to revise and re-edit the first *Codex* of imperial constitutions. The new *Codex* was published in November 534 (see constitution *Cordi nobis* prefixed to the *Codex*). With it Tribonian's work of codification was completed. But he remained Justinian's chief legal minister. He was reinstated as quaestor some time after 534 (Procop. *Pers.* i. 25; *Anecd.* 20) and seems to have held the office as long as he lived. He was evidently the prime mover in the various changes effected in the law by the novels of Justinian (*Novellae constitutiones*), which became much less frequent and less important after death had removed the great jurist. The date of his death has been variously assigned to 545, 546 and 547. Procopius says (*Anecd.* 20) that, although he left a son and many grandchildren, Justinian confiscated part of the inheritance.

The above facts, which are all that we know about Tribonian, rest on the authority of his contemporary Procopius and of the various imperial constitutions already cited. There are, however, two articles in the *Lexicon* of Suidas under the name "Tribonianos." They appear to be different articles, purporting to refer to different persons, and have been generally so received by the editors of Suidas and by modern legal historians. Some authorities, however, as for instance Gibbon, have supposed them to refer to the same person. The first article is unquestionably meant for the jurist. It is based on Procopius, whose very words are to some extent copied, and indeed it adds nothing to what the latter tells us, except the statement that Tribonian was the son of Macedonianus, was *ἀπὸ δικηγόρων τῶν ὑπάρχων*, and was a heathen and atheist, wholly averse to the Christian faith. The second article says that the Tribonian to whom it refers was of Side (in Pamphylia), was also *ἀπὸ δικηγόρων τῶν ὑπάρχων*, was a man of learning and wrote various books, among which are mentioned certain astronomical treatises, a dialogue *On Happiness*, and two addresses to Justinian. None of these books relate to law; and the better opinion seems to be that there were two Tribonians, apparently contemporaries, though possibly some of the attributes of the jurist have been, by a mistake of the compilers or transcribers of the *Lexicon* of Suidas, extended to the man of letters of the same name.

The character which Procopius gives to the jurist, even if touched by personal spite, is entitled to some credence, because it is contained in the *Histories* and not in the scandalous and secret *Anecdota*. It is as follows: "Tribonian was a man of great natural powers, and had attained as high a culture as any one of his time; but he was greedy of money, capable of selling justice for gain, and every day he repealed or enacted some law at the instance of people who purchased this from him according to their several needs. . . . He was pleasant in manner and generally agreeable, and able by the abundance of his accomplishments to cast into shade his faults of avarice" (*Pers.* i. 24, 25). In the *Anecdota* Procopius adds as an illustration of Justinian's vanity the story that he took in good faith an observation made to him by Tribonian, while sitting as assessor, that he (Tribonian) greatly feared that the emperor might some day, on account of his piety, be suddenly carried up into heaven. This agrees with the character for flattery which the minister seems to have enjoyed. The charge of heathenism we find in Suidas is probable enough; that is to say, Tribonian may well have been a crypto-pagan, like many other eminent courtiers and litterateurs of the time (including Procopius himself), a person who, while professing Christianity, was at least indifferent to its dogmas and rites, cherishing a sentimental recollection of the older and more glorious days of the empire.

In modern times Tribonian has been, as the master workman of Justinian's codification and legislation, charged with three offences—bad Latinity, a defective arrangement of the legal matter in the *Code* and *Digest*, and a too free handling of the extracts from the older jurists included in the latter compilation. The first of these charges cannot be denied; but it is hard to see why a lawyer of the 6th century, himself born in a Greek-speaking part of the empire, should be expected to write Latin as pure as that of the age of Cicero, or even of the age of Gaius and the Antonines. To the second charge also a plea of guilty must be entered. The *Code* and *Digest* are badly arranged according to our notions of scientific arrangement. These, however, are modern notions. The ancients generally cared but little for what we call a philosophic distribution of topics, and Tribonian seems to have merely followed the order of the Perpetual Edict which custom had already established, and from which custom would perhaps have refused to permit him to depart. He may more fairly be blamed for not having arranged the extracts in each title of the *Digest* according to some rational principle; for this would have been easy, and would have spared much trouble to students and practitioners ever since. As to the third complaint, that the compilers of the *Digest* altered the extracts they collected, cutting out and inserting words and sentences at their own pleasure, this was a process absolutely necessary according to the instructions given them, which were to prepare a compilation representing the existing law, and to be used for the actual administration of justice in the tribunals. The so-called *Emblemata* (insertions) of Tribonian were therefore indispensable, though, of course, we cannot say whether they were always made in the best way. Upon the whole subject of the codification and legislation in which Tribonian bore a part, see JUSTINIAN.

Tribonian, from the little we know of him, would seem to have been a remarkable man, and in the front rank of the great ones of his time. There is nothing to show that he was a profound and philosophical jurist, like Papinian or Ulpian. But he was an energetic, clear-headed man, of great practical force and skill, cultivated, accomplished, agreeable, flexible, possibly unscrupulous, just the sort of person whom a restless despot like Justinian finds useful. His interest in legal learning is proved by the fact that he had collected a vast legal library, which the compilers of the *Digest* found valuable (see const. *Tanta*).

The usual criticisms on Tribonian may be found in the *Anti-Tribonianus* (1567) of Francis Hotman, the aim of which is shown by its alternative title, *Sive discursus in quo jurisprudentiae Tribonianeae sterilitas et legum patriarum excellentia exhibetur*; and an answer to them in J. P. von Ludewig, *Vita Justiniani et Theodorae, nec non Triboniani.* (J. Br.)

TRIBUNE (Lat. *tribunus*, connected with *tribus*, tribe), a name assigned to officers of several different descriptions in the constitution of ancient Rome. The original tribunes were no doubt the commanders of the several contingents of cavalry and infantry which were supplied to the Roman army by the early gentilician tribes—the Tities, the Ramnes and the Luceres. In the historical period the infantry in each legion were commanded by six tribunes, and the number six is probably to be traced to the doubling of the three tribes by the incorporation of the new elements which received the names of *Tities secundi*, *Ramnes secundi*, *Luceres secundi*. The *tribuni celerum* or commanders of the horsemen no longer existed in the later times of the republic, having died out with the decay of the genuine Roman cavalry.[1] So long as the monarchy lasted these tribunes were doubtless nominated by the commander-in-chief, the king; and the nomination passed over on the establishment of the republic to his successors, the consuls. But, as the army increased, the popular assembly insisted on having a voice in the appointments, and from 362 B.C. six tribunes were annually nominated by popular vote, while in 311 the number was raised to sixteen, and in 207 to twenty-four, at which figure it remained. The tribunes thus elected sufficed for four legions and ranked as magistrates of the Roman people, and were designated *tribuni militum a populo*, while those who owed their office to the consuls bore the curious title of *tribuni rufuli*. The name was traced to a commander Rutilius Rufus (Liv. 7. 5; and Fest. *Ep.* 260), but was more probably derived from the dress (Mommsen, *Staatsrecht*, 1, 434). The rights of the assembly passed on to the emperors, and "the military tribunes of Augustus" were still contrasted with those nominated in the camp by the actual commanders. The obscure designation *tribunus aerarius* (tribune of the treasury) had also, in all probability, a connexion with the early organization of the army. The officer thus designated may have been the levier of the *tributum*, the original property tax, and was at any rate the paymaster of the troops. The soldier who was defrauded of his pay was allowed to exact it from this tribune by a very summary process. There was still another and important class of tribunes who owed their existence to the army. In the long struggle between the patrician and plebeian sections of the population, the first distinctions in the public service to which the plebeians forced their way were military, and the contest for admission to the consulate was, in large part, a contest for admission to the supreme command of the national forces. In 445 B.C., the year in which mixed marriages of patricians and plebeians were for the first time permitted, power was given to the senate (then wholly patrician) of determining from year to year whether consuls or military tribunes with consular authority (*tribuni militares consulari potestate* or *imperio*) should be appointed. But, even when the senate decided in favour of electing tribunes, no election was valid without the express sanction of the senate superadded to the vote of the centuriate assembly. If it happened to be too invidious for the senate openly to cancel the election, it was possible for the patricians to obtain a decision from the sacred authorities to the effect that some religious practice had not been duly observed, and that in consequence the appointment was invalid. According to tradition, recourse was had to this device at the first election, a plebeian having been successful. Forty-five years elapsed after the creation of the office before any plebeian was permitted to fill it, and it was held by very few down to the time at which it was abolished (367 B.C.) and the plebeians were fully admitted to the consulate. The number of consular tribunes elected on each occasion varied from three to six; there was no year without a patrician, and to the patrician members were probably confined the most highly esteemed duties, those relating to the administration of the law and to religion.

But by far the most important tribunes who ever existed in the Roman community were the tribunes of the commons (*tribuni plebis*). These were the most characteristic outcome of the long struggle between the two orders, the patrician and the plebeian. When in 494 B.C. the plebeian legionaries met on the Sacred Mount and bound themselves to stand by each other to the end, it was determined that the plebeians should by themselves annually appoint executive officers to stand over against the patrician officers—two tribunes (the very name commemorated the military nature of the revolt) to confront the two consuls, and two helpers called aediles to balance the two patrician helpers, the quaestors. The ancient traditions concerning the revolution are extremely confused and contradictory, and have caused endless discussions. The commonest story is that the masses assembled on the Sacred Mount bound themselves by a solemn oath to regard the persons of their tribunes and aediles as inviolable, and to treat as forfeited to Diana and Ceres, the plebeian divinities, the lives and property of those who offered them insult. That this purely plebeian oath was the real ultimate basis of the sanctity which attached to the tribunate during the whole time of its existence can hardly be believed. The revolution must have ended in something which was deemed by both the contending bodies to be a binding compact, although the lapse of time has blotted out its terms. The historian Dionysius may have been only technically wrong in supposing that peace was concluded between the two parties by the fetial priests, with the forms adopted by Rome in making treaties with a foreign state. If this were fact, the "sacrosanctity" of the tribunes would be adequately explained, because all such formal *foedera* were "sacrosanct." But, notwithstanding that the plebeians may safely be assumed to have been conscious of having to a large extent sprung from another race than the patricians and their retainers, it is not likely that the feeling was sufficiently strong to permit of the compact taking the form of a treaty between alien powers. Yet there must have been a formal acceptance by the patricians of the plebeian conditions; and most probably the oath which was first sworn by the insurgents was afterwards taken by the whole community, and the "sacrosanctity" of the plebeian officials became a part of the constitution. There must also have been some constitutional definition of the powers of the tribunes. These rested at first on an extension of the power of veto which the republic had introduced. Just as one consul could invalidate an order of his colleague, so a tribune could invalidate an order of a consul, or of any officer inferior to him. There was no doubt a vague understanding that only orders which sinned against the just and established practice of the constitution should be annulled, and then only in cases affecting definite individuals. This was technically called *auxilium*. The cases which arose most commonly concerned the administration of justice and the levying of troops.

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[1] In the legends of the foundation of the republic Brutus is represented as having exercised authority, when the king was banished, merely by virtue of holding the office of *tribunus celerum*.

Although the revolution of 494 gave the tribunes a foothold in the constitution, it left them with no very definite resources against breaches of compact by the patricians. The traditional history of the tribunate from 494 to 451 B.C. is obscure, and, so far as details are concerned, nearly worthless; but there is a thread running through it which may well be truth. We hear of attacks by patricians on the newly won privileges, even of the assassination of a tribune, and of attempts on the part of the plebeians to bring patrician offenders to justice. The assembled plebeians attempt to set up a criminal jurisdiction for their own assembly parallel to that practised by the older centuriate assembly, in which the nobles possess a preponderating influence. Nay, more, the plebs attempts something like legislation; it passes resolutions which it hopes to force the patrician body to accept as valid. As to details, only a few are worth notice. In the first place, the number of tribunes is raised to ten, how we do not know; but apparently some constitutional recognition of the increase is obtained. Then an alteration is made in the mode of election. As to the original mode, the ancient authorities are hopelessly at variance. Some of them gravely assert that the appointment lay with the assembly of the curiae—the most ancient and certainly the most patrician in Rome, even if we allow the view, which, in spite of great names, is more than doubtful, that the plebeians were members of it at any time when it still possessed political importance. The opinion of Mommsen about the method of election is more plausible than the others. It was in accordance with the Roman spirit of order that the tribunes, in summoning their assemblies, should not ask the plebeians to come *en masse* as individuals, and vote by heads, but should organize their supporters in bands. The *curia* was certainly a territorial district, and the tribunes may have originally used it as the basis of their organization. If tribunes were elected by plebeians massed *curiatim*, such a meeting would easily be mistaken in later times for the *comitia curiata*. At any rate, a change was introduced in 471 by the Publilian Law of Volero, which directed that the tribunes should be chosen in an assembly organized on the basis of the Servian or local tribe, instead of the *curia*. This assembly was the germ of the *comitia tributa*. The question by what authority the Law of Volero was sanctioned is difficult to answer. Possibly the law was a mere resolution of the plebeians with which the patricians did not interfere, because they did not consider that the mode of election was any concern of theirs. In the first period of the tribunate the tribunes almost certainly agitated to obtain for their supporters a share in the benefits of the state domain. And, whatever view may be taken of the movement which led to the decemvirate, an important element in it was of a certainty the agitation carried on by the tribunes for the reduction of the law of Rome to a written code. Until they obtained this it was impossible for them effectually to protect those who appealed against harsh treatment by the consuls in their capacity of judges.

During the decemvirate the tribunate was in abeyance. It was called into life again by the revolution of 449, which gave the tribunes a considerably stronger position. Their personal privileges and those of the aediles were renewed, while sacrosanctity was attached to a body of men called *judices decemviri*, who seem to have been the legal assistants of the tribunes. The road was opened up to valid legislation by the tribunes through an assembly summoned by them on the tribe-basis (*concilium plebis*), but in this respect they were submitted to the control of the senate. The growth of the influence of this assembly over legislation belongs rather to the history of the comitia (*q.v.*) than to that of the tribunate. After the Hortensian Law of 287 B.C. down to the end of the republic the legislation of Rome was mainly in the hands of the tribunes. The details of the history of the tribunate in its second period, from 449 to 367 B.C., are hardly less obscure than those which belong to the earlier time. There was, however, on the whole, undoubtedly an advance in dignity and importance. Gradually a right was acquired of watching and interfering with the proceedings of the senate, and even with legislation. Whether the absolute right of veto had been achieved before 367 may well be doubted. But the original *auxilium*, or right of protecting individuals, was, during this period, undergoing a very remarkable expansion. From forbidding a single act of a magistrate in relation to a single person, the tribunes advanced to forbidding by anticipation all acts of a certain class, whoever the persons affected by them might prove to be. It therefore became useless for the senate or the comitia to pass ordinances if a tribune was ready to forbid the magistrates to carry them out. Ultimately the mere announcement of such an intention by a tribune was sufficient to cause the obnoxious project to drop; that is to say, the tribunes acquired a right to stop all business alike in the deliberative assembly, the senate, and in the legislative assemblies, the comitia. The technical name for this right of veto is *intercessio*. To what extent the tribunes during the time from 449 to 367 took part in criminal prosecutions is matter of doubt. The XII. Tables had settled that offenders could only be punished in person by the centuries, but tradition speaks of prosecutions by tribunes before the tribes where the penalty sought was pecuniary. The two main objects of the tribunes, however, at the time of which we are speaking were the opening of the consulate to plebeians and the regulation of the state domain in the interests of the whole community. Both were attained by the Licinio-Sextian Laws of 367.

Then a considerable change came over the tribunate. From being an opposition weapon it became an important wheel in the regular machine of state. The senate became more and more plebeian, and a new body of nobility was evolved which comprised both orders in the state. The tribunes at first belonged to the same notable plebeian families which attained to the consulate. The old friction between senate and tribunes disappeared. It was found that the tribunate served to fill some gaps in the constitution, and its power was placed by common consent on a solid constitutional basis. From 367 to 134 B.C. (when Tiberius Gracchus became tribune) the tribunate was for the most part a mere organ of senatorial government. As the change made by the Gracchi was rather in the practice than in the theory of the tribunate, it will be convenient at this point to give a definite sketch of the conditions and privileges attaching to the office.

Even after the difference between patrician and plebeian birth had ceased to be of much practical consequence in other directions, the plebeian character was a necessity for the tribune. When the patricians P. Sulpicius Rufus and, later, P. Clodius (the antagonist of Cicero) desired to enter on a demagogic course, they were compelled to divest themselves of their patrician quality by a peculiar legal process. Even the patricians who became so by mere fiat of the emperors were excluded from the tribunate. The other necessary qualifications were for the most part such as attached to the other Roman magistracies—complete citizenship, absence of certain conditions regarded as disgraceful, fulfilment of military duties. The minimum age required for the office was, as in the case of the quaestorship, twenty-seven. The tribunate, however, stood outside the round of magistracies, the conditions of which were regulated by the Villian Law of 180 B.C. The election took place in a purely plebeian assembly, ranged by tribes, under the presidency of a tribune selected by lot. The tribune was bound by law to see a complete set of ten tribunes appointed. Technically, the tribunes were reckoned, not as magistrates of the Roman people, but as magistrates of the Roman plebs, they therefore had no special robe of office, no lictors, but only messengers (*viatores*), no official chair, like the curule seat, but only benches (*subsellia*) Their right to summon the plebs together, whether for the purpose of listening to a speech (in which case the meeting was a *contio*) or for passing ordinances (*comitia tributa*), was rendered absolute by the "laws under sacred sanction";

(*leges sacratae*), which had been incorporated with the constitution on the abolition of the decemvirate. The right to summon the senate and to lay business before it was acquired soon after 367, but was seldom exercised, as the tribunes had abundant means of securing what they wanted by pressure applied to the ordinary presidents—the consuls or the praetor. When an *interregnum* came about and there were no "magistrates of the Roman people," the plebeian tribunes became the proper presidents of the senate and conductors of ordinary state business. At the end of the republic there were *interregna* of several months' duration, when the tribunes held a position of more than usual importance. A tenure of the tribunate did not, until a comparatively late period (probably about the time of the Second Punic War), confer a claim to a permanent seat in the senate. The candidates for the office were mainly young men of good family who were at the beginning of their political career, but the office was often filled by older men of ambition who were struggling upwards with few advantages. The plebeian aediles very soon after 367 became dissociated from the tribunes and associated with the curule aediles, so that in the political hierarchy they really ranked higher than those who were originally their superior officers.

The real kernel of the tribune's power consisted in his *intercessio*, or right of invalidating ordinances, whether framed by the senate or proposed by a magistrate to the *comitia*, or issued by a magistrate in pursuance of his office. From 367 B.C. down to the time of the Gracchi the power of veto in public matters was, on the whole, used in the interests of the aristocratic governing families to check opposition arising in their own ranks. A recalcitrant consul was most readily brought to obedience by an exercise of tribunician power. But, although modern readers of the ancient historians are apt to carry away the idea that the tribunate was an intensely political office, it is safe to say that the occasions on which tribunes found it possible to play a prominent part in politics were extremely few, even in the late republic. On the other hand, the tribunes found a field for constant activity in watching the administration of justice and in rendering assistance to those who had received harsh treatment from the magistrates. The tribunes were, in fact, primarily legal functionaries, and constituted in a way the only court of appeal in republican Rome. It was to this end that they were forbidden to pass a whole night away from the city, except during the Latin festival on the Alban Mount, and that they were expected to keep their doors open to suppliants by night as well as by day. They held court by day in the Forum close by the Porcian basilica, and frequently made elaborate legal inquiries into cases where their help was sought. Naturally this ordinary humdrum work of the tribunes has left little mark on the pages of the historians, but we hear of it not infrequently in Cicero's speeches and in other writings which deal with legal matters. According to the general principle of the constitution, magistrates could forbid the acts of magistrates equal to or inferior to themselves. For this purpose the tribunes were deemed superior to all other officers. If a tribune exercised his veto no other tribune could annul it, for the veto could not be itself vetoed, but it was possible for another tribune to protect a definite individual from the consequences of disobedience. The number of the tribunes (ten) made it always possible that one might balk the action of another, except at times when popular feeling was strongly roused. In any case it was of little use for a tribune to move in any important matter unless he had secured the co-operation or at least the neutrality of all his colleagues. The veto was not, however, absolute in all directions. In some it was limited by statute; thus the law passed by Gaius Gracchus about the consular provinces did not permit a tribune to veto the annual decree of the senate concerning them. When there was a dictator at the head of the state, the veto was of no avail against him. One of the important political functions of the tribunes was to conduct prosecutions of state offenders, particularly ex-magistrates. These prosecutions began with a sentence pronounced by the tribune upon the culprit, whereupon, exercising the right given him by the XII. Tables, the culprit appealed. If the tribune sought to inflict punishment on the culprit's person, the appeal was to the assembly of the centuries; if he wished for a large fine, the appeal was to the assembly of the tribes. As the tribune had no right to summon the centuries, he had to obtain the necessary meetings through the urban praetor. In the other event he himself called together the tribute assembly and proposed a bill for fining the culprit. But the forms of trial gone through were very similar in both cases.

It is commonly stated that a great change passed over the tribunate at the time of the Gracchi, and that from their day to the end of the republic it was used as an instrument for setting on foot political agitation and for inducing revolutionary changes. This view is an inversion of the facts. The tribunate did not create the agitation and the revolutions, but these found vent through the tribunate, which gave to the democratic leaders the hope that acknowledged evils might be cured by constitutional means, and in the desperate struggle to realize it the best democratic tribunes strained the theoretic powers of their office to their ruin. For the bad tribunes did not hesitate to use for bad ends the powers which had been strained in the attempt to secure what was good. But herein the tribunate only fared like all other parts of the republican constitution in its last period. The consuls and the senate were at least as guilty as the tribunes. After a severe restriction of its powers by Sulla and a restoration by Pompey, which gave a twenty years' respite, the essential force of the tribunate was merged into the imperial constitution, of which indeed it became the principal constituent on the civil side. The ten tribunes remained, with very restricted functions. The emperors did not become tribunes, but took up into their privileges the essence of the office, the "tribunician authority." This distinction between the principle of the office and the actual tenure of the office was a creation of the late republic. Pompey, for example, when he went to the East, was not made proconsul of all the Eastern provinces, but he exercised in them a "proconsular authority" which was equal to that of the actual proconsuls—an authority which was the germ of the imperial authority on its military side. Similarly the emperor, as civil governor, without being tribune, exercised powers of like quality with the powers of the tribune, though of superior force. By virtue of his tribunician authority he acquired a veto on legislation, he became the supreme court of appeal for the empire, and to his person was attached the ancient sacrosanctity. Augustus showed the highest statesmanship in founding his power upon a metamorphosed tribunate rather than upon a metamorphosed dictatorship, upon traditions which were democratic rather than upon traditions which were patrician and optimate. The tribunes continued to exist till a late period, with gradually vanishing dignity and rights; but it is not necessary here to trace their decay in detail.

The name "tribune" was once again illuminated by a passing glory when assumed by Cola di Rienzi. The movement which he headed was in many respects extremely like the early movements of the plebeians against the patricians, and his scheme for uniting Italy in one free republic was strangely parallel with the greatest dream of the Gracchi.

The history of the tribunate is interwoven with that of Rome, and must, to a large extent, be sought for in the same sources. The principles attaching to the office are profoundly analysed by Mommsen in his *Staatsrecht*, and are clearly set forth by E. Herzog in his *Geschichte u. System der römischen Staatsverfassung* (Leipzig, 1884). (J. S. R.)

TRIBUNE (med. Lat. *tribuna*, from classical Lat. *tribunal*), in architecture, the term given to the semicircular apse of the Roman basilica, with a raised platform, where the presiding magistrate sat; subsequently applied generally to any raised structure from which speeches were delivered and to the private box of the emperor at the Circus Maximus. In Christian basilicas the term is retained for the semicircular recess behind the choir, as at S. Clemente in Rome, S. Apollinare in Classe, Ravenna, S. Zeno at Verona, S. Miniato near Florence, and other churches. The term is also loosely applied to various other raised spaces in secular as well as ecclesiastical buildings, in the latter sometimes in the place of "pulpit," as in that of the refectory of St Martin des Champs at Paris. It is also given to the celebrated octagon room of the Uffizi at Florence, and sometimes to a gallery or triforium.

TRIBUTE (Lat. *tributum*, a stated payment, contribution), a sum of money or other valuable thing paid by one state or person to another state or person, either as an acknowledgment of submission, or as the price of peace or protection. Hence, in a secondary sense, an offering to mark respect or gratitude. Revenue by means of tribute was one of the most characteristic forms of the financial systems of ancient states. In imperial Athens large revenues were derived from the states of the Delian league (*q.v.*), while in both Carthage and Rome inferior or dependent districts and races were laid under contribution to a very considerable extent (see FINANCE).

The word tribute was also applied in the Roman republic to (1) certain extraordinary taxes, as opposed to the ordinary vectigalia. Such, in particular, were certain property taxes, raised to meet the expenses of war. They were levied on all citizens alike, in proportion to the extent of a man's fortune, and varied according to the total amount of revenue to be raised. (2) To the ordinary *stipendium* or tax of fixed amount paid either in money or in kind, on property, trades, or as a poll-tax, raised in the Roman provinces (see PROVINCE).

TRICHINOPOLY, a city and district of British India, in the Madras presidency. The city is on the right bank of the river Cauvery, 250 m. by rail S.W. from Madras. Pop. (1901), 104,721. The fort which forms the nucleus of the city measures about 1 m. by ½ m.; its defences have been removed. Within it rises the Rock of Trichinopoly, 273 ft. above the city, and so completely isolated as to provide a remarkable view over the surrounding plains. It is ascended by a covered stone staircase, entered by a carved gateway, and profusely ornamented. At intervals up this stair are chambers connected with the temple on the rock. Buddhist inscriptions and carvings in some of them are attributed to the 5th or 6th century. Near the foot of the rock is a fine masonry tank called the Teppakulam, and the palace of the nawab, of which the fine domed audience hall is now used as a town-hall. In Trichinopoly is St Joseph's first-grade college, maintained by the Jesuit mission and occupying, among other buildings, a house formerly the residence of Clive. Another first-grade college is maintained by the Society for the Propagation of the Gospel; it has grown out of schools founded by the missionary Schwarz. The Roman Catholics have a fine cathedral. Trichinopoly is important as a trading centre, especially as being a railway junction. It has special industries in goldsmiths' work and modelling in pith; the well-known Trichinopoly cigars are chiefly manufactured from tobacco grown outside the district at Dindigul. Trichinopoly and its neighbourhood was the scene of much hard fighting between the English and the French during the Carnatic wars between 1749 and 1761.

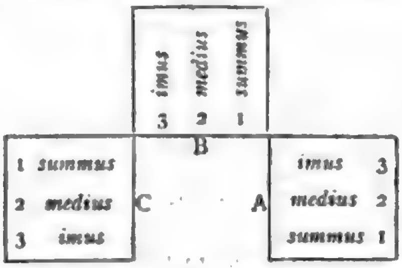
The District of Trichinopoly has an area of 3632 sq. m. The surface is generally flat, though diversified by masses of crystalline rock, of which the Trichinopoly Rock in the fort is a well-known example. The only mountains are the Pachamalais, which rise to 2500 ft. and extend into Salem district. The Cauvery and its branch, the Coleroon, are the only rivers of any importance. The climate is very hot and not liable to great variations; the annual average rainfall is about 34 in. The principal crops are rice, millets, other food-grains and oil-seeds, with a little cotton and tobacco. The main line of the South Indian railway traverses the district, with a branch to Erode. In 1901 the population was 1,444,770, showing an increase of 5% in the decade. The district came into the hands of the British along with the rest of the Carnatic in 1801.

See *Trichinopoly District Gazetteer* (Madras, 1907).

TRICHINOSIS, or Trichiniasis, a disease, in man and other animals, caused by infection by the parasite *trichina* or *trichinella spiralis*. The presence of encysted trichinae in the muscles was discovered by Sir James Paget (*q.v.*) in 1835, and they were named by Sir R. Owen; but it was not until some years after that the clinical characters of the acute disease caused by the invasion of the parasite were discovered. This discovery was made in 1860 by Friedrich von Zenker (1825–1898) on examining the abdominal muscles of a patient who died at Dresden with symptoms taken to be those of typhoid fever, the case being afterwards accounted one of trichinosis on the post mortem evidence. Epidemics of this disease occur from time to time, especially in north Germany, from the eating of uncooked swine's flesh, in which trichinae are not uncommon. Out of 6329 cases in Germany during the years 1881 to 1898, 5456 occurred in states where raw pork is a common article of food. And, from the point of view of public health, the hog is the animal which is the main source of infection, others—except rats—being only rarely infested with the parasite. The greatest care is now taken to examine the carcases of swine for trichinae, a piece of the diaphragm of every animal being searched with the microscope by an inspector specially appointed, and the trichinous hogs being condemned. But it has not been found that this microscopic examination serves as an effective check, indeed it is apt to create a false feeling of security. Over 32% of the German cases of trichinosis between 1881 and 1898 were traced to meat so inspected and passed as free from trichinae. In America accordingly microscopic examination is not considered to give any guarantee of soundness from trichinae, in spite of a government mark "inspected and passed" (see B. H. Ransom, Circular 108 of U.S. Dep. of Agriculture, 1907). The symptoms in man are occasioned by the presence of the free parasites in the intestine, by the development of young trichinae from the eggs, and most of all by the migration of the parasites from the intestinal canal to the muscles, where they become quiescent. This cycle occupies from four to six weeks. Lime-salts become deposited in the capsule, the calcification rendering the cyst visible, and this change usually takes five or six months. When consumed in small quantity, the parasites may give rise to no marked symptoms, and they are sometimes found accidentally in muscular fibre in the bodies of those who had probably experienced no definite symptoms from their invasion. In the more acute and serious cases, sometimes ending fatally, the early symptoms are nausea, failure of appetite, diarrhoea and fever, later, when the migration to the muscles begins, there is more fever, stiffness, pain and swelling in the limbs, swelling of the eyelids, continued exhausting diarrhoea, perspirations and sometimes delirium. During convalescence there is desquamation of the cuticle. The discovery by T. R. Brown of a marked leucocytosis with an extraordinary increase of eosinophiles now enables a diagnosis to be made in cases where the symptoms are obscure. If the diagnosis be made early in the case, brisk purgatives, particularly calomel, are the best treatment, if the parasites are already on their way to the muscles, the only thing left to do is to support the patient's strength. There need, however, be no fear of infection at all if the meat be thoroughly cooked and cured before eaten. This is the only effective precaution.

TRICK, a crafty or fraudulent device, deceitful artifice or stratagem, hence an exhibition of skill, especially in sleight of hand or jugglery, the term being also used of a peculiar trait or manner of speech, character or physical habit. A specific use is that for the cards played at a single round, which are taken up and count towards the winning of the game. The origin of the word is ultimately to be found in Lat. *tricae*, trifles, hindrances, wiles, whence *tricari*, to delay, shuffle, play tricks, which has also given "intricate," "extricate," "intrigue." The M Eng. *trichen*, to cheat or trick, was adapted from the O. Fr *trichier*, *trechier*, whence came *trecherie*, Eng. "treachery," a betrayal of faith, perfidy or trickery of the grossest kind. There has been also a confusion, which has influenced the meaning and form of "trick," with the Dutch *trekken*, to pull, draw, cf. the South African Dutch *trek*, a journey, migration, properly the action of drawing a vehicle or travelling by ox-wagon. "Trick" or "tricking" is thus used, in heraldry, as the technical term for the drawing of a coat of arms in monochrome, giving the tinctures by the conventions of vertical, horizontal or diagonal lines, &c.

TRICLINIUM, in Roman antiquities, a set of three couches (*lecti*) arranged round a four-sided dining table, one side of which was left open to provide free access for the attendant slaves. These couches were distinguished as the highest (A, *lectus summus*), the middle (B, *lectus medius*) and the lowest (C, *lectus imus*); the guests who reclined on B had A on their left and C on their right. Each couch was usually occupied by three persons, whose left arm rested on a cushion, the right hand being thus disengaged for purposes of eating. The nine places were allotted in accordance with strict etiquette. A and B were reserved for the guests (B for the most distinguished), C for the host and his family. In A and C the chief place was 1; in B it was 3, which was consequently the place of honour at the banquet. It was called *locus consularis* (ὑπατικός), probably as being next to the host. Another explanation is that, since it was on the open and unsupported side of the couch, it was chosen in order that, if a consul happened to be present among the guests, he might be able to receive communications, sign documents or transact business with the least inconvenience. It the *locus classicus* in Horace (*Satires*, ii. 8, 20–23), which describes the banquet given by Nasidienus in honour of Maecenas, the host appears



to have resigned his place to Nomentanus, as being more capable of entertaining the guest of the evening. In later republican times, after the introduction of round tables of citrus wood, the three couches were replaced by one of crescent shape (called *sigma* from the form C of the Greek letter; also *stibadium* and *accubitum*), which as a rule was only intended to hold five persons. The two corner seats (*cornua*) were the places of honour, that on the right being considered superior. The remaining seats were reckoned from left to right, so that the least important seat was on the left side of the most important. The use of the *sigma* continued till the middle ages. The dining-room itself was also called *triclinium*, and in the houses of wealthy Romans there were several *triclinia* suited to the different seasons of the year.

See Marquardt, *Das Privatleben der Römer* (1886), p. 302.

TRICOUPIS (or TRICOUPI), **CHARILAOS** (1832–1896), Greek statesman, was born at Nauplia in 1832. After studying law and literature in Athens and in Paris, he was sent to London in 1852 as an attaché of the Greek legation. By 1863 he had risen to be chargé d'affaires, but he aimed rather at a political than a diplomatic career. In 1865, therefore, after he had concluded the negotiations for the cession by Great Britain to Greece of the Ionian Islands, he entered the Greek chamber of deputies, and in the following year was made foreign minister, at the early age of thirty-four. In 1875 he became prime minister for a few months, but had no opportunity even to begin carrying out the policy which he had in mind. This policy was to develop the resources of his country so as to create an army and a fleet, and thus to give Greece the power to acquire a leading place among the nations of south-eastern Europe. It was not until 1882 that he was able to take measures to this end. In that year he became prime minister for the third time (his second period of office, two years earlier, had lasted only for a few months), and at once set about the task of putting Greek finance upon a firmer basis, and of increasing the prosperity of the country by making roads, railways and harbours. He was defeated at the general election in 1885, but in the following year he resumed office, and again took up the labour of economic and financial reform. His difficulties were now increased by the large expenditure which had been incurred for military preparations while he had been out of office as the result of the union effected between Bulgaria and eastern Rumelia. The Greeks had demanded from Turkey a compensation for this shifting of the balance of power, and had prepared to enforce their demand by an appeal to arms. The Great Powers, however, had interfered, and by blockading the Piraeus had compelled Greece to remain quiet. Tricoupis, nevertheless, believed that he could in a few years raise the value of Greek paper currency to par, and upon that assumption all his calculations were based. Unfortunately for himself and his country, he was not able to make his belief good. His dexterity in finance called forth general admiration, and his schemes for the construction of roads and railways met with a certain amount of success. But at last he was obliged to recognize that the warnings offered to him had been sound. Greece could not meet her obligations. Tricoupis tried to make terms with the creditors of his nation, but he failed in this also. The first taxation which he proposed aroused great hostility, and in January 1895 he resigned. At the general election, four months later, he and his party were defeated. He at once retired from public life, and soon afterwards the disease declared itself which eventually proved fatal. He died at Cannes on the 11th of April 1896. The faults of excessive ambition and of a far too sanguine optimism, which marked Tricoupis' character, could not prevent him from being regarded, even during his lifetime, as the foremost Greek statesman of his time. He was not a favourite with the populace, nor was he beloved so much as respected by his followers. By nature he was reserved—his nickname was "the Englishman"—and he had no sympathy with the arts of the demagogue. But, both in the ranks of his own party and by the nation at large, his abilities and his force of character were unquestioned. It was his misfortune that the circumstances of the time did not allow his wide schemes for the benefit of his country to be carried into effect. (H. H. F.)

TRICOUPIS, SPYRIDION (1788–1873), Greek author and statesman, son of the primate of Missolonghi, was born on the 20th of April 1788. After studying in Paris and London he became private secretary to the fifth earl of Guilford, who resided in the Ionian Islands. He was a friend of Lord Byron, and pronounced his funeral oration in the cathedral of Missolonghi (1824). During the Greek War of Independence he occupied several important administrative and diplomatic posts, being a member of the provisional government in 1826 and of the national convention at Troezen in 1827, and president of the council and minister of foreign affairs in 1832. He was thrice Greek minister in London (1835–1838, 1841–1843 and 1850–1861), and in 1850 envoy-extraordinary to Paris. After the Revolution he became minister of foreign affairs and of public instruction, and held portfolios in several subsequent short-lived ministries. He died on the 24th of February 1873.

A collection of his earlier religious and political orations was published in Paris in 1836. His chief work is a history of the Greek insurrection, *Ἱστορία τῆς ἑλληνικῆς ἐπαναστάσεως* (4 vols., London, 1853–1857; 2nd ed., 1862). He also wrote a martial poem, *Ὁ δῆμος. Ποίημα κλεπτικόν* (Paris, 1821).

TRICYCLE (from prefix *tri*, three, and Gr. *κύκλος*, circle, wheel). The tricycle, as a machine for pleasure riding, has steadily diminished in relative importance since the advent of the safety bicycle (see CYCLING). In its modern form it is a chain-driven rear-driver. The driving axle is provided with a differential gear, which allows of both wheels being driven whether the tricycle is moving in a straight or in a curved path. There are four rows of balls, two near the middle resisting the pull of the driving chain and two near the road wheels supporting the vertical load. Two types of driving axle are in use. In one the axle is supported from a parallel frame tube by four short brackets. In the other type, the Starley-Abingdon axle, the frame tube is concentric with the axle, and the middle portion is enlarged to form a casing for the chain-wheel, with two apertures for the chain to pass through. The other mechanical details are nearly all similar to those on a bicycle.

Carrier tricycles, for tradesmen's delivery purposes, are made in two types, one with an extended wheel base and the carrier behind the rider, the other with a single rear driving wheel, the two steering wheels and the carrier being mounted in front on a transverse tube or frame which is jointed to the rear frame at the steering head. The second arrangement gives the simplest possible form of tricycle, but it is unsuited for touring purposes.

Tricars.—The tricar or motor tricycle was first made by removing the front wheel of a motor bicycle and replacing it by a frame carrying two side steering wheels and a seat. With a powerful engine this arrangement gives a light vehicle from which good performances are obtained on roads with easy gradients. On steeper gradients the power must be increased, and the belt drive with only one speed is inadequate. The modern tricar is on different lines, resembling a small motor car on three wheels. The engine is 6 to 10 h.p., preferably with two cylinders, air or water cooled, with clutch and gear-box giving two or three speeds, sometimes also a "reverse" speed. The transmission is usually by a chain from the engine shaft to the gear-box, thence by another chain to the rear road wheel. The frame or chassis is supported on the three road wheels by springs. The steering gear is on the same general lines as that of a motor car. The weight of a tricar of 7 to 10 h.p. is between 700 and 1000 lb. It is a much faster vehicle, especially uphill, than a small car of equal price. The rear tire, however, is subject to severer working conditions than the two driving wheel tires of a small car, and must be of adequate strength, or trouble will be frequent.

The tricar cannot be said to have attained to the same degree of trustworthiness and freedom from breakdown as the motor bicycle or motor car. The rear tire is difficult to remove, in case of puncture. The chain drive, direct from a small chain-wheel on the engine shaft, is faulty in principle. The engine shaft running often at 2000 revolutions per minute, the chain is necessarily noisy, and is subject to continual gradual stretching, necessitating frequent readjustment. In all respects, except speed, the tricar is inferior to the small car. (A. Sp.)

TRIDENT (Lat. *tridens*, *tri-*, *tres*, three and *dens*, tooth), a three-toothed or three-pronged fork or spear. It is and has been from primitive times the typical instrument for spearing fish, the Scottish "leister" (Norw. *ljoster*), and was thus taken as the badge or emblem of the Greek Poseidon, the god of the sea. In Homer (cf. *Il.* xii. 27; *Od.* iv. 506 seq.) Poseidon is armed with the *τρίαινα* (another word is *τριόδους*, cf. Pind. *Ol.* ix. 45). The trident as the symbol of the sovereignty of the sea is found as early as Archilochus (*c.* 700 B.C.); a more familiar example is to be found in Aristophanes (*Eq.* 839). The emblematical figure of Britannia holds the trident as mistress of the sea. In the gladiatorial shows of ancient Rome the *retiarius* was armed with a trident as a weapon.

TRIDYMITE, a mineral consisting of silicon oxide or silica, SiO_2, but differing from quartz in crystalline form. The crystals are small, thin hexagonal plates or scales, which are usually twinned together in groups of three; hence the name of the mineral, from Greek *τρίδυμος*, triplet. The apparent hexagonal plates are themselves pseudo-symmetric twins of optically biaxial material, and the exact crystalline form is doubtful. The plates are colourless and transparent and have a vitreous lustre. The hardness is 7 and the specific gravity 2·3 (that of quartz being 2·65). Unlike quartz, it is soluble in a boiling solution of sodium carbonate. Tridymite occurs in the cavities of acid volcanic rocks (rhyolite, trachyte and andesite); the best-known localities are Cerro San Cristobal near Pachuca in Mexico, the Euganean Hills near Padua, and the Siebengebirge on the Rhine. Probably identical with tridymite is the form of silica known as asmanite, found in the meteorite which fell at Breitenbach in the Erzgebirge, Bohemia. (L. J. S.)

TRIER (French *Trèves*), an ancient city of Germany, formerly the capital of an archbishopric and electorate of the empire, and now the seat of a Roman Catholic bishop and the chief town of a governmental department in the Prussian province of the Rhine. Pop. (1885) 33,019, (1905) 46,709 (86% Roman Catholics). It is situated on the right bank of the Moselle, about 6 m. from the frontier of Luxemburg and 69 m. S.W. of Coblenz, on the main lines of railway from Coblenz to Metz and from Cologne to Saarbrücken. The city lies in a fertile valley shut in by vine-clad hills, and the picturesque red sandstone buildings of the old town are interspersed with orchards and gardens. On the north, east and south boulevards with gardens follow the line of the medieval walls, which have mostly disappeared. The Roman city extended much farther south and east.

Trier contains more important Roman remains than any other place in northern Europe. Perhaps the oldest remains are some of the piers and buttresses of the bridge over the Moselle, which may date from about 28 B.C. The well-preserved amphitheatre just outside the modern town to the south-east was probably built in the reign of Trajan or Hadrian. Its eastern side is built into the hill, its longer diameter is 76 yds., and it accommodated seven or eight thousand spectators. In 306 the emperor Constantine the Great caused multitudes of Frankish prisoners to be thrown to the beasts here, and in 313 made a similar spectacle of the captive Bructeri. The most remarkable Roman building in Trier is the *Porta Nigra*, the north gate of the city, a huge fortified gateway, 115 ft. long, 75 to 93 ft. high and 29 ft. deep, built of sandstone blocks blackened with age (whence the name), and held together with iron clamps. The age of this building is very uncertain; it has been assigned to dates ranging from the 1st to the 4th century A.D. It is also called the *Simeonstor*, after a Greek hermit who inhabited it. On his death in 1035 Archbishop Poppo converted the gate into two churches, one above the other, but all the additions except the apse have now been removed. In the south-east corner of the city are the picturesque ruins of the Roman imperial palace, and near the bridge are the extensive substructures of the 4th-century Roman baths, 660 ft. in length. On the Constantinsplatz stands the magnificent brick basilica, probably of the age of Constantine, though the south and east walls are modern. Having been converted into a palace for the Frankish kings and their deputies, it passed in 1197 to the archbishops, and was restored (1846–1856) and turned into a Protestant church. The adjoining barracks were formerly the elector's palace. Another Roman basilica forms the nucleus of the cathedral. Built under the emperors Valentinian I. and Gratian as a quadrilateral hall with four huge granite columns (now removed) in the centre, it was converted into a church about the close of the 4th century, and restored by Bishop Nicetius about 550. It is the most important pre-Carolingian church in Germany. Archbishop Poppo and his successors in the 11th and 12th centuries extended the cathedral westwards and added an apse at each end. The vaulting of the nave and aisles and the beautiful cloisters were added in the 13th century. In the vaults are buried twenty-six archbishops and electors. Among the monuments are those of the electors Richard von Greiffenklau (d. 1531) and Johann von Metzenhausen (d. 1540), fine examples of German Renaissance work. The most famous of the relics preserved in the cathedral is the "Holy Coat of Trier," believed by the devout to be the seamless robe of the Saviour, and said to have been discovered and presented to the city by the empress Helena. Since 1512 it has been periodically exhibited. The exhibition of 1844, which was attended by more than a million pilgrims, aroused protests, resulting in the formation of the sect of German Catholics (*q.v.*). In 1891 nearly two million pilgrims viewed the coat, and eleven miraculous cures were claimed.

The cloisters connect the cathedral with the church of Our Lady (*Liebfrauenkirche*), a beautiful building in the form of a circle intersected by a cross, with a lofty vault, built 1227–1243, and said to be the oldest Gothic church in Germany.

The earliest churches were without the walls. Of these St Matthias in the south, now represented by a 12th-century building, has a Christian cemetery of the Roman age.

In the market-place is the market cross, said to date from 958, and a beautiful Renaissance fountain, the *Petersbrunnen*, erected in 1595. Close by are the *Steipe* or *Rotes Haus*, formerly the town hall, of the 15th century, and the *Frankenturm* or *propugnaculum*, of the 10th century, said to be the oldest stone domestic building in Germany.

The Provincial Museum (1885–1889) contains many Roman and medieval antiquities. The town library contains about 100,000 volumes, including some valuable examples of early printing. Among its most treasured MSS. are the *codex aureus*, a copy of the gospels presented to the abbey of St Maximin by Ada, a reputed sister of Charlemagne, and the *codex Egberti* of the 10th century.

At Igel near Trier is a very remarkable Roman column, 83 ft. high, adorned with sculptures. It dates from the 2nd century, and was the family monument of the Secundini. At Nennig is a fine Roman mosaic pavement.

The industries of Trier include iron-founding, dyeing and the manufacture of machinery. There is a school of viticulture and a very considerable trade in Moselle wines, especially during the annual auctions.

History.—Trier had had two periods of greatness, firstly as the favourite residence of Constantine the Great and his successors in the west, and secondly as the capital of a powerful spiritual electorate.

The Treveri or Treviri, from whom the city derived its name, were one of the most powerful tribes among the Belgae, and according to Julius Caesar, who conquered them in 56 B.C., possessed the best cavalry in Gaul. Attempts have been made to show that they were of German origin (see BELGAE), but although they were doubtless subject to Germanic influences, they spoke a Celtic language. Their chiefs, Indutiomarus, who raised a rebellion against the Romans in 54 B.C., and his successor Cingetorix have Celtic names, and St Jerome, who had lived in Trier, declares that their language in his day (*c.* 370) resembled that of the Galatians. An insurrection under Julius

Florus in A.D. 21 was soon quelled. The Roman city, Augusta Treverorum, was probably fortified by Augustus about 14 B.C., and organized as a colony about A.D. 50 in the reign of Claudius, but is not mentioned before the war of Civilis in 69 (Tacitus, *Hist.* iv.). At first the Treveri resisted the appeal of Civilis and his Batavi to join the revolt, and built a defensive wall from Trier to Andernach, but soon after the two Treverans, Tutor and Classicus, led their fellow tribesmen, aided by the Lingones (Langres), in the attempt to set up a "Gallic empire" After a brief struggle the rebels were overthrown at Trier by Cerealis, and 113 senators emigrated to Germany (70). Towards the end of the 3rd century, the inroads of the Franks having been repelled by the emperor Probus, the city rapidly acquired wealth and importance. Mainly on account of its strategic position, Diocletian on his reorganization of the empire made Trier the capital not only of *Belgica Prima*, but of the whole "diocese" of Gaul. For a century, from Maximian to Maximus (286–388), it was (except under Julian, who preferred to reside in Paris) the administrative centre from which Gaul, Britain and Spain were ruled, so that the poet Ausonius could describe it as the second metropolis of the empire, or "Rome beyond the Alps." Constantine the Great, who generally resided here from 306 to 331, and his successors also, beautified the city with public works, and villas arose upon the hill-sides.

The Church added a lustre of a different kind. Legend associated Trier with the martyrdom of part of the Theban legion (*c.* 286) and with the relics found by St Helena in the Holy Land. St Agritius (d. 332) is the first historical bishop. Four great saints of the 4th century are connected with the city. It was the scene of the first banishment of St Athanasius in 336. A baseless legend relates that he composed the *Quicunque Vult* while hiding here in a cistern. St Ambrose, one of the greatest sons of Trier, was born here about 340. St Jerome's mind was first seriously directed to religion while studying at Trier about 370, and St Martin of Tours came in 385 to plead with the tryant Maximus for the lives of the heretic Priscillian and his followers.

The Franks, who had thrice previously sacked the city, gained permanent possession of it about 455. Although some Frankish kings resided here, it gradually yielded place to Metz as a Frankish capital. The great bishop St Nicetius (528–566), who was banished for rebuking the vices of king Clotaire I. and eulogized by the poet Venantius Fortunatus, repaired the cathedral, and built a splendid castle for himself. The city passed to Lorraine in 843, and to the East Frankish kingdom in 870. It was sacked by the Northmen in 881. Hetti, who occupied the see from 814 to 847, is said to have been the first archbishop of Trier, and Radbod acquired the rights of the counts of Trier in 898, thus founding the temporal power of the see. Robert claimed in vain the right to crown the German king Otto I. in 936, on the ground of the priority of his see, and in the 10th century Archbishop Dietrich I. obtained the primacy over Gaul and Germany.

The temporal power of the archbishops was not gained without opposition. The German kings Otto IV. and Conrad IV. granted charters to the city, which however admitted the jurisdiction of its archbishop, Baldwin of Luxemburg, in 1308 This prince, a brother of the emperor Henry VII., ruled from 1307 to 1354, and was the real founder of the power of Trier. His predecessor Diether III. of Nassau had left his lands heavily encumbered with debt. Baldwin raised them to great prosperity by his energy and foresight, and chiefly as a result of the active political and military support he rendered to the emperors Henry VII., Louis the Bavarian and Charles IV. enlarged his dominions almost to their ultimate extent. He assumed the title of archchancellor of Gaul and Arles (or Burgundy), and in 1315 admitted the claim of the archbishop of Cologne to the highest place after the archbishop of Mainz among the spiritual princes of the empire Thenceforward the elector of Trier held the third place in the electoral college After Baldwin's death the prosperity of Trier was checked by wars and disputes between rival claimants to the see, and in 1456 the estates united for the purpose of restoring order, and secured the right of electing their archbishops.

Throughout the middle ages the *sancta civitas Trevirorum* abounded in religious foundations and was a great seat of monastic learning. The university, founded in 1473, existed until 1797. The elector Richard von Greiffenklau (1467–1531) successfully opposed the Reformation, and inaugurated the exhibitions of the holy coat, which called forth the denunciations of Luther, but have continued since his day to bring wealth and celebrity to the city. In the latter half of the 16th century the direction of education fell into the hands of the Jesuits.

During the Thirty Years' War the elector Philip Christopher von Sötern favoured France, and accepted French protection in 1631. The French in the following year expelled both Spaniards and Swedes from his territories, but in March 1635 the Spaniards recaptured Trier and took the elector prisoner. He remained in captivity for ten years, but was reinstated by the French in 1645 and confirmed in his possessions by the peace of Westphalia. The French again temporarily took Trier in 1674 and 1688.

The last elector and archbishop, Clement Wenceslaus (1768–1802), granted toleration to the Protestants in 1782, established his residence at Coblenz in 1786, and fled from the French in 1794. By the peace of Lunéville in 1801 France annexed all the territories of Trier on the left bank of the Rhine, and in 1802 the elector abdicated. A new bishopric was created for the French department of the Sarre, of which Trier was the capital. The Treveran territories on the right bank of the Rhine were secularized and given to Nassau-Weilburg in 1803, and in 1814 nearly the whole of the former electoral dominions were given to Prussia. A bishopric was again founded in 1821, with nearly the same boundaries as the old archbishopric, but it was placed under Cologne. The area of the former electoral principality was 3210 sq. m., and its population in the 18th century was from 250,000 to 300,000. Roughly speaking, it was a broad strip of territory along the lower Saar and the Moselle from its confluence with that river to the Rhine, with a district on the right bank of the Rhine behind Ehrenbreitstein. The chief towns in addition to Trier were Coblenz, Cochem, Beilstein, Oberwesel, Lahnstein and Sayn Far more extensive was the territory under the spiritual authority of the archbishop which included the bishoprics of Metz, Toul and Verdun, and after 1777 also those of Nancy and St Dié.

See E. A Freeman's article "Augusta Treverorum" in the *British Quarterly Review* for July 1875; Hettner, *Das römische Trier* (Trier, 1880). J. N. von Wilmowsky, *Der Dom zu Trier in seinen drei Hauptperioden* (Trier, 1874); S. Beissel, *Geschichte der trierer Kirchen* (Trier, 1888), "Gesta Treverorum" (ed G Waitz), in *Mon. Germ hist* viii., xxiv., J. N. von Hontheim. *Historia trevirensis diplomatica et pragmatica* (3 vols., Augsburg, 1750); Marx, *Geschichte des Erzstifts Trier* (5 vols., Trier, 1858–1864); Leonardy, *Geschichte des trierischen Landes und Volkes* (Saarlouis, 1871); Woerl, *Führer durch die Stadt Trier* (8th ed., Leipzig, 1898). (A. B. Go.)

TRIESTE (Ger. *Triest*; Slav. *Trst*; the Roman *Tergeste, q.v.*), the principal seaport of Austria, 367 m. S.W. of Vienna by rail. Pop. (1900), 132,879, of which three-fourths are Italians, the remainder being composed of Germans, Jews, Greeks, English and French. Trieste is situated at the north-east angle of the Adriatic Sea, on the Gulf of Trieste, and is picturesquely built on terraces at the foot of the Karst hills. The aspect of the town is Italian rather than German. It is divided into the old and the new town, which are connected by the broad and handsome Via del Corso, the busiest street in the town. The old town, nestling round the Schlossberg, the hill on which the castle stands, consists of narrow, steep and irregular streets. The castle, built in 1680, is believed to occupy the site of the Roman capitol The new town, which lies on the flat expanse adjoining the crescent-shaped bay, partly on ground that has been reclaimed from the sea, has large and regularly built streets, and several large squares adorned with artistic monuments. The cathedral of San Giusto was formed as it now stands by the union in the 14th century of three adjacent early Christian buildings of the 6th century;

the tower incorporates portions of a Roman temple. The church of Santa Maria Maggiore, built in 1627–1682, is a characteristic specimen of Jesuit architecture; the church of Sant' Antonio Nuovo, built in 1827–1849, is in the Greek style, as also the Greek Orthodox church, built in 1782, which is one of the handsomest Byzantine structures in the whole of Austria. Among the most prominent secular buildings are: the Tergesteo, a huge edifice containing a cruciform arcade roofed with glass, where the exchange is established, besides numerous shops and offices; the town-hall, rebuilt in 1874, with the handsome hall of the local Diet; the imposing old exchange, now the seat of the chamber of commerce; the palatial offices of the Austrian Lloyd, the principal shipping company; the commercial and nautical academy, with its natural history museum, containing the complete fauna of the Adriatic Sea; and finally the municipal museum, Revoltella, are all worth mentioning. The Museo Lapidario contains a collection of Roman antiquities found in or near the town. It is an open-air museum, installed in a disused burial-ground, and is situated near the castle. The Arco di Riccardo, which derives its name from a popular delusion that it was connected with Richard Coeur-de-Lion, is believed by some to be a Roman triumphal arch, but is probably an arch of a Roman aqueduct.

At the head of the industrial establishments of Trieste stand the two ship-building yards of the Austrian Lloyd and of the Stabilimento Tecnico Triestino, which are the largest of their kind in Austria. The Stabilimento Tecnico is also fitted up for the construction of war-ships. They are equipped with all the latest technical innovations, and employ over 5000 workmen. Petroleum refineries, iron-foundries, chemicals, soap-boiling, silk-spinning and the production of ships' fittings, as marine steam boilers, anchors, chains, cables, are the other principal branches of industry. Several marble quarries are worked in the neighbourhood, and there are some large cement factories. Good wine, fruit and olive oil are the most important natural products of the country round Trieste.

The great importance of Trieste lies in its trade. It is the first port of Austria, and the principal outlet for the over-sea trade of the monarchy. It may be said nearly to monopolize the trade of the Adriatic, and has long eclipsed its ancient rival Venice. It owes its development to its geographical situation in the north-east angle of the Adriatic Sea at the end of the deeply indented gulf, and to its harbour, which was more accessible to large vessels than that of Venice. Besides, it was declared a free imperial port in 1719, and was therefore released from the obstructions to trade contained in the hampering legislation of the period. It was deprived of this privilege in 1891, when only the harbour was declared to be outside the customs limit. But during the last thirty years of the 19th century the increase in its trade was the lowest in comparison with the increase in the other great European ports. This was due in the first place to the lack of adequate railway communication with the interior of Austria, to the loss of part of the Levant trade through the development of the Oriental railway system, to the diversion of traffic towards the Italian and German ports, and finally to the growing rivalry of the neighbouring port of Fiume, whose interests were vigorously promoted by the Hungarian government. But in the 20th century a more active policy was inaugurated. New and direct services were started to East Africa, Central America and Mexico; the service to India and the Far East, as well as that to the Mediterranean ports, was much improved, and lastly, Trieste was made the centre of the large emigration from Austria to America by the inauguration (June 1904) of a direct emigrant service to New York. But the most important measure, designed to give a great impetus to the trade of Trieste, and to the over-sea trade of Austria generally, was the construction of the so-called second railway connexion with Trieste, begun in 1901. This measure provided for the construction of a railway over the Tauern Mountains between Schwarzach in Salzburg and Möllbrücken in Carinthia; and of a railway over the Karawanken between Trieste and Klagenfurt, with a branch to Villach. The total length of both lines is 100 m. The Karawanken railway, a direct connexion with Bohemia and the northern industrial provinces of Austria, is calculated to counteract the gravitation of traffic towards the German ports; while the Tauern railway constitutes the shortest route to the interior of Austria and to the south of Germany. By the new line the distance between Salzburg, for instance, and Trieste, is lessened by 160 m.

In order to accommodate the increase in traffic resulting from the above improvements, important works for the extension and development of the harbour were undertaken, and part of them were completed in 1910. The capacious harbour, consisting of two parts, the old and the new, is protected by extensive moles and breakwaters. The new harbour was constructed in 1867–1883, at a cost of £1,500,000. The new additions to the harbour, which are situated at the south end, were designed to give more than double the receiving capacity of the port, and were estimated to cost £3,625,000. The bulk of the over-sea trade of Trieste is done with the Levant, Egypt, India and the Far East, Italy, Great Britain and North and South America. Its most important trade by land, besides Austria, is done with Germany, Trieste being the entrepôt for Germany's commerce with India and the Mediterranean countries. The principal articles imported are cotton and cotton goods, coffee, coal, cereals, hides, fruit and tobacco; the principal articles exported are wool and woollen goods, sugar, paper, timber, machinery and various manufactured goods.

About 4 m. north-west of Trieste on the very edge of the sea is the famous castle of Miramar, built in 1854–1856 in the Norman style, for the archduke Maximilian, the ill-fated emperor of Mexico. It belongs now to the emperor of Austria, and its beautiful gardens are open to the public. About 4 m. north-east of Trieste is the village of Opčina, which possesses an obelisk 1146 ft. high, from which a beautiful view is obtained.

The town of Trieste, with its adjoining territory of a total area of 36 sq. m., forms a separate Austrian crown land. It had in 1900 a population of 178,672, of which 77% were Italians, 18% Slovenes and 5% Germans. The municipal council of Trieste constitutes at the same time the local Diet of the crown land, and is composed of 54 members. To the Reichsrat Trieste sends five deputies. Trieste is the seat of a Roman Catholic bishop, and the seat of the administration for the Küstenland or littoral, composed of the crown lands of Trieste, Görz and Gradisca, and Istria.

History.—At the time of the foundation of Aquileia by the Romans, the district which now includes Trieste was occupied by Celtic and Illyrian tribes; and the Roman colony of Tergeste (*q.v.*) does not seem to have been established till the reign of Vespasian. After the break-up of the Roman dominion Trieste shared the general fortunes of Istria and passed through various hands. From the emperor Lothair it received an independent existence under its count-bishops, and it maintained this position down to its capture by Venice in 1203. For the next 180 years its history consists chiefly of a series of conflicts with this city, which were finally put an end to by Trieste placing itself in 1382 under the protection of Leopold III. of Austria. The overlordship thus established insensibly developed into actual possession, and except in the Napoleonic period (1797–1805 and 1809–1813) Trieste has since remained an integral part of the Austrian dominions. It was an imperial free port from 1719 until 1891. The harbour was blockaded by an Italian fleet from May until August 1848. During the Italian and Hungarian revolutions Trieste remained faithful to Austria, and received the title of *Citta Fedelissima*. In 1867 Trieste and the adjoining territory was constituted into a separate crown land. In 1888 a monument was erected in commemoration of the 500th anniversary of the connexion of the town with Austria.

Giulio Caprin, *Trieste* (Bergamo, 1906); Mainati's *Croniche ossia memorie stor - sacro- profane di Trieste* (7 vols., Venice, 1817–1818); Löwenthal, *Gesch. der Stadt Triest* (Trieste, 1857), Della Croce, *Storia di Trieste* (ibid., 1879); Scussa, *Storia cronografica di Trieste* (ibid., new ed., 1885–1886); Neumann-Spallart, *Österreichs maritime Entwicklung und die Hebung von Triest* (Stuttgart, 1882); *Die österreich-ungarische Monarchie: Das Kustenland* (Vienna, 1891), Montanelli, *Il Movimento storico della popolazione di Trieste* (1905); Hartleben, *Führer durch Triest und Umgebung* (5th ed., Vienna, 1905).

TRIFORIUM, an architectural term, the origin of which is unknown but probably derived from "thoroughfarum," as it was used as a passage from one end of the building to the other. The derivation from Lat. *tres*, *tri*, three, and *foris*, door, entrance, does not seem appropriate. The earliest examples are those in the pagan basilicas, where it constituted an upper galley for conversation and business; in the early Christian basilicas it was usually reserved for women, and the same applied to those in the Greek Byzantine Church. In Romanesque and Gothic buildings it is either a spacious gallery over the side aisles or is reduced to a simple passage in the thickness of the walls; in either case it forms an important architectural division in the nave of the cathedral or church, and being of less height gives more importance to the ground storey or nave arcade. In consequence of its less height it was usually divided into two arches, which were again subdivided into two smaller arches and these subdivisions increased the scale. On account of the richness of its mouldings and carved ornament in the sculpture introduced in the spandrils, it became the most highly decorated feature of the interior, the triforium at Lincoln being one of the most beautiful compositions of Gothic architecture. Even when reduced to a simple passage it was always a highly enriched feature. In the 15th-century churches in England, when the roof over the aisles was comparatively flat, more height being required for the clerestory windows, the triforium was dispensed with altogether. In the great cathedrals and abbeys the triforium was often occupied by persons who came to witness various ceremonies, and in early days was probably utilized by the monks and clergy for work connected with the church.

From the constructive point of view, the triforium sometimes served very important functions, as under its roof exist arches and vaults carried from the nave to the outer wall, to which they transmitted the thrust of the nave vault; even when the flying buttress was frankly adopted by the Gothic architect and emphasized by its architectural design as an important feature, other cross arches were introduced under the roof to strengthen it.

TRIGLYPH (Gr. *τρεῖς*, three, and *γλυφή*, an incision or carving), an architectural term for the vertically channelled tablets of the Doric frieze, so called because of the angular channels in them, two perfect and one divided—the two chamfered angles or hemiglyphs being reckoned as one. The square sunk spaces between the triglyphs on a frieze are called metopes.

TRIGONOMETRY (from Gr. *τρίγωνον*, a triangle, *μέτρον*, measure), the branch of mathematics which is concerned with the measurement of plane and spherical triangles, that is, with the determination of three of the parts of such triangles when the numerical values of the other three parts are given. Since any plane triangle can be divided into right-angled triangles, the solution of all plane triangles can be reduced to that of right-angled triangles; moreover, according to the theory of similar triangles, the ratios between pairs of sides of a right-angled triangle depend only upon the magnitude of the acute angles of the triangle, and may therefore be regarded as functions of either of these angles. The primary object of trigonometry, therefore, requires a classification and numerical tabulation of these functions of an angular magnitude; the science is, however, now understood to include the complete investigation not only of such of the properties of these functions as are necessary for the theoretical and practical solution of triangles but also of all their analytical properties. It appears that the solution of spherical triangles is effected by means of the same functions as are required in the case of plane triangles. The trigonometrical functions are employed in many branches of mathematical and physical science not directly concerned with the measurement of angles, and hence arises the importance of analytical trigonometry. The solution of triangles of which the sides are geodesic lines on a spheroidal surface requires the introduction of other functions than those required for the solution of triangles on a plane or spherical surface, and therefore gives rise to a new branch of science, which is from analogy frequently called spheroidal trigonometry. Every new class of surfaces which may be considered would have in this extended sense a trigonometry of its own, which would consist in an investigation of the nature and properties of the functions necessary for the measurement of the sides and angles of triangles bounded by geodesics drawn on such surfaces.

HISTORY

Trigonometry, in its essential form of showing how to deduce the values of the angles and sides of a triangle when other angles and sides are given, is an invention of the Greeks. It found its origin in the computations demanded for the reduction of astronomical observations and in other problems connected with astronomical science; and since spherical triangles specially occur, it happened that spherical trigonometry was developed before the simpler plane trigonometry. Certain theorems were invented and utilized by Hipparchus, but material progress was not recorded until Ptolemy collated, amended and developed the work of his predecessors. In book xi. of the *Almagest* the principles of spherical trigonometry are stated in the form of a few simple and useful lemmas; plane trigonometry does not receive systematic treatment although several theorems and problems are stated incidentally. The solution of triangles necessitated the construction of tables of chords—the equivalent of our modern tables of sines; Ptolemy treats this subject in book i., stating several theorems relating to multiple angles, and by ingenious methods successfully deducing approximate results. He did not invent the idea of tables of chords, for, on the authority of Theon, the principle had been stated by Hipparchus (see PTOLEMY).

The Indians, who were much more apt calculators than the Greeks, availed themselves of the Greek geometry which came from Alexandria, and made it the basis of trigonometrical calculations. The principal improvement which they introduced consists in the formation of tables of half-chords or sines instead of chords. Like the Greeks, they divided the circumference of the circle into 360 degrees or 21,600 minutes, and they found the length in minutes of the arc which can be straightened out into the radius to be 3438. The value of the ratio of the circumference of the circle to the diameter used to make this determination is 62832 : 20000, or $\pi = 3{\cdot}1416$, which value was given by the astronomer Aryabhata (476–550) in a work called *Āryabhaṭiya*, written in verse, which was republished[1] in Sanskrit by Dr Kern at Leiden in 1874. The relations between the sines and cosines of the same and of complementary arcs were known, and the formula $\sin \tfrac{1}{2}a = \sqrt{\{1719(3438 - \cos a)\}}$ was applied to the determination of the sine of a half angle when the sine and cosine of the whole angle were known. In the *Sūrya-Siddhānta*, an astronomical treatise which has been translated by Ebenezer Bourgess in vol. vi. of the *Journal* of the American Oriental Society (New Haven, 1860), the sines of angles at an interval of 3° 45′ up to 90° are given; these were probably obtained from the sines of 60° and 45° by continual application of the dimidiary formula given above and by the use of the complementary angle. The values $\sin 15° = 890'$, $\sin 7° \ 30' = 449'$, $\sin 3° \ 45' = 225'$ were thus obtained. Now the angle 3° 45′ is itself *225′*; thus the arc and the sine of $\frac{1}{96}$ of the circumference were found to be the same, and consequently special importance was attached to this arc, which was called the right sine. From the tables of sines of angles at intervals of 3° 45′ the law expressed by the equation

$$\sin(n+1\,.\,225') - \sin(n\,.\,225') = \sin(n\,.\,225') - \sin(n-1\,.\,225') - \sin\frac{(n\,.\,225')}{225}$$

was discovered empirically, and used for the purpose of recalculation. Bhaskara (*fl.* 1150) used the method, to which we have now returned, of expressing sines and cosines as fractions of the radius; he obtained the more correct values $\sin 3° \ 45' = 100/1529$, $\cos 3° \ 45' = 466/467$, and showed how to form a table, according to degrees, from the values $\sin 1° = 10/573$, $\cos 1° = 6568/6569$, which are much more accurate than Ptolemy's values. The Indians did not apply their trigonometrical knowledge to the solution of triangles; for astronomical purposes they solved right-angled plane and spherical triangles by geometry.

The Arabs were acquainted with Ptolemy's *Almagest*, and they probably learned from the Indians the use of the sine. The celebrated astronomer of Batnae, Albategnius (*q.v.*), who died in A.D. 929–930, and whose *Tables* were translated in the 12th century by Plato of Tivoli into Latin, under the title *De scientia stellarum*, employed the sine regularly, and was fully conscious of the advantage of the sine over the chord; indeed, he remarks that the continual doubling is saved by the use of the former. He was the first to calculate $\sin \phi$ from the equation $\sin \phi / \cos \phi = k$, and he also made a table of the length of shadows of a vertical object of height 12 for altitudes 1°, 2°, . . . of the sun; this is a sort of cotangent table. He was acquainted not only with the triangle formulae in the *Almagest*, but also with the formula $\cos a = \cos b \cos c + \sin b \sin c \cos A$ for a spherical triangle *ABC*. Abū'l-Wafā of Bagdad (b. 940) was the first to introduce the tangent as an independent function: his "umbra" is the half of the tangent of the double arc, and the secant he defines as the "diameter umbrae." He employed the umbra to find the angle from a table and not merely as an abbreviation for sin/cos; this improvement was, however, afterwards forgotten, and the tangent was reinvented in the 15th century. Ibn Yūnos of Cairo, who died in 1008, showed even more skill than Albategnius in the solution of problems in spherical trigonometry and gave improved approximate formulae for the calculation of sines. Among the West Arabs, Geber (*q.v.*), who lived at Seville in the 11th century, wrote an astronomy in nine books, which was translated into Latin in the 12th century by Gerard of Cremona and was published in 1534. The first book contains a trigonometry which is a considerable improvement on that in the *Almagest.* He gave proofs of the formulae for right-angled spherical triangles, depending on a rule of four quantities, instead of Ptolemy's rule of six quantities. The formulae $\cos B = \cos b \sin A$, $\cos c = \cot A \cot B$, in a triangle of which C is a right angle had escaped the notice of Ptolemy and were given for the first time by Geber. Strangely enough, he made no progress in plane trigonometry. Arrachel, a Spanish Arab who lived in the 12th century, wrote a work of which we have an analysis by Purbach, in which, like the Indians, he made the sine and the arc for the value 3° 45′ coincide.

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[1] See also vol. ii. of the *Asiatic Researches* (Calcutta).

Georg Purbach (1423–1461), professor of mathematics at Vienna, wrote a work entitled *Tractatus super propositiones Ptolemaei de sinubus et chordis* (Nuremberg, 1541). This treatise consists of a development of Arrachel's method of interpolation for the calculation of tables of sines, and was published by Regiomontanus at the end of one of his works. Johannes Muller (1436–1476), known as Regiomontanus, was a pupil of Purbach and taught astronomy at Padua; he wrote an exposition of the *Almagest*, and a more important work, *De triangulis planis et sphericis cum tabulis sinuum*, which was published in 1533, a later edition appearing in 1561. He reinvented the tangent and calculated a table of tangents for each degree, but did not make any practical applications of this table, and did not use formulae involving the tangent. His work was the first complete European treatise on trigonometry, and contains a number of interesting problems; but his methods were in some respects behind those of the Arabs. Copernicus (1473–1543) gave the first simple demonstration of the fundamental formula of spherical trigonometry; the *Trigonometria Copernici* was published by Rheticus in 1542. George Joachim (1514–1576), known as Rheticus, wrote *Opus palatinum de triangulis* (see TABLES, MATHEMATICAL), which contains tables of sines, tangents and secants of arcs at intervals of 10″ from 0° to 90° His method of calculation depends upon the formulae which give $\sin na$ and $\cos na$ in terms of the sines and cosines of $(n-1)a$ and $(n-2)a$; thus these formulae may be regarded as due to him. Rheticus found the formulae for the sines of the half and third of an angle in terms of the sine of the whole angle. In 1599 there appeared an important work by Bartholomew Pitiscus (1561–1613), entitled *Trigonometriae seu De dimensione triangulorum*; this contained several important theorems on the trigonometrical functions of two angles, some of which had been given before by Finck, Landsberg (or Lansberghe de Meuleblecke) and Adriaan van Roomen. François Viète or Vieta (1540–1603) employed the equation $(2\cos\frac{1}{3}\phi)^3 - 3(2\cos\frac{1}{3}\phi) = 2\cos\phi$ to solve the cubic $x^3 - 3a^2x = a^2b (a > \frac{1}{2}b)$; he obtained, however, only one root of the cubic. In 1593 Van Roomen proposed, as a problem for all mathematicians, to solve the equation

$$45y - 3795y^3 + 95634y^5 - \dots + 945y^{41} - 45y^{43} + y^{45} = C.$$

Vieta gave $y = 2\sin\frac{1}{45}\phi$, where $C = 2\sin\phi$, as a solution, and also twenty-two of the other solutions, but he failed to obtain the negative roots. In his work *Ad angulares sectiones* Vieta gave formulae for the chords of multiples of a given arc in terms of the chord of the simple arc.

A new stage in the development of the science was commenced after John Napier's invention of logarithms in 1614. Napier also simplified the solution of spherical triangles by his well-known analogies and by his rules for the solution of right-angled triangles. The first tables of logarithmic sines and tangents were constructed by Edmund Gunter (1581–1626), professor of astronomy at Gresham College, London; he was also the first to employ the expressions cosine, cotangent and cosecant for the sine, tangent and secant of the complement of an arc. A treatise by Albert Girard (1590–1634), published at the Hague in 1626, contains the theorems which give areas of spherical triangles and polygons, and applications of the properties of the supplementary triangles to the reduction of the number of different cases in the solution of spherical triangles. He used the notation sin, tan, sec for the sine. tangent and secant of an arc. In the second half of the 17th century the theory of infinite series was developed by John Wallis, Gregory, Mercator, and afterwards by Newton and Leibnitz. In the *Analysis per aequationes numero terminorum infinitas*, which was written before 1669, Newton gave the series for the arc in powers of its sine; from this he obtained the series for the sine and cosine in powers of the arc; but these series were given in such a form that the law of the formation of the coefficients was hidden. James Gregory discovered in 1670 the series for the arc in powers of the tangent and for the tangent and secant in powers of the arc. The first of these series was also discovered independently by Leibnitz in 1673, and published without proof in the *Acta eruditorum* for 1682. The series for the sine in powers of the arc he published in 1693; this he obtained by differentiation of a series with undetermined coefficients.

In the 18th century the science began to take a more analytical form; evidence of this is given in the works of Kresa in 1720 and Mayer in 1727. Friedrich Wilhelm v. Oppel's *Analysis triangulorum* (1746) was the first complete work on analytical trigonometry. None of these mathematicians used the notation sin, cos, tan, which is the more surprising in the case of Oppel, since Leonhard Euler had in 1744 employed it in a memoir in the *Acta eruditorum.* Jean Bernoulli was the first to obtain real results by the use of the symbol $\sqrt{-1}$; he published in 1712 the general formula for $\tan n\phi$ in terms of $\tan\phi$, which he obtained by means of transformation of the arc into imaginary logarithms. The greatest advance was, however, made by Euler, who brought the science in all essential respects into the state in which it is at present. He introduced the present notation into general use, whereas until his time the trigonometrical functions had been, except by Girard, indicated by special letters, and had been regarded as certain straight lines the absolute lengths of which depended on the radius of the circle in which they were drawn. Euler's great improvement consisted in his regarding the sine, cosine, &c., as functions of the angle only, thereby giving to equations connecting these functions a purely analytical interpretation, instead of a geometrical one as heretofore. The exponential values of the sine and cosine, De Moivre's theorem, and a great number of other analytical properties of the trigonometrical functions, are due to Euler, most of whose writings are to be found in the *Memoirs* of the St Petersburg Academy.

Plane Trigonometry.

Conception of Angles of any Magnitude.

1. Imagine a straight line terminated at a fixed point O, and initially coincident with a fixed straight line OA, to revolve round O, and finally to take up any position OB. We shall suppose that, when this revolving straight line is turning in one direction, say that opposite to that in which the hands of a clock turn, it is describing a positive angle, and when it is turning in the other direction it is describing a negative angle. Before finally taking up the position OB the straight line may have passed any number of times through the position OB, making any number of complete revolutions round O in either direction. Each time that the straight line makes a complete revolution round O we consider it to have described four right angles, taken with the positive or negative sign, according to the direction in which it has revolved; thus, when it stops in the position OB, it may have revolved through any one of an infinite number of positive or negative angles any two of which differ from one another by a positive or negative multiple of four right angles, and all of which have the same bounding lines OA and OB. If OB' is the final position of the revolving line, the smallest positive angle which can have been described is that described by the revolving line making more than one-half and less than the whole of a complete revolution, so that in this case we have a positive angle greater than two and less than four right angles. We have thus shown how we may conceive an angle not restricted to be less than two right angles, but of any positive or negative magnitude, to be generated.

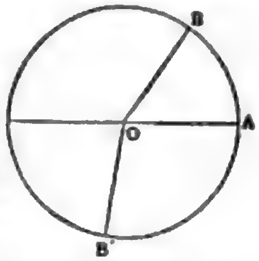

FIG. 1.

Numerical Measurement of Angular Magnitudes.

2. Two systems of numerical measurement of angular magnitudes are in ordinary use. For practical measurements the sexagesimal system is the one employed: the ninetieth part of a right angle is taken as the unit and is called a degree; the degree is divided into sixty equal parts called minutes; and the minute into sixty equal parts called seconds; angles smaller than a second are usually measured as decimals of a second, the "thirds," "fourths," &c., not being in ordinary use. In the common notation an angle, for example, of 120 degrees, 17 minutes and 14·36 seconds is written 120° 17′ 14·36″. The decimal system measurement of angles has never come into ordinary use. In analytical trigonometry the circular measure of an angle is employed. In this system the unit angle or radian is the angle subtended at the centre of a circle by an arc equal in length to the radius. The constancy of this angle follows from the geometrical propositions—(1) the circumferences of different circles vary as their radii; (2) in the same circle angles at the centre are proportional to the arcs which subtend them. It thus follows that the radian is an angle independent of the particular circle used in defining it. The constant ratio of the circumference of a circle to its diameter is a number incommensurable with unity, usually denoted by π. We shall indicate later on some of the methods which have been employed to approximate to the value of this number. Its value to 20 places is 3·14159265358979323846; its reciprocal to the same number of places is 0·31830988618379067153. In circular measure every angle is measured by the ratio which it bears to the unit angle. Two right angles are measured by the number π, and, since the same angle is 180°, we see that the number of degrees in an angle of circular measure θ is obtained from the formula $180 \times \theta/\pi$. The value of the radian has been found to 41 places of decimals by Glaisher (*Proc. London Math. Soc.* vol. iv.); the value of $1/\pi$, from which the unit can easily be calculated, is given to 140 places of decimals in *Gruners Archiv* (1841), vol. i. To 10 decimal places the value of the unit angle is 57° 17′ 44·8062470964″. The unit of circular measure is too large to be convenient for practical purposes, but its use introduces a simplification into the series in analytical trigonometry, owing to the fact that the sine of an angle and the angle itself in this measure, when the magnitude of the angle is indefinitely diminished, are ultimately in a ratio of equality.

Sign of Portions of an Infinite Straight Line.

3. If a point moves from a position A to another position B on a straight line, it has described a length AB of the straight line. It is convenient to have a simple mode of indicating in which direction on the straight line the length AB has been described; this may be done by supposing that a point moving in one specified direction is describing a positive length, and when moving in the opposite direction a negative length. Thus, if a point moving from A to B is moving in the positive direction, we consider the length AB as positive; and, since a point moving from B to A is moving in the negative direction, we consider the length BA as negative. Hence any portion of an infinite straight line is considered to be positive or negative according to the direction in which we suppose this portion to be described by a moving point; which direction is the positive one is, of course, a matter of convention.

Projections of Straight Lines on each other.

If perpendiculars AL, BM be drawn from two points, A, B on any straight line, not necessarily in the same plane with AB, the length LM, taken with the positive or negative sign according to the convention as stated above, is called the projection of AB on the given straight line; the projection of BA being ML has the opposite sign to the projection of AB. If two points A, B be joined by a number of lines in any manner, the algebraical sum of the projections of all these lines is LM—that is, the same as the projection of AB. Hence the sum of the projections of all the sides, taken in order, of any closed polygon, not necessarily plane, on any straight line, is zero. This principle of projections we shall apply below to obtain some of the most important propositions in trigonometry.

Definition of Trigonometrical Functions.

4. Let us now return to the conception of the generation of an angle as in fig. 1. Draw BOB' at right angles to and equal to AA'. We shall suppose that the direction from A' to A is the positive one for the straight line AOA', and that from B' to B for BOB'. Suppose OP of fixed length, equal to OA, and let PM, PN be drawn perpendicular to $A'A$, $B'B$ respectively; then OM and ON, taken with their proper signs, are the projections of OP on $A'A$ and $B'B$. The ratio of the projection of OP on $B'B$ to the absolute length of OP is dependent only on the magnitude of the angle POA, and is called the *sine* of that angle; the ratio of the projection of OP on $A'A$ to the length OP is called the *cosine* of the angle POA. The ratio of the sine of an angle to its cosine is called the *tangent* of the angle, and that of the cosine to the sine the *cotangent* of the angle; the reciprocal of the cosine is called the *secant*, and that of sine the *cosecant* of the angle. These functions of an angle of magnitude α are denoted by sin α, cos α, tan α, cot α, sec α, cosec α respectively. If any straight line RS be drawn parallel to OP, the projection of RS on either of the straight lines $A'A$, $B'B$ can be easily seen to bear to RS the same ratios which the corresponding projections of OP bear to OP; thus, if α be the angle which RS makes with $A'A$, the projections of RS on $A'A$, $B'B$ are $RS \cos \alpha$ and $RS \sin \alpha$ respectively, where RS denotes the absolute length RS. It must be observed that the line SR is to be considered as parallel not to OP but to OP'', and therefore makes an angle $\pi+\alpha$ with $A'A$; this is consistent with the fact that the projections of SR are of opposite sign to those of RS. By observing the signs of the projections of OP for the positions P, P', P'', P''' of P we see that the sine and cosine of the angle POA are both positive; the sine of the angle $P'OA$ is positive and its cosine is negative; both the sine and the cosine of the angle $P''OA$ are negative; and the sine of the angle $P'''OA$ is negative and its cosine positive. If α be the numerical value of the smallest angle of which OP and OA are boundaries, we see that, since these straight lines also bound all the angles $2n\pi+\alpha$, where n is any positive or negative integer, the sines and cosines of all these angles are the same as the sine and cosine of α. Hence the sine of any angle $2n\pi+\alpha$ is positive if α is between 0 and π and negative if α is between π and 2π, and the cosine of the same angle is positive if α is between 0 and $\frac{1}{2}\pi$ or $\frac{3}{2}\pi$ and 2π and negative if α is between $\frac{1}{2}\pi$ and $\frac{3}{2}\pi$.

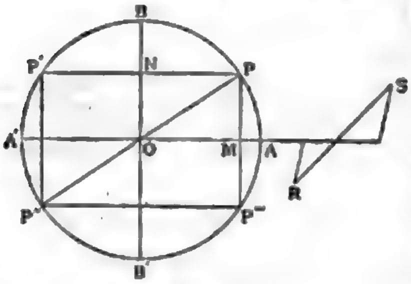

FIG. 2.

In fig. 2 the angle POA is α, the angle $P'''OA$ is $-\alpha$, $P'OA$ is $\pi-\alpha$, $P''OA$ is $\pi+\alpha$, POB is $\frac{1}{2}\pi-\alpha$. By observing the signs of the projections we see that

$$\sin(-\alpha)=-\sin\alpha,\ \sin(\pi-\alpha)=\sin\alpha,\ \sin(\pi+\alpha)=-\sin\alpha,$$
$$\cos(-\alpha)=\cos\alpha,\ \cos(\pi-\alpha)=-\cos\alpha,\ \cos(\pi+\alpha)=-\cos\alpha,$$
$$\sin(\tfrac{1}{2}\pi-\alpha)=\cos\alpha,\ \cos(\tfrac{1}{2}\pi-\alpha)=\sin\alpha.$$

Also $\sin(\frac{1}{2}\pi+\alpha)=\sin(\pi-\frac{1}{2}\pi-\alpha)=\sin(\frac{1}{2}\pi-\alpha)=\cos\alpha$,

$$\cos(\tfrac{1}{2}\pi+\alpha)=-\cos(\pi-\tfrac{1}{2}\pi-\alpha)=-\cos(\tfrac{1}{2}\pi-\alpha)=-\sin\alpha.$$

From these equations we have $\tan(-\alpha)=-\tan\alpha$, $\tan(\pi-\alpha)=-\tan\alpha$, $\tan(\pi+\alpha)=-\tan\alpha$, $\tan(\frac{1}{2}\pi-\alpha)=\cot\alpha$, $\tan(\frac{1}{2}\pi+\alpha)=-\cot\alpha$, with corresponding equations for the cotangent.

The only angles for which the projection of OP on $B'B$ is the same as for the given angle $POA(=\alpha)$ are the two sets of angles bounded by OP, OA and OP', OA; these angles are $2n\pi+\alpha$ and $2n\pi+(\pi-\alpha)$, and are all included in the formula $r\pi+(-1)^r\alpha$, where r is any integer; this therefore is the formula for all angles having the same sine as α. The only angles which have the same cosine as α are those bounded by OA, OP and OA, OP''', and these are all included in the formula $2n\pi\pm\alpha$. Similarly it can be shown that $n\pi+\alpha$ includes all the angles which have the same tangent as α.

Relations between Trigonometrical Functions.

From the Pythagorean theorem, the sum of the squares of the projections of any straight line upon two straight lines at right angles to one another is equal to the square on the projected line, we get $\sin^2\alpha+\cos^2\alpha=1$, and from this by the help of the definitions of the other functions we deduce the relations $1+\tan^2\alpha=\sec^2\alpha$, $1+\cot^2\alpha=\operatorname{cosec}^2\alpha$. We have now six relations between the six functions; these enable us to express any five of these functions in terms of the sixth. The following table shows the values of the trigonometrical functions of the angles 0, $\frac{1}{2}\pi$, π, $\frac{3}{2}\pi$, 2π, and the signs of the functions of angles between these values; I denotes numerical increase and D numerical decrease:—

Angle . .	0	0...$\frac{1}{2}\pi$	$\frac{1}{2}\pi$	$\frac{1}{2}\pi$...π	π	π...$\frac{3}{2}\pi$	$\frac{3}{2}\pi$	$\frac{3}{2}\pi$...2π	2π
Sine . .	0	$+I$	1	$+D$	0	$-I$	-1	$-D$	0
Cosine .	1	$+D$	0	$-I$	-1	$-D$	0	$+I$	1
Tangent .	0	$+I$	$\pm\infty$	$-D$	0	$+I$	$\pm\infty$	$-D$	0
Cotangent	$\pm\infty$	$+D$	0	$-I$	$\pm\infty$	$+D$	0	$-I$	$\pm\infty$
Secant .	1	$+I$	$\pm\infty$	$-D$	-1	$-I$	$\pm\infty$	$+D$	1
Cosecant .	$\pm\infty$	$+D$	1	$+I$	$\pm\infty$	$-D$	-1	$-I$	$\pm\infty$

The correctness of the table may be verified from the figure by considering the magnitudes of the projections of OP for different positions.

The following table shows the sine and cosine of some angles for which the values of the functions may be obtained geometrically:—

		sine	cosine		
$\frac{\pi}{12}$	15°	$\frac{\sqrt{6}-\sqrt{2}}{4}$	$\frac{\sqrt{6}+\sqrt{2}}{4}$	75°	$\frac{5}{12}\pi$
$\frac{\pi}{10}$	18°	$\frac{\sqrt{5}-1}{4}$	$\frac{\sqrt{10+2\sqrt{5}}}{4}$	72°	$\frac{2}{5}\pi$
$\frac{\pi}{6}$	30°	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	60°	$\frac{1}{3}\pi$
$\frac{\pi}{5}$	36°	$\frac{\sqrt{10-2\sqrt{5}}}{4}$	$\frac{\sqrt{5}+1}{4}$	54°	$\frac{3}{10}\pi$
$\frac{\pi}{4}$	45°	$\frac{1}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$	45°	$\frac{1}{4}\pi$
		cosine	sine		

Values of Trigonometrical Functions for some Angles.

These are obtained as follows. (1) $\frac{1}{4}\pi$. The sine and cosine of this angle are equal to one another, since $\sin\frac{1}{4}\pi=\cos(\frac{1}{2}\pi-\frac{1}{4}\pi)$; and since the sum of the squares of the sine and cosine is unity each is $1/\sqrt{2}$. (2) $\frac{1}{6}\pi$ and $\frac{1}{3}\pi$. Consider an equilateral triangle; the projection of one side on another is obviously half a side; hence the cosine of an angle of the triangle is $\frac{1}{2}$ or $\cos\frac{1}{3}\pi=\frac{1}{2}$, and from this the sine is found. (3) $\pi/10$, $\pi/5$, $2\pi/5$, $3\pi/10$. In the triangle constructed in Euc. iv. 10 each angle at the base is $\frac{2}{5}\pi$, and the vertical angle is $\frac{1}{5}\pi$. If a be a side and b the base, we have by the construction $a(a-b)=b^2$; hence $2b=a(\sqrt{5}-1)$; the sine of $\pi/10$ is $b/2a$ or $\frac{1}{4}(\sqrt{5}-1)$, and $\cos\frac{1}{5}\pi$ is $a/2b=\frac{1}{4}(\sqrt{5}+1)$. (4) $\frac{1}{12}\pi$, $\frac{5}{12}\pi$. Consider a right-angled triangle, having an angle $\frac{1}{6}\pi$. Bisect this angle, then the opposite side is cut by the bisector in the ratio of $\sqrt{3}$ to 2; hence the length of the smaller segment is to that of the whole in the ratio of $\sqrt{3}$ to $\sqrt{3}+2$, therefore $\tan\frac{1}{12}\pi=\{\sqrt{3}/(\sqrt{3}+2)\}\tan\frac{1}{6}\pi$ or $\tan\frac{1}{12}\pi=2-\sqrt{3}$, and from this we can obtain $\sin\frac{1}{12}\pi$ and $\cos\frac{1}{12}\pi$.

Formulae for Sine and Cosine of Sum and Difference of Two Angles.

5. Draw a straight line OD making any angle A with a fixed straight line OA, and draw OF making an angle B with OD, this angle being measured positively in the same direction as A; draw FE a perpendicular on DO (produced if necessary). The projection of OF on OA is the sum of the projections of OE and EF on OA. Now OE is the projection of OF on DO, and is therefore equal to $OF \cos B$, and EF is the projection of OP

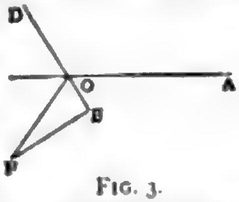

FIG. 3.

on a straight line making an angle $+\tfrac12\pi$ with OD, and is therefore equal to $OF\sin B$; hence

$$OF\cos(A+B)=OE\cos A+EF\cos(\tfrac12\pi+A)$$
$$=OF(\cos A\cos B-\sin A\sin B),$$

or $$\cos(A+B)=\cos A\cos B-\sin A\sin B.$$

The angles A, B are absolutely unrestricted in magnitude, and thus this formula is perfectly general. We may change the sign of B, thus

$$\cos(A-B)=\cos A\cos(-B)-\sin A\sin(-B),$$

or $$\cos(A-B)=\cos A\cos B+\sin A\sin B.$$

If we projected the sides of the triangle OEF on a straight line making an angle $+\tfrac12\pi$ with OA we should obtain the formulae

$$\sin(A\pm B)=\sin A\cos B\pm\cos A\sin B,$$

which are really contained in the cosine formula, since we may put $\tfrac12\pi-B$ for B. The formulae

$$\tan(A\pm B)=\frac{\tan A\pm\tan B}{1\mp\tan A\tan B},\ \cot(A\pm B)=\frac{\cot A\cot B\mp 1}{\cot B\pm\cot A}$$

are immediately deducible from the above formulae. The equations

$$\sin C+\sin D=2\sin\tfrac12(C+D)\cos\tfrac12(C-D),$$
$$\sin C-\sin D=2\sin\tfrac12(C-D)\cos\tfrac12(C+D),$$
$$\cos D+\cos C=2\cos\tfrac12(C+D)\cos\tfrac12(C-D),$$
$$\cos D-\cos C=2\sin\tfrac12(C+D)\sin\tfrac12(C-D),$$

may be obtained directly by the method of projections. Take two equal straight lines OC, OD, making angles C, D, with OA, and draw OE perpendicular to CD. The angle which OE makes with OA is $\tfrac12(C+D)$ and that which DC makes is $\tfrac12(\pi+C+D)$; the angle COE is $\tfrac12(C-D)$. The sum of the projections of OD and DE on OA is equal to that of OE, and the sum of the projections of OC and CE is equal to that of OE; hence the sum of the projections of OC and OD is twice that of OE, or $\cos C+\cos D=2\cos\tfrac12(C+D)\cos\tfrac12(C-D)$. The difference of the projections of OD and OC an OA is equal to twice that of ED, hence we have the formula $\cos D-\cos C=2\sin\tfrac12(C+D)\sin\tfrac12(C-D)$. The other two formulae will be obtained by projecting on a straight line inclined at an angle $+\tfrac12\pi$ to OA.

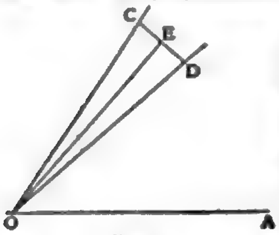

FIG. 4.

As another example of the use of projections, we will find the sum of the series $\cos\alpha+\cos(\alpha+\beta)+\cos(\alpha+2\beta)+\ldots+\cos(\alpha+\overline{n-1}\beta)$.

Sum of Series of Cosines in Arithmetical Progression.

Suppose an unclosed polygon each angle ω which is $\pi-\beta$ to be inscribed in a circle, and let A, A_1, A_2, A_3, …, A_n be $n+1$ consecutive angular points; let D be the diameter of the circle; and suppose a straight line drawn making an angle α with AA_1, then $\alpha+\beta$, $\alpha+2\beta$, … are the angles it makes with A_1A_2, A_2A_3, …; we have by projections

$$AA_n\cos(\alpha+\tfrac12\overline{n-1}\beta)=AA_1\{\cos\alpha+\cos\overline{\alpha+\beta}+\ldots+\cos\overline{\alpha+(n-1)\beta}\},$$

also $$AA_1=D\sin\tfrac12\beta,\ AA_n=D\sin\tfrac12 n\beta;$$

hence the sum of the series of cosines is

$$\cos(\alpha+\tfrac12\overline{n-1}\,\beta)\sin\tfrac12 n\beta\operatorname{cosec}\tfrac12\beta.$$

By a double application of the addition formulae we may obtain the formulae

Formulae for Sine and Cosine of Sum of Angles.

$$\sin(A_1+A_2+A_3)=\sin A_1\cos A_2\cos A_3$$
$$+\cos A_1\sin A_2\cos A_3+\cos A_1\cos A_2\sin A_3$$
$$-\sin A_1\sin A_2\sin A_3;$$
$$\cos(A_1+A_2+A_3)=\cos A_1\cos A_2\cos A_3$$
$$-\cos A_1\sin A_2\sin A_3-\sin A_1\cos A_2\sin A_3$$
$$-\sin A_1\sin A_2\cos A_3.$$

We can by induction extend these formulae to the case of n angles. Assume

$$\sin(A_1+A_2+\ldots+A_n)=S_1-S_3+S_5-\ldots$$
$$\cos(A_1+A_2+\ldots+A_n)=S_0-S_2+S_4-\ldots$$

where S_r denotes the sum of the products of the sines of r of the angles and the cosines of the remaining $n-r$ angles; then we have

$$\sin(A_1+A_2+\ldots+A_n+A_{n+1})=\cos A_{n+1}(S_1-S_3+S_5-\ldots)$$
$$+\sin A_{n+1}(S_0-S_2+S_4-\ldots).$$

The right-hand side of this equation may be written

$$(S_1\cos A_{n+1}+S_0\sin A_{n+1})-(S_3\cos A_{n+1}+S_2\sin A_{n+1})+\ldots,$$

or $$S'_1-S'_3+\ldots$$

where S'_r denotes the quantity which corresponds for $n+1$ angles to S_r for n angles; similarly we may proceed with the cosine formula. The theorems are true for $n=2$ and $n=3$; thus they are true generally. The formulae

Formulae for Multiple and Sub-Multiple Angles.

$$\cos 2A=\cos^2A-\sin^2A=2\cos^2A-1=1-2\sin^2A,$$

$$\sin 2A=2\sin A\cos A,\qquad \tan 2A=\frac{2\tan A}{1-\tan^2A},$$

$$\sin 3A=3\sin A-4\sin^3A,\quad \cos 3A=4\cos^3A-3\cos A,$$

$$\sin nA=n\cos^{n-1}A\sin A-\frac{n(n-1)(n-2)}{3!}\cos^{n-3}A\sin^3A+\ldots$$
$$+(-1)^r\frac{n(n-1)\ldots(n-2r)}{(2r+1)!}\cos^{n-2r-1}A\sin^{2r+1}A,$$

$$\cos nA=\cos^nA-\frac{n(n-1)}{2!}\cos^{n-2}A\sin^2A+\ldots$$
$$+(-)^r\frac{n(n-1)\ldots(n-2r+1)}{2r!}\cos^{n-2r}A\sin^{2r}A+\ldots$$

may all be deduced from the addition formulae by making the angles all equal. From the last two formulae we obtain by division

$$\tan nA=\frac{n\tan A-\frac{n(n-1)(n-2)}{3!}\tan^3A+\ldots+(-1)^r\frac{n(n-1)\ldots(n-2r)}{(2r+1)!}\tan^{2r+1}A+\ldots}{1-\frac{n(n-1)}{2!}\tan^2A+\ldots+(-1)^r\frac{n(n-1)\ldots(n-2r+1)}{2r!}\tan^{2r}A+\ldots}$$

In the particular case of $n=3$ we have $\tan 3A=\dfrac{3\tan A-\tan^3A}{1-3\tan^2A}$.

The values of $\sin\tfrac12A$, $\cos\tfrac12A$, $\tan\tfrac12A$ are given in terms of $\cos A$ by the formulae

$$\sin\tfrac12A=(-1)^p\left(\frac{1-\cos A}{2}\right)^{\frac12},\ \cos\tfrac12A=(-1)^q\left(\frac{1+\cos A}{2}\right)^{\frac12},$$
$$\tan\tfrac12A=(-1)^r\left(\frac{1-\cos A}{1+\cos A}\right)^{\frac12},$$

where p is the integral part of $A/2\pi$, q the integral part of $A/2\pi+\tfrac12$, and r the integral part of A/π.

Sin $\tfrac12A$, $\cos\tfrac12A$ are given in terms of $\sin A$ by the formulae

$$2\sin\tfrac12A=(-1)^{p'}(1+\sin A)^{\frac12}+(-1)^{q'}(1-\sin A)^{\frac12},$$
$$2\cos\tfrac12A=(-1)^{p'}(1+\sin A)^{\frac12}-(-1)^{q'}(1-\sin A)^{\frac12},$$

where p' is the integral part of $A/2\pi+\tfrac14$ and q' the integral part of $A/2\pi-\tfrac14$.

Properties of Triangles.

6. In any plane triangle ABC we will denote the lengths of the sides BC, CA, AB by a, b, c respectively, and the angles BAC, ABC, ACB by A, B, C respectively. The fact that the projections of b and c on a straight line perpendicular to the side a are equal to one another is expressed by the equation $b\sin C=c\sin B$; this equation and the one obtained by projecting c and a on a straight line perpendicular to a may be written $a/\sin A=b/\sin B=c/\sin C$. The equation $a=b\cos C+c\cos B$ expresses the fact that the side a is equal to the sum of the projections of the sides b and c on itself; thus we obtain the equations

$$\left.\begin{aligned}a&=b\cos C+c\cos B\\ b&=c\cos A+a\cos C\\ c&=a\cos B+b\cos A\end{aligned}\right\}.$$

If we multiply the first of these equations by $-a$, the second by b, and the third by c, and add the resulting equations, we obtain the formula $b^2+c^2-a^2=2bc\cos A$ or $\cos A=(b^2+c^2-a^2)/2bc$, which gives the cosine of an angle in terms of the sides. From this expression for $\cos A$ the formulae

$$\sin\tfrac12A=\left\{\frac{(s-b)(s-c)}{bc}\right\}^{\frac12},\ \cos\tfrac12A=\left\{\frac{s(s-a)}{bc}\right\}^{\frac12},$$
$$\tan\tfrac12A=\left\{\frac{(s-b)(s-c)}{s(s-a)}\right\}^{\frac12},\ \sin A=\frac{2}{bc}\{s(s-a)(s-b)(s-c)\}^{\frac12},$$

where s denotes $\tfrac12(a+b+c)$, can be deduced by means of the dimidiary formula.

From any general relation between the sides and angles of a triangle other relations may be deduced by various methods of transformation, of which we give two examples.

α. In any general relation between the sines and cosines of the angles A, B, C of a triangle we may substitute $pA+qB+rC$, $rA+pB+qC$, $qA+rB+pC$ for A, B, C respectively, where p, q, r are any quantities such that $p+q+r+1$ is a positive or negative multiple of 6, provided that we change the signs of all the sines. Suppose $p+q+r+1=6n$, then the sum of the three angles $2n\pi-(pA+qB+rC)$, $2n\pi-(rA+pB+qC)$, $2n\pi-(qA+rB+pC)$ is π; and, since the given relation follows from the condition $A+B+C=\pi$, we may substitute for A, B, C respectively any angles of which the sum is π; thus the transformation is admissible.

β. It may easily be shown that the sides and angles of the triangle formed by joining the feet of the perpendiculars from the angular points A, B, C on the opposite sides of the triangle ABC are respectively $a\cos A$, $b\cos B$, $c\cos C$, $\pi-2A$, $\pi-2B$, $\pi-2C$; we may therefore substitute these expressions for a, b, c, A, B, C respectively in any general formula. By drawing the perpendiculars of this second triangle and joining their feet as before, we obtain a triangle of which the sides are $-a\cos A\cos 2A$, $-b\cos B\cos 2B$, $-c\cos C\cos 2C$ and the angles are $4A-\pi$, $4B-\pi$, $4C-\pi$; we may therefore substitute these expressions for the sides and angles of the original triangle; for example, we obtain thus the formula

$$\cos 4A=\frac{a^2\cos^2A\cos^2 2A-b^2\cos^2B\cos^2 2B-c^2\cos^2C\cos^2 2C}{2bc\cos B\cos C\cos 2B\cos 2C}.$$

This transformation obviously admits of further extension.

Solution of Triangles.

(1) The three sides of a triangle ABC being given, the angles can be determined by the formula

$$L\tan\tfrac12A=10+\tfrac12\log(s-b)+\tfrac12\log(s-c)-\tfrac12\log s-\tfrac12\log(s-a)$$

and two corresponding formulae for the other angles.

(2) The two sides a, b and the included angle C being given, the angles A, B can be determined from the formulae

$$A+B=\pi-C,$$
$$L\tan\tfrac{1}{2}(A-B)=\log(a-b)-\log(a+b)+L\cot\tfrac{1}{2}C,$$

and the side c is then obtained from the formula

$$\log c=\log a+L\sin C-L\sin A.$$

(3) The two sides a, b and the angle A being given, the value of $\sin B$ may be found by means of the formula

$$L\sin B=L\sin A+\log b-\log a;$$

this gives two supplementary values of the angle B, if $b\sin A<a$. If $b\sin A>a$ there is no solution, and if $b\sin A=a$ there is one solution. In the case $b\sin A<a$, both values of B give solutions provided $b>a$, but the acute value only of B is admissible if $b<a$.

The other side c can be then determined as in case (2).

(4) If two angles A, B and a side a are given, the angle C is determined from the formula $C=\pi-A-B$ and the side b from the formula $\log b=\log a+L\sin B-L\sin A$.

Areas of Triangles and Quadrilaterals.

The area of a triangle is half the product of a side into the perpendicular from the opposite angle on that side; thus we obtain the expressions $\tfrac{1}{2}bc\sin A$, $\{s(s-a)(s-b)(s-c)\}^{\frac{1}{2}}$ for the area of a triangle. A large collection of formulae for the area of a triangle are given in the *Annals of Mathematics* for 1885 by M. Baker.

Let a, b, c, d denote the lengths of the sides AB, BC, CD, DA respectively of any plane quadrilateral and $A+C=2\alpha$; we may obtain an expression for the area S of the quadrilateral in terms of the sides and the angle α.

We have $$2S=ad\sin A+bc\sin(2\alpha-A)$$
and $$\tfrac{1}{2}(a^2+d^2-b^2-c^2)=ad\cos A-bc\cos(2\alpha-A);$$
hence $4S^2+\tfrac{1}{4}(a^2+d^2-b^2-c^2)^2=a^2d^2+b^2c^2-2abcd\cos 2\alpha$.

If $2s=a+b+c+d$, the value of S may be written in the form

$$S=\{s(s-a)(s-b)(s-c)(s-d)-abcd\cos^2\alpha\}^{\frac{1}{2}}.$$

Radii of Circumscribed, Inscribed and Escribed Circles of a Triangle.

Let R denote the radius of the circumscribed circle, r of the inscribed, and r_1, r_2, r_3 of the escribed circles of a triangle ABC; the values of these radii are given by the following formulae:—

$$R=abc/4S=a/2\sin A,$$
$$r=S/s=(s-a)\tan\tfrac{1}{2}A=4R\sin\tfrac{1}{2}A\sin\tfrac{1}{2}B\sin\tfrac{1}{2}C,$$
$$r_1=S/(s-a)=s\tan\tfrac{1}{2}A=4R\sin\tfrac{1}{2}A\cos\tfrac{1}{2}B\cos\tfrac{1}{2}C.$$

Spherical Trigonometry.

7. We shall throughout assume such elementary propositions in spherical geometry as are required for the purpose of the investigation of formulae given below.

Definition of Spherical Triangle.

A spherical triangle is the portion of the surface of a sphere bounded by three arcs of great circles of the sphere. If BC, CA, AB denote these arcs, the circular measure of the angles subtended by these arcs respectively at the centre of the sphere are the sides a, b, c of the spherical triangle ABC; and, if the portions of planes passing through these arcs and the centre of the sphere be drawn, the angles between the portions of planes intersecting at A, B, C respectively are the angles A, B, C of the spherical triangle. It is not necessary to consider triangles in which a side is greater than π, since we may replace such a side by the remaining arc of the great circle to which it belongs.

Associated Triangles.

Since two great circles intersect each other in two points, there are eight triangles of which the sides are arcs of the same three great circles. If we consider one of these triangles ABC as the fundamental one, then one of the others is equal in all respects to ABC, and the remaining six have each one side equal to, or common with, a side of the triangle ABC, the opposite angle equal to the corresponding angle of ABC, and the other sides and angles supplementary to the corresponding sides and angles of ABC. These triangles may be called the associated triangles of the fundamental one ABC. It follows that from any general formula containing the sides and angles of a spherical triangle we may obtain other formulae by replacing two sides and the two angles opposite to them by their supplements, the remaining side and the remaining angle being unaltered, for such formulae are obtained by applying the given formulae to the associated triangles.

If A', B', C' are those poles of the arcs BC, CA, AB respectively which lie upon the same sides of them as the opposite angles A, B, C, then the triangle $A'B'C'$ is called the polar triangle of the triangle ABC. The sides of the polar triangle are $\pi-A$, $\pi-B$, $\pi-C$, and the angles $\pi-a$, $\pi-b$, $\pi-c$. Hence from any general formula connecting the sides and angles of a spherical triangle we may obtain another formula by changing each side into the supplement of the opposite angle and each angle into the supplement of the opposite side.

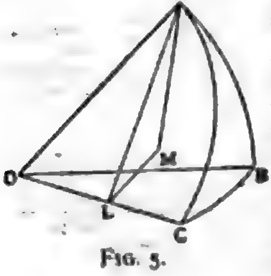

FIG. 5.

8. Let O be the centre of the sphere on which is the spherical triangle ABC. Draw AL perpendicular to OC and AM perpendicular to the plane OBC. Then the projection of OA on OB is the sum of the projections of OL, LM, MA on the same straight line. Since AM has no projection on any straight line in the plane OBC, this gives angles.

Fundamental Equations between Sides and Angles.

$$OA\cos c=OL\cos a+LM\sin a.$$

Now $OL=OA\cos b$, $LM=AL\cos C=OA\sin b\cos C$; therefore $\cos c=\cos a\cos b+\sin a\sin b\cos C$.

We may obtain similar formulae by interchanging the letters a, b, c, thus

$$\left.\begin{aligned}\cos a&=\cos b\cos c+\sin b\sin c\cos A\\ \cos b&=\cos c\cos a+\sin c\sin a\cos B\\ \cos c&=\cos a\cos b+\sin a\sin b\cos C\end{aligned}\right\}\qquad(1)$$

These formulae (1) may be regarded as the fundamental equations connecting the sides and angles of a spherical triangle; all the other relations which we shall give below may be deduced analytically from them; we shall, however, in most cases give independent proofs.

By using the polar triangle transformation we have the formulae

$$\left.\begin{aligned}\cos A&=-\cos B\cos C+\sin B\sin C\cos a\\ \cos B&=-\cos C\cos A+\sin C\sin A\cos b\\ \cos C&=-\cos A\cos B+\sin A\sin B\cos c\end{aligned}\right\}\qquad(2)$$

In the figures we have $AM=AL\sin C=r\sin b\sin C$, where r denotes the radius of the sphere. By drawing a perpendicular from A on OB, we may in a similar manner show that $AM=r\sin c\sin B$,

therefore $$\sin B\sin c=\sin C\sin b.$$

By interchanging the sides we have the equation

$$\frac{\sin A}{\sin a}=\frac{\sin B}{\sin b}=\frac{\sin C}{\sin c}=k\qquad(3)$$

we shall find below a symmetrical form for k. If we eliminate $\cos b$ between the first two formulae of (1) we have

$$\cos a\sin^2 c=\sin b\sin c\cos A+\sin c\cos c\sin a\cos B;$$

therefore $$\begin{aligned}\cot a\sin c&=(\sin b/\sin a)\cos A+\cos c\cos B\\ &=\sin B\cot A+\cos c\cos B.\end{aligned}$$

We thus have the six equations

$$\left.\begin{aligned}\cot a\sin b&=\cot A\sin C+\cos b\cos C\\ \cot b\sin a&=\cot B\sin C+\cos a\cos C\\ \cot b\sin c&=\cot B\sin A+\cos c\cos A\\ \cot c\sin b&=\cot C\sin A+\cos b\cos A\\ \cot c\sin a&=\cot C\sin B+\cos a\cos B\\ \cot a\sin c&=\cot A\sin B+\cos c\cos B\end{aligned}\right\}\qquad(4)$$

When $C=\tfrac{1}{2}\pi$ formula (1) gives

$$\cos c=\cos a\cos b\qquad(\alpha)$$

and (3) gives

$$\left.\begin{aligned}\sin b&=\sin B\sin c\\ \sin a&=\sin A\sin c\end{aligned}\right\}\qquad(\beta)$$

from (4) we get

$$\left.\begin{aligned}\tan a&=\tan A\sin b=\tan c\cos B\\ \tan b&=\tan B\sin a=\tan c\cos A\end{aligned}\right\}\qquad(\gamma)$$

The formulae

$$\cos c=\cot A\cot B\qquad(\epsilon)$$

and

$$\left.\begin{aligned}\cos A&=\cos A\sin B\\ \cos B&=\cos b\sin A\end{aligned}\right\}\qquad(\zeta)$$

follow at once from (α), (β), (γ). These are the formulae which are used for the solution of right-angled triangles. Napier gave mnemonical rules for remembering them.

The following proposition follows easily from the theorem in equation (3): If AD, BE, CF are three arcs drawn through A, B, C to meet the opposite sides in D, E, F respectively, and if these arcs pass through a point, the segments of the sides satisfy the relation $\sin BD\sin CE\sin AF=\sin CD\sin AE\sin BF$; and conversely if this relation is satisfied the arcs pass through a point. From this theorem it follows that the three perpendiculars from the angles on the opposite sides, the three bisectors of the angles, and the three arcs from the angles to the middle points of the opposite sides, each pass through a point.

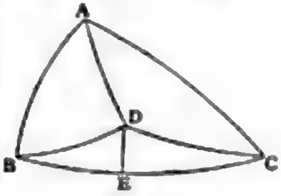

FIG. 6.

Formulae for Sine and Cosine of Half Angles.

9. If D be the point of intersection of the three bisectors of the angles A, B, C, and if DE be drawn perpendicular to BC, it may be shown that $BE=\tfrac{1}{2}(a+c-b)$ and $CE=\tfrac{1}{2}(a+b-c)$, and that the angles BDE, ADC are supplementary. We have also $\dfrac{\sin c}{\sin BD}=\dfrac{\sin ADB}{\sin\frac{1}{2}A}$, $\dfrac{\sin b}{\sin CD}=\dfrac{\sin ADC}{\sin\frac{1}{2}A}$; therefore $\sin^2\tfrac{1}{2}A=\dfrac{\sin BD\sin CD\sin CDE\sin BDE}{\sin b\sin c}$. But $\sin BD\sin BDE=\sin BE=\sin\tfrac{1}{2}(a+c-b)$, and $\sin CD\sin CDE=\sin CE=\sin\tfrac{1}{2}(a+b-c)$;

therefore $$\sin\frac{A}{2}=\left\{\frac{\sin\frac{1}{2}(a+c-b)\sin\frac{1}{2}(a+b-c)}{\sin b\sin c}\right\}^{\frac{1}{2}}\qquad(5)$$

Apply this formula to the associated triangle of which $\pi-A$, $\pi-B$, C are the angles and $\pi-a$, $\pi-b$, c are the sides; we obtain the formula

$$\cos\frac{A}{2}=\left\{\frac{\sin\frac{1}{2}(b+c-a)\sin\frac{1}{2}(a+b+c)}{\sin b\sin c}\right\}^{\frac{1}{2}}\qquad(6)$$

By division we have

$$\tan\frac{A}{2} = \left\{\frac{\sin\tfrac12(a+c-b)\sin\tfrac12(a+b-c)}{\sin\tfrac12(b+c-a)\sin\tfrac12(a+b+c)}\right\}^{\frac12} \qquad (7)$$

and by multiplication

$\sin A = 2\{\sin(a+b+c)\sin\tfrac12(b+c-a)\sin\tfrac12(c+a-b)\sin\tfrac12(a+b-c)\}^{\frac12}$ $\sin b\sin c = \{1-\cos^2 a-\cos^2 b-\cos^2 c+2\cos a\cos b\cos c\}^{\frac12}\sin b\sin c$.

Hence the quantity k in (3) is

$$\{1-\cos^2 a-\cos^2 b-\cos^2 c+2\cos a\cos b\cos c\}^{\frac12}/\sin a\sin b\sin c. \qquad (8)$$

Of Half-sides. Apply the polar triangle transformation to the formulae (5), (6), (7) (8) and we obtain

$$\cos\frac{a}{2} = \left\{\frac{\cos\tfrac12(A+C-B)\cos\tfrac12(A+B-C}{\sin B\sin C}\right\}^{\frac12} \qquad (9)$$

$$\sin\frac{a}{2} = \left\{\frac{-\cos\tfrac12(B+C-A)\cos\tfrac12(A+B+C}{\sin B\sin C}\right\}^{\frac12} \qquad (10)$$

$$\tan\frac{a}{2} = \left\{\frac{-\cos\tfrac12(B+C-A)\cos\tfrac12(A+B+C}{\cos\tfrac12(A+C-B)\cos\tfrac12(A+B-C}\right\}^{\frac12} \qquad (11)$$

If $k' = \{1-\cos^2 A-\cos^2 B-\cos^2 C-2\cos A\cos B\cos C\}^{\frac12}/\sin A\sin B\sin C$, we have.

$$kk' = 1 \qquad (12)$$

10. Let E be the middle point of AB; draw ED at right angles to AB to meet AC in D; then DE bisects the angle ADB. Let CF bisect the angle DCB and draw FG perpendicular to BC, then

Delambre's Formulae.

$$CG = \tfrac12(a-b.\ \angle FBE = \tfrac12(A+B),$$

$$\angle FCG = 90^\circ - \tfrac12 C.$$

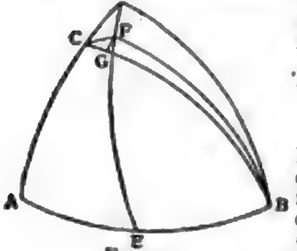

FIG. 7.

From the triangle CFG we have $\cos CFG = \cos CG\sin FCG$, and from the triangle FEB $\cos EFB = \cos EB\sin FBE$. Now the angles CFG, EFB are each supplementary to the angle DFB, therefore

$$\cos\tfrac12(a-b)\cos\tfrac12 C = \sin\tfrac12(A+B)\cos\tfrac12 c. \qquad (13)$$

Also $\sin CG = \sin CF\sin CFG$ and $\sin EB = \sin BF\sin EFB$; therefore

$$\sin\tfrac12(a-b)\cos\tfrac12 C = \sin\tfrac12(A-B)\sin\tfrac12 c. \qquad (14)$$

Apply the formulae (13), (14) to the associated triangle of which a, $\pi-b$, $\pi-c$, A, $\pi-B$, $\pi-C$ are the sides and angles, we then have

$$\sin\tfrac12(a+b)\sin\tfrac12 C = \cos\tfrac12(A-B)\sin\tfrac12 c \qquad (15)$$

$$\cos\tfrac12(a+b)\sin\tfrac12 C = \cos\tfrac12(A+B)\cos\tfrac12 c. \qquad (16)$$

The four formulae (13), (14), (15) (16) were first given by Delambre in the *Connaissance des Temps* for 1808. Formulae equivalent to these were given by Mollweide in Zach's *Monatliche Correspondenz* for November 1808. They were also given by Gauss (*Theoria motus*, 1809), and are usually called after him.

11. From the same figure we have

Napier's Analogies.

$$\tan FG = \tan FCG\sin CG = \tan FBG\sin BG;$$

therefore $\cot\tfrac12 C\sin\tfrac12(a-b)\tan\tfrac12(A-B)\sin\tfrac12(a+b)$,

or

$$\tan\tfrac12(A-B) = \frac{\sin\tfrac12(a-b)}{\sin\tfrac12(a+b)}\cot\tfrac12 C. \qquad (17)$$

Apply this formulae to the associated triangle ($\pi-a$, b, $\pi-c$, $\pi-A$, B, $\pi-C$), and we have

$$\cot\tfrac12(A+B) = \frac{\cos\tfrac12(a+b)}{\cos\tfrac12(a-b)}\tan\tfrac12 C,$$

or

$$\tan\tfrac12(A+B) = \frac{\cos\tfrac12(a-b)}{\cos\tfrac12(a+b)}\cot\tfrac12 C. \qquad (18)$$

If we apply these formulae (17), (18) to the polar triangle, we have

$$\tan\tfrac12(a-b) = \frac{\sin\tfrac12(A-B)}{\sin\tfrac12(A+B)}\tan\tfrac12 c \qquad (19)$$

$$\tan\tfrac12(A+B) = \frac{\cos\tfrac12(A-B)}{\cos\tfrac12(A+B)}\tan\tfrac12 c. \qquad (20)$$

The formulae (17), (18), (19), (20) are called Napier's "Analogies"; they were given in the *Mirif. logar. canonis descriptio.*

12. If we use the values of $\sin\tfrac12 a$, $\sin\tfrac12 b$, $\sin\tfrac12 c$, $\cos\tfrac12 a$, $\cos\tfrac12 b$, $\cos\tfrac12 c$, given by (9), (10) and the analogous formulae obtained by interchanging the letters we obtain by multiplication

Schmeisser's Formulae.

$$\left.\begin{aligned}\sin\tfrac12 a\cos\tfrac12 b\sin C &= \sin\tfrac12 c\cos\tfrac12(B+C-A)\\ \cos\tfrac12 a\cos\tfrac12 b\sin C &= \cos\tfrac12 c\cos\tfrac12(A+B-C)\\ \sin\tfrac12 a\sin\tfrac12 b\sin C &= \cos\tfrac12 c\cos\tfrac12(A+B+C)\end{aligned}\right\}$$

These formulae were given by Schmiesser in *Crelle's Journ.*, vol. x.

Cagnoli's Formulae. The relation $\sin b\sin c+\cos b\cos c\cos A = \sin B\sin C-\cos B\cos C\cos a$ was given by Cagnoli in his *Trigonometry* (1786), and was rediscovered by Cayley (*Phil. Mag.*, 1859). It follows from (1), (2) and (3) thus: the right-hand side of the equation equals $\sin B\sin C+\cos a(\cos A-\sin B\sin C\cos a) = \sin B\sin C\sin^2 a+\cos a\cos A$, and this is equal to $\sin b\sin c+\cos A(\cos a-\sin b\sin c\cos A)$ or $\sin b\sin c+\cos b\cos c\cos A$.

Solution of Triangles. 13. The formulae we have given are sufficient to determine three parts of a triangle when the other three parts are given; moreover such formulae may always be chosen as are adapted to logarithmic calculation. The solutions will be unique except in the two cases (1) where two sides and the angle opposite one of them are the given parts, and (2) where two angles and the side opposite one of them are given.

Ambiguous Cases. Suppose a, b, A are the given parts. We determine B from the formula $\sin B = \sin b\sin A/\sin a$; this gives two supplementary values of B, one acute and the other obtuse. Then C and c are determined from the equations

$$\tan\tfrac12 C = \frac{\sin\tfrac12(a-b)}{\sin\tfrac12(a+b)}\cot\tfrac12(A-B),\ \tan\tfrac12 c = \frac{\sin\tfrac12(A+B)}{\sin\tfrac12(A-B)}\tan\tfrac12(a-b).$$

Now $\tan\tfrac12 C$, $\tan\tfrac12 c$, must both be positive; hence $A-B$ and $a-b$ must have the same sign. We shall distinguish three cases. First, suppose $\sin b<\sin a$; then we have $\sin B<\sin A$. Hence A lies between the two values of B, and therefore only one of these values is admissible, the acute or the obtuse value according as a is greater or less than b; there is therefore in this case always one solution. Secondly, if $\sin b>\sin a$, there is no solution when $\sin b\sin A>\sin a$; but if $\sin b\sin A<\sin a$ there are two values of B, both greater or both less than A. If a is acute, $a-b$, and therefore $A-B$, is negative; hence there are two solutions if A is acute and none if A is obtuse. These two solutions fall together if $\sin b\sin A = \sin a$. If a is obtuse there is no solution unless A is obtuse, and in that case there are two, which coincide as before if $\sin b\sin A = \sin a$. Hence in this case there are two solutions if $\sin b\sin A \leqq \sin a$ and the two parts A, a are both acute or both obtuse, these being coincident in case $\sin b\sin A = \sin a$; and there is no solution if one of the two A, a, is acute and the other obtuse, or if $\sin b\sin A>\sin a$. Thirdly, if $\sin b = \sin a$ then $B = A$ or $\pi = A$. If a is acute, $a-b$ is zero or negative, hence $A-B$ is zero or negative; thus there is no solution unless A is acute, and then there is one. Similarly, if a is obtuse, A must be so too in order that there may be a solution. If $a = b = \tfrac12\pi$, there is no solution unless $A = \tfrac12\pi$, and then there are an infinite number of solutions, since the values of C and c become indeterminate.

The other case of ambiguity may be discussed in a similar manner, or the different cases may be deduced from the above by the use of the polar triangle transformation. The method of classification according to the three cases $\sin b \gtreqless \sin a$ was given by Professor Lloyd Tanner (*Messenger of Math.*, vol. xiv.).

Radii of Circles Related to Triangles. 14. If r is the angular radius of the small circle inscribed in the triangle ABC, we have at once $\tan r = \tan\tfrac12 A\sin(s-a)$, where $2s = a+b+c$; from this we can derive the formulae

$$\tan r = n\operatorname{cosec} s = \tfrac12 N\sec\tfrac12 A\sec\tfrac12 B\sec\tfrac12 C = \sin a\sin\tfrac12 B\sin\tfrac12 C\sec\tfrac12 A \qquad (21)$$

where n, N denote the expressions

$$\{\sin s\sin(s-a)\sin(s-b)\sin(s-c)\}^{\frac12},$$

$$\{-\cos S\cos(S-A)\cos(S-B)\cos(S-C)\}^{\frac12}.$$

The escribed circles are the small circles inscribed in three of the associated triangles; thus, applying the above formulae to the triangle (a, $\pi-b$, $\pi-c$, A, $\pi-B$, $\pi-C$), we have for r_1, the radius of the escribed circle opposite to the angle A, the following formulae

$$\tan r_1 = \tan\tfrac12 A\sin s = n\operatorname{cosec}(s-a) = \tfrac12 N\sec\tfrac12 A\operatorname{cosec}\tfrac12 B\operatorname{cosec}\tfrac12 C = \sin a\cos\tfrac12 B\cos\tfrac12 C\sec\tfrac12 A \qquad (22)$$

The pole of the circle circumscribing a triangle is that of the circle inscribed in the polar triangle, and the radii of the two circles are complementary; hence, if R be the radius of the circumscribed circle of the triangle, and R_1, R_2, R the radii of the circles circumscribing the associated triangles, we have by writing $\tfrac12\pi-R$ for r, $\tfrac12\pi-R_1$ for r_1, $\pi-a$ for A, &c., in the above formulae

$$\cot R = \cot\tfrac12 a\cos(S-A) = \tfrac12 n\operatorname{cosec}\tfrac12 a\operatorname{cosec}\tfrac12 b\operatorname{cosec}\tfrac12 c = -N\sec S = \sin A\cos\tfrac12 b\cos\tfrac12 c\operatorname{cosec}\tfrac12 a \qquad (23)$$

$$\cot R_1 = -\cot\tfrac12 a\cos S = \tfrac12 n\operatorname{cosec}\tfrac12 a\sec\tfrac12 b\sec\tfrac12 c = N\sec(S-A) = \sin A\sin\tfrac12 b\sin\tfrac12 c\operatorname{cosec}\tfrac12 a. \qquad (24)$$

The following relations follow from the formulae just given:—

$$2\tan R = \cot r_1+\cot r_2+\cot r_3-\cot r,$$

$$2\tan R_1 = \cot r+\cot r_2+\cot r_3-\cot r_1,$$

$$\tan r\tan r_1\tan r_2\tan r_3 = n^2,\ \sin^2 s = \cot r\tan r_1\tan r_2\tan r_3,$$

$$\sin^2(s-a) = \tan r\cot r_1\tan r_2\tan r_3.$$

Formulae for Spherical Excess. 15. If $E = A+B+C-\pi$, it may be shown that E multiplied by the square of the radius is the area of the triangle. We give some of the more important expressions for the quantity E, which is called the spherical excess. We have

$$\frac{\cos\tfrac12(A+B)}{\sin\tfrac12 C} = \frac{\cos\tfrac12(a+b)}{\cos\tfrac12 c} \text{ and } \frac{\sin\tfrac12(A+B)}{\cos\tfrac12 C} = \frac{\cos\tfrac12(a-b)}{\cos\tfrac12 c},$$

or

$$\frac{\sin\tfrac12(C-E)}{\sin\tfrac12 C} = \frac{\cos\tfrac12(a+b)}{\cos\tfrac12 c} \text{ and } \frac{\cos\tfrac12(C-E)}{\cos\tfrac12 C} = \frac{\cos\tfrac12(a-b)}{\cos\tfrac12 c}.$$

hence

$$\frac{\sin\tfrac12 C-\sin\tfrac12(C-E)}{\sin\tfrac12 C+\sin\tfrac12(C-E)} = \frac{\cos\tfrac12 c-\cos\tfrac12(a+b)}{\cos\tfrac12 c+\cos\tfrac12(a+b)};$$

therefore $$\frac{\tan \frac{1}{4}E}{\tan^2 \frac{1}{2}(C-E)} = \tan \tfrac{1}{2}s \tan \tfrac{1}{2}(s-c).$$

Similarly $$\tan \tfrac{1}{4}E \tan^2 \tfrac{1}{2}(C-E) = \tan \tfrac{1}{2}(s-a) \tan \tfrac{1}{2}(s-b);$$
therefore

$$\tan \tfrac{1}{4}E = \{\tan \tfrac{1}{2}s \tan \tfrac{1}{2}(s-a) \tan \tfrac{1}{2}(s-b) \tan \tfrac{1}{2}(s-c)\}^{\frac{1}{2}} \qquad (25)$$

This formula was given by J. Lhuilier.

Also $$\sin \tfrac{1}{2}C \cos \tfrac{1}{2}E - \cos \tfrac{1}{2}C \sin \tfrac{1}{2}E = \frac{\cos \frac{1}{2}(a+b)}{\cos \frac{1}{2}c} \sin \tfrac{1}{2}C;$$

$$\cos \tfrac{1}{2}C \cos \tfrac{1}{2}E + \sin \tfrac{1}{2}C \sin \tfrac{1}{2}E = \frac{\cos \frac{1}{2}(a-b)}{\cos \frac{1}{2}c} \cos \tfrac{1}{2}C;$$

whence, solving for $\cos \frac{1}{2}E$, we get

$$\cos \tfrac{1}{2}E = \frac{1 + \cos a + \cos b + \cos c}{4 \cos \frac{1}{2}a \cos \frac{1}{2}b \cos \frac{1}{2}c} \qquad (26)$$

This formula was given by Euler (*Nova acta*, vol. x.). If we find $\sin \frac{1}{2}E$ from this formula, we obtain after reduction

$$\sin \tfrac{1}{2}E = \frac{n}{2 \cos \frac{1}{2}a \cos \frac{1}{2}b \cos \frac{1}{2}c},$$

a formula given by Lexell (*Acta Petrop.*, 1782).

From the equations (21), (22), (23), (24) we obtain the following formulae for the spherical excess:—

$$\sin^2 \tfrac{1}{2}E = \tan R \cot R_1 \cot R_2 \cot R_3$$

$$= \frac{4(\cot r_1 + \cot r_2 + \cot r_3)}{(\cot r - \cot r_1 + \cot r_2 + \cot r_3)(\cot r + \cot r_1 - \cot r_2 + \cot r_3) \times (\cot r + \cot r_1 + \cot r_2 + \cot r_3)}.$$

The formula (26) may be expressed geometrically. Let M, N be the middle points of the sides AB, AC. Then we find $\cos MN$

$$= \frac{1 + \cos a + \cos b + \cos c}{4 \cos \frac{1}{2}b \cos \frac{1}{2}c}; \text{ hence } \cos \tfrac{1}{2}E = \cos MN \sec \tfrac{1}{2}a.$$

A geometrical construction has been given for E by Gudermann (in *Crelle's Journ.*, vi. and viii.). It has been shown by Cornelius Keogh that the volume of the parallelepiped of which the radii of the sphere passing through the middle points of the sides of the triangle are edges is $\sin \frac{1}{2}E$.

Properties of Spherical Quadrilateral Inscribed in Small Circle.

16. Let $ABCD$ be a spherical quadrilateral inscribed in a small circle; let a, b, c, d denote the sides AB, BC, CD, DA respectively, and x, y the diagonals AC, BD. It can easily be shown by joining the angular points of the quadrilateral to the pole of the circle that $A+C=B+D$. If we use the last expression in (23) for the radii of the circles circumscribing the triangles BAD, BCD, we have

$$\sin A \cos \tfrac{1}{2}a \cos \tfrac{1}{2}d \operatorname{cosec} \tfrac{1}{2}y = \sin C \cos \tfrac{1}{2}b \cos \tfrac{1}{2}C \operatorname{cosec} \tfrac{1}{2}y;$$

whence $$\frac{\sin A}{\cos \frac{1}{2}b \cos \frac{1}{2}c} = \frac{\sin C}{\cos \frac{1}{2}a \cos \frac{1}{2}d}.$$

This is the proposition corresponding to the relation $A+C=\pi$ for a plane quadrilateral. Also we obtain in a similar manner the theorem

$$\frac{\sin \frac{1}{2}x}{\sin B \cos \frac{1}{2}b} = \frac{\sin \frac{1}{2}y}{\sin A \cos \frac{1}{2}d},$$

analogous to the theorem for a plane quadrilateral, that the diagonals are proportional to the sines of the angles opposite to them. Also the chords AB, BC, CD, DA are equal to $2 \sin \frac{1}{2}a$, $2 \sin \frac{1}{2}b$, $2 \sin \frac{1}{2}c$, $2 \sin \frac{1}{2}d$ respectively, and the plane quadrilateral formed by these chords is inscribed in the same circle as the spherical quadrilateral; hence by Ptolemy's theorem for a plane quadrilateral we obtain the analogous theorem for a spherical one

$$\sin \tfrac{1}{2}x \sin \tfrac{1}{2}y = \sin \tfrac{1}{2}a \sin \tfrac{1}{2}c + \sin \tfrac{1}{2}b \sin \tfrac{1}{2}d.$$

It has been shown by Remy (in *Crelle's Journ.*, vol. iii.) that for any quadrilateral, if z be the spherical distance between the middle points of the diagonals,

$$\cos a + \cos b + \cos c + \cos d = 4 \cos \tfrac{1}{2}x \cos \tfrac{1}{2}y \cos \tfrac{1}{2}z.$$

This theorem is analogous to the theorem for any plane quadrilateral, that the sum of the squares of the sides is equal to the sum of the squares of the diagonals, together with twice the square on the straight line joining the middle points of the diagonals.

A theorem for a right-angled spherical triangle, analogous to the Pythagorean theorem, has been given by Gudermann (in *Crelle's Journ.*, vol. xlii.).

Analytical Trigonometry.

Periodicity of Functions.

17. Analytical trigonometry is that branch of mathematical analysis in which the analytical properties of the trigonometrical functions are investigated. These functions derive their importance in analysis from the fact that they are the simplest singly periodic functions, and are therefore adapted to the representation of undulating magnitude. The sine, cosine, secant and cosecant have the single real period 2π; *i.e.* each is unaltered in value by the addition of 2π to the variable. The tangent and cotangent have the period π. The sine, tangent, cosecant and cotangent belong to the class of odd functions; that is, they change sign when the sign of the variable is changed. The cosine and secant are even functions, since they remain unaltered when the sign of the variable is reversed.

Connexion with Theory of Complex Quantities.

The theory of the trigonometrical functions is intimately connected with that of complex numbers—that is, of numbers of the form $x + \iota y (\iota = \sqrt{-1})$. Suppose we multiply together, by the rules of ordinary algebra, two such numbers we have

$$(x_1 + \iota y_1)(x_2 + \iota y_2) = (x_1x_2 - y_1y_2) + \iota(x_1y_2 + x_2y_1).$$

We observe that the real part and the real factor of the imaginary part of the expression on the right-hand side of this equation are similar in form to the expressions which occur in the addition formulae for the cosine and sine of the sum of two angles; in fact, if we put $x_1 = r_1 \cos \theta_1$, $y_1 = r_1 \sin \theta_1$, $x_2 = r_2 \cos \theta_2$, $y_2 = r_2 \sin \theta_2$, the above equations becomes

$$r_1(\cos \theta_1 + \iota \sin \theta_1) \times r_2(\cos \theta_2 + \iota \sin \theta_2) = r_1 r_2(\cos \overline{\theta_1 + \theta_2} + \iota \sin \overline{\theta_1 + \theta_2}).$$

We may now, in accordance with the usual mode of representing complex numbers, give a geometrical interpretation of the meaning of this equation. Let P_1 be the point whose co-ordinates referred to rectangular axes Ox, Oy are x_1, y_1; then the point P_1 is employed to represent the number $x_1 + \iota y_1$. In this mode or representation real numbers are measured along the axis of x and imaginary ones along the axis of y, additions being performed according to the parallelogram law. The points A, A_1 represent the numbers ± 1, the points a, a_1 the numbers $\pm \iota$. Let P_2 represent the expression $x_2 + \iota y_2$ and P the expression $(x_1 + \iota y_1)(x_2 + \iota y_2)$. The quantities r_1, θ_1, r_2, θ_2 are the polar coordinates of P_1 and P_2 respectively, referred to O as origin and Ox as initial line; the above equation shows that $r_1 r_2$ and $\theta_1 + \theta_2$ are the polar co-ordinates of P; hence $OA : OP_1 :: OP_2 : OP$ and the angle POP_2 is equal to the angle P_1OA. Thus we have the following geometrical construction for the determination of the point P. On OP_2 draw a triangle similar to the triangle OAP_1 so that the sides OP_2, OP are homologous to the sides OA, OP_1, and so that the angle POP_2 is positive; then the vertex P represents the product of the numbers represented by P_1, P_2. If $x_2 + \iota y_2$ were to be divided by $x_1 + \iota y_1$ the triangle $OP'P_2$ would be drawn on the negative side of P_2, similar to the triangle OAP_1 and having the sides OP', OP_2 homologous to OA, OP_1, and P' would represent the quotient.

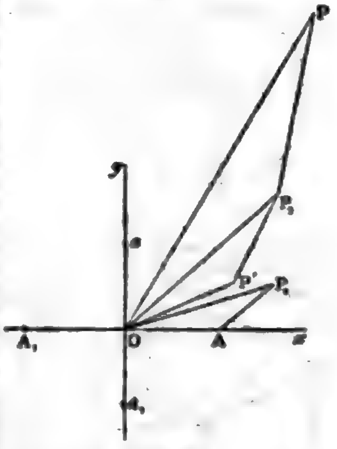

FIG. 8.

De Moivre's Theorem.

18. If we extend the above to n complex numbers by continual repetition of a similar operation, we have—

$$(\cos \theta_1 + \iota \sin \theta_1)(\cos \theta_2 + \iota \sin \theta_2) \ldots (\cos \theta_n + \iota \sin \theta_n)$$
$$= \cos (\theta_1 = \theta_2 + \ldots + \theta_n) + \iota \sin (\theta_1 + \theta_2 + \ldots + \theta_n)$$

If $\theta_1 = \theta_2 = \ldots = \theta_n = \theta_1$, this equation becomes $(\cos \theta + \iota \sin \theta)^n = \cos n\theta + \iota \sin n\theta$; this shows that $\cos \theta + \iota \sin \theta$ is a value of $(\cos n\theta + \iota \sin n\theta)^{\frac{1}{n}}$. If now we change θ into θ/n, we see that $\cos \theta/n + \iota \sin \theta/n$ is a value of $(\cos \theta + \iota \sin \theta)^{\frac{1}{n}}$; raising each of these quantities to any positive integral power m, $\cos m\theta/n + \iota \sin m\theta/n$ is one value of $(\cos \theta + \iota \sin \theta)^{\frac{m}{n}}$. Also

$$\cos (-m\theta/n) + \iota \sin (-m\theta/n) = \frac{1}{\cos m\theta/n + \iota \sin m\theta/n};$$

hence the expression of the left-hand side is one value of $(\cos \theta + \iota \sin \theta)^{-m/n}$. We have thus De Moivre's theorem that $\cos k\theta + \iota \sin k\theta$ is always one value of $(\cos \theta + \iota \sin \theta)^k$, where k is any rational number. This theorem can be extended to the case in which k is irrational, if we postulate that a value of $(\cos \theta + \iota \sin \theta)^k$ denotes the limit of a sequence of corresponding values of $(\cos \theta + \iota \sin \theta)^{k_n}$, where $k_1, k_2 \ldots k_n \ldots$ is a sequence of rational numbers of which k is the limit, and further observe that as $\cos k\theta + \iota \sin k\theta$ is the limit of $\cos k_n\theta + \iota \sin k_n\theta$.

The n Roots of a Complex Quantity.

The principal object of De Moivre's theorem is to enable us to find all the values of an expression of the form $(a + \iota b)^{m/n}$, where m and n are positive integers prime to each other. If $a = r \cos \theta$, $b = r \sin \theta$, we require the values of $r^{m/n} (\cos \theta + \iota \sin \theta)^{m/n}$. One value is immediately furnished by the theorem; but we observe that since the expression $\cos \theta + \iota \sin \theta$ is unaltered by adding any multiple of 2π to θ, the n/mth power of $r^{m/n} (\cos m.\overline{\theta + 2s\pi}/n + \iota \sin m.\overline{\theta + 2s\pi}/n)$ is $a + \iota b$, if s is any integer; hence this expression is one of the values required. Suppose that for two values s_1 and s_2 of s the values of this expression are the same; then we must have $m.\overline{\theta + 2s_1\pi}/n - m.\overline{\theta + 2s_2\pi}/n$ a multiple of 2π, or $s_1 - s_2$ must be a multiple of n. Therefore, if we give s the values $0, 1, 2, \ldots n-1$ successively, we shall get n different values of $(a + \iota b)^{m/n}$, and these will be repeated if we give s other values; hence all the values of

$(a+\iota b)^{m/n}$ are obtained by giving s the values 0, 1, 2, ... $n-1$ in the expression $r^{m/n}\ (\cos m.\overline{\theta+2s\pi/n}+\iota\sin m.\overline{\theta+2s\pi/n})$, where $r=(a^2+b^2)^{\frac{1}{2}}$ and $\theta=\text{arc}\tan b/a$.

We now return to the geometrical representation of the complex numbers. If the points B_1, B_2, B_3, ... B_n represent the expression $x+\iota y$, $(x+\iota y)^2$, $(x+\iota y)^3$, ... $(x+\iota y)^n$ respectively, the triangles OAB_1, OB_1B_2, ... $OB_{n-1}B_n$ are all similar. Let $(x+\iota y)^n=a+\iota b$, then the converse problem of finding the nth root of $a+\iota b$ is equivalent to the geometrical problem of describing such a series of triangles that OA is the first side of the first triangle and OB_n the second side of the nth. Now it is obvious that this geometrical problem has more solutions than one, since any number of complete revolutions round O may be made in travelling from B_1 to B_n. The first solution is that in which the vertical angle of each triangle is B_nOA/n; the second is that in which each is $(B_nOA+2\pi)/n$, in this case one complete revolution being made round O; the third has $(B_nOA+4\pi)/n$ for the vertical angle of each triangle; and so on. There are n sets of triangles which satisfy the required conditions. For simplicity we will take the case of the determination of the values of $(\cos\theta+\iota\sin\theta)^{\frac{1}{3}}$. Suppose B to represent the expression $\cos\theta+\iota\sin\theta$. If the angle AOP_1 is $\frac{1}{3}\theta$, P_1 represent the root $\cos\frac{1}{3}\theta+\iota\sin\frac{1}{3}\theta$; the angle AOB is filled up by the angles of the three similar triangles AOP_1, P_1Op_1, p_1OB. Also, if P_2, P_3 be such that the angles P_1OP_2 P_1OP_3 are $\frac{2}{3}\pi$, $\frac{4}{3}\pi$ respectively, the two sets of triangles AOP_2, P_2Op_2, p_2OB and AOP_3, P_3Op_3, p_3OB satisfy the conditions of similarity and of having OA, OB for the bounding sides; thus P_2, P_3 represent the roots $\cos\frac{1}{3}(\theta+2\pi)+\iota\sin\frac{1}{3}(\theta+2\pi)$, $\cos\frac{1}{3}(\theta+4\pi)+\iota\sin\frac{1}{3}(\theta+4\pi)$ respectively. If B coincides with A, the problem is reduced to that of finding the three cube roots of unity. One will be represented by A and the others by the two angular points of an equilateral triangle, with A as one angular point, inscribed in the circle.

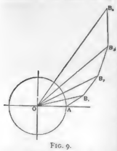

FIG. 9.

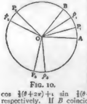

FIG. 10.

The nth Roots of Unity.

The problem of determining the values of the nth roots of unity is equivalent to the geometrical problem of inscribing a regular polygon of n sides in a circle. Gauss has shown in his *Disquisitiones arithmeticae* that this can always be done by the compass and ruler only when n is a prime of the form 2^p+1. The determination of the nth root of any complex number requires in addition, for its geometrical solution, the division of an angle into n equal parts.

Factorisations.

19. We are now in a position to factorize an expression of the form $x^n-(a+\iota b)$. Using the values which we have obtained above for $(a+\iota b)^{1/n}$, we have

$$x^n-(a+\iota b)=\mathop{P}\limits_{s=0}^{s=n-1}\left[x-r^{\frac{1}{n}}\left(\cos\frac{\theta+2s\pi}{n}+\iota\sin\frac{\theta+2s\pi}{n}\right)\right]. \tag{1}$$

If $b=0$, $a=1$, this becomes

$$x^n-1=\mathop{P}\limits_{s=0}^{s=n-1}\left[x-\cos\frac{2s\pi}{n}-\iota\sin\frac{2s\pi}{n}\right]$$

$$=(x-1)(x+1)\mathop{P}\limits_{s=1}^{s=\frac{1}{2}n-1}\left(x-\cos\frac{2s\pi}{n}\pm\iota\sin\frac{2s\pi}{n}\right)$$

$$=(x-1)(x+1)\mathop{P}\limits_{s=1}^{s=\frac{1}{2}n-1}\left(x^2-2x\cos\frac{2s\pi}{n}+1\right)\ (n\text{ even}). \tag{2}$$

$$x^n-1=(x-1)\mathop{P}\limits_{s=1}^{s=\frac{1}{2}(n-1)}\left(x^2-2x\cos\frac{2s\pi}{n}+1\right)\qquad(n\text{ odd}). \tag{3}$$

If in (1) we put $a=-1$, $b=0$, and therefore $\theta=\pi$, we have

$$x^n+1=\mathop{P}\limits_{s=0}^{s=n-1}\left[x-\cos\frac{\overline{2s+1}\pi}{n}-\iota\sin\frac{\overline{2s+1}\pi}{n}\right]$$

$$=\mathop{P}\limits_{s=0}^{s=\frac{1}{2}(n-2)}\left[x^2-2x\cos\frac{\overline{2s+1}\pi}{n}+1\right]\quad(n\text{ even}). \tag{4}$$

$$x^n+1=(x+1)\mathop{P}\limits_{s=0}^{s=\frac{1}{2}(n-3)}\left[x^2-2x\cos\frac{\overline{2s+1}\pi}{n}+1\right]\quad(n\text{ odd}). \tag{5}$$

Also $x^{2n}-2x^ny^n\cos n\theta+y^{2n}$

$$=(x^n-y^n\,\overline{\cos n\theta+\iota\sin n\theta})(x^n-y^n\,\overline{\cos n\theta-\iota\sin n\theta})$$

$$=\mathop{P}\limits_{s=0}^{s=n-1}\left(x-y\,\overline{\cos\frac{\theta+2s\pi}{n}\pm\iota\sin\frac{\theta+2s\pi}{n}}\right)$$

$$=\mathop{P}\limits_{s=0}^{s=n-1}\left[x^2-2xy\cos\overline{\theta+\frac{2s\pi}{n}}+y^2\right]. \tag{6}$$

Airy and Adams have given proofs of this theorem which do not involve the use of the symbol ι (see *Camb. Phil. Trans.*, vol. xi).

A large number of interesting theorems may be derived from De Moivre's theorem and the factorizations which we have deduced from it; we shall notice one of them.

Example of De Moivre's Theorem.

In equation (6) put $y=1/x$, take logarithms, and then differentiate each side with respect to x, and we get

$$\frac{2n(x^{2n-1}-x^{-2n-1})}{x^{2n}-2\cos n\theta+x^{-2n}}=\sum_{s=0}^{s=n-1}\frac{2(x-x^{-3})}{x^2-2\cos\overline{\theta+\frac{2s\pi}{n}}+x^{-2}}.$$

Put $x^2=a/b$, then we have the expression

$$\frac{n(a^{2n}-b^{2n})}{(a^2-b^2)(a^{2n}-2a^nb^n\cos n\theta+b^{2n})}$$

for the sum of the series

$$\sum_{s=0}^{s=n-1}\frac{1}{a^2-2ab\cos\overline{\theta+\frac{2s\pi}{n}}+b^2}.$$

The Exponential Series.

20. Denoting the complex number $x+iy$ by z, let us consider the series $1+z+z^2/2!+\ldots+z^n/n!+\ldots$ This series converges uniformly and absolutely for all values of z whose moduli do not exceed an arbitrarily chosen positive number R. Consequently the function $E(z)$, defined as the limiting sum of the above series, is continuous in every finite domain. The two series representing $E(z_1)$ and $E(z_2)$, when multiplied together give the series represented by $E(z_1+z_2)$. In accordance with a known theorem, since the series for $E(z_1)$ $E(z_2)$ are absolutely convergent, we have $E(z_1)\times E(z_2)=E(z_1+z_2)$. From this fundamental relation, we deduce at once that $\{E(z)\}^n=E(nz)$, where n is any positive integer. The number $E(1)$, the sum of the convergent series $1+1+1/2!+1/3!\ldots$, is usually denoted by e; its value can be shown to be 2·718281828459.... It is known to be a transcendental number, *i.e.* it cannot be the root of any algebraical equation with rational coefficients; this was first established by Hermite. Writing $z=1$, we have $E(n)=e^n$, where n is a positive integer. If z has as a value a positive fraction p/q, we find that $\{E(p/q)\}^q=E(p)=e^p$; hence $E(p/q)$ is the real positive value of $e^{p/q}$. Again $E(-p/q)\times E(p/q)=E(0)=1$, hence $E(-p/q)$ is the real positive value of $e^{-p/q}$. It has been thus shown that for any real and rational number x, the value of $E(x)$ is the principal value of e^x. This result can be extended to irrational values of x, if we assume that e^x is for such a value of x defined as the limit of the sequence $e^{x_1}, e^{x_2},\ldots$, where x_1, x_2,... is a sequence of rational numbers of which x is the limit, since $E(x_1)$, $E(x_2)$..., then converges to $E(x)$.

Next consider $(1+z/m)^m$, where m is a positive integer. We have by the binomial theorem,

$$\left(1+\frac{z}{m}\right)^m=1+z+\left(1-\frac{1}{m}\right)\frac{z^2}{2!}+.+\left(1-\frac{1}{m}\right)\left(1-\frac{2}{m}\right)\ldots$$
$$\left(1-\frac{s-1}{m}\right)\frac{z^s}{s!}+\ldots+\left(\frac{z}{m}\right)^m.$$

Also $$\left(1-\frac{1}{m}\right)\left(1-\frac{2}{m}\right)\ldots\left(1-\frac{s-1}{m}\right)$$

lies between 1 and $$1+\left(\frac{1}{m}+\frac{2}{m}+\ldots+\frac{s-1}{m}\right);$$

hence the product equals $1-\theta_s s.\overline{s-1}/2m$ where θ_s is such that $0<\theta_s<1$.

We have now

$$\left(1+\frac{z}{m}\right)^m=1+z+\left(1-\frac{1}{m}\right)\frac{z^2}{2!}+\ldots+\left[1-\theta_s\frac{s.\overline{s-1}}{2m}\right]\frac{z^s}{s!}+\ldots$$
$$+\left[1-\theta_m\frac{m-1}{2}\right]\frac{z^m}{m!}$$

$$=1+z+z^2/2!+\ldots+z^s/s!+\mathrm{R}_s,$$

where

$$\mathrm{R}_s=\frac{z^{s+1}}{(s+1)!}+\ldots+\frac{z^m}{m!}-\frac{z^2}{2m}\left\{1+\theta_1\frac{z}{1}+\ldots\right.$$
$$\left.+\theta_s\frac{z^{s-2}}{(s-2)!}+\ldots+\theta_m\frac{z^{m-2}}{(m-2)!}\right\}.$$

Since the series for $E(z)$ converges, s can be fixed so that for all values of $m>s$ the modulus of $z^{s+1}/(s+1)!+\ldots+z^m/m!$ is less than an arbitrarily chosen number $\frac{1}{2}\epsilon$. Also the modulus of $1+\theta_1z/1+\ldots+\theta_mz^{m-2}/(m-2)!$ is less than that of $1+1|z|/1!+|z|^2/2!+\ldots$, or of $e^{\text{mod}\,z}$, hence mod $\mathrm{R}_s<\frac{1}{2}\epsilon+(1/2m)$. mod $(z^2e^z)<\epsilon$, if m be chosen sufficiently great. It follows that $\lim_{m=\infty}(1+z/m)^m=E(z)$, where z is any complex number. To evaluate $E(z)$, write $1+x/m=\rho\cos\phi$, $y/m=\rho\sin\phi$, then

$E(z)=\lim_{m=\infty}\{\rho^m(\cos m\phi+i\sin m\phi)\}$, by De Moivre's theorem. Since $\rho^m=\left(1+\frac{x}{m}\right)^m\left\{1+\frac{y^2}{m(\sqrt{m}+x/\sqrt{m})^2}\right\}^{\frac{1}{2}m}$, we have $\lim_{m=\infty}\rho^m=e^x.\lim_{m=\infty}\left\{1+\frac{y^2}{m(\sqrt{m}+x/\sqrt{m})^2}\right\}^{\frac{1}{2}m}$. Let r be a fixed number less than $\sqrt{m}+x/\sqrt{m}$, then $\lim_{m=\infty}\left\{1+\frac{y^2}{m(\sqrt{m}+x\sqrt{m})^2}\right\}^{\frac{1}{2}m}$ lies between 1 and $\lim_{m=\infty}\left\{1+\frac{y^2}{mr^2}\right\}^{\frac{1}{2}m}$, or between 1 and $e^{y^2/2r^2}$; hence since r can be taken arbitrarily large, the limit is 1. The limit of $m\phi$ or $m\tan^{-1}\{y/(x+m)\}$ is the same as that of $my/(x+m)$ which is y. Hence we have shown that $E(z)=e^x(\cos y+i\sin y)$.

Exponential Values of Trigonometrical Functions.

21. Since $E(x+iy)=e^x(\cos y+\sin y$, we have $\cos y+i\sin y=E(iy)$, and $\cos y-i\sin y=E(-iy)$. Therefore $\cos y=\frac{1}{2}\{E(iy)+E(-iy)\}$, $\sin y=\frac{1}{2}i\{E(iy)-E(-iy)\}$; and using the series defined by $E(iy)$ and $E(-iy)$, we find that $\cos y=1-y^2/2!+y^4/4!-\ldots$, $\sin y=y-y^3/3!+y^5/5!-\ldots$, where y is any real number. These are the well-known expansions of $\cos y$, $\sin y$ in powers of the circular measure y. Where z is a complex number, the symbol e^z may be defined to be such that its *principal value* is $E(z)$; thus the principal values of e^{iy}, e^{-iy} are $E(iy)$, $E(-iy)$. The above expressions for $\cos y$, $\sin y$ may then be written $\cos y=\frac{1}{2}(e^{iy}+e^{-iy})$, $\sin y=\frac{1}{2}i(e^{iy}-e^{-iy})$. These are known as the exponential values of the cosine and sine. It can be shown that the symbol e^z as defined here satisfies the usual laws of combination for exponents.

Analytical Definitions of Trigonometrical Functions.

22. The two functions $\cos z$, $\sin z$ may be defined for all complex or real values of z by means of the equations $\cos y=\frac{1}{2}\{E(z)+E(-z)\}$, $\sin z=(\frac{1}{2i})\{E(z)-E(-z)\}$, where $E(z)$ represents the sum-function of $1+z+z^2/2!+\ldots+z^n/n!+\ldots$ For real values of z this is in accordance with the ordinary definitions, as appears from the series obtained above for $\cos y$, $\sin y$. The fundamental properties of $\cos z$, $\sin z$ can be deduced from this definition. Thus $\cos z+i\sin z=E(z)$, $\cos z-i\sin z=E(-iz)$; therefore $\cos^2z+\sin^2z=E(iz).E(-iz)=1$. Again $\cos(z_1+z_2)$ is given by $\frac{1}{2}\{E(iz_1+iz_2)+E(-iz_1-iz_2)\}=\frac{1}{2}\{E(iz_1)E(iz_2)+E(-iz_1)E(-iz_2)\}$ or $\frac{1}{4}\{E(iz_1)+E(-iz_1)\}\{E(iz_2)+E(-iz_2)\}+\frac{1}{4}\{E(iz_1)-E(-iz_1)\}\{E(iz_2)-E(-iz_2)\}$, whence we have $\cos(z_1+z_2)=\cos z_1\cos z_2-\sin z_1\sin z_2$. Similarly, we find that $\sin(z_1+z_2)=\sin z_1\cos z_2+\cos z_1\sin z_2$. Again the equation $E(z)=1$ has no real roots except $z=0$, for $e^z>1$, if z is real and >0. Also $E(z)=1$ has no complex root $\alpha+i\beta$, for $\alpha-i\beta$ would then also be a root, and $E(2\alpha)=E(\alpha+i\beta)E(\alpha-i\beta)=1$, which is impossible unless $\alpha=0$. The roots of $E(z)=1$ are therefore purely imaginary (except $z=0$); the smallest numerically we denote by $2i\pi$, so that $E(2i\pi)=1$. We have then $E(2i\pi r)=\{E(2i\pi)\}^r=1$, if r is any integer; therefore $2i\pi r$ is a root. It can be shown that no root lies between $2i\pi r$ and $2(r+1)i\pi$; and thus that all the roots are given by $z=\pm 2i\pi r$. Since $E(y+2i\pi)=E(z)E(2i\pi)=E(z)$, we see that $E(z)$ is periodic, of period $2i\pi$. It follows that $\cos z$, $\sin z$ are periodic, of periods 2π. The number here introduced may be identified with the ratio of the circumference to the diameter of a circle by considering the case of real values of z.

Expansion of Powers of Sines and Cosines in Series of Sines and Cosines of Multiple Arc.

23. Consider the binomial theorem

$$(a+b)^n=a^n+na^{n-1}b+\frac{n(n-1)}{2!}a^{n-2}b^2+\ldots$$
$$+\frac{n(n-1)\ldots(n-r+1)}{r!}a^{n-r}b^r+\ldots+b^n.$$

Putting $a=e^{i\theta}$, $b=e^{-i\theta}$, we obtain

$$(2\cos\theta)^n=2\cos n\theta+n2\cos\overline{n-2\theta}$$
$$+\frac{n(n-1)}{2!}2\cos\overline{n-4\theta}+\ldots$$
$$+\frac{n(n-1)\,.\,(n-r+1)}{r!}2\cos(n-2r)\theta+\ldots$$

When n is odd the last term is $2\frac{n(n-1)\,.\,\frac{1}{2}(n+3)}{\frac{1}{2}(n-1)!}\cos\theta$,

and when n is even it is $\frac{n(n-1)\,.\,(\frac{1}{2}n+1)}{\frac{1}{2}n!}$

If we put $a=e^{i\theta}$, $b=-e^{-i\theta}$, we obtain the formula

$$(-1)^{\frac{1}{2}n}(2\sin\theta)^n=2\cos n\theta-2n\cos(n-2)\theta+\frac{n(n-1)}{1\ 2}2\cos(n-4)\theta-\ldots$$
$$+(-1)^{r}\frac{n(n-1)\ldots(n-r+1)}{r!}2\cos(n-2r)\theta\ldots$$
$$+(-1)^{\frac{n}{2}}\frac{n(n-1)\ldots(\frac{1}{2}n+1)}{\frac{1}{2}n!}$$

when n is even, and

$$(-1)^{\frac{1}{2}(n-1)}(2\sin\theta)^n=2\sin n\theta-n\,.\,2\sin(n-2)\theta+\frac{n(n-1)}{1.2}2\sin(n-4)\theta\ldots$$
$$+(-)^{\frac{n-1}{2}}\frac{n(n-1)\ldots\frac{1}{2}(n+3)}{\frac{1}{2}(n-1)!}\sin\theta$$

when n is odd. These formulae enable us to express any positive integral power of the sine or cosine in terms of sines or cosines of multiples of the argument. There are corresponding formulae when n is not a positive integer.

Expansion of Sines and Cosines of Multiple Arcs in Powers of Sines and Cosines of Arc.

Consider the identity $\log(1-px)+\log(1-qx)=\log(1-\overline{p+q}x+pqx^2)$. Expand both sides of this equation in powers of x, and equate the coefficients of x^n, we then get

$$p^n+q^n=(p+q)^n-n(p+q)^{n-2}pq$$
$$+\frac{n(n-3)}{2!}(p+q)^{n-4}p^2q^2+\ldots$$
$$+(-1)^r\frac{n(n-r-1)(n-r-2)\ldots(n-2r+1)}{r!}$$
$$(p+q)^{n-2r}p^rq^r+\ldots$$

If we write this series in the reverse order, we have

$$p^n+q^n=2(-1)^{\frac{n}{2}}\Big[(pq)^{\frac{n}{2}}-\frac{n^2}{2!}(pq)^{\frac{n}{2}-1}\left(\frac{p+q}{2}\right)^2$$
$$+\frac{n^2(n^2-2^2)}{4!}(pq)^{\frac{n}{2}-2}\left(\frac{p+q}{2}\right)^4$$
$$-\frac{n^2(n^2-2^2)(n^2-4^2)}{6!}(pq)^{\frac{n}{2}-3}\left(\frac{p+q}{2}\right)^6+\ldots+(-1)^{\frac{n}{2}}\tfrac{1}{2}(p+q)^n\Big]$$

when n is even, and

$$p^n+q^n=2(-1)^{\frac{n-1}{2}}\Big[n(pq)^{\frac{n-1}{2}}\left(\frac{p+q}{2}\right)-\frac{n(n^2-1^2)}{3!}(pq)^{\frac{n-3}{2}}\left(\frac{p+q}{2}\right)^3$$
$$+\frac{n(n^2-1^2)(n^2-3^2)}{5!}(pq)^{\frac{n-5}{2}}\left(\frac{p+q}{2}\right)^5+\ldots+(-1)^{\frac{n-1}{2}}\tfrac{1}{2}(p+q)^n\Big]$$

when n is odd. If in these three formulae we put $p=e^{i\theta}$, $q=e^{-i\theta}$, we obtain the following series for $\cos n\theta$:—

$$2\cos n\theta=(2\cos\theta)^n-n(2\cos\theta)^{n-2}+\frac{n(n-3)}{2!}(2\cos\theta)^{n-4}-\ldots$$
$$+(-1)^r\frac{n(n-r-1)(n-r-2)\ldots(n-2r+1)}{r!}(2\cos\theta)^{n-2r}+\ldots\quad(7)$$

when n is any positive integer;

$$(-1)^{\frac{n}{2}}\cos n\theta=1-\frac{n^2}{2!}\cos^2\theta+\frac{n^2(n^2-2^2)}{4!}\cos^4\theta-\frac{n^2(n^2-2^2)(n^2-4^2)}{6!}\cos^6\theta$$
$$+\ldots+(-1)^{\frac{n}{2}}2^{n-1}\cos^n\theta\quad(8)$$

when n is an even positive integer;

$$(-1)^{\frac{n-1}{2}}\cos n\theta=n\cos n\theta-\frac{n(n^2-1^2)}{3!}\cos^3\theta+\frac{n(n^2-1^2)(n^2-3^2)}{5!}\cos^5\theta-$$
$$\ldots+(-1)^{\frac{n-1}{2}}2^{n-1}\cos^n\theta\quad(9)$$

when n is odd. If in the same three formulae we put $p=e^{i\theta}$, $q=-e^{-i\theta}$, we obtain the following four formulae:—

$$(-1)^{\frac{n}{2}}2\cos n\theta=(2\sin\theta)^n-n(2\sin\theta)^{n-2}+\frac{n(n-3)}{2!}(2\sin\theta)^{n-4}-\ldots$$
$$+(-1)^r\frac{n(n-r-1)\ldots(n-2r-1)}{r!}(2\sin\theta)^{n-2r}+\ldots(n\text{ even});\quad(10)$$

$$(-1)^{\frac{n-1}{2}}2\sin n\theta=\text{the same series }(n\text{ odd});\quad(11)$$

$$\cos n\theta=1-\frac{n^2}{2!}\sin^2\theta+\frac{n^2(n^2-2^2)}{4!}\sin^4\theta-\frac{n^2(n^2-2^2)(n^2-4^2)}{6!}\sin^6\theta$$
$$+\ldots+2^{n-1}\sin^n\theta\ (n\text{ even});\quad(12)$$

$$\sin n\theta=n\sin\theta-\frac{n(n^2-1^2)}{3!}\sin^3\theta+\frac{n(n^2-1^2)(n^2-3^2)}{5!}\sin^5\theta-\ldots$$
$$+(-1)^{\frac{n-1}{2}}2^{n-1}\sin^n\theta\ (n\text{ odd}).\quad(13)$$

Next consider the identity $\frac{p}{1-px}-\frac{q}{1-qx}=\frac{p-q}{1-(p+q)x+pqx^2}$.

Expand both sides of this equation in powers of x, and equate the coefficients of x^{n-1}, then we obtain the equation

$$\frac{p^n-q^n}{p-q}=(p+q)^{n-1}-(n-2)(p+q)^{n-3}pq$$
$$+\frac{(n-3)(n-4)}{2!}(p+q)^{n-5}p^2q^2-\ldots$$
$$(-1)^r\frac{(n-r-1)(n-r-2)\ldots(n-2r)}{r!}(p+q)^{n-2r-1}p^rq^r+\ldots$$

If, as before, we write this in the reverse order, we have the series

$$(-1)^{\frac{n}{2}-1}\Big[n\left(\frac{p+q}{2}\right)(pq)^{\frac{n}{2}-1}-\frac{n(n^2-2^2)}{3!}\left(\frac{p+q}{2}\right)^3(pq)^{\frac{n}{2}-2}$$
$$+\frac{n(n^2-2^2)(n^2-4^2)}{5!}\left(\frac{p+q}{2}\right)^5(pq)^{\frac{n}{2}-3}+\ldots+(-1)^{\frac{n}{2}-1}(p+q)^{n-1}\Big]$$

when n is even, and

$$(-1)^{\frac{n-1}{2}}\left[(pq)^{\frac{n-1}{2}}-\frac{n^2-1^2}{2!}\left(\frac{p+q}{2}\right)^2(pq)^{\frac{n-3}{2}}\right.$$
$$\left.+\frac{(n^2-1^2)(n^2-3^2)}{4!}\left(\frac{p+q}{2}\right)^4(pq)^{\frac{n-5}{2}}+\ldots+(-1)^{\frac{n-1}{2}}(p+q)^{n-1}\right]$$

when n is odd. If we put $p=e^{\iota\theta}$, $q=e-^{\iota\theta}$, we obtain the formulae

$$\sin n\theta=\sin\theta\left\{(2\cos\theta)^{n-1}-(n-2)(2\cos\theta)^{n-3}+\frac{(n-3)(n-4)}{2!}(2\cos\theta)^{n-5}\right.$$
$$\left.+(-1)^r\frac{(n-r-1)(n-r-2\ \ldots\ (n-2r)}{r!}(2\ \cos\ \theta)^{n-2r-1}+\ldots\right\}\quad(14)$$

where n is any positive integer;

$$(-1)^{\frac{n}{2}-1}\sin n\theta=\sin\theta\left\{n\cos\theta-\frac{n(n^2-2^2)}{3!}\cos^3\theta+\frac{n(n^2-2^2)(n^2-4^2)}{5!}\cos^5-\ldots\right.$$
$$\left.+(-1)^{\frac{n}{2}-1}(2\cos\theta)^{n-1}\right\}(n\text{ even});\qquad(15)$$

$$(-1)^{\frac{n-1}{2}}\sin n\theta=\sin\theta\left\{1-\frac{n^2-1^2}{2!}\cos^2\theta+\frac{(n^2-1^2)\ (n^2-3^2)}{4!}\cos^4\theta-\ldots\right.$$
$$\left.+(-1)^{\frac{n}{2}-1}(2\cos\theta)^{n-1}\right\}(n\text{ odd}).\qquad(16)$$

If we put in the same three formulae $p=e^{\iota\theta}$, $q=-e^{-\iota\theta}$, we obtain the series

$$(-1)^{\frac{n-2}{2}}\sin n\theta=\cos\theta\left[\sin^{n-1}\theta-(n-2)\sin^{n-3}\theta+\frac{(n-3)(n-4)}{2!}\sin^{n-5}\theta-\ldots\right.$$
$$\left.+(-1)^r\frac{(n-r-1)(n-r-2)\ldots(n-2r)}{r!}\sin^{n-2r-1}\theta+\ldots\right](n\text{ even});\quad(17)$$

$$(-1)^{\frac{n-1}{2}}\cos n\theta=\text{the same series }(n\text{ odd});\qquad(18)$$

$$\sin n\theta=\cos\theta\left\{n\sin\theta-\frac{n(n^2-2^2)}{3!}\sin^3\theta+\frac{n(n^2-2^2)\ (n^2-4^2)}{5!}\sin^5\theta+\right.$$
$$\left.\ldots+(-1)^{\frac{n}{2}-1}(2\sin\theta)^{n-1}\right\}(n\text{ even});\qquad(19)$$

$$\cos n\theta=\cos\theta\left\{1-\frac{n^2-1^2}{2!}\sin^2\theta+\frac{(n^2-1^2)(n^2-3^2)}{4!}\sin^4\theta-\ldots\right.$$
$$\left.+(2\sin\theta)^{n-1}\right\}(n\text{ odd}).\qquad(20)$$

We have thus obtained formulae for cos $n\theta$ and sin $n\theta$ both in ascending and in descending powers of cos θ and sin θ. Vieta obtained formulae for chords of multiple arcs in powers of chords of the simple or complementary arcs equivalent to the formulae (13) and (19) above. These are contained in his work *Theoremata ad angulares sectiones*. Jacques Bernoulli found formulae equivalent to (12) and (13) (*Mém. de l'Académie des Sciences*, 1702), and transformed these series into a form equivalent to (10) and (11). Jean Bernoulli published in the *Acta eruditorum* for 1701, among other formulae already found by Vieta, one equivalent to (17). These formulae have been extended to cases in which n is fractional, negative or irrational; see a paper by D. F. Gregory in *Camb. Math. Journ.* vol. iv., in which the series for cos $n\theta$, sin $n\theta$ in ascending powers of cos θ and sin θ are extended to the case of a fractional value of n. These series have been considered by Euler in a memoir in the *Nova acta*, vol. ix., by Lagrange in his *Calcul des fonctions* (1806), and by Poinsot in *Recherches sur l'analyse des sections angulaires* (1825).

Theory of Logarithms.

24. The general definition of Napierian logarithms is that, if $e^{x+\iota y}=a+\iota b$, then $x+\iota y=\log\ (a+\iota b)$. Now we know that $e^{x+\iota y}=e^x\cos\ y+\iota e^x\ \sin\ y$; hence $e^x\ \cos\ y=a$, $e^x\ \sin\ y=b$, or $e^x=(a^2+b^2)^{\frac{1}{2}}$, $y=\text{arc tan}\ b/a\pm m\pi$, where m is an integer. If $b=0$, then m must be even or odd according as a is positive or negative; hence

$$\log_e\ (a+\iota b)=\log_e\ (a^2+b^2)^{\frac{1}{2}}+\iota\ (\text{arc tan}\ b/a\pm 2n\pi)$$
or $$\log_e\ (a+\iota b)=\log_e\ (a^2+b^2)^{\frac{1}{2}}+\iota\ (\text{arc tan}\ b/a\pm\overline{2n+1}\pi),$$

according as a is positive or negative. Thus the logarithm of any complex or real quantity is a multiple-valued function, the difference between successive values being $2\pi\iota$; in particular, the most general form of the logarithm of a real positive quantity is obtained by adding positive or negative multiples of $2\pi\iota$ to the arithmetical logarithm. On this subject, see De Morgan's *Trigonometry and Double Algebra*, ch. iv., and a paper by Professor Cayley in vol. ii. of *Proc. London Math. Soc.*

Hyperbolic Trigonometry.

25. We have from the definitions given in § 21, $\cos\ \iota y=\frac{1}{2}(e^y+e^{-y})$ and $\sin\ \iota y=\frac{1}{2}\iota(e^y-e^{-y})$. The expressions, $\frac{1}{2}(e^y+e^{-y})$, $\frac{1}{2}(e^y-e^{-y})$ are said to define the hyperbolic cosine and sine of y and are written cosh y, sinh y: thus cosh $y=\cos\ \iota y$, sinh $y=-\iota\ \sin\ \iota y$. The functions cosh y, sinh y are connected with the rectangular hyperbola in a manner analogous to that in which the cosine and sine are connected with the circle. We may easily show from the definitions that

$$\cos^2(x+\iota y)+\sin^2(x+\iota y)=1,$$
$$\cosh^2 y-\sinh^2 y=1;$$
$$\cos(x+\iota y)=\cos x\cosh y-i\sin x\sinh y,$$
$$\sin(x+\iota y)=\sin x\cosh y+\iota\cos x\sinh y,$$
$$\cosh(\alpha+\beta)=\cosh\alpha\cosh\beta+\sinh\alpha\sinh\beta,$$
$$\sinh(\alpha+\beta)=\sinh\alpha\cosh\beta+\cosh\alpha\sinh\beta.$$

These formulae are the basis of a complete hyperbolic trigonometry. The connexion of these functions with the hyperbola was first pointed out by Lambert.

Expansion of an Angle in Powers of its Sine.

26. If we equate the coefficients of x on both sides of equation (13), this process requiring, however, a justification of its validity, we get

$$\theta=\sin\theta+\frac{1}{2}\ \frac{\sin^3\theta}{3}+\frac{1\cdot3}{2\cdot4}\ \frac{\sin^5\theta}{5}+\frac{1\cdot3\cdot5}{2\cdot4\cdot6}\ \frac{\sin^7\theta}{7}+\ldots;\quad(21)$$

θ must lie between the values $\pm\frac{1}{2}\pi$. This equation may also be written in the form

$$\text{arc sin}\ x=x+\frac{1}{2}\ \frac{x^3}{3}+\frac{1\cdot3}{2\cdot4}\ \frac{x^5}{5}+\frac{1\cdot3\cdot5}{2\cdot4\cdot6}\ \frac{x^7}{7}+\ldots$$

when x lies between ±1.

By equating the coefficients of x^2 on both sides of equation (12) we get

$$\theta^2=\sin^2\theta+\frac{2}{3}\ \frac{\sin^4\theta}{2}+\frac{2\cdot4}{3\cdot5}\ \frac{\sin^6\theta}{3}+\frac{2\cdot4\cdot6}{3\cdot5\cdot7}\ \frac{\sin^8\theta}{4}+\ldots,\qquad(22)$$

which may also be written in the form

$$(\text{arc sin}\ x)^2=x^2+\frac{2}{3}\ \frac{x^4}{2}+\frac{2\cdot4}{3\cdot5}\ \frac{x^6}{3}+\frac{2\cdot4\cdot6}{3\cdot5\cdot7}\ \frac{x^8}{4}+\ldots$$

when x is between ±1. Differentiating this equation with regard to x, we get

$$\frac{\text{arc sin}\ x}{\sqrt{1-x^2}}=x+\frac{2}{3}x^3+\frac{2\cdot4}{3\cdot5}x^5+\frac{2\cdot4\cdot6}{3\cdot5\cdot7}x^7+\ldots;$$

if we put arc sin $x=$ arc tan y, this equation becomes

$$\text{arc tan}\ y=\frac{y}{1+y^2}\left\{1+\frac{2}{3}\ \frac{y^2}{1+y^2}+\frac{2\cdot4}{3\cdot5}\left(\frac{y^2}{1+y^2}\right)^2+\ldots\right\}.\qquad(23)$$

This equation was given with two proofs by Euler in the *Nova acta* for 1793.

It can be shown that if mod $x<1$, then for any such real or complex value of x, a value of $\log_e(1+x)$ is given by the sum of the series $x-x^2/2+x^3/3-\ldots$

We then have

Gregory's Series.

$$\frac{1}{2}\log\frac{1+x}{1-x}=x+\frac{x^3}{3}+\frac{x^5}{5}+\frac{x^7}{7}+\ldots;$$

put ιy for x, the left side then becomes $\frac{1}{2}\{\log\ (1+\iota y)-\log\ (1-\iota y)\}$ or ι arc tan $y\pm\iota n\pi$;

hence $$\text{arc tan}\ y\pm n\pi=y-\frac{y^3}{3}+\frac{y^5}{5}-\frac{y^7}{7}+\ldots$$

The series is convergent if y lies between ±1; if we suppose arc tan y restricted to values between $\pm\frac{1}{4}\pi$, we have

$$\text{arc tan}\ y=y-\frac{y^3}{3}+\frac{y^5}{5}-\ldots,\qquad(24)$$

which is Gregory's series.

Series for Calculation of π.

Various series derived from (24) have been employed to calculate the value of π. At the end of the 17th century π was calculated to 72 places of decimals by Abraham Sharp, by means of the series obtained by putting arc tan $y=\pi/6$, $y=1/\sqrt{3}$ in (24). The calculation is to be found in Sherwin's *Mathematical Tables* (1742). About the same time J. Machin employed the series obtained from the equation 4 arc tan $\frac{1}{5}-$ arc tan $\frac{1}{239}=\frac{1}{4}\pi$ to calculate π to 100 decimal places. Long afterwards Euler employed the series obtained from $\frac{1}{4}\pi=$ arc tan $\frac{1}{2}+$ arc tan $\frac{1}{3}$, which, however, gives less rapidly converging series (Introd., *Anal. infin.* vol. i.). T. F. de Lagny employed the formula arc tan $1/\sqrt{3}=\pi/6$ to calculate π to 127 places; the result was communicated to the Paris Academy in 1719. G. Vega calculated π to 140 decimal places by means of the series obtained from the equation $\frac{1}{4}\pi=5$ arc tan $\frac{1}{7}+2$ arc tan $\frac{3}{79}$. The formula $\frac{1}{4}\pi=$ arc tan $\frac{1}{2}+$ arc tan $\frac{1}{5}+$ arc tan $\frac{1}{8}$ was used by J. M. Z. Dase to calculate π to 200 decimal places. W. Rutherford used the equation $\pi=4$ arc tan $\frac{1}{5}-$ arc tan $\frac{1}{70}+$ arc tan $\frac{1}{99}$.

If in (23) we put $y=\frac{1}{3}$ and $\frac{1}{7}$, we have

$$\pi=8\ \text{arc tan}\ \tfrac{1}{3}+4\ \text{arc tan}\ \tfrac{1}{7}=2\cdot4\left\{1+\frac{2}{3}\cdot\frac{1}{10}+\frac{2\cdot4}{3\cdot5}\ \frac{1}{10^2}+\ldots\right\}$$
$$+\ 56\left\{1+\frac{2}{3}\cdot\frac{2}{100}+\frac{2\cdot4}{3\cdot5}\left(\frac{2}{100}\right)^2+\ldots\right\},$$

a rapidly convergent series for π which was first given by Hutton in *Phil. Trans.* for 1776, and afterwards by Euler in *Nova acta* for 1793. Euler gives an equation deduced in the same manner from the identity $\pi=20$ arc tan $\frac{1}{7}+8$ arc tan $\frac{3}{79}$. The calculation of π has been carried out to 707 places of decimals; see *Proc. Roy. Soc.* vols. xxi. and xxii.; also CIRCLE.

27. We shall now obtain expressions for sin x and cos x as infinite products of rational factors. We have

Factorisation of Sine and Cosine.

$$\sin x = 2\sin\frac{x}{2}\sin\frac{x+\pi}{2} = 2^3\sin\frac{x}{4}\sin\frac{x+\pi}{4}\sin\frac{x+2\pi}{4}\sin\frac{x+3\pi}{4};$$

proceeding continually in this way with each factor, we obtain

$$\sin x = 2^{n-1}\sin\frac{x}{n}\sin\frac{x+\pi}{n}\sin\frac{x+2\pi}{n}\ldots\sin\frac{x+\overline{n-1}\pi}{n},$$

where n is any positive integral power of 2. Now

$$\sin\frac{x+r\pi}{n}\sin\frac{x+\overline{n-r}\pi}{n} = \sin\frac{x+r\pi}{n}\sin\frac{\overline{r\pi-x}}{n} = \sin^2\frac{r\pi}{n}-\sin^2\frac{x}{n},$$

and

$$\sin\frac{x+\frac{1}{2}n\pi}{n} = \cos\frac{x}{n}.$$

Hence the above may be written

$$\sin x = 2^{n-1}\sin\frac{x}{n}\left(\sin^2\frac{\pi}{n}-\sin^2\frac{x}{n}\right)\left(\sin^2\frac{2\pi}{n}-\sin^2\frac{x}{n}\right)\ldots\left(\sin^2\frac{k\pi}{n}-\sin^2\frac{x}{n}\right)\cos\frac{x}{n},$$

where $k=\frac{1}{2}n=1$. Let x be indefinitely small, then we have

$$1 = \frac{2^{n-1}}{n}\sin^2\frac{\pi}{n}\sin^2\frac{2\pi}{n}\ldots\sin^2\frac{k\pi}{n};$$

hence

$$\sin x = n\sin\frac{x}{n}\cos\frac{x}{n}\left(1-\frac{\sin^2 x/n}{\sin^2\pi/n}\right)\left(1-\frac{\sin^2 x/n}{\sin^2 2\pi/n}\right)\ldots\left(1-\frac{\sin^2 x/n}{\sin^2 k\pi/n}\right).$$

We may write this

$$\sin x = n\sin\frac{x}{n}\cos\frac{x}{n}\left(1-\frac{\sin^2 x/n}{\sin^2\pi/n}\right)\ldots\left(1-\frac{\sin^2 x/n}{\sin^2 m\pi/n}\right)R,$$

where R denotes the product

$$\left(1-\frac{\sin^2 x/n}{\sin^2\overline{m+1}\pi/n}\right)\left(1-\frac{\sin^2 x/n}{\sin^2\overline{m+2}\pi/n}\right)\ldots\left(1-\frac{\sin^2 x/n}{\sin^2 k\pi/n}\right),$$

and m is any fixed integer independent of n. It is necessary, when we make n infinite, to determine the limiting value of the quantity R; then, since the limit of $\dfrac{\sin x}{n\sin x/n\cos x/n}$ is $\dfrac{\sin x}{x}$, and that of $\dfrac{\sin m\pi/n}{m\pi/n}$ is unity, we have

$$\frac{\sin x}{x} = \left(1-\frac{x^2}{\pi^2}\right)\left(1-\frac{x^2}{2^2\pi^2}\right)\ldots\left(1-\frac{x^2}{m^2\pi^2}\right)\lim_{n=\infty} R.$$

The modulus of $R-1$ is less than

$$\left(1+\frac{\rho^2}{\sin^2\overline{m+1}\pi/n}\right)\left(1+\frac{\rho^2}{\sin^2\overline{m+2}\pi/n}\right)\ldots\left(1+\frac{\rho^2}{\sin^2 k\pi/n}\right)-1,$$

where $\rho=$ mod. $\sin x/n$. Now $e^{A\rho^2}>1+A\rho^2$, if A is positive; hence mod. $(R-1)$ is less than exp. $\{\rho^2(\operatorname{cosec}^2\overline{m+1}\pi/n+\ldots+\operatorname{cosec}^2 k\pi/n)\}-1$, or than exp. $\{\rho^2n^2\{1/(m+1)^2+\ldots+1/k^2\}\}-1$, or than exp. $\{\rho^2n^2/4m^2\}-1$. Now $\rho^2=\sin^2\alpha/n.\cosh^2\beta/n+\cos^2\alpha/n.\sinh^2\beta/n$, if $x=\alpha+i\beta$; or $\rho^2=\sin^2\alpha/n+\sinh^2\beta/n$. Hence $\lim_{n=\infty}\rho^2n^2=\alpha^2+\beta^2$, $\lim_{n=\infty}\rho n=$ mod. x. It follows that $\text{mod.}_{n=\infty}(R-1)$ is between 0 and exp. $\{(\text{mod. }4)^2/xm^2\}-1$, and the latter may be made arbitrarily small by taking m large enough. It has now been shown that $\sin x=x(1-x^2/\pi^2)(1-x^2/2^2\pi^2)\ldots(1-x^2/m^2\pi^2)(1+\epsilon_m)$, where mod. ϵ_m decreases indefinitely as m is increased indefinitely. When m is indefinitely increased this becomes

$$\sin x = x\left(1-\frac{x^2}{\pi^2}\right)\left(1-\frac{x^2}{2^2\pi^2}\right)\ldots = x\mathop{P}_{n=1}^{n=\infty}\left(1-\frac{x^2}{n^2\pi^2}\right). \qquad (25)$$

This has been shown to hold for any real or complex value of x. The expression for cos x in factors may be found in a similar manner by means of the equation $\cos x = 2\sin\dfrac{\pi-2x}{4}\cos\dfrac{3\pi-2x}{4}$, or may be deduced thus

$$\cos x = \frac{\sin 2x}{2\sin x} = \frac{P\left(1-\frac{4x^2}{n^2\pi^2}\right)}{P\left(1-\frac{x^2}{n^2\pi^2}\right)} = \left(1-\frac{4x^2}{\pi^2}\right)\left(1-\frac{4x^2}{3^2\pi^2}\right)\left(1-\frac{4x^2}{5^2\pi^2}\right)\ldots$$

$$= \mathop{P}_{n=0}^{n=\infty}\left(1-\frac{4x^2}{(2n+1)^2\pi^2}\right). \qquad (26)$$

If we change x into ix, we have the formulae for sinh x, cosh x as infinite products—

$$\sinh x = x\mathop{P}_{n=0}^{n=\infty}\left(1+\frac{x^2}{n^2\pi^2}\right),\ \cosh x = \mathop{P}_{n=0}^{n=\infty}\left(1+\frac{4x^2}{(2n+1)^2\pi^2}\right).$$

In the formula for sin x as an infinite product put $x=\frac{1}{2}\pi$, we then get $1=\dfrac{\pi}{2}\cdot\dfrac{1}{2}\dfrac{3}{2}\dfrac{3}{4}\dfrac{5}{4}\dfrac{5\ldots}{6\ldots}$; if we stop after $2n$ factors in the numerator and denominator, we obtain the approximate equation

$$1=\frac{\pi}{2}\frac{1^2\ 3^2\ 5^2\ldots(2n-1)^2}{2^2.4^2.6^2\ldots\ (2n)^2}.(2n+1)$$

or $\dfrac{2.4.6\ldots\ 2n}{1.3.5\ldots 2n-1}=\sqrt{n\pi}$, where n is a large integer. This expression was obtained in a quite different manner by Wallis (*Arithmetica infinitorum*, vol. i. of *Opp.*).

28. We have

Series for Cot, Cosec, Tan and Sec.

$$\frac{\sin(x+y)}{\sin x} = \frac{(x+y)P\left(1+\frac{x+y}{n\pi}\right)}{xP\left(1+\frac{x}{n\pi}\right)},$$

or cos y + sin y cot x

$$=\left(1+\frac{y}{x}\right)\left(1+\frac{y}{x+\pi}\right)\left(1+\frac{y}{x-\pi}\right)\left(1+\frac{y}{x+2\pi}\right)\left(1+\frac{y}{x-2\pi}\right)\ldots$$

Equating the coefficients of the first power of y on both sides we obtain the series

$$\cot x = \frac{1}{x}+\frac{1}{x+\pi}+\frac{1}{x-\pi}+\frac{1}{x+2\pi}+\frac{1}{x-2\pi}+\ldots \qquad (27)$$

From this we may deduce a corresponding series for cosec x, for, since cosec x = cot $\frac{1}{2}x$ − cot x, we obtain

$$\operatorname{cosec} x = \frac{1}{x}-\frac{1}{x+\pi}-\frac{1}{x-\pi}+\frac{1}{x+2\pi}+\frac{1}{x-2\pi}-\frac{1}{x+3\pi}-\frac{1}{x-3\pi}+\ldots \qquad (28)$$

By resolving $\dfrac{\cos(x+y)}{\cos x}$ into factors we should obtain in a similar manner the series

$$\tan x = \frac{2}{\pi-2x}-\frac{2}{\pi+2x}+\frac{2}{3\pi-2x}-\frac{2}{3\pi+2x}+\frac{2}{5\pi-2x}-\frac{2}{5\pi+2x}+\ldots, \qquad (29)$$

and thence

$$\sec x = \tan\left(\frac{\pi}{4}+\frac{x}{2}\right)-\tan x = \frac{2}{\pi-2x}+\frac{2}{\pi+2x}-\frac{2}{3\pi-2x}-\frac{2}{3\pi+2x}+\ldots. \qquad (30)$$

These four formulae may also be derived from the product formulae for sin x and cos x by taking logarithms and then differentiating. Glaisher has proved them by resolving the expressions for cos x/sin x and 1/sin x ... as products into partial fractions (see *Quart. Journ. Math.*, vol. xvii.). The series for cot x may also be obtained by a continued use of the equation $\cot x=\frac{1}{2}\{\cot\frac{1}{2}x+\cot\frac{1}{2}(x+\pi)\}$ (see a paper by Dr Schröter in Schlömilch's *Zeitschrift*, vol. xiii.).

Various series for π may be derived from the series (27), (28), (29), (30), and from the series obtained by differentiating them one or more times. For example, in the formulae (27) and (28), by putting $x=\pi/n$ we get

Series for π derived from Series for Cot and Cosec.

$$\pi = n\tan\frac{\pi}{n}\left\{1-\frac{1}{n-1}+\frac{1}{n+1}-\frac{1}{2n-1}+\frac{1}{2n+1}\ldots\right\},$$

$$\pi = n\sin\frac{\pi}{n}\left\{1+\frac{1}{n-1}-\frac{1}{n+1}-\frac{1}{2n-1}+\frac{1}{2n+1}\ldots\right\};$$

If we put $n=3$, these become

$$\pi = 3\sqrt{3}\left(1-\frac{1}{2}+\frac{1}{4}-\frac{1}{5}+\frac{1}{7}-\frac{1}{8}+\ldots\right),$$

$$\pi = \frac{3\sqrt{3}}{2}\left(1+\frac{1}{2}-\frac{1}{4}-\frac{1}{5}+\frac{1}{7}+\frac{1}{8}\ldots\right).$$

By differentiating (27) we get

$$\operatorname{cosec}^2 x = \frac{1}{x^2}+\frac{1}{(x+\pi)^2}+\frac{1}{(x-\pi)^2}+\frac{1}{(x+2\pi)^2}+\frac{1}{(x-2\pi)^2}+\ldots;$$

put $x=\dfrac{\pi}{6}$, and we get $\pi^2=9\left\{1+\dfrac{1}{5^2}+\dfrac{1}{7^2}+\dfrac{1}{11^2}+\ldots\right\}$.

These series, among others, were given by Glaisher (*Quart. Journ Math.* vol. xii.).

29. We have $\sinh\pi x=\pi xP\left(1+\dfrac{x^2}{n^2}\right)$, $\cosh\pi x=P\left(1+\dfrac{x^2}{(2n+1)^2}\right)$.

if we differentiate these formulae after taking logarithms we obtain the series

Sums of Certain Series.

$$\frac{\pi}{2x}\coth\pi x-\frac{1}{2x^2}=\frac{1}{1^2+x^2}+\frac{1}{2^2+x^2}+\frac{1}{3^2+x^2}+\ldots,$$

$$\frac{\pi}{2x}\tanh\pi x=\frac{1}{1^2+x^2}+\frac{1}{3^2+x^2}+\frac{1}{5^2+x^2}+\ldots$$

These series were given by Kummer (in *Crelle's Journ.* vol. xvii.)

The sum of the more general series $\dfrac{1}{1^{2n}+x^{2n}}+\dfrac{1}{2^{2n}+x^{2n}}+\dfrac{1}{3^{2n}+x^{2n}}+\ldots$, has been found by Glaisher (*Proc. Lond. Math. Soc.*, vol. vii.)

If U^m denotes the sum of the series $\dfrac{1}{1^m}+\dfrac{1}{2^m}+\dfrac{1}{3^m}+\ldots$, V^m that of the series $\frac{1}{1^m}+\frac{1}{3^m}+\frac{1}{5^m}+\ldots$, and W^m that of the series $\frac{1}{1^m}-\frac{1}{3^m}+\frac{1}{5^m}-\frac{1}{7^m}+\ldots$, we obtain by taking logarithms in the formulae (25) and (26)

Sums of Powers of Reciprocals of Natural Numbers.

$$\log(x \operatorname{cosec} x)=U_2\left(\frac{x}{\pi}\right)^2+\frac{1}{2}U_4\left(\frac{x}{\pi}\right)^4+\frac{1}{3}U_6\left(\frac{x}{\pi}\right)^6+\ldots,$$

$$\log(\sec x)=V_2\left(\frac{2x}{\pi}\right)^2+\frac{1}{2}V_4\left(\frac{2x}{\pi}\right)^4+\frac{1}{3}V_6\left(\frac{2x}{\pi}\right)^6+\ldots;$$

and differentiating these series we get

$$\frac{1}{2}\cot x=\frac{1}{2x}-\frac{U_2}{\pi^2}x-\frac{U_4}{\pi^4}x^3-\frac{U_6}{\pi^6}x^5-\ldots, \qquad (31)$$

$$\frac{1}{2}\tan x=\frac{V_2}{\pi^2}2^2x+\frac{V_4}{\pi^4}2^4x^3+\frac{V^6}{\pi_6}2^6x^5+\ldots. \qquad (32)$$

In (31) x must lie between $\pm\pi$ and in (32) between $\pm\frac{1}{2}\pi$. Write equation (30) in the form

$$\sec x=\Sigma(-1)^n\frac{(2n+1)\pi}{(2n+1\ \frac{1}{2}\pi)^2-x^2},$$

and expand each term of this series in powers of x^2, then we get

$$\sec x=\frac{2^2W_1}{\pi}+\frac{2^4W_3x^2}{\pi^3}+\frac{2^6W_5x^4}{\pi^5}+\ldots \qquad (33)$$

where x must lie between $\pm\frac{1}{2}\pi$. By comparing the series (31), (32), (33) with the expansions of cot x, tan x, sec x obtained otherwise, we can calculate the values of U_2, $U_4\ldots$ V_2, $V_4\ldots$ and W_1, $W_3\ldots$. When U_n has been found, V_n may be obtained from the formula $2^nV^n=(2^n-1)U_n$.

Continued Factors for π.

For Lord Brounker's series of π, see CIRCLE. It can be got at once by putting $a=1$, $b=3$, $c=5\ldots$ in Euler's theorem $=\frac{1}{a}-\frac{1}{b}+\frac{1}{c}-\ldots=\frac{1}{a+}\,\frac{a^2}{b-a+}\,\frac{b^2}{c-b+}\ldots$

Sylvester gave (*Phil. Mag.*, 1869) the continued fraction

$$\frac{\pi}{2}=1+\frac{1}{1+}\,\frac{1.2}{1+}\,\frac{2.3}{1+}\,\frac{3.4}{1+}\ldots;$$

which is equivalent to Wallis's formula for π. This fraction was originally given by Euler (*Comm. Acad. Petropol.* vol. xi.); it is also given by Stern (in *Crelle's Journ.* vol. x.).

Continued Fractions for Trigonometrical Functions.

30. It may be shown by means of a transformation of the series for cos x and $\frac{\sin x}{x}$ that $\tan x=\frac{x}{1-}\,\frac{x^2}{3-}\,\frac{x^2}{5-}\,\frac{x^2}{7-}\ldots$ This may be also easily shown as follows. Let $y=\cos\sqrt{x}$, and let y', $y''\ldots$ denote the differential coefficients of y with regard to x, then by forming these we can show that $4xy''+2y'+y=0$, and thence by Leibnitz's theorem we have

$$4xy^{(n+2)}+(4n+2)y^{(n+1)}+y^{(n)}=0.$$

Therefore $\frac{y}{y'}=-2-\frac{4x}{y'/y''}$, $\frac{y^{n}}{y^{(n+1)}}=-2(2n+1)-\frac{4x}{y^{(n+1)}/y^{(n+2)}}$;

hence $-2\sqrt{x}\cot\sqrt{x}=-2-\frac{4x}{-6-}\,\frac{4x}{-10-}\,\frac{4x}{-14-}\ldots$

Replacing $\sqrt{x}$ by x we have $\tan x=\frac{x}{1-}\,\frac{x^2}{3-}\,\frac{x^2}{5-}\ldots$

Euler gave the continued fraction

$$\tan nx=\frac{n\tan x}{1-}\,\frac{(n^2-1)\tan^2x}{3-}\,\frac{(n^2-4)\tan^2x}{5-}\,\frac{(n^2-9)\tan^2x}{7-}\ldots;$$

this was published in *Mém. de l'acad. de St Pétersb.* vol. vi. Glaisher has remarked (*Mess. of Math.* vols. iv.) that this may be derived by forming the differential equation

$$(1-x^2)y^{(m+2)}-(2m+1)xy^{(m+1)}+(n^2-m^2)y^{(m)}=0,$$

where $y=\cos(n \text{ arc} \cos x)$, then replacing x by cos x, and proceeding as in the former case. If we put $n=0$, this becomes

$$x=\frac{\tan x}{1+}\,\frac{\tan^2x}{3+}\,\frac{4\tan^2x}{5+}\,\frac{9\tan^2x}{7+}\ldots;$$

whence we have

$$\text{arc}\tan x=\frac{x}{1+}\,\frac{x^2}{3+}\,\frac{4x^2}{5+}\,\frac{9x^2}{7+}\ldots+\frac{n^2x^2}{2n+1+}\ldots$$

Purely Analytical Treatment of Circular Functions.

31. It is possible to make the investigation of the properties of the simple circular functions rest on a purely analytical basis other than the one indicated in § 22. The sine of x would be defined as a function such that, if $x=\int_0^y\frac{dy}{\sqrt{(1-y^2)}}$, then $y=\sin x$; the quantity $\frac{\pi}{2}$ would be defined to be the complete integral $\int_0^1\frac{dy}{\sqrt{(1-y^2)}}$. We should then have $\frac{\pi}{2}-x=\int_y^1\frac{dy}{\sqrt{(1-y^2)}}$. Now change the variable in the integral to z, where $y^2+z^2=1$, we then have $\frac{\pi}{2}-x=\int_0^z\frac{dz}{\sqrt{(1-z^2)}}$, and z must be defined as the cosine of x, and is thus equal to $\sin(\frac{1}{2}\pi-x)$, satisfying the equation $\sin^2x+\cos^2x=1$.

Next consider the differential equation

$$\frac{dy}{\sqrt{(1-y^2)}}+\frac{dz}{\sqrt{(1-z^2)}}=0.$$

This is equivalent to

$$d\{y\sqrt{(1-z^2)}+z\sqrt{(1-y^2)}\}=0;$$

hence the integral is

$$y\sqrt{(1-z^2)}+z\sqrt{(1-y^2)}=\text{ a constant.}$$

The constant will be equal to the value u of y when $z=0$; whence $\quad y\sqrt{(1-z^2)}+z\sqrt{(1-y^2)}=u.$

The integral may also be obtained in the form

$$yz-\sqrt{(1-y^2)}\sqrt{(1-z^2)}=\sqrt{(1-u^2)}.$$

Let $\alpha=\int_0^y\frac{dy}{\sqrt{(1-y^2)}}$, $\beta=\int_0^z\frac{dz}{\sqrt{(1-z^2)}}$, $\gamma=\int_0^u\frac{du}{\sqrt{(1-u^2)}}$;

we have $\alpha+\beta=\gamma$, and $\sin\gamma=\sin\alpha\cos\beta+\cos\alpha\sin\beta$,
$\cos\gamma=\cos\alpha\cos\beta-\sin\alpha\sin\beta$,

the addition theorems. By means of the addition theorems and the values $\sin\frac{1}{2}\pi=1$, $\cos\frac{1}{2}\pi=0$ we can prove that $\sin(\frac{1}{2}\pi+x)=\cos x$, $\cos(\frac{1}{2}\pi+x)=-\sin x$; and thence, by another use of the addition theorems, that $\sin(\pi+x)=-\sin x$ $\cos(\pi+x)=-\cos x$, from which the periodicity of the functions sin x, cos x follows:—

We have also $\quad\int\frac{dy}{\sqrt{(1-y^2)}}=-\iota\log_e\{\sqrt{(1-y^2)}+\iota y\}$;

whence $\log_e\{\sqrt{(1-y^2)}+\iota y\}+\log_e\{\sqrt{(1-z^2)}+\iota z\}=$ a constant.
Therefore $\quad\{\sqrt{(1-y^2)}\}+\iota y\}\{\sqrt{(1-z^2)}+\iota z\}=\sqrt{(1-u^2)}+\iota u$,
since $u=y$ when $z=0$; whence we have the equation

$$(\cos\alpha+\iota\sin\alpha)(\cos\beta+\iota\sin\beta)=\cos(\alpha+\beta)+\iota\sin(\alpha+\beta),$$

from which De Moivre's theorem follows.

REFERENCES.—Further information will be found in Hobson's *Plane Trigonometry*, and in Chrystal's *Algebra*, vol. ii. For further information on the history of the subject, see Braunmühl's *Vorlesungen über Geschichte der Trigonometrie* (Leipzig, 1900). (E. W. H.)

TRIGONON, a small triangular harp, occasionally used by the ancient Greeks and probably derived from Assyria or Egypt. The trigonon is thought to be either a variety of the sambuca or identical with it. A trigonon is represented on one of the Athenian red-figured vases from Cameiros in the island of Rhodes, dating from the 5th century B.C., which are preserved in the British Museum. The triangle is here an irregular one, consisting of a narrow base to which one end of the string was fixed, while the second side, forming a slightly obtuse angle with the base, consisted of a wide and slightly curved sound-board pierced with holes through which the other end of the strings passed, being either knotted or wound round pegs. The third side of the triangle was formed by the strings themselves, the front pillar, which in modern European harps plays such an important part, being always absent in these early Oriental instruments. A small harp of this kind having 20 strings was discovered at Thebes in 1823. (K. S.)

TRIKKALA (anc. *Trika*), a town of Greece, capital of the department of Trikkala, and the see of an archbishop, 38 m. W. of Larissa. In winter, when great numbers of Vlach herdsmen take up their quarters in the town, its population exceeds that of Larissa. It has the appearance of a Mussulman town on account of its mosques (only two of which are in use) and it is a centre of trade in wheat, maize, tobacco and cocoons. The town was in ancient times a celebrated seat of the worship of Aesculapius. Pop. (1889), 14,820; (1907) 17,809; of the department, 90,548.

TRILEMMA (Gr. τρεῖς, three, λῆμμα, something taken), in logic, an argument akin to the dilemma (*q.v.*), in which there are three possibilities. By getting rid of two, the third is proved, provided the original three exhaust the number. The terms "tetralemma" (four possibilities) and "polylemma" (many) have also been used.

TRILOBITES, extinct Arthropoda, formerly classified with the Crustacea, but of late years relegated to the Arachnida (*q.v.*), which occurred abundantly in seas of the Cambrian and Silurian periods, but disappeared entirely at the close of the Palaeozoic epoch. Both their origin and the causes which led to their extinction are quite unknown. Widely divergent forms make their appearance suddenly in the Cambrian period amongst the earliest known fossils, and the high perfection of structure to which they had at that time attained implies the antecedent existence of much simpler types, and refers the origin of life to a date immeasurably distant from that at which we have actual proof of the existence of animal and vegetable organisms.

However different in structure Trilobites may be, they all agree in possessing a head-shield usually semi-circular in shape, which results from the fusion of apparently five segments, and bears, except in some blind forms, a pair of large reniform compound eyes like those of the king-crab (*Xiphosura*). This head-shield is succeeded by a varying number of free segments, each of which consists of a medium convex tergal piece and a pair of arched lateral plates, the pleura, of which there is one on each side. The terga and pleura of each individual segment overlap those of the segment that serially succeeds it. The mid-region of the body, composed of jointed segments, is followed by a larger or smaller region consisting of fused segments and termed the *pygidium* or caudal shield, which in some cases is as large as the head-shield itself, in other cases much smaller. When the pygidium is large and composed of many segments, the number of free body segments is correspondingly reduced, and vice versa. It is with respect to this number of segments that respectively constitute the pygidium and the mid-region of the body that Trilobites differ most markedly from each other; and it is a singular fact that the extremes in structural organization in this particular to be met with in the Trilobita are found side by side in strata of Cambrian age. In *Paradoxides*, for example, there are about twenty freely movable segments followed by a very short and small pygidium, whereas in *Agnostus* the freely movable segments are reduced to two and the pygidium is as large as the cephalic shield. In this genus the number of segments composing the pygidium is obscured, as also it is in the genus *Illaenus*, which has as many as ten movable segments preceding the large semi-circular pygidium; but in such forms as *Ogygia* and *Asaphus*, which have about eight free segments, the sutural lines on the pygidium indicate that it is composed of about a dozen or more segments. Somewhat resembling *Agnostus* is *Microdiscus*, with four movable segments and a large pygidium consisting of about five fused segments, the lines of union between the latter being clearly indicated.

The tergal and pleural elements of the pygidium are generally well marked. They are also well marked on the cephalic shield, the tergal elements being represented by a median axial elevated area showing indistinct signs of segmentation, and a lateral unsegmented plate, the *gena*, which carries the eyes. The postero-lateral angles of the gena are commonly produced into spiniform processes, which may project backwards beyond the middle of the body as in *Paradoxides*, or considerably beyond its posterior termination as in *Trinucleus* or *Ampyx*. The latter is further remarkable for having the median area of the head-shield, the *flabellum*, produced into an anteriorly directed spike.

For many years only the dorsal surface of Trilobites was known, nothing having been ascertained of the ventral surface and appendages. Comparatively recently, however, specimens have been obtained with the ventral surface exposed, revealing the number and structure of the limbs. A pair of the latter was articulated to the sides of a moderately wide dorsal plate on each segment of the body, and similar limbs were attached to the ventral surface of the head-shield behind the mouth. Each of these limbs was two-branched, the external branch consisting of a slender fringed flagellum possibly respiratory in function, and the inner of a normal jointed ambulatory leg. These two branches arose from a common basal segment or coxa, the inner surface of which was produced into a strong process underlying the external area In the region of the mouth the basal segments were armed with teeth and subserved the purpose of mastication. As in all Arachnida there is only a single pair of appendages in front of the mouth, and these were one-branched, long and filiform and acted as antennae. Under the pygidium or caudal shield the appendages were much shortened, and their main branch consisted of broader and flatter segments than those of the preceding limbs

Such was the structure of the appendages in Trilobites belonging to the genus *Triarthrus*; but considering the great structural differences that obtain between *Triarthrus* and many other genera, it would be rash to assume that there were not corresponding differences in the structure of the limbs It must not indeed be assumed that those of the first pair were in all cases antenniform.

It is probable that no satisfactory classification of the Trilobites will be proposed until the limbs of most of the genera have been examined. Up to the present time all attempts to arrange the genera in natural and definable groups have failed to meet with general approval; and this criticism must be extended to Beecher's subdivision of the class into three orders, named Hypoparia, Proparia and Opisthoparia, based upon the form and position of a groove, the so-called *genal suture*, which marks the lateral portion of the head-shield. In the majority of Trilobites this groove passes backwards from the anterior or anterolateral edge of this plate to its posterior or postero-lateral border, dividing it into an inner portion continuous with the flabellum and fused tergal regions, and an outer portion bearing the eye. Those genera, like *Paradoxides*, *Olenus*, *Asaphus*, *Phillipsia* and others, in which this groove cuts the posterior edge of the head-shield on the inner side of its angle are referred to the Opisthoparia; those, like *Dalmanites* and *Phacops*, in which it cuts the lateral border in front of the posterior angle, belong to the Proparia. But in certain genera, like *Conocoryphe*, *Calymmene* and *Triarthrus*, it cuts the margin of the head-shield so close to the posterior angle that the distinction between the two groups practically breaks down. To the Hypoparia belongs a comparatively small number of genera, like *Trinucleus* and *Agnostus*, in which this groove or genal suture is beneath the margin of the head-shield and does not appear upon its upper surface.

In external form Trilobites are not unlike Isopod Crustaceans, especially the terrestrial species commonly called " woodlice ", and until the nature of their appendages was known, it was thought by some authorities that the two groups might be related. Like the woodlice they were capable of rolling themselves up into a ball, many specimens having been found fossilized in this state, with the pygidium pressed tightly against the head-shield. There is very little doubt that they lived at the bottom of the sea, feeding upon worms or other soft marine organisms, crawling slowly about the sandy or muddy bottom and burying themselves beneath its surface when danger threatened. That these animals were widely distributed in former times is proved by their occurrence at the present day in palaeozoic fossiliferous strata both of the northern hemisphere and of Australia; and despite the fact that their remains have not been found in rocks of the Mesozoic or Kainozoic epochs, it was conceived to be possible that living specimens might be dredged from the sea-floor during the exploration of the ocean depths undertaken by the " Challenger " expedition. Needless to say this faint hope was not borne out by results. (R. I. P.)

TRIM, a market town and the county town of Co. Meath, Ireland, on the upper waters of the Boyne, 30 m. N.W. by W. from Dublin on a branch of the Midland Great Western railway. Pop. (1901), 1513. The county buildings are here; monthly fairs are held, and there is considerable trade in corn and flour; but the chief interest of the town lies in its historical associations and remains, enhanced by a beautiful situation. It was the seat of a very early bishopric. A Norman tower, called the Yellow Steeple, is supposed to mark the site of St Patrick's Abbey of St Mary. Two gates remain from the old town walls. King John's Castle (incorrectly so called, as this monarch only resided here on the occasion of a visit) was originally founded by Hugh de Lacy in 1173, but a later date is assignable to the greater part of the magnificent moated building, of which the keep, flanking turrets, drawbridge, portcullis and barbican, still testify to its former strength, which was augmented by its frontage to the river. Other smaller fortified buildings are Talbot's and Scurlogstown Castles; the former erected by Sir John Talbot, lord lieutenant of Ireland in 1415—afterwards earl of Shrewsbury, the latter dating from 1180. About a mile east of the town, the ruins of the abbey of St Peter and St Paul occupy both banks of the river. These include the transitional-Norman cathedral on the north bank, and a castle, guarding the crossing of the river, on the south, together with a chapel and other remains. North of the town ruins may be seen of a Dominican friary of the 13th century. The tower of the old parish church dates from 1449. In the annals of Trim many famous names have a place; Humphrey of Gloucester and Henry of Lancaster were imprisoned here by Richard II before Henry came to the throne; and Richard, duke of York, and father of Edward IV held court at the castle, where also several Irish parliaments met until the middle of the 15th century, and a mint was established in 1469. The residence in a house in Dublingate Street of the famous duke of Wellington is commemorated by a Corinthian column and statue. Trim is governed by an urban district council. It was incorporated by Edward III., and returned two members to the Irish parliament until the Union in 1800.

TRIMMER, JOSHUA (1795–1857), English geologist, was born at North Cray in Kent, on the 11th of July 1795. He was son of Joshua Kirby Trimmer of Brentford, and grandson of Mrs Sarah Trimmer (1741–1810), authoress of the *Story of the Robins* (1786). At the age of nineteen he was sent to North Wales to manage a copper-mine for his father; subsequently he was placed in charge of a farm in Middlesex, where he acquired a knowledge of and an interest in soils; in 1825 he became manager (for his father) of slate quarries near Bangor and Carnarvon, and in this district he remained for many years. He discovered the marine shells in the drift of Moel Tryfaen. During the years 1850–1854 he was engaged on the Geological Survey, and surveyed parts of the New Forest in Hampshire. He died in London on the 16th of September 1857.

He published memoirs on the *Origin of the Soils which cover the Chalk of Kent, On the Geology of Norfolk, as Illustrating the Laws of the Distribution of Soils* (1847); and *Proposals for a Geological Survey, specially directed to Agricultural Objects* (1850); in this respect he was a pioneer in agricultural geology He was author also of a useful work *Practical Geology and Mineralogy* (1841). Obituary by J. E. Portlock, in *Quart. Journ. Geol. Soc.* (1858).

TRIMONTIUM, the name of a Roman fort at Newstead, near Melrose, Scotland, close under the three Eildon Hills (whence the name *trium montium*). It was an advanced post of the Romans towards Scotland both about 80 A.D. and after, and again (after an interval of evacuation) from about A.D. 140–180. Excavations during the last four years have yielded finds of almost unique importance. These include the foundations of several successive forts, one above the other, which throw much light on the character of the Roman military post; an unparalleled collection of Roman armour, including ornate helmets, and a good series of coins and datable pottery. The whole illustrate the history of the Roman army and that of Roman Scotland very remarkably and to an extent equalled by no Scottish site as yet explored.

See the report published for the Society of Antiquaries of Scotland by the excavator Mr James Curle. (F. J. H.)

TRINCOMALEE, a town and former naval station on the north-east coast of Ceylon, 100 m. N.E. by N. of Kandy. Pop. (1901), 11,295. It is built on the north side of the bay of Trincomalee, on the neck of a bold peninsula separating the inner from the outer harbour. There is a lighthouse on the extremity of Foul Point at the southern side of the bay, and another on the summit of Round Island. The inner harbour is landlocked, with a safe anchorage and deep water close to the principal wharves; the outer harbour has an area of about 4 sq. m. with a depth of about 70 fathoms. With its magnificent harbour—one of the five or six greatest natural harbours in the world—it used to be the headquarters of the admiral commanding on the East Indian station, with a garrison of infantry and British artillery. The breadth of the streets and esplanades somewhat atones for the mean appearance of the houses, but the town generally has a gloomy and impoverished aspect. Pearl oysters are found in the lagoon of Tambalagam to the west of the bay. A steamer from Colombo calls weekly with and for passengers and cargo. Average annual rainfall, 62¾ in; average temperature, 81·2° F. Some tobacco, rice, and palm are grown in the district.

Attention was directed to the importance of Trincomalee as a naval base in 1896, when a commission of officers recommended its being turned into a modern fortress. The work was commenced in 1898 and finished in 1904. All the batteries were rebuilt and fitted with modern appliances. The whole area was connected with cable and telephone communication, and armed with the latest type of guns; and the fortress was supposed to be impregnable; but in the following year the station was abandoned, the naval yard closed, and the military garrison withdrawn. A man-of-war is still kept in Trincomalee Harbour, to work the defences.

The town was one of the first settlements of the Tamil race in Ceylon, who at a very early period erected on a height at the extremity of the peninsula, now crowned by Fort Frederick, a temple dedicated to Konatha, or Konasir, named the "temple of a thousand columns." The building was desecrated and destroyed in 1622, when the town was taken by the Portuguese, who made use of the materials for the erection of the fort. The town was successively held by the Dutch (1639), the French (1673), the Dutch (1674), the French (1782), and the Dutch (1783). After a siege of three weeks it surrendered to the British fleet in 1795, and with other Dutch possessions in Ceylon was formally ceded to Great Britain by the Treaty of Amiens in 1802.

TRING, a market town in the Watford parliamentary division of Hertfordshire, England, 31¼ m. N.W. by W. from London by the London and North Western railway. Pop. of urban district (1901), 4349. It lies on the western slope of the Chiltern Hills, close to the entrance to a narrow valley which pierces them, and forms one of the highways through them to London, carrying the railway, the Grand Junction Canal, and a main road. The church of St Peter and St Paul shows fine Perpendicular work, especially in the ornate interior of the nave. Industries include straw-plaiting and the weaving of canvas and silk. The Rothschild Museum, erected in 1889, contains an extensive natural history collection. Living wild animals are also kept in a neighbouring paddock and cages. The road which passes through Tring and along the face of the hills represents the ancient Icknield Way, and there may have been a Romano-British village on the site of Tring.

TRINIDAD, the most southerly and, with the exception of Jamaica, the largest of the British West Indian Islands. Pop. (1901), 236,397. It is situated 6 m. E. of the coast of Venezuela, between 10° 3′ and 10° 50′ N. and 60° 39′ and 62° W. Its average length is 48 m., its breadth 35 m. and its area 1754 sq. m. In shape it is almost square, but it throws off two peninsulas westward from its north and south corners. Corozal Point projecting from its north-western and Icacos Point from its south-western extremity enclose the Gulf of Paria. To the west of Corozal Point lie several islands, of which Chacachacare, Huevos Monos and Monos Gaspar Grande are the most important. The surface is level or undulating, excepting in the north and south where there are ranges of hills, with eastern and western axes, prolongations of the Venezuelan coast ranges. Of these the northern is the more elevated ridge, its highest point being Tucuche Peak (3100 ft.). The southern hills attain an elevation of 600 ft. A small ridge runs east to west by south through the centre of the island, from Manzanilla Point to San Fernando, having an isolated elevation in Mt Tamana (1028). The hills of the northern and southern ranges are furrowed by innumerable ravines, and are clad to their summits with dense forests. There are numerous small streams, none navigable, and all flowing either east or west.

In its geology, as well as in its flora and fauna Trinidad differs little from the mainland, with which it was probably at one time connected. There are four mineral springs and several mud volcanoes, but the two most striking natural features are the Maracas Falls, and the Pitch Lake. The Maracas Falls are situated at the head of a valley of the same name, to the north-east of Port of Spain, where the river leaps in a foaming torrent over a sheer wall of rock, 312 ft. high. The Pitch Lake lies some 38 m. by water south-east of the capital, in the ward of La Brea. It is circular in form, about 3 m. in circumference, and 104 acres in extent. Underground forces acting on the pitch cause it to rise in unequal masses, which are rounded off like huge mushrooms, separated from one another by narrow fissures, in which the rainwater collects and forms pools. Near the centre of the lake the pitch is always soft and can be observed bubbling up in a liquid state. When the sun is hot the lightest footfall leaves an impression and the pitch emits an unpleasant odour. The soil of the surrounding district is charged with asphalt, but is very fertile, while the road to the neighbouring port of La Brea, running on a bed of asphalt, moves slowly towards the sea like a glacier The lake is worked by a company which exports the asphalt to the United States; paying royalty to the local government on every ton exported.

The mountain range which runs along the north coast is formed of clay-slates, micaceous and talcose schists, and crystalline and compact limestones, constituting the group called the Caribbean series, the age of which is unknown. The rest of the island is composed of Cretaceous, Tertiary and Quaternary strata. The Cretaceous beds rise to the surface in the centre and are flanked to north and south by the later deposits. Owing to the rarity of satisfactory sections the relations of the various divisions of the Tertiary formation are still somewhat obscure; but they are grouped by J. B. Harrison into (1) Nariva and San Fernando beds, = Eocene and Oligocene; (2) Naparima marls = Miocene and (3) Moruga series = Pliocene and Pleistocene. The Naparima marls consist of a lower division containing *Globigerina* and an upper division with Radiolaria and diatoms and are clearly of deep-sea origin. The bitumen of the Pliocene and Pleistocene deposits appears to have been formed by the decomposition of vegetable matter. Salses or mud volcanoes occur upon the island, but there is no evidence of true volcanic action in Tertiary or recent times, except the presence of occasional bands of pumiceous earth in some of the Tertiary deposits, and the pumice in these cases was probably derived from a distance.

The presence of oil in large quantities in Trinidad had been suspected for many years, and early in the 20th century the government undertook a geological survey to determine the probabilities of an industry. This survey revealed the presence of a series of anticlines at payable depths in the southern division of the island, and experimental borings by three companies at La Brea and Point Fortin in the south-west and Guayaguayare in the south-east proved the presence of oil in large quantities. In 1910 the commercial exploitation of Trinidad oil was being rapidly pushed forward.

The soil of the island is exceedingly rich, and well adapted to the growth of tropical products, especially of sugar and cocoa, which are its staples. The planting of new lands is rapidly progressing, the greater part of the unsold crown lands (various blocks of which have been formed into forest or water reserves) being covered with forests, containing a valuable supply of timber. Poisonous and medicinal herbs grow everywhere. Owing to the variety of its resources, Trinidad has suffered less from general depression than the other islands in the British West Indies. It exports cocoa, sugar, rum, molasses, coffee, tobacco, coco-nuts, fruit, timber, dyewoods, balata gum, india-rubber and asphalt. Large quantities of tonga-beans, the produce of the mainland, are cured in bond at Port of Spain. The manufacture of bitters (Angostura and others) is an important industry, as is also the raising of stock. In addition Trinidad has a large carrying trade with the neighbouring republics, and rivals St Thomas (*q.v.*) as a centre of distribution for British and American merchandise through the West Indies and Venezuela.

Lying in the tract of the trade winds and being practically a part of the mainland, Trinidad is immune from the vicissitudes of climate to which the other Antilles are exposed. It is never visited by hurricanes and its seasons are regular, wet from May to January, with a short dry season in October known as the Indian summer and lasting usually about four weeks, and dry from end of January to middle of May. The average annual rainfall is 66·26 in. and the mean temperature is 78·6° F. A volunteer force was established in 1879, and now consists of infantry, garrison artillery and three companies of Light Horse stationed in Port of Spain, San Fernando and St Joseph. Elementary education is given chiefly in the state-aided schools of the different denominations, but there are a number of entirely secular schools managed by the government. The Presbyterian schools are conducted by a Canadian mission. Instruction is free, but in some few schools fees are paid. Agriculture is a compulsory subject in all the primary schools. Higher education is provided by the Queen's Royal College, a secular institution, to which the Presbyterian Naparima College and the Roman Catholic St Mary's College are affiliated. Attached to these colleges are four scholarships of the annual value of £150 for four years, tenable at any British university. The religious bodies, both Christian and pagan are exceedingly numerous. The Roman Catholics (with an archbishop at Port of Spain) and the Anglicans, with the bishop of Trinidad at their head, are the more powerful bodies. Of the inhabitants of the island, one-third are East Indians. Immigration from India is conducted under government control, and the prosperity of Trinidad is largely due to the contract labour obtained under this system. Of the rest the upper classes are creoles of British, French and Spanish blood, while the lower classes are of pure or mixed negro origin, with a few Chinese. English is spoken in the towns and in some of the country districts, but in the north and generally in the cocoa-growing areas a French *patois* prevails, and in several districts Spanish is still in use. English money is legal tender, as also is the United States gold currency. Accounts are kept in dollars by the general public, but in sterling by the government. There is a complete system of main and local roads constructed or under construction; there are about 90 m. of railways, and practically all the towns of any size can be reached from Port of Spain by rail. Steamers ply daily between Port of Spain and the islands at the northern entrance to the Gulf of Paria and between San Fernando (the southern terminus of the railway) and the south-western ports of the island, while two steamers of the Royal Mail Company under contract connect Port of Spain with the other parts of Trinidad and Tobago. Port of Spain is also in direct communication with Southampton.

The colony (Trinidad and Tobago) is administered by a governor assisted by an executive council and a legislative council of twenty members of whom ten are officials sitting by virtue of office and ten are unofficials nominated by the Crown. Port of Spain, the capital, is situated on the west coast on the shores of the Gulf of Paria. It is considered one of the finest towns in the West Indies, its streets are regular and well shaded, its water supply abundant, and an excellent service of tramways connects the various quarters of the town. It has two cathedrals, a fine block of public buildings containing the principal government departments, the courts of justice and the legislative council chamber, many other large government buildings, a public library, and many good shops, while one of its most beautiful features is its botanical garden, in which the residence of the governor is situated. The harbour is an open roadstead, safe and sheltered, but so shallow that large ships have to lie at anchor half a mile from the jetties. It is, nevertheless, the place of shipment not only for the produce of the entire island but also for that of the Orinoco region. The population is about 55,000. The other towns are San Fernando (pop. 7613), also on the Gulf of Paria, about 30 m. south of the capital; and Arima (pop. 4076), an inland town 16 m. by rail east of Port of Spain.

Trinidad was discovered by Columbus in 1496. It remained in Spanish possession (although its then capital, San José de Oruna, was burned by Sir Walter Raleigh in 1595) until 1797, when a British expedition from Martinique caused its capitulation. It was finally ceded to Great Britain by the Treaty of Amiens in 1802.

See F. Eversley, *The Trinidad Reviewer* (London, 1900); Stark's *Guide-book and History of Trinidad* (London); the *Journal of the Royal Colonial Institute*, passim; and for geology, G. P Wall and J. G. Sawkins, *Report on the Geology of Trinidad* (London, 1860); J. B. Harrison and A. J. Jukes-Browne, "The Oceanic Deposits of Trinidad" (British West Indies), *Quart. Journ. Geol. Soc.* (London, 1899), lv. 177–189; R. J. L. Guppy, "The Growth of Trinidad," *Trans. Canadian Inst.* (1905), viii. 137–149, with plate. The last paper gives a list of all the more important works and papers on the geology of the island.

TRINIDAD, an uninhabited island in the South Atlantic, 680 m. E. of the coast of Espirito Santo, Brazil, in 20° 30′ S. 29° 30′ W., 4 m. long by 2 broad. It is of volcanic formation, and has springs of fresh water. As a possible coaling and telegraph station in mid-ocean, it formed a subject of contention between Brazil and Great Britain in 1895. The dispute was settled in favour of Brazil, which claimed on the ground of its discovery by Tristan da Cunha early in the 16th century, while Great Britain relied on its occupation by the astronomer Halley in the name of England in the year 1700. About 30 m. east are the three islets of Martin Vaz so named from the Portuguese mariner who discovered them about 1510.

TRINIDAD, a city and the county-seat of Las Animas county, Colorado, U.S.A., in the south part of the state, about 100 m. S. of Pueblo. Pop. (1890) 5523; (1900) 5345 (659 foreign-born); (1910) 10,204. Trinidad is served by the Denver & Rio Grande, the Colorado & Southern, the Colorado & Wyoming, and the Atchison, Topeka & Santa Fé railways and by electric railways to the neighbouring coal-mining towns. The city is regularly laid out on a hilly site, on both sides of the Purgatory (or Las Animas) river, near a picturesque canyon and mountain district, including the Stonewall Valley, and at the foot of the Raton Mountains, of which the highest peak, Fisher's (or Raton) Peak (9586 ft.), is 10 m. south of Trinidad. The city has a Carnegie library, a Federal building, an opera house, an amusement park, and the San Rafael hospital, under the charge of the Sisters of Charity. A steam heating plant pipes heat to many shops, offices and residences. Trinidad is in a coal and coke and stock-raising region, and alfalfa, frijole and sugar beets are produced in large quantities in the surrounding region, much of which is irrigated. Dry farming has been successfully carried on at an experiment farm, established in 1906, 12 m. north of the city. Trinidad has railway shops, foundry and machine shops, and coking ovens, ships large quantities of coal, has a wool-scouring mill, and various manufactures. The municipality owns and operates the waterworks. Trinidad was incorporated as a town in 1876, and in 1879 became a city of the second class.

TRINIDAD, a town near the southern coast of Cuba, in Santa Clara Province, about 45 m. south-east of Cienfuegos, and 3 m. from its seaport, Casilda, which lies due south.

Pop. (1907), 11,197. There is a small local railway, not connected (in 1909) with the central trunk line of the island. The city lies on the slope of La Vigia hill (900 ft.) amid higher mountains, and on the banks of the Jayoba (San Juan) river. The streets are narrow, broken and tortuous, and the general aspect of the town is medieval. There are some attractive buildings and a very fine market square. The fine scenery in the neighbourhood, and the climate, which is possibly the healthiest in Cuba, make the place a favourite resort for natives and foreigners. Casilda (pop. in 1907, 1246) has a land-locked, shallow harbour; but Masio Bay, a trifle farther distant, accommodates larger craft; and there are excellent deep-water anchorages among the quays off the coast. The Manati river is navigable for about 7 m. inland, and is used as an outlet for sugar and molasses crops. These and honey are the chief exports; tobacco and various vegetables and fruits are of minor importance. Trinidad is one of the seven original cities of Cuba established by Diego Velasquez. It was founded in 1514 on the coast, but after being attacked by pirates was removed inland. It was thrice sacked by English buccaneers—in 1642, 1654 and 1702; and in the following years, up to and for a time after the peace of Utrecht (1713), it maintained ships and soldiers. Indeed, throughout the first half of the 18th century it was on a continuous war footing against English corsairs, making reprisals on British ships and thriving at the same time on a large contraband trade with Jamaica and other foreign colonies. In 1818 Casilda was opened to legal commerce under the national and foreign flags.

TRINITARIANS, a religious order founded in 1198 by St John of Matha and St Felix of Valois, for the liberation of Christian prisoners and slaves from captivity under the Moors and Saracens. The two founders went to Rome and there obtained the approbation of Innocent III., 1198. The rule was the Augustinian, supplemented by regulations of an austere character. The habit was white, with a red and blue cross on the breast. The Trinitarians are canons regular, but in England they were often spoken of as friars. The first monastery and head house of the order was at Cerfroy near Soissons. Among the earliest recruits were some Englishmen, and the first to go on the special mission of the order were two Englishmen, who in 1200 went to Morocco and returned thence to France with 186 liberated Christian captives. This success excited great enthusiasm and led to the diffusion of the order all over Western Christendom. At the beginning of the 18th century there were still 250 houses, and it is stated that there had been 800; this, however, includes 43 in England, where Dugdale says he could find traces only of a dozen: so that the high figures are probably apocryphal. The first house in England was at Mottenden, in Kent, founded in 1224. The ordinary method of freeing captives was by paying their ransom and for this purpose vast sums of money were collected by the Trinitarians; but they were called upon, if other means failed, to offer themselves in exchange for Christian captives. Many thousands were liberated by their efforts. In the 17th century a reform called the Barefooted Trinitarians was initiated, which became a distinct order and is the only one that survives. There are now less than 500 members. Their headquarters are at San Crisogono in Rome. They devote themselves to the ransoming of negro slaves, especially children, and a great district in Somaliland has been since 1904 entrusted to them as a field for missionary work. There were Trinitarian nuns and a Third Order.

The chief modern book on the Trinitarians is Deslandres, *L'Ordre français des Trinitaires* (2 vols. 1903). Sufficient information will be found in Helyot, *Histoire des ordres religieux* (1714), vol. ii. chs. 45-50; and in Max Heimbucher, *Orden u. Kongregationen* (1907), ii. §57. (E. C. B.)

TRINITY HOUSE, CORPORATION OF, an association of English mariners which originally had its headquarters at Deptford in Kent. In its first charter, received from Henry VIII. in 1514, it was described as the "guild or fraternity of the most glorious and undividable Trinity of St Clement." The first master appointed was the founder of the corporation, Sir Thomas Spert, comptroller of the navy to the king, and commander of the "Harry Grace de Dieu." Deptford having been made a royal dockyard by Henry VIII., and being the station where outgoing ships were supplied with pilots, the corporation rapidly developed its influence and usefulness. By Henry VIII. it was entrusted with the direction of the new naval dockyard. From Elizabeth, who conferred on it a grant of arms in 1573, it received authority to erect beacons and other marks for the guidance of navigators along the coasts of England. In 1604 a select class, was constituted called Elder Brethren, the other members being called Younger Brethren. By the charter of 1609 the sole management of affairs was conferred on the Elder Brethren; the Younger Brethren, however, having a vote in the election of master and wardens. The practical duties of the fraternity are discharged by the acting Elder Brethren, 13 in number, of whom 2 are elected from the royal navy and 11 from the merchant service; but as a mark of honour persons of rank and eminence are admitted as honorary Elder Brethren. In 1647 the corporation was dissolved by parliament, but it was reconstructed in 1660, and the charter was renewed by James II. in 1685. In 1687 a by-law of the Trinity House for the first time required an agreement in writing between the master and crew of a ship. A new hall and almshouses were erected at Deptford in 1765; but for some time the offices of the corporation had been transferred to London, where for a while they had a house in Water Lane, Lower Thames Street, and in 1795 their headquarters were removed to Trinity House, Tower Hill, built from the designs of Samuel Wyatt. By an act of 1836 they received powers to purchase from the Crown, as well as from private proprietors, all interests in coast lights. For the maintenance of lights, buoys, &c., they had power to raise money by tolls, the surplus being devoted to the relief of old and indigent mariners or their near relatives. In 1853 the control of the funds collected by the corporation was transferred to the board of trade, and the money over which the brethren were allowed independent control was ultimately reduced to the private income derived from funded and trust property. Their practical duties in erection and maintenance of lighthouses, buoys and beacons remain as important as ever. Similar functions are carried out by the Northern Lighthouse Board and the Irish Lighthouse Board, for Scotland and Ireland respectively. They have also the care and supervision of pilots. Other Trinity Houses established under charter or act of parliament for the appointment and control of pilots are at Hull and Newcastle. The Elder Brethren of Trinity Masters also act as nautical assessors in the high court of admiralty. The corporation has a large wharf and repair shop at the mouth of the river Lea, where most of the work in connexion with buoying the Thames is carried out.

See W. H. Mayo, *Trinity House, London, Past and Present* (London, 1905); C. R. B. Barrett, *The Trinity House of Deptford Strond* (1893).

TRINITY SUNDAY, the Sunday next after Whitsunday. A festival in honour of the Trinity had been celebrated locally at various dates before Pope John XXII. in 1334 ordered its general observance on the octave of Whitsunday. According to Gervase of Canterbury, it had been introduced into England by Thomas Becket, archbishop of Canterbury, in 1162. It has, however, never been reckoned among the great festivals of the Church. From Trinity Sunday onwards all Sundays until the close of the ecclesiastical year are reckoned as "after Trinity." In the Roman Church these Sundays are also reckoned as "after Pentecost." In the latter case they are described as *dominicae trinitatis*, not to be confused with *dominicae post trinitatis*; e.g. *Dominica sexta post trinitatis* is the same as *Dominica septima trinitatis*.

TRINODA NECESSITAS, the name used by modern historians to describe the threefold obligation of serving in the host (*fyrd*), repairing and constructing bridges (*bryc-geweorc*), and the construction and maintenance of fortresses (*burhbot*), to which all freeholders were subject in Anglo-Saxon times. The obligations are usually mentioned in charters as the sole exceptions to grants of immunities; sometimes, however, a fourth obligation (*singulare practium contra alium*) is reserved, as in the charter granted by Wiglaf of Mercia on the 28th of December 831 (*Cod. dip.* i. 294). Ceolwulf's charter of 822 to Archbishop Wilfred is remarkable, as the military service is there restricted to *expeditiones contra paganos ostes* (ibid. i. 272). The threefold obligation is first mentioned in a Latin charter (*expeditione pontis arcisue constructione*) of doubtful authenticity, which professes to have been granted by Eadbald of Kent in A.D. 616 (*Cod. dip.* v. 2), but it is not until the 8th century that it appears in documents which are generally admitted to be genuine. Although there were corresponding obligations in the Frankish Empire which were called by Charles the Bald (*antiquam et aliarum gentium consuetudinem*), Stubbs held that the arguments which refer them to a Roman origin want both congruity and continuity.

The phrase "trinoda necessitas" is not to be found in the Anglo-Saxon laws and charters; and Selden was probably the first historian of eminence who used it. "These three exceptions," he says, "are noted by the term of a three-knotted necessity in an old charter wherein King Cedwalla granted to Wilfrid, the first bishop of Shelsey in Sussex, the village of Paganham." This charter is an 11th-century copy of a lost original, but the words to which Selden referred are plainly written as *trimoda necessitas* not *trinoda necessitas*. Du Cange gives two examples of the word *trimoda* in medieval Latin, in which language it meant "triple"; but he cites no medieval example of trinoda; and in classical Latin the form is unknown, while *trinodis* (*ter-nodus*, "triple-knotted") occurs only rarely (Ovid. *Her.* iv. 115; *Fast.* i. 575).

See Du Cange, *Glossarium*; W. Stubbs, The *Constitutional History of England*, i. 86, 87; J. M. Kemble, *Codex anglo-saxonicus*, passim; Selden, *English Janus* (London, 1682), p. 43; Walter de Gray Birch, *Cartularium saxonicum*, passim; Facsimiles of Ancient Charters in the British Museum, pt. iv. Cotton MS. Augustus, ii. 86. (G. J. T.)

TRINOVANTES (commonly *Trinobantes*), a powerful British tribe about 50 B.C.–A.D. 50 dwelling north and north-east of London, rivals and neighbours of the Catuvellauni. When Caesar invaded Britain 54 B.C. they joined him against their domestic rivals and it is possible (though not certain) that half a century after Caesar's departure they succumbed to them. Certainly they were conquered by Rome in A.D. 43 and joined in Boadicea's revolt in 61. In the tribal division of Roman Britain given by Ptolemy their land included Camulodunum (Colchester), but nothing more is known of them. But their name plays a part in medieval legends and romances. There it was interpreted as Troy Novant, the "new Troy," and connected with the names of the Trojans Brutus and Corineus who were reputed to have given their names to Britain and Cornwall. (F. J. H.)

TRIOLET, one of the fixed forms of verse invented in medieval France, and preserved in the practice of many modern literatures. It consists of eight short lines on two rhymes, arranged a b a a a b a b, and in French usually begins on the masculine rhyme. The first line reappears as the fourth line, and the seventh and eighth lines repeat the opening couplet; the first line, therefore, is repeated three times, and hence the name. No more typical specimen of the triolet could be found than the following, by Jacques Ranchin (*c.* 1690):—

"Le premier jour du mois de mai
Fut le plus heureux de ma vie:
Le beau dessein que je formais,
Le premier jour du mois de mai !
Je vous vis et je vous aimais.
Si ce dessein vous plut, Sylvie,
Le premier jour du mois de mai
Fut le plus heureux de ma vie."

This poem was styled by Ménage "the king of triolets." The great art of the triolet consists in using the refrain-line with such naturalness and ease that it should seem inevitable, and yet in each repetition slightly altering its meaning, or at least its relation to the rest of the poem. The triolet seems to have been invented in the 13th century. The earliest example known occurs in the *Cléomadés* of Adenés-le-Roi (1258–1297). The medieval triolet was usually written in lines of ten syllables, and the lightness of touch in the modern specimens was unknown to these perfectly serious examples. One of the best-known is that of Froissart, "Mon cœur s'ebât en odorant la rose." The rules are laid down in the *Art et Science de Rhéthorique* (1493) of Henry de Croi, who quotes a triolet written in words of one syllable. According to Sarrasin, who introduces the triolet as a mourner in his *Pompe funèbre de Voiture*, it was that writer who "remis en vogue" the ancient precise forms of verse, "par ses balades, ses triolets et ses rondeaux, qui par sa mort (1648) retournaient dans leur ancien décri." Boileau threw scorn upon the delicate art of these pieces, and mocked the memory of Clément Marot because he "tourna des triolets," but Marmontel recognized the neatness and charm of the form. They continued to be written in France, but not by poets of much pretension, until the middle of the 19th century, when there was a great revival of their use.

The earliest triolets in English are those of a devotional nature composed in 1651 by Patrick Carey, a Benedictine monk at Douai, where he probably had become acquainted with what Voiture had made a fashionable French pastime. In modern times, the triolet was re-introduced into English by Robert Bridges, in 1873, with his—

"When first we met, we did not guess
That Love would prove so hard a master;
Of more than common friendliness
When first we met we did not guess.
Who could foretell the sore distress,
This irretrievable disaster,
When first we met?—we did not guess
That Love would prove so hard a master."

Since then the triolet has been cultivated very widely in English, most successfully by Austin Dobson, whose "Rose kissed me to-day," "I intended an Ode" and "In the School of Coquettes" are masterpieces of ingenuity and easy grace. In later French literature, triolets are innumerable; perhaps the most graceful cycle of them is "Les Prunes," attached by Alphonse Daudet to his *Les Amoureuses* in 1858; and there are delightful examples by Théodore de Banville. In Germany the triolet has attracted much attention. Those which had been written before his day were collected by Friedrich Rassmann, in 1815 and 1817. But as early as 1795 an anthology of triolets had been published at Halberstadt, and another at Brunswick in 1796. Rassmann distinguished three species of triolet, the legitimate form (which has been described above), the loose triolet, which only approximately abides by the rules as to number of rhymes and lines, and single-strophe poems which more or less accidentally approach the true triolet in character. The true triolet was employed by W. Schlegel, Hagedorn, Rückert, Platen and other romantic poets of the early 19th century. In many languages the triolet has come into very frequent use to give point and brightness to a brief stroke of satire; the French newspapers are full of examples of this. The triolet always, or at least since medieval times, has laboured under a suspicion of frivolity, and Rivarol, in 1788, found no more cutting thing to say of Conjon de Bayeux than that he was "si recherché pour le triolet." But in the hands of a genuine poet who desires to record and to repeat a mood of graceful reverie or pathetic humour, the triolet possesses a very delicate charm.

See Friedrich Rassmann, *Sammlung triolettischer Spiele* (Leipzig, 1817). (E. G.)

TRIPHENYLMETHANE, $(C_6H_5)_3CH$, a hydrocarbon, important as being the parent substance of several series of exceedingly valuable dyestuffs, *e.g.* rosanilines and malachite greens derived from aminotriphenylmethanes, and aurins and phthaleins derived from oxytriphenylmethanes. It is obtained by condensing benzal chloride with mercury diphenyl (Kekulé and Franchimont, *Ber.*, 1872, 5, p. 907); from benzal chloride or benzotrichloride and zinc dust or aluminium chloride; from chloroform or carbon tetrachloride and benzene in the presence of aluminium chloride; and deamidating di- and tri-aminotriphenylmethane with nitrous acid and alcohol (O. and E. Fischer, *Ann.*, 1881, 206, p. 152). The last reaction is most important, for it established the connexion between this hydrocarbon and the rosanilines. Triphenylmethane is a white crystalline solid, melting at 92° and boiling at 358°. It separates from benzene and thiophene with one molecule of the "solvent of crystallization." On oxidation it gives triphenylcarbinol, $(C_6H_5)_3C\cdot OH$, and reduction with hydriodic acid and red phosphorus gives benzene and toluene. It combines with potassium to give $(C_6H_5)_3CK$, which with carbon dioxide gives potassium triphenylacetate, $(C_6H_5)_3C\ CO_2K$. Fuming nitric acid gives a paratrinitro substitution derivative which on reduction gives paraleucaniline; the salt of the carbinol formed on oxidizing this substance is the valuable dye rosaniline.

Considerable interest is attached to the remarkable series of hydrocarbons obtained by Gomberg (*Ber.*, 1900, 33, p. 3150, et seq.) by acting on triphenylmethane chloride (from triphenylmethane carbinol and phosphorus pentachloride, or from carbon tetrachloride and benzene in the presence of aluminium chloride) and its homologues with zinc, silver or mercury. Triphenylmethane chloride yields triphenylmethyl; ditolylphenylmethyl and tritolylmethyl have also been prepared. They behave as unsaturated compounds, combining with oxygen to form peroxides and with the halogens to form triarylmethane halides. Triphenylmethyl also combines with ethers and esters, but the compounds so formed are unsaturated. In the solid state triphenyl is colourless, crystalline and bimolecular. It was thought that it might be identical with hexaphenylethane, but the supposed synthesis of this substance by Ullmann and Borsum (*Ber.*, 1902, 35, p. 2877) appeared to disprove this, although it showed that triphenylmethyl readily isomerized into their product, under the influence of catalysts. A.E. Tschitschibabin (*Ber.*, 1908, 41, p. 2421), however, has shown that Ullmann and Borsum's preparation was para-benzhydroltetraphenylmethane $(C_6H_5)_2CH\cdot C_6H_4\cdot C(C_6H_5)_3$; and the view that solid triphenylmethyl is hexaphenylethane has much in its favour. Another remarkable fact is that these substances yield coloured solutions in organic solvents; triphenylmethyl gives a yellow solution, whilst ditolylphenyl and tritolylmethyls give orange solutions which on warming turn to a violet and to a magenta, the changes being reversed on cooling. Several views have been published to explain this fact. A summary is given by Tschitschibabin (*Journ. prak. Chem.*, 1907 (ii.), 74, p. 340). It appears probable that the solutions contain a quinonoid modification (see Gomberg and Cone, *Ann.*, 1909, 370, p. 142).

TRIPOD (Gr. *τρίπους*, Lat. *tripus*), in classical antiquities, any "three-footed" utensil or article of furniture. The name is specially applied to the following: (1) A seat or table with three legs. (2) A stand for holding the caldron used for boiling water or cooking meat; when caldron and stand were made in one piece, the name was given to the complete apparatus. (3) A sacrificial tripod, or altar, the most famous of which was the Delphic tripod, on which the Pythian priestess took her seat to deliver the oracles of the god, the seat being formed by a circular slab on the top, on which a branch of laurel was deposited when it was unoccupied by the priestess. Another well-known tripod was the "Plataean," made from a tenth part of the spoils taken from the Persian army after the battle of Plataea. This consisted of a golden basin, supported by a bronze serpent with three heads (or three serpents intertwined), with a list of the states that had taken part in the war inscribed on the coils of the serpent. The golden bowl was carried off by the Phocians during the Sacred War; the stand was removed by the emperor Constantine to Constantinople, where it is still to be seen in the Atmeidan (hippodrome), but in a damaged condition, the heads of the serpents having disappeared. The inscription, however, has been almost entirely restored (see Frazer on Pausanias, v. 299 seq.). Such tripods were usually of bronze and had three "ears" (rings which served as handles). They also frequently had a central upright as support in addition to the three legs. Tripods are frequently mentioned in Homer as prizes in athletic games and as complimentary gifts, and in later times, highly decorated and bearing inscriptions, they served the same purpose. They were also used as dedicatory offerings to the gods, and in the dramatic contests at the Dionysia the victorious *choregus* (a wealthy citizen who bore the expense of equipping and training the chorus) received a crown and a tripod, which he either dedicated to some god or set upon the top of a marble structure erected in the form of a small circular temple in a street in Athens, called the "street of tripods," from the large number of memorials of this kind. One of these, the "monument of Lysicrates," erected by him to commemorate his victory in a dramatic contest in 335 B.C. is still in existence (see Frazer, ii. 207).

See C. O. Müller, *De tripode delphico* (1820); F. Wieseler, *Ueber den delphischen Dreifuss* (1871); E. Reisch, *Griechische Weihgeschenke* (1890) and his article "Dreifuss" in Pauly-Wissowa, *Realencyclopadie der classischen Altertumswissenschaft*, v. pt. 2 (1905).

TRIPOLI, a Turkish vilayet (regency) of North Africa. It is bounded N. by the Mediterranean (between 11° 40′ and 25° 12′ E.) and has a coast-line of over 1100 m. Tripoli comprises at least five distinct regions—Tripoli proper, the Barca plateau (*Cyrenaica*), the Aujila oases, Fezzan (*q.v.*) and the oases of Ghadames and Ghat—which with the intervening sandy and stony wastes occupy the space between Tunisia and Egypt, extend from the Mediterranean southwards to the Tropic of Cancer, and have a collective area of about 400,000 sq. m., with a population estimated at from 800,000 to 1,300,000. Towards the south and east the frontiers are undefined. But on the west side the conventional line laid down by agreement with France in 1886 was more accurately determined in 1892, when the terminal point on the Mediterranean was shifted from Borj-el-Biban to Ras Ajir, 18 m. to the south-east, in 33° 12′ N. 11° 40′ E. From this point the line passes along the Wad Magla and across the Erg (sand) dunes in such a way as to leave Ghadames to Turkey. In consequence of frontier collisions the boundary as far as Ghadames was precisely defined in 1910. South of that point the rival claims of France and Turkey remained in dispute.

Physical Features.

For some distance east of Tunisia the seaboard is low and sandy, and is often regarded as a part of the Sahara, which, however, begins only some 80 m. farther south, beyond the Jebels Nefusi, Yefren and Ghurian (Gharian). The "Jebel," as this system is locally called, terminates eastwards in the Tarhona heights of the Homs (Khoms) coast district, has a mean altitude of about 2000 ft. and culminates in the Takut (Tekuk) volcano (2800 ft.) nearly due south of the capital. It is not a true mountain range, but rather the steep scarp of the Saharan plateau, which encloses southwards the Jefara coast plains, and probably represents the original coast-line. The Ghurian section is scored in places by the beds of intermittent coast streams, and on its lower slopes is clothed with a rich sub-tropical vegetation. South of these escarpments, the vast Hammada el-Homra, the "Red Hammada," an interminable stony table-land covering some 40,000 sq. m., occupies the whole space between Tripoli proper and the Fezzan depression. The now uninhabited and waterless Hammada formerly drained through several large rivers, such as the Wadis Targelat (Uani, Kseia), Terrgurt, Sofejin, Zemzem and Bel, north-eastwards to the Gulf of Sidra (*Syrtis major*). Southwards the table-land is skirted by the Jebel Welad Hassan, the Jebel es-Suda, the Jebel Morai-Yeh, and other detached ranges, which have a normal west to east trend in the direction of the Aujila oases, rising a little above the level of the plateau, but falling precipitously towards Fezzan. The Jebel es-Suda (Black Mountains), most conspicuous of these ranges, with a mean altitude of 2800 ft., takes its name from the blackened aspect of its limestone and sandstone rocks, which have been subjected to volcanic action, giving them the appearance of basalt. Eastwards this range ramifies into the two crescent-shaped chains of the Harûj el-Aswad and Harûj el-Abiad ("Black" and "White" Harûj), which rise some 700 ft. above the Red Hammada, and enclose an extensive Cretaceous plateau. Rocks of Cretaceous age cover, indeed, an immense area of the northern part of the vilayet, recent eruptive rocks being represented by the lavas and ashes of the craters of Takut and Manterus. The later palaeozoic formations occur in Fezzan.

Beyond the barren Ghadama district in the north of the Hammada the dreary aspect of the wilderness is broken by several tracts under grass, corn and date-palms, and containing some permanent reservoirs in the beds of the Wadis Sofejin and Zemzem, where the plateau falls from a mean height of 2000 ft. to 1000 and 530 ft. respectively. But it again rises rapidly southwards to a somewhat uniform level of 1600 or 1700 ft., and here the main caravan route from Tripoli to Murzuk and Lake Chad traverses for a distance of fully 130 m. a monotonous region of sandstone, underlying clays, marls, gypsum and fossiliferous silicious deposits. In its northern section this part of the Hammada, as it is locally called in a pre-eminent sense, is relieved by a few patches of herbage, scrub and brushwood, with a little water left in the rocky cavities by the heavy showers which occasionally fall.

The Aujila Depression.

North-eastwards the Neddik pass over the Jebel Morai-Yeh leads down to the remarkable chain of low-lying oases, which, from the chief member of the group, is commonly called the Aujila depression. Collectively the oases present the aspect of a long winding valley, which is enclosed on the north side by the southern escarpments of the Barca plateau, expands at intervals into patches of perennial verdure and shallow saline basins, and extends from the Wadi el-Fareg, near the Gulf of Sidra, through the Bir Rassam, Aujila, Jalo, Faredgha, and Siwa oases, to the Natron lakes and the dried-up branch of the Nile delta known as the Bahr bilā-Mā (waterless river). The whole region presents the aspect of a silted-up marine inlet, which perhaps in Pliocene times penetrated some 300 m. south-eastwards in the direction of the Nile. Nearly all the fossil shells found in its sands belong to the fauna now living in the Mediterranean, and Siwa is 98 ft. below sea-level. This is true also of its eastern extensions, Sittra (80) and the Birket el-Kerun in the Fayum (141). But Aujila and Jalo stand 130 and 296 ft. respectively above sea-level, so that the idea entertained by the explorer Gerhard Rohlfs of transforming the chain of oases into a marine gulf, and thus converting the Barca plateau into an island or peninsula in the midst of the Mediterranean waters, and in fact flooding the Libyan desert, must share the fate of Colonel François Roudaire's equally visionary scheme in respect of the Western Sahara.

The Barca Plateau.

The Barca plateau, which consists largely of strata of tertiary formation, falls in terraces down to the Aujila depression, and presents an unbroken rampart of steep cliffs towards the Mediterranean, is by far the most favoured region of the vilayet. Its many natural advantages of climate, soil and vegetation led to the establishment of several Greek colonies, the oldest and most famous of which was that of *Cyrene* (*q.v.*), dating from about 630 B.C. From this place the whole region took the name of Cyrenaica (*q.v.*) and was also known as *Pentapolis*, from its "five cities" of Cyrene, Apollonia, Arsinoe, Berenice and Barca. The elevated plateau of Cyrenaica, which encloses the Gulf of Sidra on the west, is separated southwards by the Aujila depression from the Libyan desert, and projects northwards far into the Mediterranean, might seem, like the Atlas region in the west, to belong geologically rather to the European than to the African mainland. It has a mean altitude of considerably over 2000 ft., and in the Jebel Akhdar (Green Mountains) attains a height of nearly 3500 ft. Eastwards the Barca uplands merge gradually in the less elevated Marmarica plateau, which nowhere rises more than 1800 ft. above sea-level, and disappears altogether in the direction of the Nile delta. The most easterly spot on the coast belonging to Tripoli is the head of the Gulf of Solum; from this point the frontier line separating the regency from the Egyptian dominions runs south so as to leave the Siwa oasis on the Egyptian side of the line.

The Kufra Oases.

South of the Aujila depression the land rises steadily to a height of nearly 1200 feet in the *Kufra* oases, which lie between 21° and 24° E., north of the Tropic of Cancer and due east of Fezzan. The group consists of five distinct oases in the heart of the Libyan desert—Taizerbo, Zighen, Bu-Zeima, Erbena and Kebabo—which extend for a distance of 200 m. north-west and south-east, and have a collective area of 7000 sq. m. and a population of 6000 or 7000 Arabo-Berber nomads. Good water is obtained in abundance from the underground reservoirs, which lie within a few feet of the surface, and support over a million date-palms. Kufra, that is, "Infidels" (in reference to the now extinct pagan Tibu aborigines), is a centre of the Senūssite brotherhood, whose *zawya* (convent) at Jof, in Kebabo, ranks in importance with that of Jarabub, their chief station in Cyrenaica. This circumstance, together with the great fertility of the group and its position midway on the caravan route between Cyrenaica and Wadai, imparts exceptional importance to these oases. Formerly the Turks did not exercise authority in Kufra, the influence of the Senussi being paramount. Kufra, moreover, is outside the limits usually assigned to Tripoli. But in 1910 Ottoman troops were in occupation of the oases.

Ghat.

Ghat stands 2400 feet above the sea, on the Wadi Aghelad in the Igharghar basin, and consequently belongs, not to the Fezzan depression, but to the Saharan plateau. The Aghelad, or "Passage," trends north to the Iasawan valley along the east foot of the Tasili plateau, that is, the divide between the waters which formerly flowed north to the Mediterranean, west to the Atlantic, and south to the Niger and Chad basins. Ghat, which is skirted eastwards by the Akakus range, is a sandy plain dotted over with clumps or groves of date-palms. In the centre is an open space where is held a great annual fair, and to this, combined with its position on one of the caravan routes across the desert, the oasis owes all its importance. For several years, at the end of the 19th and beginning of the 20th centuries, the only caravan route used from the Niger countries to Tripoli was by way of Ghat, disturbances in Bornu and raids by Tuareg having closed all other routes. There is, in the oasis, a population of perhaps 10,000, nearly all Ihajenen Tuareg, about half of whom live in the town of Ghat (350 m. south of Ghadames and 250 south-west of Murzuk), which appears to be a relatively modern place, successor to *Rapsa*, a great commercial centre and military station under the Roman Empire.

Ghadames.

Ghadames, on the contrary, is ancient, being the *Cydamus* of the Garamantes, the capture of which by L. Cornelius Balbus Minor led to the overthrow of their empire. The oasis, which stands on the cretaceous Tinghert plateau 300 m. south-west of Tripoli, and 1200 ft. above the sea, is enclosed by a circular rampart over 3 m. in circumference. The town, which occupies the south-west corner of the enclosure, has a population of about 7000. Owing to its perennial springs and artesian wells, the oasis yields an abundance of dates, figs, apricots and vegetables, besides some wheat, barley and millet. It occupies a highly advantageous position at the converging-point of several caravan routes, and has extensive trading relations with the markets of Tripoli, Tunisia and the Sudan.

Climate.—The climate of Tripoli is very variable; cold nights often succeed warm days. The rainfall in the northern regions varies from 5 in. to 15 in. a year—December, January and February being the rainy season. The mean temperature on the coast lands is 68°; it is very much higher in the Hammada, where rain seldom falls.

Flora and Fauna.—The flora in the greater part of the regency is Saharan, the date-palm being the characteristic tree. The gum-yielding acacia, the tamarisk, sapan, mastic and pistachio are found in the wadis, and *shi* (wormwood) grows in clusters on the stony plateaus. In the Barca plateau and in parts of the coast belt the flora is more varied, resembling that of the Mediterranean countries generally. In these regions the laurel, myrtle and other evergreens are fairly common, and the oak, cypress, pine, carob and other trees occur, notably the olive, found also in the oases. Other fruit trees are the almond, fig, pomegranate, quince and apricot. Vines flourish in a few districts.

The larger wild animals are scarcely represented in Tripoli. The wild boar is found in Jebel Akhdar, the hyena, fox and jackal in the deserts. The moufion, gazelle, hares, rabbits and marmots are among the commoner animals. Reptiles include the horned viper and the gecko. The characteristic animal is the camel, found only in the domesticated state. Horses and cattle are bred, but the horses are not numerous; goats and a fat-tailed variety of sheep are kept in large numbers. Birds include the ostrich, vultures, hoopoes, wood pigeons and doves. Bees are numerous and honey forms an article of export.

Inhabitants.

The explorations of Henri Duveyrier, Victor Largeau, Erwin von Bary and H. S. Cowper during the second half of the 19th century showed that Tripoli was not only inhabited by primitive man, but was the seat of a flourishing Neolithic culture, comparable to and in many respects resembling that of Iberia, Brittany and the British Isles. As in other parts of Mauretania, many now arid and uninhabitable wastes are strewn with monolithic and other remains, which occur in great variety of form and in vast numbers, as many as 10,000, chiefly of the menhir type, having been enumerated in the Mejana steppe alone. All kinds of megalithic structures are found—dolmens and circles like Stonehenge, cairns, underground cells excavated in the live rock, barrows topped with huge slabs, cup stones, mounds in the form of step pyramids, and sacrificial altars. Most remarkable are the "Senams," or trilithons of the Jebel Msīd and other districts, some still standing, some in ruins, the purpose of which has not been determined. They occur either singly or in rows, and consist of two square uprights 10 ft. high standing on a common pedestal and supporting a huge transverse beam. In the Terrgurt valley "there had been originally no less than eighteen or twenty megalithic trilithons, in a line, each with its massive altar placed before it" (Cowper). There is reason to believe that the builders of these prehistoric monuments are represented by the Berber people, who still form the substratum, and in some places the bulk, of the inhabitants of Tripoli proper. But even here the Berbers have for the most part been driven to the Ghurian and Tarhona uplands by the Arab nomads, who now occupy the Jefara flats about the capital, and are in almost exclusive possession of Cyrenaica, Marmarica, and the Aujila oases. In Fezzan the Saharan Berbers (Tinylkum Tuareg) are dominant, but are here largely intermingled with Negro or Negroid intruders from the Sudan. But even in the uplands many of the Berbers have been Arabized, and Cowper describes the people of the Tarbona heights as "pure-bred Arabs." Other early intruders are the Jews, some of whom arrived from Egypt in the time of the Ptolemies, and still lead the life of troglodytes in the limestone caves of the Ghurian escarpments. They are also numerous in the large towns, where there are also colonies of Turks, and Maltese, Italian, Cretan and other South European traders and artisans.

Tripoli and other Towns.

On the other hand, no trace can be now detected either of the Greeks who colonized Cyrenaica in the 7th century B.C., or of the Phoenicians who at a still earlier date founded the three great cities of Oea, Sabrata and Leptis Magna (*q.v.*), from which the western region projecting seawards between the two Syrtes took the name of Tripolitana. Later, when Oea, which stood between the two others, was made the capital of the province it was called Tripolis, the "Three Cities," as it were, rolled into one, and this name it has retained since Roman times, being now distinguished from the Tripolis of Syria as West Tripolis, the *Tarabulus el-Gharb* of the Turks and Arabs. Tripoli (*q.v.*), the capital of the province, is thus one of the oldest places in the world, and no doubt owes its stability in large measure to its position over against Sicily at the northern terminus of three great historic caravan routes, one of which runs due south to Lake Chad through Fezzan and Bilma, that is, across the narrowest part of the Sahara; another runs south-west through Ghadames and Ghat to Timbuktu and Kano, and the third south by east through Sokna to Wadai and Darfur. East of Tripoli are the small seaports of Homs (Khoms) and Lebda.

In Barca the largest town is Bengazi (*q.v.*), the ancient Berenice, at the southern extremity of a headland which formerly enclosed a spacious natural haven on the north-east side of the Gulf of Sidra. But the harbour has been partly filled up by the ruins of a large fortress, and is inaccessible to vessels drawing over 6 or 7 ft. East of Bengazi are Merj, the ancient Barca (*q.v.*), and the exposed roadstead of Derna (*q.v.*). Marsa-Susa, the ancient Apollonia, lies under the Ras Sem headland, and was the emporium of the neighbouring city of Cyrene (Ain Shahat-Grenna). The Turkish government displayed much activity in this fertile and healthy district in the period 1897–1903. To it were removed many of the Moslem inhabitants of Crete dissatisfied with the autonomous régime established in that island in 1898.

Agriculture and Trade.—Tripoli proper is purely an agricultural and trading country; it possesses no manufactures of importance, nor exploited mineral wealth save salt. The uncertainty of the rainfall, the apparent increasing poverty of the soil and the heavy taxation of the peasants reduced agriculture at the close of the 19th century to a lower point than theretofore recorded. The cultivation of wheat was largely supplanted by that of barley—the staple food of the peasantry, whilst esparto grass, a fibre growing wild in the rural districts within the cereal zone, acquired the chief place among local exports. The importation of foreign flour, begun in 1881, assumed large dimensions in providing for the deficiencies occasioned by ever-recurring failures of the wheat and barley harvests. Besides wheat and barley the principal products of the country are esparto grass, olives, saffron, figs and dates—these last being perhaps the finest in North Africa. Fruit also is abundant in certain parts, including oranges and lemons, and so are many kinds of vegetables. There is a lucrative sponge fishery, a monopoly of Greek traders, over 100 barques being engaged in the industry.

Trade, before the suppression of the oversea slave traffic, was largely in negroes, brought across the Sahara with other Sudan produce, for the Turkish market. It now consists chiefly in the export of esparto, barley in years of plenty, eggs, cattle, sponges, mats and henna, all articles of local production, and, from Central Africa, ivory, ostrich feathers, tanned goat-skins and a little gold dust. The cattle go mainly to Malta, the esparto, barley, eggs and ivory mostly to England, the feathers to Paris and London, and the skins to New York. The henna and mats are sent to Turkey, Egypt, Tunis and Malta. The exports of esparto grass vary with the success or failure of the cereal crops; thus in 1903 the value of barley exported was £70,800, and of esparto £76,400. In 1904 the exports of barley fell to £3,200 and those of esparto rose to £126,000. From Bengazi hundreds of thousands of sheep are exported to Egypt, Malta and Crete. With Egypt there is an overland as well as sea trade. The caravan trade, which in the forty years ending 1901 had an annual average value of £114,000, is so costly that only articles yielding considerable profit can be carried; the desert trade is, moreover, being deflected to the Niger and the Guinea coast. Tripoli imports, chiefly, food-stuffs (flour, rice, sugar, tea) cotton goods, tobacco, metals and hardware About two-thirds of the imports are from Great Britain. Exclusive of Bengazi the value of trade, imports and exports combined, was for the last thirty years of the 19th century some £770,000 per annum. The trade of Bengazi and Derna, chiefly with Great Britain and Malta, largely increased at the beginning of the 20th century. For the five years 1902–1906 the average annual value of imports was £214,000, of exports £455,700. From these ports the chief exports are sheep and goats, oxen, wool and skins, barley and camels—the last sent overland to Alexandria. Food-stuffs, tea, olive oil and cotton goods are the chief imports. There is an active contraband trade with Greece and Malta in firearms and gunpowder.

Barley is the chief food of the people both in Tripoli proper and in Bengazi. The nomad Arabs possess thousands of camels, cattle and sheep. They weave rough woollen garments, make reed matting, carpets of alternative strips of woven goat and woven camel hair, and manufacture butter. Olive and date-palm trees are cultivated in large numbers. Tea has become a favourite beverage both in the regency and with the Sudanese. Tea, sugar and cottons form the staple articles of exchange with the Sudanese for their produce.

Communications.—The town of Tripoli is connected by telegraph cable with Malta, and telegraph lines run inland from that town to Murzuk, Bengazi, Derna and other towns in the regency, and to Gabes in Tunisia. A wireless telegraphic apparatus connects Derna and Rhodes. There are regular sailings between Malta and Tripoli and between Tunis and Tripoli. Italian vessels also call regularly at Bengazi and Derna. The shipping trade is mostly in the hands of Italians—who have more than half the total tonnage—and French, British shipping coming third. Inland communication is almost entirely by camel caravans.

Administration.—The *vali* or governor-general, who exercises chief authority both civil and military, is appointed by the sultan of Turkey and holds office at his majesty's pleasure. The system of government, executive and judicial, resembles that of other Turkish provinces, but with some modifications in the direction of local autonomy. Bengazi or Barca is a separate sub-province with an administration responsible direct to Constantinople. Revenue is derived chiefly from customs, tithes and a poll tax called *verghi*. Owing to expenditure on the army, some 10,000 Turkish troops being stationed in the regency, the receipts from revenue are generally below the cost of administration. The receipts in the period 1900–1905 averaged about £150,000 a year and the expenditure £170,000, of which amount some £100,000 was on military requirements.

History.—The early history of Cyrenaica and Tripoli is distinct though similar. Cyrenaica was first colonized by Greeks, afterwards it fell under the sway of the Ptolemies and from them passed to the Romans (see CYRENAICA). Tripoli, on the other hand, was originally a Phoenician colony (*vide ante, Towns*). Later it was dependent on Carthage and followed its fortunes. From the Romans the province received its present name. In the 5th century both Tripoli and Cyrenaica were conquered by the Vandals, whose power was destroyed by the Byzantine general Belisarius in the following century. In the middle of the 7th century the whole country was overrun by the Arabs, and Christianity gave place to Islam. From this period, for many centuries, Tripoli was subject to the successive rulers of Tunisia. It was pillaged in 1146 by the Normans of Sicily. In 1321 the Beni Ammar established an independent dynasty, which lasted with an interval (1354–1369), during which two sovereigns of the Beni Mekki reigned, until 1401 when Tripoli was reconquered by the Tunisians. In 1510 Ferdinand the Catholic of Spain took Tripoli, and in 1528 it was given to the knights of St John, who were expelled in 1553 by the Turkish corsairs Dragut and Sinan. Dragut, who afterwards fell in Malta, lies buried in a much venerated *kubba* close to one of the mosques. After his decease the connexion between Tripoli and Constantinople seems to have been considerably weakened. But the Tripolitan pirates soon became the terror and scourge of the Mediterranean; half the states of Europe seem at one time or other to have sent their fleets to bombard the capital. In 1714 Ahmed Pasha Caramanli achieved practical independence and he and his descendants governed Tripoli as a regency, the claims of the Porte being recognized by the payment of tribute, or "presents." In the early part of the 19th century the regency, owing to its piratical practices, was twice involved in war with the United States. In May 1801 the pasha demanded from America an increase in the tribute ($83,000) which the government of that country had paid since 1796 for the protection of their commerce from piracy. The demand was refused and a naval force was sent from America to blockade Tripoli. The war dragged on for four years, the Americans in 1803 losing the frigate "Philadelphia," the commander (Captain William Bainbridge) and the whole crew being made prisoners. The most picturesque incident in the war was the expedition undertaken by William Eaton (*q.v.*), with the object of replacing upon the Tripolitan throne an exiled pasha, elder brother of the reigning sovereign, who had promised to accede to all the wishes of the United States. Eaton at the head of a motley assembly of 500 men marched across the desert from Alexandria, and with the aid of American ships succeeded in capturing Derna. Soon afterwards (June 3, 1805) peace was concluded, the reigning pasha relinquishing his demands but receiving $60,000 (about £12,000) as ransom for the "Philadelphia" prisoners. In 1815, in consequence of further outrages, Captains Bainbridge and Stephen Decatur, at the head of an American squadron, again visited Tripoli and forced the pasha to comply with the demands of America. In 1835 the Turks took advantage of a civil war to reassert their direct authority, and since that date Tripoli has been an integral part of the Ottoman Empire, rebellions in 1842 and 1844 being unsuccessful. After the occupation of Tunisia by the French (1881) the Turks increased their garrison in Tripoli considerably. After the Anglo-French agreement of 1889 recognizing the central Sahara as within the French sphere, various disputes arose as to the extent of the Tripolitan hinterland, which the French endeavoured to circumscribe (see TUNISIA). The French, on their part, believed that their opponents in Wadai and elsewhere in the central Sudan received support from the Turks.

The *khouan* (*ikhwān*) or semi-religious semi-political Moslem fraternities are powerful in Tripoli. The most remarkable is that of the Senussites. The explorers Rohlfs, Nachtigal and Duveyrier found their passage barred by Senussite agents. (See SENUSSI.)

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TRIPOLI (*Tarabulus el-Gharb, i.e.* Tripoli of the West), capital of the Turkish vilayet of Tripoli, North Africa, situated in 32° 53′ 40″ N. and 13° 11′ 32″ E. on a promontory stretching out into the Mediterranean and forming a small crescent-shaped bay which shelters the harbour from the north winds. Its crenellated enceinte wall has the form of an irregular pentagon. A line of small ancient forts is supposed to protect one side of the harbour, and the citadel the other. This citadel, dating from the time of the Spanish occupation, now serves as the residence of the governor. The harbour has a depth of water varying from 15 to 24 ft.; steamers drawing 21 ft. can anchor inside, but shoals render the entry difficult. At the quayside the depth of water is from 2 to 5 ft. only. The desert almost touches the western side of the city, while on the east is the verdant oasis of Meshia, where are still to be seen the tombs of the Caramanlian sultanas and the twelve-domed *ḳubba* of Sidi Hamonda. The aspect of the city is picturesque; the houses (many possessing beautiful gardens) rise in terraces from the seashore. The Turkish quarter contains numerous mosques whose minarets and cupolas break the monotony of the flat-roofed and whitewashed houses. The Grand mosque and the Pasha mosque (originally a church built by the Spaniards) both have octagonal minarets. By the harbour are several houses built in European style, but the general aspect of the city is Oriental. Many of the streets are arcaded; the *suks* or markets are the scene of much animation. Near the port stands a Roman triumphal arch. This arch, quadrifrontal in form, is made entirely of white marble, the blocks being held together with cramps, and is richly embellished with sculpture. It was begun in the reign of the emperor Antoninus, according to a still unmutilated dedicatory inscription, and finished in that of Marcus Aurelius. In the arch, now partly buried in débris, a cabaret has been installed.

A few small manufactures of carpets and silks as well as "Cordova leather" are carried on, but Tripoli is essentially a trading town, being the chief Mediterranean gateway to the Sahara. The population, about 60,000, is very mixed—Berber, Arab, Turk, Jew, Maltese, Italian and Negro. The Maltese inhabitants number about 4000, the Italians 1000 and the Jews 8000. The local trade is almost entirely in the hands of the Jews and Maltese; the shipping in the port is largely Italian.

See H. M. de Mathuisieulx, *A travers la Tripolitaine* (Paris, 1903).

TRIPOLI, or TARABULUS (anc. *Tripolis*), the chief town of a sanjak of the same name in the Beirut vilayet of Syria, situated about 2 m. inland from its port, al-Mina. The ancient Phoenician city, which we know only by its Greek name of Tripolis, was the seat in Persian times of the federal council of Sidon, Tyre and Aradus, each of which cities had its separate quarter in the "triple town." In the 2nd and 1st centuries B.C., under Seleucid and Roman influences successively, it struck autonomous coins. These are succeeded by imperial coins ranging from 32 B.C. to A.D. 221. About 450, and again in 550, it was destroyed by earthquake. The Arabs took it in 638 after a prolonged siege, the inhabitants withdrawing by sea. Moawiya recruited the population by a colony of Jews and gave it fortifications and a garrison against the naval attacks of the Greeks, who, notwithstanding, retook it for a brief space in the time of Abdalmalik. It was again taken by the Greeks in the war of 966–69 and was besieged by Basil II. in 995, after which date it was held by a garrison in the pay of the Fatimite caliphs of Egypt, who treated the city with favour and maintained in it a trading fleet. At this time, according to the description of Nāsir Khosrau, who visited it in 1047, it lay on the peninsula of Al-Mīnā, bathed on three sides by the sea, and had about 20,000 inhabitants and important industries of sugar and paper-making. Of the great sea-walls and towers there are still imposing remains. From this date till it was taken by the crusaders, after a five years' siege, in 1109, the ruling family was that of 'Ammār, which founded a library of over 100,000 volumes. Under the crusaders Tripoli continued to flourish, exported glass to Venice, and had 4000 looms. In 1289 it was taken and destroyed by the sultan Kolā'ūn of Egypt, and a new city was begun on the present site, which rapidly rose to importance. Its medieval prosperity has obliterated most relics of remoter antiquity. Tripoli had a troubled existence during the period of Ottoman weakness (the 18th and early 19th centuries), being frequently in dispute between the pasha of Aleppo and the rebel pashas of Acre. After the Egyptian conquest of Syria it was made the capital of a province in 1834; but in 1840 it reverted to the minor position which it now holds. It is connected by a carriage road with Homs and by a steam tramway with Beirut, and is the natural outlet of the upper Orontes valley; but its inland trade has been greatly damaged by the Homs-Aleppo railway. From its own district, however, it exports silk, tobacco, oil, soap, sponges, eggs and fruit, and is a prosperous and growing place with a large Christian element in its population (about 30,000, the port-town included). It is served regularly by the Levantine lines of steamers. (D. G. H.)

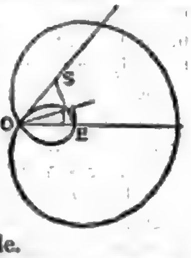
TRIPOLITSA, officially *Tripolis*, a town of Greece, capital of the nomarchy of Arcadia, and the seat of an archbishop, situated in a plain over 2,000 ft. above sea-level, 22 m. S.W. of Argos. The name has reference to the three ancient cities of Mantineia, Pallantium and Tegea, of which Tripolitsa is the modern representative. It does not stand on any ancient site. Before the war of independence it was the capital of the Morea and the seat of a pasha, with about 20,000 inhabitants; but in 1821 it was taken and sacked by the insurgents, and in 1825 its ruin was completed by Ibrahim Pasha. The town has since been rebuilt, and contains 10,789 inhabitants (1907).

TRIPTOLEMUS, in Greek mythology, the inventor of agriculture, first priest of Demeter, and founder of the Eleusinian mysteries. His name is probably connected with the "triple ploughing" (*τρίς, πολεῖν*), recommended in Hesiod's *Works and Days* and celebrated at an annual festival. It may be noted that in some traditions he is called the son of Dysaules (possibly identical with *diaulos*, the "double furrow" traced by the ox), and that, according to the Latin poets (*e.g.* Virgil, *Georgics*, i. 19), he is the inventor of the plough.[1] Later, as the god of ploughing, he is confounded with Osiris, and on a vase-painting at St Petersburg he is represented leaving Egypt in his dragon-drawn chariot on his journey round the world. According to the best known Attic legend (Apollodorus, i. 5, 2) Triptolemus was the son of Celeus, king of Eleusis, and Metaneira. Demeter, during her search for her daughter Persephone, arrived at Eleusis in the form of an old woman. Here she was hospitably received by Celeus, and out of gratitude would have made his son Demophon immortal by anointing him with ambrosia and destroying his mortal parts by fire; but Metaneira, happening to see what was going on, screamed out and disturbed the goddess. Demophon was burnt to death, and Demeter, to console his parents, took upon herself the care of Triptolemus, instructed him in everything connected with agriculture, and presented him with a wonderful chariot, in which he travelled all over the world, spreading the knowledge of the precious art and the blessings of civilization. In another account (Hyginus, *Fab.* 147) Triptolemus is the son of Eleusinus, and takes the place of Demophon in the above narrative. Celeus endeavoured to kill him on his return, but Demeter intervened and forced him to surrender his country to Triptolemus, who named it Eleusis after his father and instituted the festival of Demeter called Thesmophoria. In the Homeric hymn to Demeter, Triptolemus is simply one of the nobles of Eleusis, who was instructed by the goddess in her rites and ceremonies. The Attic legend of Eleusis also represented him as one of the judges of the underworld. His adventures on his world-wide mission formed the subject of a play of the same name by Sophocles. In works of art Triptolemus appears mounted on a chariot (winged or drawn by dragons, symbols of the fruitfulness of the earth), with Demeter and Persephone handing him the implements of agriculture. His attributes were a sceptre of ears of corn, sometimes a drinking-cup, which is being filled by Demeter. His altar and threshing-floor were shown on the Rarian plain near Eleusis, hence he is sometimes called the son of Rarus.

See the Homeric hymn to Demeter, 153. 474; Ovid, *Metam.* v. 642-661, Virgil, *Georgics*, i. 19, and Servius *ad loc.*; Hyginus, *Astronom.* ii. 14; Dion Halic. i. 12, Preller, *Griechische Mythologie* (4th ed , 1894).

TRIPTYCH (Gr. *τρίπτυχος*, three-fold, made in three layers, *τρι-*, *τρεῖς*, three; *πτυχή*, a fold, *πτύσσειν*, to fold, double over), a painting, carving or other decorative design, executed on three compartments or panels, so constructed that the two wings may fold on hinges over the centre-piece; the backs of the wing-pieces are often also painted, carved or otherwise decorated. The subject of the side-pieces are usually appropriate and subsidiary to that of the centre. The triptych is most frequently designed as an altar-piece. An earlier use of the term is for a set of three wooden or ivory writing-tablets, hinged or otherwise fastened together, the central tablet being waxed on both sides for the impression of the *stilus* or writing implement, the outer tablets only on the inside. The three tablets thus formed a small book.

TRISECTRIX, a curve which is a variety of the limaçon (*q.v.*) of Pascal, and named from its property of trisecting an angle. The polar equation is $r=1+2\cos\theta$ and the form of the curve is shown in the figure. To trisect an angle by means of this curve, describe a circle with centre O and radius OE, and let the given angle which is to be trisected be laid off from OE and cut the circle at S; let the chord ES cut the trisectrix in J. Then OJ trisects the given angle.



TRISTAN, or TRISTRAM, one of the most famous heroes of medieval romance. In the earlier versions of his story he is the son of Rivalin, a prince of North West Britain, and Blancheflor, sister to King Mark of Cornwall. Rivalin is killed in battle, and Blancheflor, after giving birth to a son, dies of grief. The boy is brought up as his own by Roâld, or Rual, seneschal of the kingdom, who has him carefully trained in all chivalric and courtly arts. With the possible exception of Horn, Tristan is by far the most accomplished hero in the whole range of knightly romance; a finished musician, linguist and chess-player, no one can rival him in more knightly arts, in horsemanship or fencing. He has, besides, the whole science of "venérie" at his finger-tips; in fact Tristan is the "Admirable Crichton" of medieval romance, there is nothing he cannot do, and that superlatively well—it must be regretfully admitted that he is also a most accomplished liar! Attracted by his gifts, pirates from the North Sea kidnap the boy, but terrified by the storms which subsequently beset them, put him ashore on the coast of Cornwall, whence he finds his way to the court of his uncle King Mark. Here we have a first proof of his talent for romancing; for alike to two pilgrims who show him the road and to the huntsmen of Mark's court (whom he instructs in the rightful method of cutting up and disposing the quarry), Tristan invents different, and most detailed, fictions of his land and parentage. He becomes a great favourite at court, and when Roâld, who has sought his young lord far and wide, at last reaches Tintagel, Mark welcomes the revelation of Tristan's identity with joy. Cornwall is at this time in subjection to the king of Ireland, Gormond, and every third year must pay tribute; the Irish champion, Morôlt, brother to the queen, arrives to claim his toll of thirty youths and as many maidens. The Cornish knights (who in Arthurian romance are always represented as hopeless cowards), dare not contest his claim but Tristan challenges him to single combat, slays him and frees Cornwall from tribute. Unfortunately he himself has been wounded in the fight, and that by a poisoned weapon; and none but the queen of Ireland, Isôlt, or Iseult, possessed the secret of healing. Tristan causes himself to be placed in a boat with his harp, and committed to the waves, which carry him to the shores of Ireland. There he gives himself out for a minstrel, Tantris, and as such is tended and healed by Queen Iseult and her daughter of the same name. When recovered he makes a plausible excuse for leaving Ireland (pretending he has left a wife in his native land, and returns to Cornwall. His uncle receives him with joy, but the barons of the court are bitterly jealous and plot his destruction. They persuade Mark that he should marry, and Tristan, who has sung the praises of the princess Iseult, is despatched to Ireland to demand her hand, a most dangerous errand, as Gormond, incensed at the death of Morôlt, has sworn to slay any Cornish knight who sets foot in Ireland. Tristan undertakes the mission, though he stipulates that he shall be accompanied by twenty of the barons, greatly to their disgust. His good fortune, however, does not forsake him; he lands in Ireland just as a fierce dragon is devastating the country, and the king has promised the hand of the princess to the slayer of the monster. Tristan achieves this feat, but, overcome by the venom exhaled from the dragon's tongue, which he has cut out, falls in a swoon. The seneschal of the court, a coward who has been watching for such an opportunity, cuts off the dragon's head, and, presenting it to the king, claims the reward, much to the dismay of Iseult and her mother. Suspecting that the seneschal is not really the slayer of the dragon, mother and daughter go secretly to the scene of the combat, find Tristan, whom they recognize as the minstrel, Tantris, and bring him back to the palace. They tend him in secret, but one day, through the medium of a splinter from his sword, which had remained fixed in Morôlt's skull, and been preserved by the queen, the identity of Tantris and Tristan is made clear. The princess would slay him, but is withheld by her mother, who sees they have need of Tristan's aid to unmask the seneschal. This is done in the presence of the court; Tristan is pardoned, formally declares his errand, and receives the hand of Iseult for his uncle King Mark.

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[1] Other suggested derivations are from *τρίβω*, *οὐλαί* (*ὀλαί*), the "grain crusher," or from *πόλεμος* (= "triple fighter," see DEMETER).

Tristan and Iseult set sail for Cornwall, Iseult accompanied by her waiting-woman, Brangaene (who, in some versions, is also a kinswoman), to whose care the queen, skilled in magic arts, confides a love-potion. This is intended to be drunk by king and queen on their bridal night and will ensure their undying love for each other. Unhappily, on the voyage, by some mistake (accounted for in different ways), Tristan and Iseult drink the love drink, and are forthwith seized with a fatal passion each for the other. From this moment begins a long-drawn-out series of tricks and subterfuges, undertaken with the view of deceiving Mark, whose suspicions, excited by sundry of his courtiers, from time to time get beyond his control, and are as often laid to rest by some clever ruse on the part of his nephew, or his wife, ably seconded by Brangaene. In the poems, Mark is, as a rule, represented in a favourable light, a gentle, kindly man, deeply attached to both Tristan and Iseult, and only too ready to allow his suspicions to be dispelled by any plausible explanation they may choose to offer. At the same time the fact that the lovers are the helpless victims of the fatal force of a magic spell is insisted upon, in order that their career of falsehood and deception may not deprive them of sympathy.

One episode, in especial, has been most charmingly treated by the poets. Mark, in one of his fits of jealousy, banishes Tristan and Iseult from the court; the two fly to the woods, where they lead an idyllic life, blissfully happy in each other's company. Mark, hunting in the forest, comes upon them sleeping in a cave, and as Tristan, who knows that the king is in the neighbourhood, has placed his sword between them, is convinced of their innocence. Through a cleft in the rock a ray of light falls upon Iseult's face, Mark stops up the crevice with his glove (or with grass and flowers), and goes his way, determined to recall his wife and nephew. He does so, and the same drama of plot and counter-plot is resumed. Eventually Mark surprises the two under circumstances which leave no possible room for doubt as to their mutual relation; Tristan flies for his life and takes refuge with Hoel, duke of Britanny. After some time, hearing nothing of Queen Iseult, and believing himself forgotten, he weds the duke's daughter, Iseult of the white hand, but weds her only in name, remaining otherwise faithful to Iseult of Ireland. Later on he returns to Cornwall in disguise, and has more than one interview with his mistress. Ultimately, while assisting his brother-in-law in an intrigue with the wife of a neighbouring knight, Tristan is wounded by a poisoned arrow; unable to find healing, and being near to death, he sends a messenger to bring Queen Iseult to his aid; if successful the ship which brings her is to have a white sail, if she refuses to come, a black. Iseult of the white hand overhears this, and when the ship returns, bringing Iseult to her lover's aid, either through jealousy or by pure inadvertence (both versions are given), she tells Tristan that the sail is black, whereon, despairing of seeing his love again, the hero turns his face to the wall and dies. Iseult of Ireland lands to find the city in mourning for its lord; hastening to the bier, she lays herself down beside Tristan, and with one last embrace expires. (One dramatic version represents her as finding the wife seated by the bier, and ordering her away, "Why sit ye there, ye who have slain him? Arise, and begone!") The bodies are sent to Cornwall, and Mark, learning the truth, has a fair chapel erected and lays them in tombs, one at each side of the building, when a sapling springs from the heart of Tristan, and reaching its boughs across the chapel, makes its way into the grave of Iseult. However often the tree may be cut down it never fails to grow again. (In some versions it is respectively a vine and a rose which grow from either tomb and interlace midway.)

We need have little wonder that this beautiful love-story was extremely popular throughout the middle ages. Medieval literature abounds in references to Tristan and Iseult, and their adventures were translated into many tongues and are found depicted in carvings and tapestries. Probably the story was first told in the form of short *lais*, each recounting some special episode, such as the *lai* known as the *chèvrefeuille;* how old these may be it is impossible to say. Professor Zimmer, in his examination of the story, sees reason to believe that the main incidents may repose on a genuine historic tradition, dating back to the 9th or 10th century, the period of Viking rule in Ireland. The name of Iseult's father, Gormond, is distinctly Scandinavian; she, herself, is always noted for her golden hair, and it is quite a misrendering of the tradition to speak of her as a dark-haired Irish princess. In the German tradition she is *die lichte*, Iseult of Britanny *die schwarze* Isôlt; it is this latter who is the Celtic princess. The name Tristan is now generally admitted to be the equivalent of the Pictish Drôstan, and on the whole, the story is now very generally allowed to be of insular, probably of British, origin.

Some time in the 12th century the story was wrought into consecutive poems. The latest theory, championed with great skill by M. Bédier, is that there was one poem, and one only, at the root of the various versions preserved to us, and that that poem, composed in England, probably by an Anglo-Norman, was a work of such force and genius that it determined for all time the form of the *Tristan* story. The obvious objection to this view is that a work of such importance, composed at so comparatively late a date, is scarcely likely to have perished so completely as to leave no trace; if there were one poet held as an authority, the name of that poet would surely have been mentioned. Moreover the evidence of the author of the principal *Tristan* poem preserved to us points in another direction. This poet was an Anglo-Norman named Thomas; and, although little over 3000 lines of his poem have been preserved, we have three translations; a German, by Gottfried von Strassburg; a Scandinavian, by a certain Brother Robert; and an English, by Thomas, sometimes identified with Thomas of Erceldoune, though this is doubtful. With the help of the extant fragments and these translations we can form a very good idea of the character and content of Thomas's work, a task now rendered far more easy by M. Bédier's skilful reconstruction (cf. vol. i. of his edition of Thomas). It was certainly a work of great merit and charm. As authority Thomas cites a certain Bréri, who has now been identified with the Bleheris quoted as authority for the *Grail* and *Gawain* stories, and the Bledhericus referred to by Giraldus Cambrensis as *famosus ille fabulator*. This is what Thomas says:—

> "Seignurs, cest cunte est mult divers,
> E pur ço l'uni par mes vers
> E di en tant cum est mester
> E le surplus voil relesser.
> Ne vol pas trop en uni dire!
> Ici diverse la matyre.

Entre ceus qui solent cunter
E del cunte Tristran parler,
Il en cuntent diversement:
Oï en ai de plusur gent.
Asez sai que chescun en dit
E co qu'il unt mis en escrit,
Mes sulun ço que j'ai oï
Nel dient pas sulun Bréri
Ky solt les gestes e les cuntes
De tuz les reis, de tuz les cuntes,
Ki orent este en Bretaingne."
(Thomas, i. 377).

These are not the words of a man who is following a complete and authoritative poem; judging from the context of the other references to Bleheris he was rather a collector and versifier of short episodic tales, and it seems far more natural to understand Thomas as having wrought into one complete and consecutive form the various poems with which the name of Bréri was associated, than to hold that that, or a similar, work had already been achieved by another.

Thomas's work, fortunately, fell into the hands of a true poet in the person of Gottfried von Strassburg, whose *Tristan und Isolde* is, from a literary point of view, the gem of medieval German literature. Gottfried is a far greater master of style than Wolfram von Eschenbach, and his treatment of some of the episodes, notably the sojourn in the woods, is most exquisite. He did not live to complete his poem, but happily he carried it up to the point where the original fragments begin, so that we can judge very fairly what must have been the effect of the whole, the style of the two poets being very similar. Inspiring as the Tristan story is, it seems improbable that it should have been handled, and that within a comparatively short period, by *three* writers of genius, and that of these three the first, and greatest, should have utterly disappeared! The translators of Thomas do not fail to quote him as their source, why then has no one quoted the original poet?

Besides the version of Thomas, we have a fragment by a certain Béroul, also an Anglo-Norman, and a German poem by Eilhart von Oberge, both of which derive from a common source. There also exists in two manuscripts a short poem, *La Folie Tristan*, relating how Tristan, disguised as a fool, visits the court of King Mark. This poem is valuable, as, presuming upon the sufficiency of his disguise, Tristan audaciously gives a resumé of his feats and of his relations with Iseult, in this agreeing with the version of Thomas. The "Gerbert" continuation of the *Perceval* contains the working over of one of two short Tristan poems, called by him the *Luite Tristran*; the latter part, probably a distinct poem, shows Tristan, in the disguise of a minstrel, visiting the court of Mark. Here the tradition is more in accordance with Béroul.

Besides the poems, we possess the prose *Tristan*, an enormous compilation, akin to the prose *Lancelot*, where the original story, though still to be traced, is obscured by a mass of later Arthurian adventures. The interest here centres in the rivalry between Tristan and Lancelot, alike as knights and lovers, and in the later redaction, ascribed to Hélie de Borron, the story is spun out to an interminable length.

Certain points of difference between the poetical and the prose versions should be noted. Tristan is here the son of Meliadus, king of Loonois; his father does not die, but is decoyed away by an enchantress, and the mother, searching for her husband, gives birth to her child in the forest and dies. Meliadus marries again, and the second wife, jealous of Tristan, tries to kill him. Mark has another nephew, Andret, who is Tristan's enemy throughout the romance. Mark himself is a cowardly, treacherous and vindictive character. Some of the early printed editions follow the original version of Tristan's death, now found in one manuscript only (B.N. 103), the majority represent him as having been stabbed in the back by Mark in the presence of the queen, as we find in Malory, who drew the larger portion of his compilation from the prose *Tristan*. It should be noted that Tristan is never more than superficially connected with Arthur, an occasional visitor at his court; though in its later form ranked among the Arthurian romances, the *Tristan* is really an independent story, and does not form a part of the ordinary cyclic redaction.

The Italian prose text, *La Travola ritonda* differs from the French in adhering to the original version, and is classed by N. Bédier among the derivatives from Thomas. Like the story of Perceval that of Tristan has been made familiar to the present generation by Richard Wagner's noble music drama, *Tristan und Isolde*, founded upon the poem of Gottfried von Strassburg; though, being a drama of feeling rather than of action, the story is reduced to its simple elements; the drinking of the love-potion, the passion of the lovers, their discovery by Mark and finally their death.

Bibliography.—Thomas, *Roman de Tristan*, ed. J. Bédier (2 vols., *Société des anciens textes français*, 1902, 1905); Béroul, *Roman de Tristan* (ed. E. Muret, same series, 1903); E. Kölbing, *Die nordische und die englische Version der Tristansaga* (1877, 1883), pt. i., *Tristrams Saga*, pt. ii., *Sir Tristrem*. "La Folie Tristan" was published by F. Michel in his *Tristan* (1835), a collection of all the extant fragments of Tristan poems; "Tristan Menestrel" from the *Perceval*, ed. J. L. Weston and J. Bédier (*Romania*, vol. xxxv., Oct. 1906). Gottfried's *Tristan und Isolde* has been several times published; the best editions are those of Bechstein (1890) and Golther (1889); modern German versions by Kurz, Simrock and Hertz; English prose rendering, J. L. Weston, 2 vols. (*Arthurian Romances*, No. ii.). Cf. also Piquet, *L'Originalité de Gottfried de Strassburg* (1905). Eilhart von Oberge, *Tristan*, ed. Lichtenstein (1877); *La Tavola ritonda*, ed. Polidori, (3 vols., 1864–1865). There is no modern edition of the prose romance, but a detailed analysis of the contents, compiled from the numerous manuscripts in the Paris Library, was published by E. Löseth in *Le Roman en prose de Tristan* (1890). The general reader will find Gaston Paris's study of the legend in *Poèmes et légendes du moyen âge* most interesting; also Joseph Bédier's popular retelling of the tale *Tristan et Iseult*. For Wagner's version cf. J. L. Weston, *Legends of the Wagner Drama*. For an exhaustive study of the Tristan legend and literature, see the recent work by Professor Golther; also an examination of the Welsh fragments by Ivor John in the Grimm Library. (J. L. W.)

TRISTAN DA CUNHA, the general name for a group of three small volcanic islands belonging to Great Britain, situated in the South Atlantic, the summit of the largest being in 37° 5′ 50″ S., 12° 16′ 40″ W. They are about 2000 m. W. of the Cape of Good Hope and about 4000 m. N.E. of Cape Horn and lie somewhat north of a line drawn between the two capes. St Helena lies about 1500 m. N.N.E. of the group. The islands rise from the submarine elevation which runs down the centre of the Atlantic and on which are likewise situated Ascension, St Paul's Rocks and the Azores; the average depth on this ridge is from 1600 to 1700 fathoms, while depths of 3000 fathoms are found on each side of it. The depth between the islands is in some places over 1000 fathoms.

Tristan, the largest and northernmost island, has an area of 16 sq. m., is nearly circular in form, about 7 m. in diameter, and has a volcanic cone (7640 ft.), usually capped with snow, in the centre. Precipitous cliffs, 1000 to 2000 ft. in height, rise directly from the ocean on all sides, except on the north-west, where there is an irregular plain, 100 ft. above the sea, and 2½ m. in length and ½ m. in breadth. A stream crosses the northern end of the plateau, falling over the cliff edge in a fine cascade. The crater of the central cone contains a fresh-water lake about 150 yds. in diameter. This and other crater lakes are said never to be frozen over.

Inaccessible Island, the westernmost of the group, is about 20 m. from Tristan. It is quadrilateral in form, the sides being about 2 m. long, and its area is about 4 sq. m. The highest point (1840 ft.) is on the west side; all round there are perpendicular cliffs about 1000 ft. in height. At the base of the cliffs in some places are narrow fringes of beach a few feet above the sea-level.

Nightingale Island, the smallest and most southern of the group, is 10 m. from Inaccessible Island. Its area is not more than 1 sq. m. Its coasts, unlike those of the other two islands, are surrounded by low cliffs, from which there is a gentle slope up to two peaks, the one 1100 ft., the other 960 ft. high. There are two small islets—Stoltenkoff (325 ft.) and Middle (150 ft.)—and several rocks adjacent to the coast.

The rocks of Tristan da Cunha are felspathic basalt, dolerite, augite-andesite, sideromelane and palagonite; some specimens of the basalt have porphyritic augite.[1] The caves in Nightingale Island indicate that it has been elevated several feet. On almost all sides the islands are surrounded by a broad belt of kelp, the gigantic southern seaweed (*Macrocystis pyrifera*), through which a boat may approach the rocky shores even in stormy weather. There is no good anchorage in rough weather.

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[1] On the occurrence in Tristan da Cunha of rock of continental type (gneiss) see E. H. L. Schwarz of the Geological Survey, Cape Colony, in the *Transactions South African Philosoph. Soc.*, No. 16 of 1905.

The beaches and lower lands are covered with a dense growth of tussock grass (*Spartina arundinacea*), 8 to 10 ft. in height. It shelters vast numbers of penguins (*Eudyptes chrysocoma*), which there form their rookeries. There is one small tree (*Phylica nitida*), which grows in detached patches on the lower grounds. Independently of introduced plants, fifty-five species have been collected in the group, twenty-nine being flowering plants and twenty-six ferns and lycopods. A majority of the species are characteristic of the present general flora of the south temperate zone rather than any particular part of it: botanically the group is generally classed with the islands of the Southern Ocean. A finch (*Nesospiza acunhae*), a thrush (*Nesocichla eremita*), and a water-hen (*Gallinula nesiotis*) are the only land birds—the first two being peculiar to the islands. In addition to the penguins numerous other sea birds nest on the islands, as petrels, albatrosses, terns, skuas and prions. One or two land shells, a few spiders, several *Coleoptera*, a small lepidopter and a few other insects are recorded, but no *Orthoptera* or *Hymenoptera*. There appear to have been no indigenous mammals or reptiles. Seals frequent Nightingale and Inaccessible Islands, and the whale (*Balaena australis*) is found in the adjacent waters.

The prevailing winds are westerly. December to March is the fine season. The climate is mild and on the whole healthy, the temperature averaging 68° Fahr. In summer, 55° in winter—sometimes falling to 40°. Rain is frequent; hail and snow fall occasionally on the lower grounds. The sky is usually cloudy. The islands have a cold and barren appearance. The tide rises and falls about 4 ft.

History.—The islands were discovered in 1506 by the Portuguese admiral Tristan, or more correctly Tristão da Cunha,[1] after whom they are named, during a voyage to India. Thereafter the islands (which were uninhabited) were occasionally visited by outward bound ships to the Indies. Dutch vessels brought back reports on the islands in 1643, and in 1656 Van Riebeek, the founder of Cape Town, sent a ship from Table Bay to Tristan to see if it was suitable for a military station, but the absence of a harbour led to the project being abandoned. Later in the 17th century ships were sent from St Helena by the English East India Company to Tristan to report on a proposed settlement there, but that project also came to naught. A British naval officer who visited the group in 1760 gave his name to Nightingale Island. John Patten, the master of an English merchant ship, and part of his crew lived on Tristan from August 1790 to April 1791, during which time they captured 5600 seals; but the first permanent inhabitant was one Thomas Currie, who landed on the island in 1810. At this time American whalers frequented the neighbouring waters and, in the same year, an American named Lambert "late of Salem, mariner and citizen thereof" and a man named Williams made Tristan their home. Lambert declared himself sovereign and sole possessor of the group (which he renamed Islands of Refreshment) "grounding my right and claim on the rational and sure ground of absolute occupancy." Lambert's sovereignty was short lived, as he and Williams were drowned while out fishing in May 1812. Currie was joined, however, by two other men and they busied themselves in growing vegetables, wheat and oats, and in breeding pigs. War having broken out in this year between the United States and Great Britain the islands were largely used as a base by American cruisers sent to prey on British merchant ships. This and other considerations urged by Lord Charles Somerset, then governor of Cape Colony, led the British government to authorize the islands being taken possession of as dependencies of the Cape. The formal proclamation of annexation was made on the 14th of August 1816. A small garrison was maintained on Tristan until November of the following year. At their own request William Glass (d. 1853), a corporal in the Royal Artillery, with his wife and two children and two masons were left behind, and thus was begun the present settlement. From time to time additional settlers arrived or shipwrecked mariners decided to remain; in 1827 five coloured women from St Helena were induced to migrate to Tristan to become the wives of the five bachelors then on the island. Later coloured women from Cape Colony married residents in the island. Other settlers are of Dutch, Italian and Asiatic origin. Thus the inhabitants are of mixed blood, but the British strain greatly predominates. Over the little community Glass (1817–1853) ruled in patriarchal fashion. Besides raising crops, the settlers possessed numbers of cattle, sheep and pigs, but their most lucrative occupation was seal fishing. The island was still frequented by American whalers, and in 1856 out of a total population of about 100 twenty-five emigrated to the United States. The next year forty-five of the inhabitants removed to Cape Colony; whither the younger or more restless members of the community have since gone—or else taken to a seafaring life. The inhabitants had of necessity made their settlement on the plain on the north-west of Tristan; here a number of substantial stone cottages and a church were built. It is named Edinburgh in memory of a visit in 1867 by the duke of Edinburgh. In October 1873 the islands were carefully surveyed by the "Challenger," which removed to Cape Town two Germans, brothers named Stoltenhoff, who had been living on Inaccessible Island since November 1871. This was the only attempt at colonization made on any save the main island of the group.

After the death of Glass the head of the community for some time was an old man-of-war's man named Cotton, who had been for three years guard over Napoleon at St Helena; Cotton was succeeded by Peter William Green, a native of Amsterdam who settled in the island in 1836. During Green's "reign" the economic condition of Tristan was considerably affected by the desertion of the neighbouring seas by the whalers; this was largely due to the depredations of the Confederate cruisers "Alabama" and "Shenandoah" during the American Civil War, many whaling boats being captured and burnt by them. As a result the number of ships calling at Tristan considerably diminished and trade languished. In 1880 the population appears to have attained its maximum—109. In 1885 a serious disaster befell the islanders, a lifeboat which went to take provisions to a ship in the offing was lost with all hands—fifteen men—and only four adult males were left on the island. At the same time a plague of rats—survivors of a shipwrecked vessel—wrought much havoc among the crops. Plans were made for the total removal of the inhabitants to the Cape, but the majority preferred to remain. Stores and provisions were sent out to them by the British government. The ravages of the rats have rendered impossible the growing of wheat; the wealth of the islanders now consists in their cattle, sheep, potatoes and apple and peach trees. The population in 1897 was only 64; in 1901 it was 74, and in 1909, 95. They manage their own affairs without any written laws, the project once entertained of providing them with a formal constitution being deemed unnecessary. The inhabitants are described as moral, religious, hospitable to strangers, well mannered and industrious, healthy and long lived. They are without intoxicating liquors and are said to commit no crimes. They are daring sailors, and in small canvas boats of their own building voyage to Nightingale and Inaccessible islands. They knit garments from the wool of their sheep; are good carpenters and make serviceable carts. From time to time ministers of the Church of England have lived on the island and to their efforts is mainly due the education of the children. In 1906 the islanders passed through a period of distress owing to great mortality among the cattle and the almost total failure of the potato crop. The majority again refused, however, to desert the island, though offered allotments of land in Cape Colony. Similar proposals had been made and declined several times since the question was first mooted in 1886. In 1905 a lease of

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[1] Tristan da Cunha (*fl.* 1460–1540) was nominated first viceroy of Portuguese India in 1504, but was unable to serve owing to temporary blindness; in 1506 he was placed in command of a fleet which operated on the east coast of Africa and in the Indies, Alphonso d'Albuquerque (*q.v.*) having charge of a squadron under da Cunha. After discovering the islands which now bear his name, da Cunha landed in Madagascar, subsequently visiting Mozambique, Brava (where he reduced the Arab power) and Sokotra, which he conquered. He also distinguished himself in the Indies in various actions. In 1514 he was ambassador to Pope Leo X. to pay homage for the new conquests of Portugal, and was, later on, made a member of the Portuguese privy council.

Nightingale, Inaccessible and Gough islands, for the purpose of working the guano deposits, was granted by the British government.

Gough Island.—Gough Island or Diego Alvarez lies in the South Atlantic in 40° 20′ S., 9° 44′ W., and is 250 m. S.S.E. of Tristan da Cunha and some 1500 m. west by south of Cape Town. It is of volcanic origin, is rugged and mountainous, the highest peak rising to 4380 ft. The island is about 8 m. long by 4 m. broad and has an area of 40 sq. m. Precipitous cliffs, from 200 to 1000 ft. high, characterize the coast. They are divided by picturesque valleys, which, in some instances, have been cut down to sea-level and afford landing-places. Streams fall over the cliffs into the sea in fine cascades. The island is visited by vast numbers of penguins and contains valuable guano deposits. It is also the home of numerous seals. The rainfall is heavy and vegetation abundant. The island is believed to have been discovered by the Portuguese in the 16th century. Originally called Diego Alvarez, it derives its other name from a Captain Gough, the commander of a British ship which visited it in 1731. It has been claimed as a British possession since the annexation of Tristan da Cunha. In 1904 Gough Island was visited by the Antarctic exploring ship "Scotia" of the Bruce expedition, which discovered a rich marine fauna, two new buntings and three new species of plants. It has no permanent population.

A comprehensive account of Tristan da Cunha appeared in *The Cape Times* (January–March 1906), in a series of articles by W. Hammond Tooke, the commissioner sent to the islands by the Cape government in 1904. See also *Transactions of the Linnean Society* for 1819 (contains a report of an ascent of the summit by Captain Dugald Carmichael in 1817); A. Earle, *Narrative of a . . . Residence in New Zealand . . . together with a Journal of a Residence in Tristan d'Acunha* (London, 1832); Mrs K. M. Barrow, *Three Years in Tristan da Cunha* (London, 1910); H. N. Moseley, *Notes by a Naturalist on the "Challenger"* (new ed., London, 1892); F. and G. Stoltenhoff "Two Years on Inaccessible," in *Cape Monthly Mag.* (December 1873). Among papers relating to Tristan da Cunha published by the British government, see especially reports issued in 1897, 1903, 1906—which gives a detailed account of the island and islanders—and 1907. For the discovery of Tristan see *The Commentaries of the Great Afonso Dalboquerque* (Hakluyt Society's Series, 1875, vol. 53). For Gough Island, see R. N. R. Brown of the "Scotia" expedition, "Diego Alvarez or Gough Island," in *Scottish Geog. Mag.* (August 1905); Brown and others, "The Botany of Gough Island," in *Journ. Linnean Soc.* (*Botany*) (1905), and *The Voyage of the "Scotia"* ch. xii. (London, 1906). *The Africa Pilot*, pt. ii. (5th ed., 1901), contains descriptions both of Tristan da Cunha and Gough Island.

TRISTAN L'HERMITE, FRANÇOIS (1601–1655), French dramatist, was born at the château de Soliers in the Haute Marche about 1601. His adventures began early, for he killed his enemy in a duel at the age of thirteen, and was obliged to flee to England. The story of his childhood and youth he embroiders in a burlesque novel, the *Page disgracié*. He was in succession poet to Gaston d'Orléans, to the duchesse de Chaulnes and the duke of Guise. He died on the 7th of September 1655. His first tragedy, *Mariamne* (1636), was also his best. It was followed by *Penthée* (1637), *La Mort de Sénèque* (1644), *La Mort de Crispe* (1645) and the *Parasite* (1653). He was also the author of some admirable lyrics. Three of his best plays are printed in the *Théâtre français* of 1737.

TRITHEMIUS, JOHANNES (1462–1516), German historian and divine, was born at Trittenheim on the Moselle, on the 1st of February 1462. His name was originally "von Heidenberg," but according to the fashion of the times he adopted the name of his birthplace. After an unhappy childhood, he studied at Heidelberg, and at the age of twenty entered the Benedictine monastery of Sponheim near Kreuznach, of which, in 1485, he became abbot. He established an excellent library, and through his strict discipline and consummate scholarship soon raised the monastery to an educational institution of a high order. In 1506 he resigned, and was appointed soon after abbot of the monastery of St Jakob at Würzburg; and in this city he died on the 13th of December 1516. Trithemius was, though an accomplished scholar, untrustworthy as a chronicler, and his *Annales hirsaugienses* (1514), *Annales de origine Francorum*, as well as his *Chronologia mystica* (1516) are, on this account, of doubtful value. More reliance can, however, be placed on his *De scriptoribus ecclesiasticis* (1494) and the *Catalogus illustrium virorum Germaniae* (1491). He also wrote a fanatical book against sorcery, *Antipalus maleficiorum* (1508).

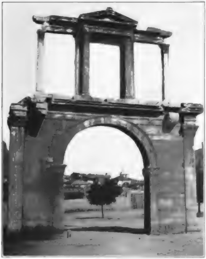
See Silbernagel, *J. Trithemius* (1868; 2nd ed., 1885); Schneegans, *Abt Joh. Trithemius und Kloster Sponheim* (1882); and F. X. Wegele, in *Allgemeine deutsche Biographie*.

TRITON, in Greek mythology, son of Poseidon and Amphitrite, the personification of the roaring waters. According to Hesiod (*Theog.* 930), he dwelt with his parents in a golden palace in the depths of the sea. The story of the Argonauts places his home on the coast of Libya. When the Argo was driven ashore on the Lesser Syrtes the crew carried the vessel to Lake Tritonis, whence Triton, the local deity, guided them across to the Mediterranean (Apollonius Rhodius iv. 1552). He was represented as human down to the waist, with the tail of a fish. His special attribute was a twisted seashell, on which he blew to calm or raise the waves. Its sound was so terrible, when loudly blown, that it put the giants to flight, who imagined it to be the roar of a mighty wild beast (Hyginus, *Poet. astronom.* ii. 23). When Misenus, the trumpeter of Aeneas, challenged him to a contest of blowing, Triton in his jealousy flung him into the sea. In course of time Triton became the name for individuals of a class, like Pan and Silenus, and Tritons (male and female) are mentioned in the plural, usually as forming the escort of marine divinities. The beings called Centauro-Tritons or Ichthyocentaurs were of a triple nature, with the forefeet of a horse in addition to the human body and fish tail. Pausanias (ix. 21) gives a detailed description of the ordinary Triton. It is probable that the idea of Triton owes its origin to the Phoenician fish-deities.

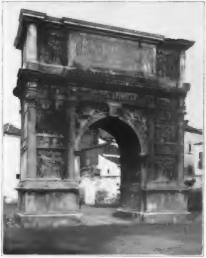
See Preller, *Griechische Mythologie* (4th ed., 1894); F. R. Dressler, *Triton und die Tritonen* (Wurzen, 1892).

TRIUMPH (*triumphus*), amongst the ancient Romans, the highest honour bestowed upon a victorious general. Originally it was only granted on certain conditions, which were subsequently relaxed in special cases. Only those who had held the office of dictator, consul or praetor were entitled to the distinction; the war must have been brought to a definite conclusion, resulting in an extension of the boundaries of the state; at least 5000 of the enemy must have been slain; the victory must have been gained over a foreign enemy, victories in civil war or over rebels not being counted. The power of granting a triumph rested with the senate, which held a meeting outside the city walls (generally in the temple of Bellona) to consider the claims put forward by the general. If they were considered satisfactory special legislation was necessary to keep the general in possession of the *imperium* on his entry into the city. Without this, his command would have expired and he would have become a private individual the moment he was inside the city walls, and would have had no right to a triumph. Consequently he remained outside the pomoerium until the special ordinance was passed; thus Lucullus on his return from Asia waited outside Rome three years for his triumph.

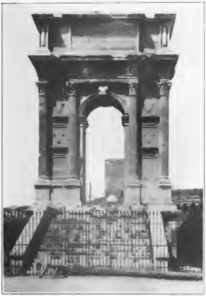
The triumph consisted of a solemn procession, which, starting from the Campus Martius outside the city walls, passed through the city to the Capitol. The streets were adorned with garlands, the temples open, and the procession was greeted with shouts of *Io triumphe!* At its head were the magistrates and senate, who were followed by trumpeters and then by the spoils, which included not only arms, standards, statues, &c., but also representations of battles, and of the towns, rivers and mountains of the conquered country, models of fortresses, &c. Next came the victims destined for sacrifice, especially white oxen with gilded horns. They were followed by the prisoners who had not been sold as slaves but kept to grace the triumph; when the procession reached the Capitol they were taken off to prison and put to death. The chariot which carried the victorious general (*triumphator*) was crowned with laurel and drawn by four horses. The general was attired like the Capitoline Jupiter in robes of purple and gold borrowed from the treasury of the god; in his right hand he held a laurel branch, in his left an ivory sceptre surmounted by an eagle. Above his head the golden crown of Jupiter was held by a slave who reminded him in the midst of his glory that he was a mortal man. Last came the soldiers shouting *Io triumphe* and singing



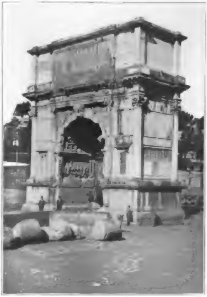
Photo, Bonfils.
Fig. 1.—Arch of Hadrian, Athens.



Photo, Alinari.
Fig. 2.—Arch of Trajan, Benevento.

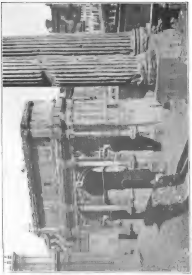


Photo, Alinari.
Fig. 3.—Arch of Trajan, Ancona.



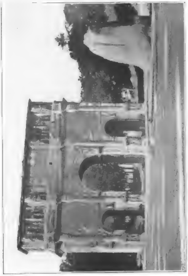
Photo, Anderson.
Fig. 4.—Arch of Titus, Rome.

TRIUMPHAL ARCH



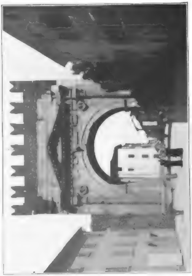
Photo, Anderson.

Fig. 5.—Arch of Septimius Severus, Rome.



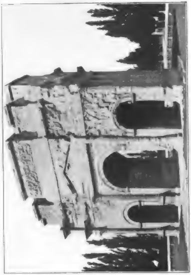
Photo, Brogi.

Fig. 6.—Arch of Constantine, Rome.



Photo, Alinari.

Fig. 7.—Arch of Augustus, Rimini.



Photo, Neurdein.

Fig. 8.—Arch at Orange.

songs both of a laudatory and scurrilous kind. On reaching the temple of Jupiter on the Capitol, the general placed the laurel branch (in later times a palm branch) on the lap of the image of the god, and then offered the thank-offerings. A feast of the magistrates and senate, and sometimes of the soldiers and people, concluded the ceremony, which in earlier times lasted one day, but in later times occupied several. Generals who were not allowed a regular triumph by the senate had a right to triumph at the temple of Jupiter Latiaris on the Alban Mount. Under the empire only the emperors celebrated a triumph, because the generals commanded under the auspices of the emperors (not under their own) merely as lieutenants (*legati*); the only honour they received was the right of wearing the triumphal insignia (the robes of purple and gold and the wreath of bay leaves) on holidays. After the time of Trajan, when all consuls were allowed to wear the triumphal dress on entering office and in festal processions, the only military reward for a successful general was a statue in some public place. The last triumph recorded is that of Diocletian (A.D. 302). A naval or maritime triumph was sometimes allowed for victories at sea, the earliest being that celebrated by C. Duilius in honour of his victory over the Carthaginians in 260 B.C.

See Mommsen, *Römisches Staatsrecht* (1887), i. 126–136; Marquardt, *Romische Staatsverwaltung* (1884), ii. 582–593; H. A. Göll, *De triumphi romani origine, permissu, apparatu, via* (1854); S. Peine, "De ornamentis triumphalibus" (1885), in C. E. Ascherson's *Berliner Studien*, ii.

TRIUMPHAL ARCH, the term given to arches erected to commemorate some special victory, but here extended to include those built as memorial arches to some benefactor of the Roman Empire, such as those at Rimini, Ancona and Benevento; arches erected as monumental entrances to towns, as at Nîmes and Autun; arches on bridges, as at Chamas in France and Alcantara in Spain; and lastly those which preceded the entrance to a forum or sacred enclosure, or formed part of a colonnaded street, as in Syria. There is every reason to suppose that in early times in Greece and Etruria temporary erections, such as those of the present day, were set up on the occasion of the public entry, after a great victory, of some emperor or general; but the Romans would seem to have been the first to erect such structures in stone or marble, to enrich them with sculpture, and to raise aloft on their summit the quadriga or four-horsed chariot with statues and trophies. The time involved in the construction of such a memorial, and more especially that which would be required for its enrichment with sculpture, rendered it impossible that they should be set up on the occasion of the triumphal entry itself, and it is known that the arch of Titus was not erected till some time after his death by his successor Domitian. There is always some difficulty in deciding between triumphal and memorial arches, as they were virtually similar in design, equally enriched with sculpture, generally surmounted with a quadriga and statues, and as a rule were isolated structures. The earlier arches were pierced with a single arch and were comparatively simple in design, being decorated by pilasters or semi-detached columns only; the existence of chariots and statues on their summit is known only from coins or gems, on which such features are always shown. The arch of Titus in Rome (fig. 4), A.D. 81, is the first one enriched with bas-relief sculpture, in this case representing the triumphs of Titus with the seven-branched candlestick and the golden table brought from Jerusalem. The next sculptural arch of triumph is that built at Benevento (fig. 2) in South Italy (A.D. 112) by Trajan, recording the Dacian victories. The triumphal arch (fig. 5) of Septimius Severus (A.D. 203) has a central and two side arches, the bas-reliefs on it representing the Parthian victories; and the last important arch in Rome is that of Constantine (fig. 6), which had also three arches, and was embellished with bas-reliefs, representing the Dacian victories, which were taken from the arch of Trajan on the Via Appia and others of Constantine's time, representing the conquest of Maxentius.

Passing to other countries, we have the triumphal arches at St Remy and at Orange (fig. 8); those at Carpentras and Cavaillon, also in France, which were probably of later date, as possibly also the triple arch at Reims. The triumphal arch with three arches at Fano in Italy is said to have been commenced by Augustus, but completed by Constantine, who probably added the two side arches and decorated it with inferior sculpture. At Timgad (Thamugada) in North Africa is a triumphal arch with central and two side arches, probably of Hadrian's time, and one with triple arches at Sbeitla (Suffetula), also in North Africa, and another example at Saintes in France, built on a bridge.

Of memorial arches the earliest are the examples of Rimini (fig. 7) and Aosta, erected to Augustus, and later the arch at Ancona (fig. 3) erected to Trajan (A.D. 112) as a record of the construction of the port there. At Pola, in Istria, is an archway erected in memory of the Sergii. Of less important examples in Rome are the arches of Dolabella (A.D. 10), Drusus (A.D. 23), Gallienus (A.D. 262), the silversmith's arch (A.D. 204); in Verona, the Porta dei Borsari and the Porta de Leoni, erected by Gallienus (A.D. 265); at Aix-les-Bains in France, an arch of late 3rd century; and at Lambessa, in North Africa, the arches of Commodus (A.D. 187) and of Septimius Severus (A.D. 200). In Spain there are two monumental arches erected by Trajan at Alcantara, in the centre of the bridge built by him (A.D. 108), and the arch of Santiago at Merida; a third example exists in the Arco di Bara at Tarragona.

Quadriportal archways are those which were built in the centre of four cross roads, such as the arch of Janus in Rome, built by Constans (A.D. 350), the arch of Caracalla at Tebessc (Thevesti) in North Africa, and many examples in Syria, of which the arch at Ladikiyah (Laodicea ad Mare) is in perfect preservation.

The colonnaded streets in Syria were entered through magnificent archways, of which the finest examples are those at Palmyra and Gerasa. As entrance gateways to towns there are many examples which were sometimes built as memorial arches, but formed part of the city walls, such as the entrance gate at Susa in Italy, erected in memory of Augustus (8 B.C.), decorated with reliefs of the Suovetaurelia (sacrifices); the Porte d'Avroux and Porte St André at Autun, and the Porte d'Auguste at Nîmes, in France; the Porte d'Auguste at Perugia in Italy and the Porta Nigra at Treves in Germany; to these should be added the three entrance gateways to the palace of Spalato (A.D. 303), one of these, the Porta Aurea, or Golden Gate, showing in its enriched design certain decadent forms which led to the Byzantine and Renaissance styles; lastly there are the arched entrances to sacred or civil enclosures, such as the example at Sbeitla (Suffetula) in North Africa, the arch of Hadrian at Athens (fig. 1), built to his memory by his successors, and the archway of the Propylaea at Damascus.

The triumphal arch found no place in medieval architecture, but in Renaissance works there are many examples, of which the triumphal entrance arch of King Alfonso at Naples (A.D. 1470) comes first. Of isolated structures, there are in Paris the Porte St Martin (1647), St Denis (1684), arch of Carrousel in the Tuileries (1808), and the Arc de l'Etoile in the Champs Élysées, completed in 1830; in Berlin the Brandenburger Thor (1790); in Munich the Siegesthor (1843) and Metzger Thor (1880); in Milan the Arch of Peace, commenced by Napoleon in 1807 and completed in 1857 by the Austrians (an interesting example, as it still preserves the chariot and horses and statues which formerly crowned all triumphal arches); and in London the Marble Arch, originally built in front of Buckingham Palace, but removed to the north-east angle of Hyde Park in 1843, and the Wellington Arch at Hyde Park Corner, without the statue of the duke on horseback, afterwards set up at Aldershot. (R. P. S.)

TRIVANDRUM, or TREVANDRUM, a city of southern India, capital of the state of Travancore, situated 2 m. from the seacoast. Pop. (1901), 57,882. It is the residence of the maharaja, and contains an observatory and a museum, besides several other fine buildings. The chief fame of the place, however, centres upon the shrine of Sri Ananta Padmanabhaswami, a great resort of pilgrims, round which the city grew up. The best houses and chief public buildings stand on hilly terraces. The city contains the maharaja's college, a Sanskrit college, a high school, a school for girls, an industrial school of arts, and a hospital and medical school. There is little trade, but a speciality of wood-carving. Trivandrum has a small seaport, but the vessels that touch here have to anchor at some considerable distance from the shore, and the port itself is not fitted for any great commercial development.

TRIVET, a small metal tripod for holding cooking vessels near a fire. The word is also applied to a round, square or oval openwork plate, usually of steel or brass, fixed to the bars of a grate by a socket for keeping hot plates, dishes, or food.

TRIVIUM (Lat. for cross-road, *i.e.* where three roads meet, from *tres*, three, and *via*, road), in medieval educational systems, the curriculum which included grammar, rhetoric and logic. The trivium and the quadrivium (arithmetic, music, geometry and astronomy) together made up what are known as the seven liberal arts (see EDUCATION: *Schools*). From the word in its original sense is derived the adjective "trivial" (post-Aug. Lat. *trivialis*), that which can be seen at the cross-roads, *i.e.* unimportant, commonplace. In botany and zoology the "trivial" name is the adjectival name which follows the genus name in a binominal system of nomenclature, as *canina*, *perennis*, in *Rosa canina*, *Bellis perennis*.

TRNOVO, or TIRNOVO, an episcopal city and the capital of a department of Bulgaria; 124 m. E.N.E. of Sofia, on the river Yantra, and on the Sofia-Varna railway, at the junction of the branch line from Rustchuk. Pop. (1906), 12,171. The city consists of two divisions—the Christian quarter, situated chiefly on a high rocky plateau, and the so-called Turkish quarter, on the lower ground; but many of the Turkish inhabitants emigrated after 1878. On the Tsarevetz Hill above the city are the remains of the ancient citadel. The Husarjaini mosque is used as a military powder and dynamite factory. In the Christian quarter there are some interesting churches of the middle ages, notably that of the Forty Martyrs, in which the Bulgarian tsars were crowned. Numerous antiquarian remains have also been discovered. There are a gymnasium and a high-class girls' school. The city possesses large dye-works, and important manufactures of copper utensils.

Trnovo was the ancient capital of Bulgaria, and from 1186 until its capture by the Turks, 17th of July 1394, the residence of the Bulgarian tsars. From the beginning of the 13th century it was also the seat of the patriarchate of Bulgaria, until the suppression of the patriarchate in 1767. In 1877 it was taken from Turkey by the Russians, and in 1879 Prince Alexander of Battenberg was here elected prince of Bulgaria. On the 5th of October 1908 the independence of Bulgaria was proclaimed here by King Ferdinand, in the church of the Forty Martyrs.

TROCHAIC (from Gr. τροχαῖος, τροχαϊκός; Lat. *trochaeus*), the name of a metre very commonly used by the Greeks and Romans in their tragedies and comedies. Its characteristic foot is a trochee consisting of two syllables, one long, one short (−⏑). The usual form, in which the Greeks employed the measure, was the trochaic tetrameter catalectic, the scheme of which is as follows:—

−⏑	−⏑	−⏑	−⏑	−⏑	−⏑	−⏑	⏑
⏑⏑⏑	⏑⏑⏑	⏑⏑⏑	⏑⏑⏑	⏑⏑⏑	⏑⏑⏑	⏑⏑⏑	
	−−		−−		−−	⏑⏑−	
	⏑⏑−		⏑⏑−				
−⏑⏑	−⏑⏑	−⏑⏑	−⏑⏑	−⏑⏑	−⏑⏑	−⏑⏑	

The trochaic metre is rapid in movement and breathless, and is generally used to depict strong emotions or to tell an exciting narrative. It is, however, very closely related to the ordinary iambic metre; in fact, by subtracting the first foot and a half of the longer line, we find ourselves left with a pure iambic line as used by the tragedians.

In modern times, the trochaic measure has been adopted by the prosody of England, Germany and Scandinavia. The swift and hurrying movement of it, which we see reflected in its derivation, as the Greek name is certainly to be traced back to the verb τρέχειν, to run, has made it a favourite with our lyrical poets. In the early English writers on versification the foot is called a trocheus.

TROCHU, LOUIS JULES (1815–1896), French general, was born at Palais (Belle-Ile-en-Mer) on the 12th of March 1815. Educated at St Cyr he received a commission in the Staff Corps in 1837, was promoted lieutenant in 1840, and captain in 1843. He served as a captain in Algeria under Marshal Bugeaud, who, in recognition of his gallantry in the battles of Sidi Yussuf and Isly, made him his aide-de-camp and entrusted him with important commissions. He was promoted major in 1845, and colonel in 1853. He served with distinction throughout the Crimean campaign, first as aide-de-camp to Marshal St Arnaud, and then as general of brigade, and was made a commander of the Legion of Honour and general of division. He again distinguished himself in command of a division in the Italian campaign of 1859, where he won the grand cross of the Legion of Honour. In 1866 he was employed at the ministry of war in the preparation of army reorganization schemes, and he published anonymously in the following year *L'Armée française en 1867*, a work inspired with Orleanist sentiment, which ran through ten editions in a few months and reached a twentieth in 1870. This brochure brought him into bad odour at court, and he left the war office on half-pay, and was refused a command in the field at the outbreak of the Franco-German War. After the earlier disasters in 1870, he was appointed by the emperor first commandant of the troops of Châlons camp, and soon afterwards (Aug. 17) governor of Paris and commander-in-chief of all the forces destined for the defence of the capital, including some 120,000 regular troops, 80,000 mobiles, and 330,000 National Guards. He worked energetically to put Paris in a state of defence and throughout the siege showed himself a master of the passive defensive. At the revolution of the 4th of September he became president of the government of national defence, in addition to his other offices. His "plan" for defending the city raised expectations doomed to disappointment; the successive sorties made under pressure of public opinion were unsuccessful, and having declared in one of his proclamations that the governor of Paris would never capitulate, when capitulation became inevitable he resigned the governorship of Paris on the 22nd of January 1871 to General Vinoy, retaining the presidency of the government until after the armistice in February. He was elected to the National Assembly by eight departments, and sat for Morbihan. In October he was elected president of the council general for Morbihan. In July 1872 he retired from political life, and in 1873 from the army. He published in 1873 *Pour la vérité et pour la justice*, in justification of the government of national defence, and in 1879 *L'Armée française en 1879, par un officier en retraite*, a sort of supplement to his former work of 1867. He died at Tours on the 7th of October 1896.

TROGEN, a neat and clean little town in the Ausser Rhoden half of the Swiss canton of Appenzell. By light railway it is 6 m. from St Gall, or by carriage road 7 m. from Heiden (the chief goats' whey cure resort in the canton), or 9 m. from Altstätten in the Rhine valley. It is built on the side of a steepish hill, and in 1900 had 2496 inhabitants, mostly Protestant and German-speaking. In the square before the parish church the *Landsgemeinde* or primitive democratic assembly of Ausser Rhoden meets in the even years (in other years at Hundwil, not far from Herisau) on the last Sunday in April. Like other towns in Appenzell, Trogen is engaged in the manufacture (in the houses of the workpeople) of embroidery and muslins.

TROGLODYTES (τρωγλοδύται, from τρώγλη, hole, δύω, creep), "cave-dwellers," a name applied by ancient writers to different tribes in various parts of the world. Strabo speaks of them in Moesia, south of the Danube (vii. 318), in the Caucasus (xi. 506), but especially in various parts of Africa from Libya (xvii. 828) to the Red Sea. The troglodyte Ethiopians of Herodotus (iv. 183) in inner Africa, very swift of foot, living on lizards and creeping things, and with a speech like the screech of an owl, have been identified with the Tibbus of Fezzan.

According to Aristotle (*Hist. An.* viii. 12) a dwarfish race of Troglodytes dwelt on the upper course of the Nile, who possessed horses and were in his opinion the Pygmies of fable. But the best known of these African cave-dwellers were the inhabitants of the "Troglodyte country" (Τρωγλοδυτική) on the coast of the Red Sea, as far north as the Greek port of Berenice, of whom an account has been preserved by Diodorus (iii. 31) and Photius (p. 454 Bekker) from Agatharchides of Cnidus, and by Artemidorus in Strabo (xvi. 776). They were a pastoral people, living entirely on the flesh of their herds, or, in the season of fresh pasture, on mingled milk and blood. But they killed only old or sick cattle (as indeed they killed old men who could no longer follow the flock), and the butchers were called "unclean"; nay, they gave the name of parent to no man, but only to the cattle which provided their subsistence. This last point seems to be a confused indication of totemism. They went almost naked; the women wore necklaces of shells as amulets. Marriage was unknown, except among the chiefs—a fact which agrees with the prevalence of female kinship in these regions in much later times. They practised circumcision or a mutilation of a more serious kind. Their burial rites were peculiar. The dead body, its neck and legs bound together with withies of the shrub called *paliurus*, was set up on a mound, and pelted with stones amidst the jeers of the onlookers, until its face was completely covered with them. A goat's horn was then placed above it, and the crowd dispersed with manifestations of joy. It is supposed that the Horim or Horites, the aboriginal inhabitants of Mount Seir, if their name is correctly interpreted "cave-dwellers," were a kindred people to the Troglodytes on the other side of the Red Sea.

TROGON, a word apparently first used as English[1] by G. Shaw (*Mus. Leverianum*, p. 177) in 1792, and now for many years accepted as the general name of certain birds forming the family Trogonidae of modern ornithology. The trogons are birds of moderate size: the smallest is hardly bigger than a thrush and the largest less bulky than a crow. In most of them the bill is very wide at the gape, which is invariably beset by recurved bristles. They seize most of their food, whether caterpillars or fruits, on the wing, though their alar power is not exceptionally great, their flight being described as short, rapid and spasmodic. Their feet are weak and of a unique structure, the second toe, which in most birds is the inner anterior one, being reverted, and thus the trogons stand alone, since in all other birds that have two toes before and two behind it is the outer toe that is turned backward. The plumage is very remarkable and characteristic. There is not a species which has not beauty beyond most birds, and the glory of the group culminates in the quezal (*q.v.*). But in others golden green and steely blue, rich crimson[2] and tender pink, yellow varying from primrose to amber, vie with one another in vivid coloration, or contrasted, as happens in many species, with a warm tawny or a sombre slaty grey—to say nothing of the delicate freckling of black and white, as minute as the markings of a moth's wing—the whole set off by bands of white, producing an effect hardly equalled in any group. The plumage is further remarkable for the large size of its contour-feathers, which are extremely soft and so loosely seated as to come off in scores at a touch, and there is no down. The tail is generally a very characteristic feature, the rectrices, though in some cases pointed, being often curiously squared at the tip, and when this is the case they are usually barred ladder-like with white and black.[3] According to J. Gould, they are larger and more pointed in the young than in the old, and grow squarer and have the white bands narrower at each succeeding moult. He also asserts that in the species which have the wing coverts freckled, the freckling becomes finer with age. So far as has been observed, the nidification of these birds is in holes of trees, wherein are laid without any bedding two roundish eggs, generally white, but certainly in one species (quezal) tinted with bluish green.

The trogons form a very well-marked family, belonging to the coraciiform birds, and probably to be placed in that assemblage near the colies (see Mouse Bird) and swifts (*q.v.*). The remains of one, *T. gallicus*, have been recognized by A. Milne-Edwards (*Ois. foss. de la France*, ii. 395, pl. 177, figs. 18–22) from the Miocene of the Allier. This fortunate discovery seems to account for the remarkable distribution of the trogons at the present day. While they chiefly abound, and have developed their climax of magnificence, in the tropical parts of the New World, they yet occur in the tropical parts of the Old. The species now inhabiting Africa, forming the group *Hapaloderma*, can hardly be separated generically from those of the Neotropical *Trogon*, and the difference between the Asiatic forms, if somewhat greater, is still comparatively slight. It is plain then that the Trogons are an exceptionally persistent type; indeed in the whole class few similar instances occur, and perhaps none that can be called parallel. The extreme development of the type in the New World just noticed also furnishes another hint. While in some of the American trogons (*Pharomacrus*, for instance) the plumage of the females is not very much less beautiful than that of the males, there are others in which the hen birds retain what may be fairly deemed a more ancient livery, while the cocks flaunt in brilliant attire. Now the plumage of both sexes in all but one[4] of the Asiatic trogons, *Harpactes*, resembles rather that of the young and of those females of the American species which are modestly clothed. The inference from this fact would seem to be that the general coloration of the Trogons prior to the establishment, by geographical estrangement, of the two types was a russet similar to that now worn by the adults of both sexes in the Indian region, and by a portion only of the females in the Neotropical. The Ethiopian type, as already said, very closely agrees with the American, and therefore would be likely to have been longer in connexion therewith. Again, while the adults of most of the American trogons (*Pharomacrus* and *Euptilotis* excepted) have the edges of the bill serrated, their young have them smooth or only with a single notch on either side near the tip, and this is observable in the Asiatic trogons at all ages. At the same time the most distinctive features of the whole group, which are easily taken in at a glance, but are difficult to express briefly in words, are equally possessed by both branches of the family, showing that they were in all likelihood—for the possibility that the peculiarities may have been evolved apart is not to be overlooked—reached before the geographical sundering of these branches (whereby they are now placed on opposite sides of the globe) was effected.

About sixty species of trogons are recognized, which J. Gould in the second edition of his *Monograph* of the family (1875) divides into seven genera. *Pharomacrus*, *Euptilotis* and *Trogon* inhabit the mainland of tropical America, no species passing to the northward of the Rio Grande nor southward of the forest district of Brazil, while none occur on the west coast of Peru or Chile. *Prionotelus* and *Tmetotrogon*, each with one species, are peculiar respectively to Cuba and Haiti. The African form *Hapaloderma* has two species, one found only on the west coast, the other of more general range. The Asiatic trogons, *Harpactes* (with eleven species according to the same authority), occur from Nepal to Malacca, in Ceylon, and in Sumatra, Java and Borneo, while one species is peculiar to some of the Philippine Islands. (A. N.)

TROGUS, GNAEUS POMPEIUS, Roman historian from the country of the Vocontii in Gallia Narbonensis, nearly contemporary with Livy, flourished during the age of Augustus. His grandfather served in the war against Sertorius with Pompey, through whose influence he obtained the Roman citizenship; hence the name Pompeius, adopted as a token of gratitude to his benefactor. His father served under Julius Caesar in the capacity of secretary and interpreter. Trogus himself seems to have been a man of encyclopaedic knowledge. He wrote, after Aristotle and Theophrastus, books on the natural history of animals and plants, frequently quoted by the elder Pliny. But his principal work was *Historiae Philippicae* in forty-four books, so called because the Macedonian empire founded by Philip is the central theme of the narrative. This was a general history of the world, or rather of those portions of it which came under the sway of Alexander and his successors. It began with Ninus, the founder of Nineveh, and ended at about the same point as Livy (A.D. 9). The last event recorded by the epitomator Justin (*q.v.*) is the recovery of the Roman standards captured by the Parthians (20 B.C.). He left untouched Roman history up to the time when Greece and the East came into contact with Rome, possibly because Livy had sufficiently treated it. The work was based upon the writings of Greek historians, such as Theopompus (also the author of a *Philippica*), Ephorus, Timaeus, Polybius. Chiefly on the ground that such a work was beyond the powers of a Roman, it is generally agreed that Trogus did not gather together the information from the leading Greek historians for himself, but that it was already combined into a single book by some Greek (very probably Timagenes of Alexandria). His idea of history was more severe and less rhetorical than that of Sallust and Livy, whom he blamed for putting elaborate speeches into the mouths of the characters of whom they wrote. Of his great work, we possess only the epitome by Justin, the *prologi* or summaries of the 44 books, and fragments in Vopiscus, Jerome, Augustine and other writers. But even in its present mutilated state it is often an important authority for the ancient history of the East. Ethnographical and geographical excursuses are a special feature of the work.

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[1] *Trogonem* (the oblique case) occurs in Pliny (*H. N.* x. 16) as the name of a bird of which he knew nothing, save that it was mentioned by Hylas, an augur, whose work is lost; but some would read *Trygonem* (turtle-dove). In 1752 Möhring (*Av. Genera*, p. 85) applied the name to the "Curucui" (pronounced "Suruquá," *vide* Bates, *Nat. Amazons*, i. 254) of Marcgrav (*Hist. nat. Brasiliae*, p. 211), who described and figured it in 1648 recognizably. In 1760 Brisson (*Ornithologie*, iv. 164) adopted *Trogon* as a generic term, and, Linnaeus having followed his example, it has since been universally accepted.

[2] Anatole Bogdanoff determined the red pigment of the feathers of *Pharomacrus auriceps* to be a substance which he called "zooxanthine" (*Comptes rendus*, Nov. 2, 1857, xlv. 690).

[3] In the trogon of Cuba, *Prionotelus*, they are most curiously scooped out, as it were, at the extremity, and the lateral pointed ends diverge in a way almost unique among birds.

[4] Or two species if *N. macloti* be more than a local form of *H. reinwardti*.

Fragments edited by A. Bielowski (1853); see also, A. H. L. Heeren, *De Trogi P. fontibus et auctoritate* (prefixed to C. H. Frotscher's edition of Justin); A. Enmann on the authorities used by Trogus for Greek and Sicilian history (1880); A. von Gutschmid, *Über die Fragmente des Pompeius Trogus* (1857); M. Schanz, *Geschichte der römischen Litteratur* (2nd ed., 1899), ii., where all that is known of Timagenes is given; Teuffel-Schwabe, *Hist. of Roman Literature*, § 258; and article JUSTIN.

TROIA, a town and episcopal see of Apulia, Italy, in the province of Foggia, situated 1440 ft. above sea-level, 7 m. N.W. of the station of Giardinetto-Troia, which is 16 m. S.W. of Foggia. Pop. (1901), 6674. Troia occupies the site of the ancient Aecae, 12 m. S. of Luceria, on the Via Traiana, a town which fell to Hannibal after the victory of Cannae, but was won back by the Romans in 214. Under the empire it appears to have become a colony. Troia was itself founded in 1017 by the Greek prefect Basilius Bugianus. The cathedral dates from 1107, but the upper part of the façade with its curious sculptures, fine rose-window and polychromatic decoration, the choir apse and the interior were restored early in the 13th century. The latter has been somewhat spoilt by recent decorations. The bronze doors, partly in relief and partly in niello, of 1119 and 1127 respectively, were cast in Beneventum by Oderisius Berardus. The small domed church of S. Basilio has an ambo of 1158.

TROÏLUS, in Greek legend, son of Priam (or Apollo) and Hecuba. His father, when upbraiding his surviving sons for their cowardice, speaks in the *Iliad* (xxiv. 257) of Troilus as already slain before the action of the poem commences. According to a tradition drawn from other sources and adopted by Virgil (*Aen.* i. 474), when a mere boy he fell by the hand of Achilles. In another account, he was dragged to death by his own horses. His death formed the subject of a lost tragedy by Sophocles. There is no trace in classical writers of the story of Shakespeare's *Troilus and Cressida*, the materials for which were derived from Chaucer's poem of the same name, Lydgate's *History, Sege, and Destruccion of Troy*, Caxton's *Recuyell of the Historyes of Troy* (trans. from Norman French of Raoul le Fevre), Chapman's translation of Homer, and perhaps a play on the subject by Dekker and Chattle.

TROITSK, a town of eastern Russia, in the government of Orenburg, situated in a fertile steppe, 315 m. N.E. of Orenburg, and 77 m. S. of Chelyabinsk, on the Siberian highway. Pop. (1885), 18,497; (1900), 23,293. It has grown rapidly in modern times. The Troitskiy fort, erected in 1743, became a centre for trade with the Kirghiz steppe and Turkestan, and in that trade Troitsk is now second only to Orenburg. Cotton, silk, and especially horses and cattle are imported, while leather, cotton, woollen and metal wares are exported. An active trade in corn for the Ural gold mines is carried on. The place has ironworks and tanneries.

TROLLE, HERLUF (1516–1565), Danish naval hero, was born on the 14th of January 1516 at Lillö. At the age of nineteen Trolle went to *Vor Frue Skole* at Copenhagen, subsequently completing his studies at Wittenberg, where he adopted the views of Melanchthon, with whom he was in intimate correspondence for some years. His marriage with Brigitte, the daughter of Lord Treasurer Mogens Gjöe, brought him a rich inheritance, and in 1557 he took his seat in the senate. Both Christian III. and Frederick II. had a very high opinion of Trolle's trustworthiness and ability and employed him in various diplomatic missions. Trolle was, indeed, richly endowed by nature, and his handsome face and lively manners made him popular everywhere. His one enemy was his wife's nephew Peder Oxe, the subsequently distinguished finance minister, whose narrow grasping ways, especially as the two men were near neighbours, did not contribute towards family harmony. It was Trolle whom Frederick II. appointed to investigate the charges of malversation brought against Oxe. Both Trolle and his wife were far renowned for their piety and good works, and their whole household had to conform to their example or seek service elsewhere. A man of culture, moreover, he translated David's 31st Psalm into Danish verse. He also promoted literature and learning by educating poor students both at home and abroad, endowing Latin schools and encouraging historical research. In 1559 Trolle was appointed admiral and inspector of the fleet, a task which occupied all his time and energy. In 1563 he superseded the aged Peder Skram as admiral in chief. On the 10th of May he put to sea with twenty-one ships of the line and five smaller vessels and, after uniting with a Lübeck squadron of six liners, encountered, off the isle of Öland, a superior Swedish fleet of thirty-eight ships under Jacob Bagge. Supported by two other Danish ships Trolle attacked the Swedish flagship "Makalös" (Matchless), then the largest battleship in northern waters, but was beaten off at nightfall. The fight was renewed at six o'clock the following morning, when the "Makalös" was again attacked and forced to surrender, but blew up immediately afterwards, no fewer than 300 Lübeck and Danish sailors perishing with her. But the Swedish admiral was captured and the remnant of the Swedish fleet took refuge at Stockholm. Despite the damage done to his own fleet and flagship "Fortuna" by this great victory, Trolle, on the 14th of August, fought another but indecisive action with a second Swedish fleet under the famous Swedish admiral Klas Horn, and kept the sea till the 13th of October. Trolle spent the winter partly at his castle of Herlufsholm completing his long cherished plan of establishing a school for all classes, and partly at Copenhagen equipping a new fleet for the ensuing campaign. On the 1st of June 1565 he set sail with twenty-eight liners, which were reinforced off Femern by five Lübeck vessels. Klas Horn had put to sea still earlier with a superior fleet and the two admirals encountered off Fehmarn on the 4th of June. The fight was severe but indecisive, and both commanders finally separated to repair their ships. Trolle had been severely wounded in the thigh and shoulder, but he would not let the ship's surgeon see to his injuries till every one else had been attended to. This characteristic act of unselfishness was his undoing, for he died at Copenhagen on the 25th of June, seventeen days after they had put him ashore.

TROLLHÄTTAN, a town of Sweden in the district (*län*) of Elfsborg, 45 m. by rail N. by E. of Gothenburg. Pop. 6000. It lies on the left (east) bank of the Göta at the point where that river descends 108 ft. in the course of nearly a mile by the famous falls of Trollhättan (six in number) and several rapids. The scenic setting of the falls is not striking, but the great volume of water, nearly 18,000 cub. ft. per second, renders them most imposing. The narrowed river here surrounds several islands, on either side of one of which (Toppö) are the first falls of the series, Toppö and Tjuf. These are 42 ft. in height. The water-power is used in rolling-mills, a cellulose factory and other works.

Several "giant's caldrons" are seen in the exposed bed of a former channel. Below the falls are valuable salmon fisheries. To the east of the river the Berg canal, part of the Göta canal system, ascends in a series of eleven new locks (Akersvass) completed in 1844. An old series of locks (1800) is in use for small vessels. There are also ruins of an abortive attempt made to lock the falls in 1755. (See GOTA.)

TROLLOPE, ANTHONY (1815–1882), English novelist, was born in London, on the 24th of April 1815. His father, Thomas Anthony Trollope (1780–1835), a barrister who had been fellow of New College, Oxford, was reduced to poverty by unbusinesslike habits and injudicious speculation, and in 1829 Anthony's mother, FRANCES MILTON TROLLOPE (1780–1863), went with her husband to the United States to open a small fancy-goods shop in Cincinnati. The enterprise was a failure, but her three years' stay in that country resulted in a book on the *Domestic Manners of the Americans* (1832), of which she gave an unflattering account that aroused keen resentment. Returning to England her husband was compelled to flee the country in order to escape his creditors, and Mrs Trollope thereafter supported him in Bruges until his death by her incessant literary work. She published some books of travel, most of which are coloured by prejudice, and many novels, among the best known of which are *The Vicar of Wrexhill* (1837) and the *Widow Barnaby* (1839), studies in that vein of broad comedy in which lay her peculiar gift. She wrote steadily for more than twenty years, until her death, at Florence, on the 6th of October 1863. (See *Frances Trollope, her Life and Literary Work*, by her daughter-in-law 1895.) Her eldest son THOMAS ADOLPHUS TROLLOPE (1810–1892), was educated at Winchester and Oxford, and spent most of his life in Italy. He wrote a number of works on Italian subjects, among them *Homes and Haunts of Italian Poets* (1881), in collaboration with his second wife, Frances Eleanor Trollope, herself a novelist of no mean ability. He was a voluminous author, and perhaps the quantity of his work has obscured its real merit. Among his novels are *La Beata* (1861) *Gemma* (1866), and *The Garstangs of Garstang Grange* (1869). (See his autobiography, *What I Remember* 1887.)

Anthony Trollope was the third son. By his own account few English men of letters have had an unhappier childhood and youth. He puts down his own misfortunes, at Harrow, at Winchester, at Harrow again, and elsewhere, to his father's pecuniary circumstances, which made his own appearance dirty and shabby, and subjected him to various humiliations. But it is permissible to suspect that this was not quite the truth, and that some peculiarities of temper, of which in after life he had many, contributed to his unpopularity. At any rate he seems to have reached the verge of manhood as ignorant as if he had had no education at all. After an experience as usher in a private school at Brussels he obtained, at the age of nineteen, by favour (for he could not pass even the ridiculous examination then usual) a position in the London post office. Even then his troubles were not over. He got into debt; he got into ridiculous entanglements of love affairs, which he has very candidly avowed; he was in constant hot water with the authorities; and he seems to have kept some very queer company, which long afterwards stood him in good stead as models for some of his novels. At last in August 1841 he obtained the appointment of clerk to one of the post office surveyors in a remote part of Ireland with a very small salary. This, however, was practically quadrupled by allowances; living was cheap; and the life suited Trollope exactly, being not office work, which he always hated, but a kind of travelling inspectorship. In the discharge of his duties he evinced a business capacity quite unsuspected by his former superiors. Here he began that habit of hunting which, after a manner hardly possible in later conditions of official work, he kept up for many years even in England. Within three years of his appointment he became engaged to Rose Heseltine, whom he had met in Ireland but who was of English birth. They were married in June 1844. His headquarters had previously been at Banagher; he was now transferred to Clonmel.

Trollope had always dreamt of novel-writing, and his Irish experiences seemed to supply him with promising subjects. With some assistance from his mother he got published his first two books, *The Macdermots of Ballycloran* (1847) and *The Kellys and the O'Kellys* (1848). Neither was in the least a success, though the second perhaps deserved to be, and a third, *La Vendée* (1850), besides being a much worse book than either, was equally a failure. Trollope made various literary attempts, but for a time ill fortune attended all of them. Meanwhile he was set on a new kind of post office work, which suited him even better than his former employment—a sort of roving commission to inspect rural deliveries and devise their extension, first in Ireland, then throughout the west of England and South Wales. That he did good work is undeniable; but his curious conception of official duty, on his discharge of which he prided himself immensely, is exhibited by his confessions that he "got his hunting out of it," and that he felt "the necessity of travelling miles enough"—he was paid by the mileage—"to keep his horses." It was during this work that he struck the vein which gave him fortune and fame. A visit to Salisbury Close inspired him with the idea of *The Warden* (1855). It brought him little immediate profit, nor was even *Barchester Towers*, which followed in 1857, very profitable, though it contains his freshest, his most original, and, with the exception of *The Last Chronicle of Barset*, his best work. The two made him a reputation, however, and in 1858 he was able for the first time to sell a novel, *The Three Clerks*, for a substantial sum, £250. A journey on post office business to the West Indies gave him material for a book of travel, *The West Indies and the Spanish Main* (1859), which he frankly and quite truly acknowledges to be much better than some subsequent work of his in the same line. From this time his production, mainly of novels, was incessant, and the sums which he received were very large, amounting in one case to as much as £3525 for a single book, and to nearly £70,000 in the twenty years between 1859 and 1879. All these particulars are given with great minuteness by himself, and are characteristic. The full high tide of his fortunes began when the *Cornhill Magazine* was established. He was asked at short notice to contribute a novel, and wrote in 1861 *Framley Parsonage*, which was extremely popular; two novels immediately preceding it, *The Bertrams* (1859) and *Castle Richmond* (1860) had been much less successful.

As it will be possible to notice few of his other works, the list of them, a sufficiently astonishing one, may be given here: *Doctor Thorne* (1858); *Tales of All Countries* (3rd series 1863); *Orley Farm*; *North America* (1862); *Rachael Ray* (1863); *The Small House at Allington*, *Can You Forgive Her?* (1864); *Miss Mackenzie* (1865); *The Belton Estate* (1866); *The Claverings*, *Nina Balatka*, *The Last Chronicle of Barset* (1867); *Linda Tressel* (1868); *Phineas Finn*, *He Knew He Was Right* (1869); *The Struggles of Brown, Jones and Robinson*, *the Vicar of Bullhampton*, *An Editor's Tales*, *The Commentaries of Caesar* (1870); *Sir Harry Hotspur of Humblethwaite*, *Ralph the Heir* (1871); *The Golden Lion of Granpere* (1872); *The Eustace Diamonds*, *Australia and New Zealand* (1873); *Phineas Redux*, *Harry Heathcote of Gangoil*, *Lady Anna* (1874); *The Way We Live Now* (1875); *The Prime Minister* (1876); *The American Senator* (1877); *Is He Popenjoy?* *South Africa* (1878); *John Caldigate*, *An Eye for an Eye*, *Cousin Henry*, *Thackeray* (1879); *The Duke's Children*, *Cicero* (1880); *Ayala's Angel*, *Dr Wortle's School* (1881); *Frau Frohmann*, *Lord Palmerston*, *The Fixed Period*, *Kept in the Dark*, *Marion Fay* (1882); *Mr Scarborough's Family*, *The Land Leaguers* (1883); and *An Old Man's Love* (1884), and several volumes of short stories.

How this enormous total was achieved in spite of official work (of which, lightly as he took it, he did a good deal, and which he did not give up for many years), of hunting three times a week in the season, of whist-playing, of not a little going into general society, he has explained with his usual curious minuteness. He reduced novel-writing to the conditions of regular mechanical work—so much so that latterly he turned out 250 words every quarter of an hour, and wrote at this rate three hours a day. He divided every book beforehand into so many days' work and checked off the amount as he wrote.

A life thus spent could not be very eventful, and its events may be summed up rapidly. In 1858 he went to Egypt on post office business, and at the end of 1859 he got himself transferred from Ireland to the eastern district of England. Here he took a house, at Waltham. He took an active part in the establishment of the *Fortnightly Review* in 1865; he was editor of *St Paul's* for some time after 1867; and at the end of that year he resigned his position in the post office. He stood as a parliamentary candidate for Beverley and was defeated; he received from his old department special missions to America and elsewhere—he had already gone to America during the Civil War. He went to Australia in 1871, and before going broke up his household at Waltham. When he returned he established himself in London, and lived there until 1880, when he removed to Harting, on the confines of Sussex and Hampshire. He had visited South Africa in 1877 and travelled elsewhere. He died of paralysis on the 6th of December 1882.

Of Trollope's personal character it is not necessary to say much. Strange as his conception of official duty may seem, it was evidently quite honest and sincere, and, though he is said to have been as an official popular neither with superiors nor inferiors, he no doubt did much good work. Privately he was much liked and much disliked—a great deal of real kindness being accompanied by a blustering and overbearing manner, and an egotism, not perhaps more deep than other men's, but more vociferous. None of his literary work except the novels is remarkable for merit. His *Caesar* and *Cicero* are curious examples of a man's undertaking work for which he was not in the least fitted. *Thackeray* exhibits, though Trollope appears to have both admired Thackeray as an artist and liked him as a man, grave faults of taste and judgment, and a complete lack of real criticism. The books of travel are not good, and of a kind not good. *Nina Balatka* and *Linda Tressel*—stories dealing with Prague and Nuremberg respectively—were published anonymously and as experiments in the romantic style. They have been better thought of by the author and by some competent judges than by the public or the publishers. *The Struggles of Brown, Jones and Robinson* was still more disliked, and is certainly very bad as a whole, but has touches of curious originality in parts. Trollope seldom creates a character of the first merit; at the same time his characters are always alive. Dr Thorne, Mr Harding, who has the courage to resign his sinecure in *The Warden*, Mr Crawley, Archdeacon Grantley, and Mrs Proudie in the same ecclesiastical series, are distinct additions to the *personae* of English fiction. After his first failures he never produced anything that was not a faithful and sometimes a very amusing transcript of the sayings and doings of possible men and women. His characters are never marionettes, much less sticks. He has some irritating mannerisms, notably a trick of repetition of the same form of words. He is sometimes absolutely vulgar—that is to say, he does not deal with low life, but shows, though always robust and pure in morality, a certain coarseness of taste. He is constantly rather trivial, and perhaps nowhere out of the Barset series (which, however, is of itself no inconsiderable work) has he produced books that will live. The very faithfulness of his representation of a certain phase of thought, of cultivation, of society, uninformed as it is by any higher spirit, in the long run damaged, as it had first helped, the popularity of his work. But, allowing for all this it may and must still be said that he held up his mirror steadily to nature, and that the mirror itself was fashioned with no inconsiderable art.

Trollope wrote an *Autobiography*, edited by his son Henry M. Trollope in 1883, explaining his literary methods with amusing frankness. See also Sir L. Stephen's *Studies of a Biographer* (1898), James Bryce's *Studies in Contemporary Biography* (1903), and Henry James's *Partial Portraits* (1888).

TROMBA MARINA, or MARINE TRUMPET (Fr. *trompette marine*; Ger. *Marine Trompete, Trompetengeige, Nonnengeige, Tympanischiza* or *Trummscheit*), a triangular bowed instrument about 6 ft. in length, which owes its characteristic timbre to the peculiar construction of the bridge. The tromba marina consists of a body and neck in the shape of a truncated cone resting on a triangular base. In the days of Michael Praetorius (1618), the length of the Trummscheit was 7 ft. 3 in. and the three sides at the base measured 7 in., tapering to 2 in. at the neck. These measurements varied considerably, as did also the shape of the body and the number of strings. In some cases the base of the body was left open, and in others there were sound-holes. The bridge, from its curiously irregular shape, was known as the "shoe"; it was thick and high at the one side on which rested the string, and low and narrow at the other which was left loose so that it vibrated against the belly with every movement of the bow, producing a trumpet-like timbre. It is to this feature, in conjunction with its general resemblance in contour to the marine speaking-trumpet of the middle ages, that the name of the instrument is doubtless due.

There was at first but one string, generally a D violoncello string, which was not stopped by the fingers in the usual way, but played only in harmonics by lightly touching it with the thumb at the nodal points. The heavy blow, similar to that of the violoncello, is used between the highest positions of the left hand at the nodal points and the nut of the head. In a Trummscheit in the collection of the Kgl. Hochschule, at Charlottenburg (No. 772 in catalogue) the frets are lettered A,D,F,A,D,F,G,A,B,C,D. Sometimes an octave string, half the length of the melody string, and even two more, respectively the twelfth and the double octave, not resting on the bridge but acting as sympathetic strings, were added to improve the timbre by strengthening the pure harmonic tones without increasing the blare due to the action of the bridge. In Germany, at the time when the trumpet was extensively used in the churches, nuns often substituted the tromba marina, whence the name *Nonnengeige*. In France, the Grande Écurie du Roi comprised five trumpets-marine and cromornes among the band in 1662, when the charge was mentioned for the first time in the accounts; and in 1666 the number was increased to six. The instrument fell into disuse during the first half of the 18th century, and was only to be seen in the hands of itinerant and street musicians. (K. S.)

TROMBONE (Fr. *trombone*, Ger. *Posaune*, Ital. *trombono*), an important member of the brass wind family of musical instruments formerly known as *sackbut*. The trombone is characterized by the *slide*, consisting of two parallel cylindrical tubes, over which two other cylindrical tubes, communicating at their lower extremities by means of a short semicircular pipe, slip without loss of air. The outer tube, therefore, slides upon the inner, and as it is drawn downwards by the right hand opens a greater length of tube proportional to the depth of pitch required. When the slide is closed the instrument is at its highest pitch. To the upper end of one of the inner tubes is fastened the cup-shaped mouthpiece and to the end of the other tube is fixed the bell-joint. This joint, on the proper proportions of which depend in a greater measure the acoustic properties of the trombone, consists of a length of tubing with conical bore widening out into a large bell and doubled back once upon itself in a plane at right angles to that of the slide. The bell-joint is strengthened by two or three stays, and the slide also has two, one between the inner immovable tubes and the other on the outer sliding tubes, by means of which the slide is drawn out and pushed in.

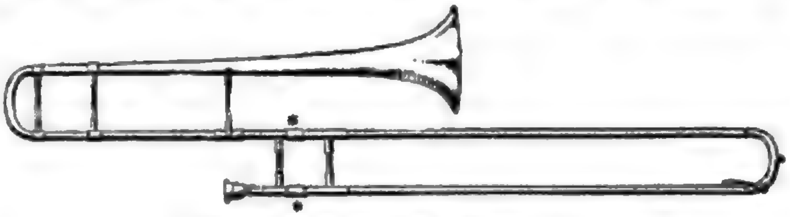
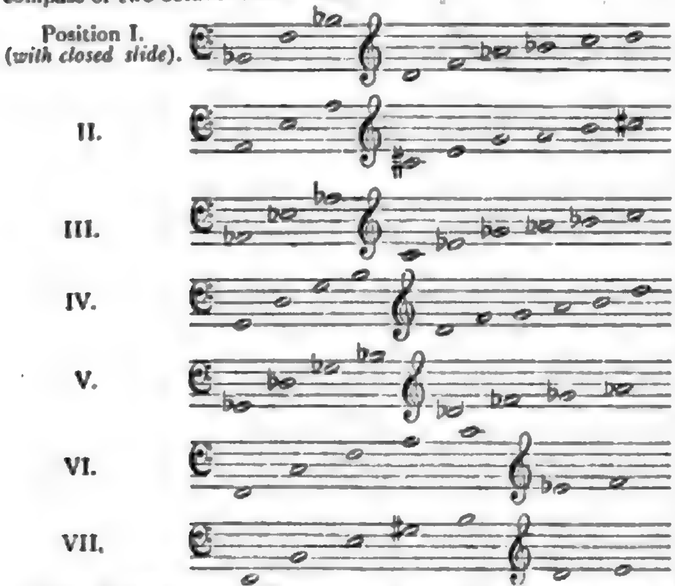


FIG. 1.—Tenor Trombone (Besson & Co.).

Sound is produced on the trombone, as on the horn, by means of the lips stretched like a vibrating reed across the cup mouthpiece from rim to rim; the acoustic principles involved are the same for both instruments. By overblowing, *i.e.* by the varying tension of the lips and pressure of breath, the harmonic series is obtained, which is effective between the second and the tenth harmonics, the fundamental being but rarely of practical use.

There are seven positions of the slide on the trombone, each giving a theoretical fundamental tone and its upper partials a semitone lower than the last, and corresponding to the seven shifts on the violin and to the seven positions on valve instruments. These seven positions are found by drawing out the slide a little more for each one, the first position being that in which the slide remains closed. The performer on the trombone is just as dependent on an accurate ear for finding the correct positions as a violinist.

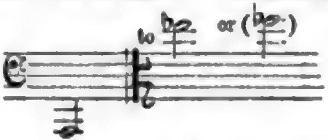
The table of harmonics for the seven positions of the tenor trombone in B♭ is appended; they furnish a complete chromatic compass of two octaves and a sixth.



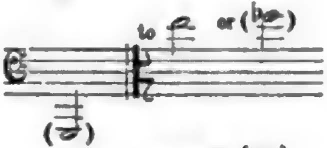
These notes represent all the notes in practical use, although it is possible to produce certain of the higher harmonics. The instrument being non-transposing, the notation represents the real sounds.

The four chief trombones used in the orchestra are the following:—

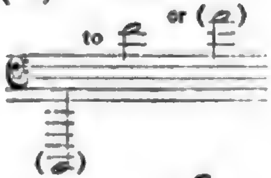
The Alto in E flat or F.



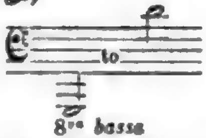
The Tenor-Bass in B flat.



The Bass in F or G
(with double slide in E flat).



The Contra-Bass in B flat.
An octave below the Tenor-Bass.



The compass given above is extreme and includes the notes obtained by means of the slide; the notes in brackets are very difficult; the fundamental notes, even when they can be played, are not of much practical use. The contra-bass trombone, although not much in request in the concert hall, is required for the *Nibelungen Ring*, in which Wagner has scored effectively for it.

The quality of tone varies greatly in the different instruments and registers. The alto trombone has neither power nor richness of tone, but sounds hard and has a timbre between that of a trumpet and a French horn. The tenor and bass have a full rich quality suitable for heroic, majestic music, but the tone depends greatly on the performer's method of playing; the modern tendency to produce a harsh, noisy blare is greatly to be deplored.

Besides the slide trombone, which is most largely used, there are the valve trombones, and the double-slide trombones. The former are made in the same keys as the instruments given above and are constructed in the same manner, except that the slide is replaced by three pistons, which enable the performer to obtain a greater technical execution; as the tone suffers thereby and loses its characteristic timbre, the instruments have never become popular in England.

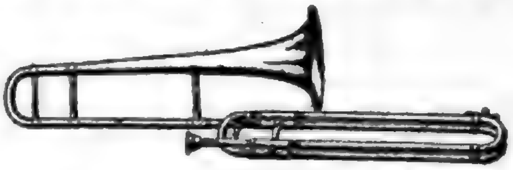


FIG. 2.

The double-slide trombone (fig. 2)—patented by Messrs Rudall Carte & Co. but said to have been originally invented by Halary in 1830—is made in B♭, G bass and E♭ contrabass. In these instruments each of the branches of the slide is made half the usual length. There are four branches instead of two and the two pairs lie one over the other, each pair being connected at the bottom by a semicircular tube and the second pair similarly at the top as well. The usual bar or stay suffices for drawing out both pairs of slides simultaneously, but as the lengthening of the air column is now doubled in proportion to the shift of the slide, the extension of arm for the lower positions is lessened by half, which increases the facility of execution but calls for greater nicety in the adjustment of the slide, more especially in the higher positions.

The history of the evolution of the trombone from the buccina is given in the article on the Sackbut (*q.v.*), the name by which the earliest *draw* or *slide* trumpets were known in England. The Germans call the trombone *Posaune*, formerly *busaun*, *busine*, *pusin* or *pusun* in the poems and romances of the 12th and 13th century, words all clearly derived from the Latin *buccina*. The modern designation "large trumpet" comes from the Italian, in which *tromba* means not only trumpet, but also pump and elephant's trunk. It is difficult to say where or at what epoch the instrument was invented. In a psalter (No. 20) of the 11th century, preserved at Boulogne, there is a drawing of an instrument which bears a great resemblance to a trombone deprived of its bell. Sebastian Virdung, Ottmar Luscinius, and Martin Agricola say little about the trombone, but they give illustrations of it under the name of *busaun* which show that early in the 16th century it was almost the same as that employed in our day. It would not be correct to assume from this that the trombone was not well known at that date in Germany, and for the following reasons. First, the art of trombone playing was in the 15th century in Germany mostly in the hands of the members of the town bands, whose duties included playing on the watch towers, in churches, at pageants, banquets and festivals, and they, being jealous of their privileges, kept the secrets of their art closely, so that writers, such as the above, although acquainted with the appearance, tone and action of the instrument would have but little opportunity of learning much about the method of producing the sound. Secondly, German and Dutch trombone players are known to have been in request during the 15th century at the courts of Italian princes.[1] Thirdly, Hans Neuschel of Nuremberg, the most celebrated performer and maker of his day, had already won a name at the end of the 15th century for the excellence of his "Posaunen," and it is recorded that he made great improvements in the construction of the instrument in 1498,[2] a date which probably marks the transition from sackbut to trombone, by enlarging the bore and turning the bell-joint round at right angles to the slide. Finally in early German translations of Vegetius's *De re militari* (1470) the buccina is described (bk. III., 5) as the trumpet or posaun which is drawn in and out, showing that the instrument was not only well known, but that it had been identified as the descendant of the buccina.

By the 16th century the trombone had come into vogue in England, and from the name it bore at first, not *sackbut*, but *shakbusshe*, it is evident that the instrument had been introduced from Spain and not from France (where it bore the name of saquebute), as some have assumed from the more frequent use of the word sackbut. The band of musicians in the service of Henry VIII. included ten sackbut players, and under Elizabeth, in 1587, there were six English instrumentalists then enjoyed a certain reputation and were sought for by foreign courts; thus in 1604 Charles III. of Lorraine sought to recruit his sackbut players from English bands.[1] Praetorius[2] classes the trombones in a complete family, the relative tonalities of which were thus composed: 1 *Alt-Posaun*, 4 *Gemeine rechte Posaunen*, 2 *Quart-Posaunen*, 1 *Octav-Posaun*—eight in all. The Alt-posaun was in D. With the slide closed, it gave the first of the accompanying harmonics:—

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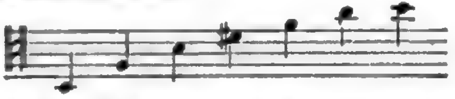
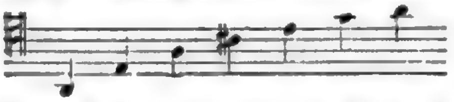
[1] E. Van der Straeten, *Les Musiciens néerlandais* p. 26.

[2] See G. von Retberg "Zur Gesch. d. Musik-instrumente" in *Anzeiger für Kunde der deutschen Vorzeit* p. 241. (Nuremberg, 1860). See also letters from Jorg Neuschell 1540–1545 in *Monatshefte f. Musikwissenschaft*, ix. p. 149 seq.



The gemeine rechte Posaunen, or ordinary trombones, were in A. Without using the slide they gave the subjoined sounds:—



The Quart-Posaun was made either in E, the fourth below the gemeine rechte Posaun, or in D, the lower fifth. In the latter case it was exactly an octave below the Alt-Posaun. The Octav-Posaun was in A. It was constructed in two different fashions: either it had a length double that of the ordinary trombone, or the slide was shortened, the length of the column of air being still maintained by the adaptation of a crook. The first system, which was invented by Hans Schreiber four years before the work of Praetorius appeared, gave the instrumentalist a slide by which he could procure in the lower octave all the sounds of the ordinary trombone. The second system, which Praetorius had known for years, was distinguished from the first, not only by modifications affecting the form, but also by a larger bore. Mersenne[3] calls the trombone *trompette harmonique*, or *tuba tractilis*. He describes carefully the seven positions and gives the diatonic scale for the first octave, but he does not, like Praetorius, mention the pitch of the trombones in use in his day. He established this fact, however, that it was customary in France, as in Germany, to lower the instrument a fourth below the pitch of the ordinary trombone by means of a *tortil*, a kind of crook with a double turn that was fitted between the bell and the slide, "in order," he said, "to make the bass to hautbois concerts." This system, so simple and rational, might have been expected always to serve for the basis of the technique of the instrument; but from the middle of the 18th century the art of playing the trombone became the object of purely empiric teaching. Owing to the decline in the popularity of the trombone during the 18th century in England, France, Germany and Italy, writers of that period are sometimes at a loss to describe the working and effect of the slide, as were the early 16th-century authors. J. J. Eisel, and after him Jacob Lotter, whose work is a *réchauffé* of Eisel's, mention four principal positions, "the others not being of much importance." The lowering of the pitch effected by means of these four positions, however, is almost equal to that of the seven positions of the modern trombone. The tenor or ordinary trombone is given as an example. It stood in the first position in A. The second position, equal to the modern third produced the harmonic series of the fundamental G one tone lower than the first position. The third position gave F again a tone lower and corresponding to our sixth position. The fourth position, which extended so far outward "that the arm could hardly reach it," gave E as fundamental. The intermediate semitones, instead of being considered as positions, are treated as accidentals, lowering or raising any note obtained in one of the positions by drawing out, or pushing in, the slide approximately an extra two-fingers breadth. It would not be correct to state without qualification that four positions only were used on the trombone in the 18th century.

Samuel Wesley, who has left notes on the scales of various instruments, in his own hand (Add MS. 35011 fol. 166 Brit. Mus.), has added under the scales of the trombones—bass, tenor and alto—the remark "sacbut or double trumpet, the scale of which is wanting."

Of all wind instruments the trombone has perhaps been least modified in form; changes have occasionally been attempted, but for the most part with only trifling success. The innovation which has had the most vogue dates from the end of the 18th century; it consisted in bending the tube of the bell in a half circle above the head of the executant, which produced a very bizarre effect. It also gave rise to very serious inconveniences: by destroying the regularity of the proportions of the bell it prejudicially affected the quality of tone and intonation of the instrument. For a long time the curved bell with its serpent's mask known as the Bucin—a term borrowed from the French in this instance—was maintained in military music, and it is not so very long since it was completely given up. By giving a half turn more to the bell tube its opening was directed to the back of the executant; but this form, in fashion for a little while about 1830, was not long adhered to, and the trombone reassumed its primitive form, which is still maintained. As appears from a patent deposited by Stölzel and Blümel at Berlin on the 12th of April 1818 the application of ventils or pistons was then made for the first time.[4] The ventils, at first two in number, effected a definite lengthening of the instrument. The first augmented the length of the tube by a tone, lowering by as much the natural harmonics. The second produced a similar effect for a semitone, and the simultaneous employment of the two pistons resulted in the depression of a tone and a half. The principle, therefore, of the employment of ventils or pistons is the same as that which governs the use of slides (see VALVES). Notwithstanding the increased facility obtained by the use of pistons, they are very far from having gained the suffrage of all players: many prefer the slide, believing that it gives a facility of emission that they cannot obtain with a piston trombone. The flat tonalities having been preferred for military music since the beginning of the 19th century the pitch of each variety of trombones has been raised a semitone. At present six trombones are more or less in use, viz. the alto trombone in F, the alto in E♭ (formerly in D), the tenor in B♭ (formerly in A), the bass in G, the bass in F (formerly in E), the bass in E♭ (formerly in D), and the contrabass in B♭. This transposition has no reference to the number of vibrations that may be officially or tacitly adopted as the standard pitch of any country or locality. A trombone an octave lower than the tenor has recently been re-introduced into the orchestra, principally by Wagner. The different varieties just cited are constructed with pistons or slides, as the case may be.

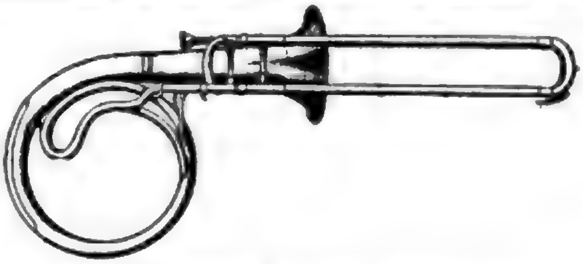


FIG. 3.—Contrabass Trombone (Boosey & Co.).

Further information on the trombone will be found in the monographs by the Rev. F. W. Galpin, "The Sackbut: its Evolution and History," *Proc. Mus. Assoc.* (1906–1907); by Victor Mahillon, *Le Trombone, son histoire, sa théorie, sa construction* (Brussels, London, 1907). Before his recent death Professor George Case had in preparation an important work on the trombone. (V. M.; K. S.)

TROMP, the name of two famous Dutch admirals.

1. MARTIN HARPERTZOON TROMP (1597–1653) was born at Brielle, South Holland, in 1597. At the age of eight he made a voyage to the East Indies in a merchantman, but was made prisoner and spent several years on board an English cruiser. On making his escape to Holland he entered the navy in 1624, and in 1637 was made lieutenant-admiral. In February 1639 he surprised, off the Flemish coast near Gravelines, a large Spanish fleet, which he completely destroyed, and in the following September he defeated the combined fleets of Spain and Portugal off the English coast—achievements which placed him in the first rank of Dutch naval commanders. On the outbreak of war with England Tromp appeared in the Downs in command of a large fleet and anchored off Dover. On the approach of Blake he weighed anchor and stood over towards France, but suddenly altered his course and bore down on the English fleet, which was much inferior to his in numbers. In the engagement which followed (May 19, 1652) he had rather the worst of it and drew off with the loss of two ships. In November he again appeared in command of eighty ships of war, and a convoy of 300 merchantmen, which he had undertaken to guard past the English coast. Blake resolved to attack him, and, the two fleets coming to close quarters near Dungeness on the 30th of November, the English, after severe losses, drew off in the darkness and anchored off Dover, retiring next day to the Downs, while Tromp anchored off Boulogne

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[1] See A. Jacquot, *La Musique en Lorraine*, p. 61.

[2] *Organographia* (Wolfenbüttel, 1619).

[3] *Harmonie universelle* (Paris, 1636).

[4] This was mentioned in the Leipzig *Allg. musik. Ztg.* (1815), the merit of the invention being assigned to Heinrich Stölzel of Pless in Silesia.

till the Dutch merchantmen had all passed beyond danger. The statement that he sailed up the Channel with a broom at his masthead in token of his ability to sweep the seas is probably mythical. In the following February (1653), while in charge of a large convoy of merchantmen, he maintained a running fight with the combined English fleets under Blake, Penn and Monk off Portland to the sands of Calais, and, though baffling to some extent the purposes of the English, had the worst of the encounter, losing nine ships of war and thirty or forty merchantmen. On the 3rd of June he fought an indecisive battle with the English fleet under Richard Dean in the Channel, but the arrival of reinforcements under Blake on the following day enabled the English to turn the scale against him and he retired to the Texel with the loss of seventeen ships. Greatly discouraged by the results of the battle, the Dutch sent commissioners to Cromwell to treat for peace, but the proposal was so coldly received that war was immediately renewed, Tromp again appearing in the Channel towards the end of July 1653. In the hotly contested conflict which followed with the English under Monk on the 29th Tromp was shot by a musket bullet through the heart. He was buried with great pomp at Delft, where there is a monument to his memory in the old church.

2. **Cornelius Van Tromp** (1629–1691), the second son of the preceding, was born at Rotterdam on the 9th of September 1629. At the age of nineteen he commanded a small squadron charged to pursue the Barbary pirates. In 1652 and 1653 he served in Van Galen's fleet in the Mediterranean, and after the action with the English fleet off Leghorn on the 13th of March 1653, in which Van Galen was killed, Tromp was promoted to be rear-admiral. On the 13th of July 1665 his squadron was, by a hard stroke of ill-fortune, defeated by the English under the duke of York. In the following year Tromp served under De Ruyter, and on account of De Ruyter's complaints of his negligence in the action of the 5th of August he was deprived of his command. He was, however, reinstated in 1673 by the stadtholder William, afterwards king of England, and in the actions of the 7th and of the 14th of June, against the allied fleets of England and France, manifested a skill and bravery which completely justified his reappointment. In 1675 he visited England, where he was received with honour by King Charles II. In the following year he was named lieutenant-admiral of the United Provinces. He died at Amsterdam, on the 29th of May 1691, shortly after he had been appointed to the command of a fleet against France. Like his father he was buried at Delft.

See H. de Jager, *Het Geslacht Tromp* (1883).

TROMSÖ, a seaport of Norway, capital of the *amt* (county) and *stift* (diocese) of the same name on the north-western coast. Pop. (1900), 6955. It stands on the eastern shore of a low fertile islet between Kvalö and the mainland, in 69° 38′ N., 18° 55′ E. (the latitude is that of Disco, Greenland). The vegetation of the island (mountain ash and birch) is remarkably luxuriant. The buildings, mostly of wood, include the town-hall and a museum, which contains a good zoological collection. Sealskins and other furs, and whale and seal oil, are exported, and the herring fishery is very productive. Imports are coal, textiles, salt, grain and flour. Mean temperature of year 36·4° F.; February 25°; July 51·8°. Tromsö was founded in 1794. A number of Lapps usually encamp in the neighbouring Tromsdal during summer. The coast scenery, with its islands and snowy mountains, is wild and beautiful.

TRONCHET, FRANÇOIS DENIS (1726–1806), French jurist, was born in Paris on the 23rd of March 1726 He was an avocat at the parlement of Paris, and gained a great reputation in a consultative capacity. In 1789 he was elected deputy to the states-general. In the Constituent Assembly he made himself especially conspicuous by his efforts to obtain the rejection of the jurisdiction of the jury in civil cases. In the king's trial, he was chosen by Louis as counsel for the defence, and performed this difficult and dangerous task with high ability and courage. During the Directory he was deputy at the Council of the Ancients, where he unsuccessfully opposed the resolution that judges be nominated by the executive directory. Under the Consulate he was president of the tribunal of cassation, and collaborated in preparing the final scheme for the civil code. He had a marked influence on the code, and succeeded in introducing common law principles in spite of the opposition of his colleagues, who were deeply imbued with Roman law. He died on the 10th of March 1806, being the first senator of the empire to be buried in the Panthéon.

See François de Neufchâteau, *Discours sur Tronchet* (Paris, undated); Coqueret, *Essai sur Tronchet* (Caen, 1867).

TRONDHJEM, or Throndhjem (sometimes written in the German form *Drontheim*), a city and seaport of Norway, chief town of the *stift* (diocese) of Trondhjem and the *amt* (county) of South Trondhjem, 384 m. by rail N. of Christiania. Pop. (1900), 38,156. It lies on the south side of the broad Trondhjem Fjord on a low peninsula between the fjord and the River Nid, its situation, though picturesque, lacking the peculiar beauty of that of Christiania or Bergen. The latitude is 63° 26′ N., that of southern Iceland. In front of the town is the islet of Munkholm, formerly a monastery and now a fortress; on the high ground to the east is the small stronghold of Christiansten. The houses are principally of wood, and the streets are wide, as a precaution against the spreading of fire. The principal building is the cathedral, standing finely on a slightly elevated open site, and dating in part from the close of the 11th century, but chiefly belonging to the 12th and 13th centuries (*c.* 1161–1248). Its extreme length is 325 ft. and its extreme breadth 124 ft.; but in the 14th, 15th and 17th centuries it suffered greatly from repeated fires, and after the last of these the nave was completely abandoned and soon became a heap of ruins. The whole building, however, had been extensively and judiciously restored, and is the finest church in Norway and the scene of the coronation of the Norwegian sovereigns. It is cruciform, with a central tower, and has an eastern octagon which may have been copied from the corona of Canterbury Cathedral, as Eystein, archbishop of Trondhjem (1160–1188) and an active builder, was in England during his episcopate. The cathedral contains rich work in Norman style, and also much that is comparable with the best Early English. In the museums at Trondhjem there are interesting zoological and antiquarian collections, also exhibits illustrative of the fisheries and other industries. The port, which has regular communication with all the Norwegian coast towns—Hull, Newcastle, Hamburg, &c.—carries on an extensive trade in timber, oil, fish, copper, &c. The industries include shipbuilding, sawmilling, wood-pulp and fish-curing works and machine shops. Imports (coal, grain, salt, machinery, &c.) come chiefly from Great Britain. A considerable portion of the exports pass into Sweden by the Meraker railway.

Trondhjem, originally Nidaros, was founded by Olaf Tryggvason, who built a royal residence and a church here in 996. It was made an archbishopric in 1152. The city attained its highest development about the latter half of the 13th century, by which time it had become an important pilgrimage centre and had as many as fifteen churches. It sustained frequent sieges, as well as devastating conflagrations. Its importance declined about the time of the Reformation when it ceased to be a resort of pilgrims.

TROON, a police burgh, seaport and watering-place of Ayrshire, Scotland. Pop. (1901), 4764. It is situated 6 m. N. by W. of Ayr, and 35 m. S.W. of Glasgow by the Glasgow & South-Western railway. It has the best natural harbour in the county, with over a mile of quayage, a breakwater 3000 ft. long, and two graving docks. Shipbuilding is the leading industry, and there is a rope and sail factory. The town contains a public hall and library and reading-room. The municipality controls the waterworks and gasworks. Fullarton House, 1 m. south-east, is a seat of the duke of Portland; and at Auchans, about 3 m. west, Susannah, countess of Eglinton, in 1773 entertained Dr Johnson. Adjoining this estate stands the ruined castle of the Dundonalds.

TROOP (an adaptation of Fr. *troupe*, O. Fr. *trope*; cf. Ital. *troppa*, *truppa*; Med. Lat. *truppus*; the origin is doubtful; suggestions have been made that it represents a German conception of Latin *turba*, crowd, or is an adaptation of Norw. *torp*, flock), a company or assemblage of persons, the term being usually applied in the plural to a body of soldiers of varying strength and of different arms. Specifically, a "troop" is one of the smaller units into which a regiment of horse-soldiers is divided, forming a subdivision of a squadron. Roughly speaking, it consists of sixteen files, and does not exceed from 30 to 40 sabres; in some armies, however, a maximum limit of 60 sabres are found (see CAVALRY). For the military ceremony known as "trooping of the colours," see COLOURS, MILITARY.

TROPHY (Gr. *τρόπαιον*, from *τρέπω*, put to flight; Lat. *tropaeum*), in classical antiquities, in the strict sense a memorial of victory set up on the field of battle at the spot where the enemy had been routed. It consisted of captured arms and standards hung upon a tree (preferably an olive or an oak) and booty heaped up at its foot, dedicated to the god to whom the victory was attributed, especially Zeus Tropaeus. If no suitable tree was at hand, a lopped trunk was fixed in the ground on an eminence. The tree or trunk bore an inscription containing the names of the god and the combatants, a list of the booty and of the chief incidents of the battle or the entire war. In the case of a naval victory the trophy, composed of the beaks of ships (sometimes an entire ship), was generally set up on the nearest beach and consecrated to Poseidon. It was regarded as a sacrilege to destroy a trophy, since it was dedicated to a god; but, on the other hand, one that had fallen to pieces through lapse of time was not restored, to prevent feelings of resentment being kept alive. For the same reason trophies of stone or metal were forbidden by law, although this rule was not always observed. To facilitate reconciliation with their conquered foes, neither the Macedonians nor the Romans in early times erected such trophies. The usual custom was to take home the spoils, and to use them for decorating public buildings and private houses. The first example of a trophy set up after the Greek fashion occurs in 121 B.C., when Domitius Ahenobarbus celebrated his victory over the Allobroges in this manner. Although instances are not uncommon in later times, the Romans still showed a preference for setting up the memorials of victory in Rome rather than on the field of battle. These were decorated with the spoils, and were themselves called trophies; such were the trophies of Marius recording his victories over Jugurtha and the Cimbri and Teutones. In later republican and imperial times enormous columns, on which the chief incidents of a battle or war were represented in bas-relief, were frequently erected, the most famous and most perfect example being the column of Trajan (see ROME: *Archaeology*, "The Imperial Forums").

TROPIC-BIRD, so called of sailors from early times,[1] because as W. Dampier (*Voyages*, i. 53) among many others testifies, it is "never seen far without either Tropick"; hence, indulging a pretty fancy, Linnaeus bestowed on it the generic term, continued by modern writers, of *Phaethon*, in allusion to its attempt to follow the path of the sun.[2] There are certainly three well-marked species of this genus, but their respective geographical ranges have not yet been definitely laid down. All of them can be easily known by their totipalmate condition, in which the four toes of each foot are united by a web, and by the great length of the two middle tail-quills, which project beyond the rest, so as to have gained for the birds the name of "Rabijunco," "Paille-en-queue" and "Pijlstaart" among mariners of different nations. These birds fly to a great distance from land and seem to be attracted by ships, frequently hovering round or even settling on the mast-head. Their flight is performed by rapid strokes, unlike the action of other long-winged sea-fowl, and they are rarely seen on the water.

The yellow-billed tropic-bird, *P. flavirostris* or *candidus*, appears to have habitually the most northerly, as well, perhaps, as the widest range, visiting Bermuda yearly to breed there, but also occurring numerously in the southern Atlantic, the Indian, and a great part of the Pacific Ocean. In some islands of all these three it breeds, sometimes on trees, which the other species are not known to do. However, like the rest of its congeners, it lays but a single egg, and this is of a pinkish white, mottled, spotted, and smeared with brownish purple, often so closely as to conceal the ground colour. This is the smallest of the group, and hardly exceeds in size a large pigeon; but the spread of its wings and its long tail make it appear more bulky than it really is. Except some black markings on the face (common to all the species known), a large black patch partly covering the scapulars and wing-coverts, and the black shafts of its elongated rectrices its ground colour is white, glossy as satin, and often tinged with roseate. Its yellow bill readily distinguishes it from its larger congener *P. aethereus*, but that has nearly all the upper surface of the body and wings closely barred with black, while the shafts of its elongated rectrices are white. This species has a range almost equally wide as the last; but it does not seem to occur in the western part of the Indian Ocean. The third and largest species, the red-tailed tropic-bird, *P. rubricauda* or *phoenicurus*, not only has a red bill, but the elongated and very attenuated rectrices are of a bright crimson red, and when adult the whole body shows a deep roseate tinge. The young are beautifully barred above with black arrow-headed markings. This species has not been known to occur in the Atlantic, but is perhaps the most numerous in the Indian and Pacific oceans, in which last great value used to be attached to its tail-feathers to be worked into ornaments.[3]

That the tropic-birds form a distinct family, Phaethontidae, of the Steganopodes (the Dysporomorphae of Huxley), was originally maintained by Brandt, and is now generally admitted, yet it cannot be denied that they differ a good deal from the other members of the group[4]; indeed St G. Mivart in the Zoological *Transactions* (x. 364) hardly allowed *Fregata* and *Phaethon* to be steganopodous at all; and one curious difference is shown by the eggs of the latter, which are in appearance so wholly unlike those of the rest. The osteology of two species has been well described and illustrated by Alph. Milne-Edwards in A. Grandidier's fine *Oiseaux de Madagascar* (pp. 701–704, pls. 279–281*a*). (A. N.)

TROPINE, $C_8H_{15}NO$, a base formed together with tropic acid, $C_9H_{10}O_3$, in the hydrolysis of the alkaloid atropine (K. Kraut, *Ann.*, 1863, 128, p. 280; 1865, 133, p. 87). It crystallizes in plates which melt at 63° C. and boil at 233° C.; it is very hygroscopic and easily soluble in water. It is an optically inactive, strongly alkaline tertiary base. On heating with sodium in amyl alcoholic solution it is transformed into a stereoisomer, identical with the ψ-tropine obtained by hydrolysing tropa-cocaine with hydrochloric acid. It possesses alcoholic properties, since it forms esters, the so-called "tropeines." On distillation with caustic baryta or soda lime it decomposes into methylamine and tropilidine, C_7H_8 (A. Ladenburg, *Ann.* 1883, 217, p. 74), the same hydrocarbon being also obtained when it is destructively methylated, a certain amount of tropiline, $C_7H_{10}O$, being produced simultaneously When heated with fuming hydrochloric acid to 150–180° C. it yields tropidine, $C_8H_{13}N$, and with hydriodic acid similarly forms an iodo-compound, $C_8H_{15}NI_2$, which, on reduction with zinc and hydrochloric acid, is converted into hydrotropidine, $C_8H_{15}N$. It yields various oxidation products. With an alkaline solution of potassium permanganate it yields tropigenine, $C_7H_{13}NO$; with chromic acid in the presence of acetic acid it yields tropinone, $C_8H_{13}NO$; and with chromic acid in the presence of sulphuric acid it yields tropinic acid, $C_6H_{11}N(CO_2H)_2$.

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[1] More recently sailors have taken to call it "Boatswain-bird"—a name probably belonging to a very different kind. (See SKUA.)

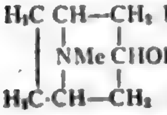
[2] Occasionally, perhaps through violent storms, tropic-birds wander very far from their proper haunts. In 1700 Leigh, in his *Nat. Hist. Lancashire* (i. 164, 195, Birds, pl. i., fig. 3), described and figured a "Tropick Bird" found dead in that county. Another is said by Mr Lees (*Zoologist*, 2nd series, p. 2666) to have been found dead at Cradley near Malvern—apparently before 1856 (J. H. Gurney, jun., *op. cit.*, p. 4766)—which, like the last, would seem (W. H. Heaton, *op. cit.*, p. 5086) to have been of the species known as *P. aethereus*. Naumann was told (*Rhea*, i. 25) of its supposed occurrence at Heligoland, and Colonel Legge (*B. Ceylon*, p. 1174) mentions one taken in India 170 m. from the sea. The case cited by Degland and Gerbe (*Ornith. européenne*, ii. 363) seems to be that of an albatross.

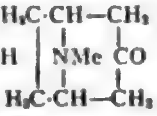
[3] A fourth species, *P. indicus*, has been described from the Gulf of Oman, but doubt has been expressed as to its validity (Legge, pp. 1173, 1174).

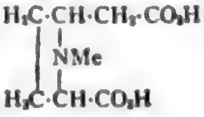
[4] Sulidae (Gannet), Pelecanidae (Pelican), Plotidae (Snake-bird), Phalacrocoracidae (Cormorant,) and Fregatidae (Frigate-bird).

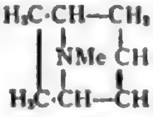
Tropidine, $C_8H_{13}N$, is a liquid having an odour resembling that of conine. It is a strong tertiary base, and is an unsaturated compound, forming addition products with the halogen acids. *Hydrotropidine*, $C_8H_{15}N$, is also a liquid. Its hydrochloride on distillation loses methyl chloride and yields norhydrotropidine, $C_7H_{13}N$, a compound which is a secondary base, and whose hydrochloride when distilled over zinc dust yields α-ethylpyridine. *Tropinic acid*, $C_6H_{11}N(CO_2H)_2$, obtained as above, is inactive; it was resolved by J. Gadamer (*Arch. Pharm.*, 1901, 239, p. 663) by means of its cinchonine salt. It is a dibasic acid, and the methiodide of its dimethyl ester on fusion with caustic alkalis yields *n*-adipic acid. It is apparently a derivative of N—methyl pyrrollidine, since it may be oxidized ultimately to N—methyl succinimide. *Tropigenine*, $C_7H_{13}NO$, is a secondary base.

The most important of the oxidation products of tropine is *tropinone*, $C_8H_{13}NO$, which is a ketone containing the grouping —$CH_2·CO·CH_2$—since it yields a di-isonitroso derivative, a dibenzal derivative, and also forms mono- and di-oxalic esters. It is a strong base and has a powerful reducing action. Its constitution is determined by the above facts and also because tropinic acid on destructive methylation yields a diolefine dicarboxylic acid which on reduction is converted into *n*-pimelic acid. These data point to tropine possessing an unbranched chain of seven carbon atoms and incidentally determine the constitution of the other various oxidation products, &c. (R. Willstätter, *Ber.*, 1895-1901). These compounds may consequently be represented as


Tropine

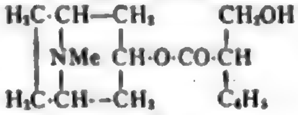

Tropinone


Tropinic acid


Tropidine.

On the synthesis of tropine, see R. Willstätter, *Ber.*, 1901, 34, pp. 130, 3163.

Tropic acid, $C_9H_{10}O_3$, the other decomposition product of atropine, is a saturated hydroxy-acid which is readily converted into atropic acid, $C_9H_8O_2$, by dehydrating agents. This latter acid is shown by all its reactions to be $C_6H_5C(:CH_2)·CO_2H$, a fact which is confirmed by its synthesis from acetophenone by the action of phosphorus pentachloride, followed by the decomposition of the resulting chloride with an alcoholic solution of potassium cyanide and subsequent hydrolysis of the nitrile so formed. These results show that tropic acid must be either $C_6H_5·CH(CH_2OH)·CO_2H$ or $C_6H_5C·(OH)(CH_3)·CO_2H$, and since the latter compound has been prepared from acetophenone by the addition of the elements of hydrocyanic acid, followed by subsequent hydrolysis and is an isomer of tropic acid, it follows that tropic acid must be represented by the former of the two formulae. Hence the alkaloid atropine, being a tropine-tropate, must have the annexed formula—


Atropine.

TROPPAU (Polish, *Oppava*; Czech, *Opava*), the capital of the Austrian duchy and crown land of Silesia, 180 m. N.E. of Vienna by rail. Pop. (1900), 26,725. It is situated on the Oppa river, close to the Prussian frontier, and is a well-built town with extensive suburbs. The industries comprise the manufacture of cloth, industrial machines, sugar-refining, jute fabrics and brewing. Troppau was founded in the 13th century; but almost its only claim to historical mention is the fact that in 1820 the monarchs of Austria, Russia and Prussia met here to deliberate on the tendencies of the Neapolitan revolution. This congress of Troppau, however, left nearly the whole matter to be considered and decided at Laibach. The former principality of Troppau is now divided between Austria and Prussia, the latter holding the lion's share.

TROPPAU, CONGRESS OF, a conference of the allied sovereigns or their representatives to discuss a concerted policy with regard to the questions raised by the revolution in Naples of July 1820. At this congress, which met on the 20th of October 1820, the emperor Alexander I. of Russia and Francis I. of Austria were present in person; King Frederick William III. of Prussia was represented by the crown prince (afterwards Frederick William IV.). The three eastern powers were further represented by the ministers responsible for their foreign policy: Austria by Prince Metternich, Russia by Count Capo d'Istria, Prussia by Prince Hardenberg. Great Britain, on the other hand, which objected on principle to the suggested concerted action against the Neapolitan Liberals, sent no plenipotentiary, but was represented by Lord Stewart, ambassador in Vienna. France, too, though her policy was less clearly defined, had given no plenary powers to her representatives. Thus from the very first was emphasized that division within the concert of the powers which the outcome of the congress was to make patent.

The characteristic note of this congress was its intimate and informal nature; the determining fact at the outset was Metternich's discovery that he had no longer anything to fear from the "Jacobinism" of the emperor Alexander. In a three hours' conversation over a cup of tea at the little inn he had heard the tsar's confession and promise of amendment: "Aujourd'hui je déplore tout ce que j'ai dit et fait entre les années 1814 et 1818 . . . Dites-moi ce que vous voulez de moi. Je le ferai" (Metternich to Esterhazy, Oct. 24, 1820, *F. O. Austria Dom. Sep.-Dec. 1820*). His failure to convert Castlereagh to his views was now of secondary importance; the "free" powers being in accord, it was safe to ignore the opinions of Great Britain and France, whose governments, whatever their goodwill, were fettered by constitutional forms.

In a series of conferences—to which the representatives of Great Britain and France were not admitted, on the excuse that they were only empowered to "report," not to "decide"—was drawn up the famous preliminary protocol signed by Austria, Russia and Prussia on the 19th of November. The main pronouncement of the "Troppau Protocol" is as follows: "States which have undergone a change of government due to revolution, the result of which threaten other states, *ipso facto* cease to be members of the European Alliance, and remain excluded from it until their situation gives guarantees for legal order and stability. If, owing to such alterations, immediate danger threatens other states the powers bind themselves, by peaceful means, or if need be, by arms, to bring back the guilty state into the bosom of the Great Alliance."

No effort was made by the powers to give immediate effect to the principles enunciated in the protocol; and after its promulgation the conferences were adjourned, it being decided to resume them at Laibach in the following January (see LAIBACH).

For authorities see the bibliography to ch. i. "The Congresses," by W. Alison Phillips, in the *Cambridge Mod. Hist.* x. 787.

TROSSACHS, THE (Gaelic, "the bristled country," a crude allusion to its physical features), a defile in the south-west of Perthshire, Scotland. It is a narrow, beautifully wooded glen, of no great depth, extending from Loch Achray to Loch Katrine, and continued thence by a strip on the north-eastern shore to a point above the now submerged Silver Strand opposite to Ellen's Isle—a total distance of 2½ m. It is situated 8 m. W. of Callander and 5 m. N. of Aberfoyle, with both of which places there is daily communication by coach during the tourist season. It lies between the steep green slopes of Ben Venue (2393 ft.) on the S.W. and the precipitous craigs of Ben A'an (1750 ft.) on the N.E. Characterized by lovely scenery, owing to its harmonious blending of wood, water, rock and hill, the region has been famous ever since the appearance of Sir Walter Scott's *The Lady of the Lake* and *Rob Roy*. Before the construction of the road that now winds through the pass, Sir Walter says that the only access to the lake was by means of a ladder formed out of the branches and roots of trees. A rustic pier has been built at the Trossachs end of Loch Katrine for the convenience of tourists, and a large hotel stands on the northern shore of Loch Achray, near the beginning of the pass.

TROTZENDORFF (or Trocedorfius), **VALENTIN FRIEDLAND** (1490–1556), German educationist, called Trotzendorff from his birthplace, near Görlitz, in Prussian Silesia, was born on the 14th of February 1490, of parents so poor that they could not keep him at school. The boy taught himself to read and write while herding cattle; he made paper from birch bark and ink from soot. When difficulties were overcome and he was sent for education to Görlitz, his mother's last words were "Stick to the school, dear son." The words determined his career: he refused all ecclesiastical promotion, and lived and died a schoolmaster. He became a distinguished student, learned Ciceronian Latin from Peter Mosellanus and Greek from Richard Croke, and after graduation was appointed assistant master in the school at Görlitz. There he also taught the rector and other teachers. When Luther began his attack on indulgences, Trotzendorff resigned his position and went to study under Luther and Melanchthon, supporting himself by private tuition. Thence he was called to be a master in the school at Goldberg in Silesia, and in 1524 became rector. There he remained three years, when he was sent to Liegnitz. He returned to Goldberg in 1531 and began that career which has made him the typical German schoolmaster of the Reformation period. His system of education and discipline speedily attracted attention. He made his best elder scholars the teachers of the younger classes, and insisted that the way to learn was to teach. He organized the school in such a way that the whole ordinary discipline was in the hands of the boys themselves. Every month a "consul," twelve "senators" and two "censors" were chosen from the pupils, and over all Trotzendorff ruled as "dictator perpetuus." One hour a day was spent in going over the lessons of the previous day. The lessons were repeatedly recalled by examinations, which were conducted on the plan of academical disputations. Every week each pupil had to write two "exercitia styli," one in prose and the other in verse, and Trotzendorff took pains to see that the subject of each exercise was something interesting. The fame of the Goldberg School extended over all Protestant Germany, and a large number of the more famous men of the following generation were taught by Trotzendorff. He died on the 20th of April 1556.

See Herrmann, *Merkwürdige Lebensgeschichte eines berühmten Schulmanns, V. F. Trotzendorffs* (1727); Frosch, *V. F. Trotzendorff, Rektor zu Goldberg* (1818); Pinzger, *V. F. Trotzendorff* (with the Goldberg portrait, and a complete list of his writings, 1825); Koehler, *V. F. Trotzendorff, ein biographischer Versuch* (1848). The biographical facts appear to be derived from a funeral or memorial oration delivered by Balthasar Rhau in the university of Wittenberg on the 15th of August 1564, and published in an edition of Trotzendorff's *Rosarium* (1565).

TROUBADOUR, the name given to the poets of southern France and of northern Spain and Italy who wrote in the *langue d'oc* from the 12th to the 14th centuries. In Provençal the word is spelt *trobaire* or *trovador*, and is derived from the verb *trobar*, to find, or to invent (Fr. *trouver*). The troubadour was one who invented, and originally improvised, poetry, who "found out" new and striking stanzaic forms for the elaborate lyrics he composed. In later times, the word has been used for romantic and sentimental persons, who dress in what is supposed to be medieval fashion, and who indite trivial verses to the sound of a lute; but this significance does less than justice to the serious artistic aims of the original and historic troubadours of Provence.

The earliest troubadour of whom anything definite is known is Guilhem IX. (b. 1071), count of Poitiers and duke of Aquitaine, whose career was typical of that of his whole class, for, according to his Provençal biographer, "he knew well how to sing and make verses, and for a long time he roamed all through the land to deceive the ladies." The high rank of this founder of the tradition was typical of its continuation; by far the largest number of the troubadours belonged to the noble class, while no fewer than twenty-three of their number were reigning princes. Among them is a king of England, Richard I., who is believed to have written in *langue d'oil* as well as in *langue d'oc*, and who has left at least one canzo, that written in prison, which is of remarkable beauty. These noble troubadours were distinguished by their wealth and independence from those who made their song their profession, and who wandered from castle to castle and from bower to bower. But whether dependent or independent, the poets exercised a social influence which was extremely remarkable, and had been paralleled by nothing before it in the history of medieval poetry. They had great privileges of speech and censure, they entered into questions of politics, and above all they created around the ladies of the court an atmosphere of cultivation and amenity which nothing had hitherto approached. The troubadour was occasionally accompanied in his travels by an apprentice or servant, called a *joglar*, whose business was to provide a musical setting for the poet's words; sometimes it was not the troubadour himself, but his *joglar*, who sang the songs. It was a matter of jealous attention to the troubadour to keep his name and fame clear of the claims of the *joglar*, who belonged to a lower caste; although it is true that some poets of very high talent rose from being *joglars* and attained the rank of troubadours. The latter were looked upon with deep admiration, and their deeds and sayings, as well as their verses, were preserved and were even embroidered with fiction.

There were recognized about four hundred troubadours, during the whole period in which they flourished, from Guilhem de Poitiers down to Guiraut Riquier (*c.* 1230–1294). Several MS. collections of biographies have been preserved, and from these we gain some idea of the careers of no fewer than 111 of the poets. In this respect, the troubadours possess an immense advantage over the trouvères of northern France, of whose private life very little is any longer known. Early in the living history of the troubadours their personal adventures came to be thought worthy of record. One of themselves, Uc of St Cyr (*c.* 1200–1240), interested himself in "the deeds and words of goodly men and women," and in the collection of lives he seems to claim to be, in several instances, the biographer. At the beginning of the 14th century it became the practice to preface the MS. works of each poet by a life of him, and even where the text seems to be quite independent, it is noticeable that there is little variation in the biography. One late troubadour, Rambaud of Orange, left a commentary on his own poems, and Guiraut Riquier one on those of a fellow troubadour, Guiraut of Calanson (1280). All this proves the poetry of Provence to have passed early into the critical stage, and to have been treated very seriously by those who were proficient in it. This is further shown by the respect with which the Provençal poets are mentioned by Dante, Petrarch and the authors of the *Novelle Criticke*.

The principal source of the lives of the troubadours is a collection, evidently written by various hands, which was made towards the middle of the 13th century. Of these we have said that Uc of Saint Cyr was certainly one of the authors. Another source of information is the *Vies des plus célèbres et anciens poètes provencaux*, published by Jehan de Notredame or Nostradamus, in 1575. This work professed to be founded on the MSS. of a learned monk, who was librarian of the monastery of St Honorat, in the island of Lérins, and died there in 1408. He was known by no other name than that of the Monk of the Golden Isles. This book, unfortunately, lies under more than a suspicion of forgery. Nostradamus no doubt possessed valuable documents, but he did not hesitate to deal with them in a highly fantastic way. His *Vies des poètes* has yet to be examined by careful and searching criticism. Even the genuine biographies, and they are numerous and above suspicion, are often embroidered with fantastic and whimsical statements which make a severe demand upon the credulity of a modern reader.

The verse form most frequently employed by the troubadours was the *sirventés*, a term which is earliest met with in the second half of the 12th century. The early critics believed this word to be derived from *servir*, and to mean that the poem was made by a servant; but Paul Meyer has contested this derivation, and holds that a *sirventés* is a poem composed by a sirvent, that is to say a *soudoyer* or paid man-at-arms. The troubadours also employed the *ballada*, which was a song with a long refrain, not much like the formal ballade of the north of France; the *pastourella*; and the *alba*. This last took its name from the circumstance that the word *alba* (dawn) was repeated in each stanza. This was a morning-song, as the *serena*, a later invention, was an evensong. The *planh* was a funeral elegy, composed by the troubadour for the obsequies of his protector, or for those of the lady of his devotion. Most interesting of all, perhaps, was the *tenson*, which was a lyrical dialogue between two persons, who discussed in it, as a rule, some point of amorous casuistry, but sometimes matters of a religious, metaphysical or satirical nature. The notion that the troubadours cultivated epic or dramatic poetry is now generally discarded; they were in their essence lyrical (see Provençal Literature).

The biographies of the troubadours, which, in spite of their imperfection and conventionality of form, throw an unparalleled light upon medieval literary life, may perhaps be most conveniently treated in connexion with the courts at which each group of them flourished It is in Poitou that we trace them first, where Guilhem, count of Poitiers, who reigned from 1087 to 1127, was both the earliest patron and the earliest poet of the school. This prince was the type of medieval gallantry, sudden and violent in arms, brilliant and impudent in wit, with women so seductive as to be esteemed irresistible. He led an army of 300,000 men in the crusade of 1101, being then thirty years of age; he returned in dismal disarray, supported in his defeat by the arts of love and song. His levity was the wonder and delight of his contemporaries; William of Malmesbury, who speaks much of him, tells us of Guilhem's project to found a religious house at Niort for the worship of Venus. Guilhem of Poitiers was handsome, bold and of easy access; Gottfried of Vendôme says that he moved among other men as a god among mortals for the beauty of his body and the magnanimity of his soul. The surviving poems of the great count are simple in form; he does not attempt the technical subtleties of later poets; but he laboured at the art, and he was anxious to be thought a professional, not an amateur writer. His songs are highly personal and betray the author's variety, sensuality, wit and skill as a versifier.

The son of the earliest of the troubadours is known neither as a poet nor as a patron of poets, but the daughter of Guilhem IX. carried on her father's tradition. This was Eleanor of Guienne, at whose court Bernart of Ventadour rose to eminence. This poet was an exception to the rule that the troubadours belonged to the princely class. He seems to have been the son of a kitchen-scullion in the castle of Eble II., viscount of Ventadour. Eble was himself a poet, *valde gratiosus in cantilenis*, but his compositions have wholly disappeared; he was early impressed, we know not how, by the talents of his serving-boy, and he trained him to be a poet. The wife of Eble, the viscountess Agnes of Montluçon, who was extremely beautiful, encouraged the suit of the youthful Bernart; indeed, they had secretly loved one another from their childhood. The poems which this passion inspired are among the most admirable lyrics which have come down to us from the middle ages. The husband at last discovered the intrigue between his wife and the poet, and exiled Bernart from Ventadour, although, as it would seem, without violence. The troubadour took shelter with Eleanor of Guienne, who became in 1152 the queen-consort of Henry II. of England, himself a protector of poets. It has been supposed that Bernart accompanied the royal pair to London. He afterwards proceeded to the court of Raymond V. at Toulouse, where he is said to have remained until the death of that prince in 1194, when he withdrew to a cloister at Dalou in Poitou. He must at that time have been a very old man.

The son of Henry II., Henry Curtmantle, was the patron of another eminent troubadour. Bertran de Born, viscount of Hautefort in Perigord, had become a vassal of England by the marriage of Eleanor. He is the member of his class about whom we possess the most exact historical information. Dante saw Bertran de Born in hell, carrying his severed head before him like a lantern, and compared him with Achitophel, who excited the sons of David against their father. This referred to the subtle intrigues by which the troubadour had worked on the jealousy existing between the three sons of the king of England. The death of Prince Henry (1183) produced from Bertran de Born two *planhs*, which are among the most sincere and beautiful works in Provençal literature. The poet was immediately afterwards besieged in his castle of Hautefort by Richard Cœur de Lion, to whom he became reconciled and whom he accompanied to Palestine. He grew devout in his old age, and died about 1205. As a soldier and a condottiere, as the friend and enemy of kings, and as an active factor in the European politics of his time, Bertran de Born occupies an exceptional position among the troubadours.

There were poetesses in the highly refined society of Provençe, and of these by far the most eminent was Beatrix, countess of Die, whose career was inextricably interwoven with that of another eminent and noble troubadour, Rambaut III., count of Orange, who held his court at Courthézon, a few miles south of Orange. Rambaut said that since Adam ate the apple no poet had been born who could compete in skill with himself, but his existing lyrics have neither the tenderness nor the ingenuity of those of his illustrious lady-love. The poems of Beatrix are remarkable for a simplicity of form rare among the poets of her age. One of the earliest troubadours, Cercamon, was at the court of Guilhem IX. of Poitiers, and was the master of perhaps the most original of all the school, namely the illustrious Marcabrun (*c.* 1120–1195), from whose pen some forty poems survive. He was a foundling, left on the door-step of a rich man in Gascony, and no one knew anything about his descent. Marcabrun was an innovator and a reformer; to him the severity of classical Provençal style is mainly due, and he was one of the first to make use of that complexity and obscurity of form which was known as the *trobar clus*. He was also original in his attitude to love; he posed as a violent misogynist—"I never loved and I was never loved"—and he expressed, in the accents of amorous poetry, an aversion to women. "Famine, pestilence and war do less evil upon earth than the love of woman" is one of his aphorisms. He was in the service of Richard Cœur de Lion, and after 1167 in that of Alfonso II. of Aragon. Marcabrun was the object of much dislike and attack, and it is said that he was murdered by Castellane of Guian, whom he had satirized. This, however, is improbable, and it is rather believed that Marcabrun survived to a great age. For one of his contemporaries he mitigated the severities of his satiric pen; he expresses great affection for "that sweet poet," Jaufre Rudel, prince of Blaye, whose heart turned, like the disk of a sunflower, towards the Lady of Tripoli. Little else than that famous adventure is known about the career of this ultra-romantic troubadour, except that he went as a crusader to the Holy Land, and that his surviving poems, which are few in number, have so mystical a tone that Jaufre Rudel has been suspected of being a religious writer who used the amorous language of his age for sanctified purposes, and whose "Princess Far-away" was really the Church of Christ. If so, the statement that he died in the arms of the Lady of Tripoli would merely mean that he passed away, perhaps at Antioch, in the odour of sanctity. Peire d' Alveona (Peter of Auvergne), like Marcabrun, was of mean birth, son of a tradesman in Clermont-Ferrand, but he was handsome and engaging, and being the first troubadour who had appeared in the mountain district, "he was greatly honoured and fêted by the valiant barons and noble ladies of Auvergne." . . . "He was very proud and despised the other troubadours." It is believed that Peire's poems were produced between 1158 and 1180. He flourished at the court of Sancho III., king of Castile, and afterwards at that of Ermengarde, viscountess of Narbonne.

It is doubtless owing to the vehement and repeated praise which was given by Dante, in the *Inferno* and elsewhere, to Arnaut Daniel that this name remains the most famous among those of the troubadours. Yet not very much is known of the personal history of this poet. He was a knight of Riberac, in Perigord, and he attached himself as a troubadour to the court of Richard Cœur de Lion. Dante had been made acquainted with the highly complicated and obscure verse of Arnaut Daniel by Guido Guinicelli, and thus to the historian of literature a most valuable link is provided between medieval and modern poetry. Dante calls Daniel the "smith," the finished craftsman, of language, and it is evident that it was the brilliant art of the Provençal's elaborated verse which delighted the Italian. In the *De vulgari eloquentia* Dante returned to the praise of Arnaut Daniel, as the greatest of all those who have sung of love, and Petrarch was not less enthusiastic. His invention of forms of verse (see SESTINA), in particular, dazzled the great Italians. But the seventeen *sirventés* which have survived scarcely sustain the traditional idea of the supremacy of Arnaut Daniel as a poet, while their lack of historical and personal allusions deprives them of general interest. Dante was curiously anxious to defend Arnaut Daniel as being a better artist than his immediate rival, Giraut de Bornelh, whose "rectitude" Dante admits, in the sense that Giraut was a singer of gnomic verses of a high morality, but prefers the poetry of Daniel; critical posterity, however, has reversed this verdict. Giraut came from the neighbourhood of Limoges, passed over into Spain about 1180, and became famous in the courts of Pedro II. of Aragon and other Spanish monarchs. He disappears about 1230. There is a curious anecdote of his having incurred the hatred or the cupidity of the viscount of Limoges, who robbed him of his library and then burned his house to the ground. Giraut laments, in his poems, the brutality of the age and the lawlessness of princes. A troubadour of the same district of south-western France was Arnaut de Mareuil, to whom is attributed the introduction into Provençal poetry of the amatory epistle. He settled at the courts of Toulouse and Beziers, where he sang, in mystical terms, his passion for the countess Adalasia, in whose affections he had a dangerous rival in the person of Alfonso II., king of Aragon. Arnaut de Mareuil fled for his life to Montpellier, where he found a protector in Count William VIII., but he continued to address his *sirventés* to Adalasia. As that princess died in 1199, and as no *planh* to her memory is found among the works of Arnaut de Mareuil, it is conjectured that by that time he was already dead.

Peire Vidal of Toulouse was the type of the reckless and scatterbrained troubadour. His biographer says that he was "the maddest man in all the world." His early life was a series of bewildering excursions through France and Spain, but he settled down at last at Marseilles, where he made a mortal enemy of Azalaïs, the wife of Viscount Barral de Baux, from whom he stole a kiss (1180). Vidal fled to Genoa, but he continued to address the viscountess in his songs. At the entreaty of her husband, Azalaïs forgave the poet, and Peire Vidal returned to Marseilles. He committed a thousand follies; among others, being in love with a lady called Louve (she-wolf), the poet dressed himself as a wolf, and was hunted by a pack of hounds in front of the lady's castle. Starting on a crusade, he stopped at Cyprus, where a Greek girl was presented to him as being of the imperial family. He married her, assumed the title of emperor, and carried a throne about with him from camp to camp. According to a late poem, his eccentric adventures closed in Hungary about the year 1215. Folquet of Marseilles was a troubadour of Italian race, the son of a merchant of Genoa; Dante met Folquet in paradise, and gives an interesting notice of him. He was a rival with Peire Vidal for the favours of the beautiful Azalaïs; and he was one of the troubadours who gathered around the unfortunate Eudoxia, empress of Montpellier, until the close of her singular and romantic adventure (1187). He wrote a very touching *planh* on the death of the viscount Barral de Baux in 1192. Soon after this, disgusted with love, Folquet took holy orders, became the abbot of the rich Cistercian house of Torronet in Provençe, and in 1205 became bishop of Toulouse. Here he threw in his lot with Simon de Montfort and disgraced himself by his fanatic rage against the Albigenses, of whom a contemporary says that he slew 500,000 persons, acting "more like Antichrist than like an envoy of Rome." Folquet died in 1231 in the abbey of Grandselve, in his diocese. It is in the *sirventés* of Folquet that critics have seen the earliest signs of that decadence which was so rapidly to destroy Provençal poetry.

Gaucelm Faidit came from Uzerche, in the Limousin. He seems to have been a wandering minstrel of gay and reckless habits, and to have been accompanied by a light-o'-love, Guillelma Monja, who was the object of much satire and ridicule. In Gaucelm we probably see, if we can credit his story, the troubadour at his lowest social level. He made, however, Maria of Ventadour, who was probably a scion of the princely and neighbouring house of that name, the object of his songs, and he addresses her in strains of unusual pathos and delicacy. Gaucelm Faidit ultimately proceeded to Italy, to the court of the marquis Boniface of Montferrat, a prince who greatly encouraged the troubadours and who in 1201 undertook the conduct of a crusade. Gaucelm, who was still celebrating the perfections of Maria of Ventadour, accompanied him to the East. He wrote several canzones in the Holy Land and Syria, returned safely to Uzerche, and disappears about 1240. We possess sixty of his poems. Another troubadour, Raimbaut of Vaquières, passed the greater part of his life at the same court of Montferrat; he devoted himself to the Lady Beatrix, sister of the marquis. It is believed that he died in the Holy Land in 1207. The most celebrated of the Italian troubadours was Sordello, born at Mantua, at the beginning of the 13th century, who owes his fame rather to the benevolence of later poets, from Dante to Robert Browning, than to the originality of his adventures or the excellence of his verse.

We have now mentioned the troubadours who were most famous in their own time, and on the whole modern criticism has been in unison with contemporary opinion. There are, however, still one or two names to be recorded. The English historian of the troubadours, Dr Hueffer, gave great prominence to the writings of a poet who had previously been chiefly heard of in connexion with a romantic adventure, Guillem de Cabestanh (or Capestang). This was a knight of Roussillon, who made love to Seremonda, countess of Castel-Roussillon. The lady's husband, meeting the poet out hunting, slew him in a paroxysm of jealousy and, having cut out his heart, had it delicately cooked and served to his wife's dinner. When Seremonda had eaten her lover's heart, her husband told her what she had done, and she fainted away. Coming to her senses she said: "My Lord, you have served to me so excellent a dish that I will never eat of another," and she threw herself out of window and was killed. The importance of this story lies in the fact that the cruelty of the count of Castel-Roussillon was the cause of universal scandal in all good society. Feeling grew so strong that the surrounding nobles rose against the murderer, with Alfonso, king of Spain, at their head, hunted him down and killed him. The bodies of the lady and the troubadour were buried side by side, with great pomp, in the cathedral of Perpignan, and became the objects of pilgrimage. Doubt has, of course, been thrown on the veracity of this romantic story, but at all events it testifies to the fact that the troubadour enjoyed, or was expected to enjoy, all the privileges of toleration and exemption. A burlesque or satiric troubadour, who disregarded the laws of gallantry and wrote satires of great virulence against the ladies and their lovers, remains anonymous, and is spoken of as the monk or prior of Montaudon.

The classic period of the troubadours lasted until about 1210, and was contemporaneous with the magnificence of the nobles of the south of France. The wealth and cultivated tastes of the seigneurs, and the peace which had long surrounded them, led them into voluptuous extravagances and sometimes into a madness of expenditure. From this the troubadours reaped an immediate advantage, but when the inevitable reaction came they were the first to suffer. The great cause, however, of the decadence and ruin of the troubadours was the struggle between Rome and the heretics. This broke out into actual war in June 1209, when the northern barons, called to a crusade by Pope Innocent III., fell upon the Albigenses and pillaged Beziers and Carcassonne. Most of the protectors of the troubadours were, if not heretics, indulgent to the heretical party, and shared in their downfall. The poets, themselves, were not immediately injured, and no doubt their habits and their art kept them immune from the instant religious catastrophe, but the darkness began to gather round them as the ruin of Languedoc became more and more complete, culminating with the siege of Toulouse in 1218. The greatest name of this period, which was the beginning of the end, is that of Peire Cardenal, of Le Puy. He was protected by Jacme I., king of Aragon, having apparently fled from Narbonne and then from Toulouse in order to escape from the armies of Simon de Montfort. He was the inventor and the principal cultivator of the moral or ethical *sirventês*; and he was the author of singularly outspoken satires against the clergy, continuing the tradition of Marcabrun. The biographer of Cardenal certifies that he lived to be nearly one hundred years of age. Another and a still more violent troubadour of this transitional time was Guillem Figueira, the son of a Toulouse tailor, an open heretic who attacked the papacy with extraordinary vigour, supported and protected by Raimon II. Figueira was answered, strophe by strophe, by a female troubadour, Gormonda of Montpellier. The ruin of the southern courts, most of which belonged to the conquered Albigensi party, continued to depress and to exasperate the troubadours, whose system was further disintegrated by the establishment of the Inquisition and by the creation of the religious orders. The genial and cultured society of Provençe and Languedoc sank rapidly into barbarism again, and there was no welcome anywhere for secular poets.

The last of the French troubadours was Guiraut Riquier (*c.* 1230–1294), who was born at Narbonne, and addressed his earliest poems to Phillippa of Anduza, the viscountess of that city. She does not seem to have encouraged poetry, and Guiraut Riquier left Narbonne, first appealing to St Louis, without success. He then turned to Spain, and found protection at the court of Alfonso X. the Learned. This monarch, himself a great poet, welcomed the crowd of troubadours who were now flying from the troubles of southern France. It was the ambition of Alfonso to be himself a troubadour, but the Provençal pieces which bear his name are now attributed to Riquier and to Nat de Mons; the king's genuine poems are those written in Galician. Riquier remained in the court of Castile until about 1279, when he returned to France and settled in Rodez with the count of that town, Henri II This prince was almost the last seigneur in the south or centre of France who gathered a school of poets around him, and at Rodez the troubadours enjoyed for a few years their latest gleams of success and recognition. Riquier, in a *sirventês* of about 1285, gives pathetic expression to his sense of the gathering darkness, which makes it useless and almost unbecoming for a troubadour to practise his art, while of himself he mournfully confesses: "Song should express joy, but sorrow oppresses me, and I have come into the world too late." Guiraut Riquier passed away about 1294, and left no successor behind him.

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TROUBRIDGE, SIR THOMAS, Bart. (*c.* 1758–1807), English admiral, was educated at St Paul's School, London, and entered the navy in 1773. Having seen some service in the East Indies, he was taken prisoner by the French in 1794, but his captivity was only a short one and in February 1797 he commanded his ship, the "Culloden," at the battle of Cape St Vincent. In the following July he assisted Nelson in the unsuccessful attack on Santa Cruz, and in August 1798, when getting into position for the attack on the French fleet, the "Culloden" ran aground and was consequently unable to take any part in the battle of the Nile. He then served in the Mediterranean and was created a baronet in 1799; from 1801 to 1804 he was a lord of the admiralty, being made a rear-admiral just before his retirement. In 1805 Troubridge was given a command in the East and he went out in the "Blenheim." In January 1807 in this ship, an old and damaged one, he left Madras for the Cape of Good Hope, but off the coast of Madagascar the "Blenheim" foundered in a cyclone and the admiral perished. His only son, Sir Edward Thomas Troubridge, bart. (d. 1852), entered the navy in 1797 and was present at the battle of Copenhagen. From 1831 to 1847 he was member of parliament for Sandwich and from 1835 to 1841 he was a lord of the admiralty. His son, Sir Thomas St Vincent Hope Cochrane Troubridge, bart. (1815–1867), entered the army in 1834, and was severely wounded at the battle of Inkerman.

TROUGHTON, EDWARD (1753–1835), English instrument maker, was born in the parish of Corney in Cumberland in October 1753. He joined his elder brother John in carrying on the business of making mathematical instruments in Fleet Street, London, and continued it alone after his brother's death, until in 1826 he took W. Simms as a partner. He died in London on the 12th of June 1835.

Troughton was very successful in improving the mechanical part of most nautical, geodetic and astronomical instruments, but complete colour-blindness prevented him from attempting experiments in optics. The first modern transit circle was constructed by him in 1806 for Stephen Groombridge; but Troughton was dissatisfied with this form of instrument, which a few years afterwards was brought to great perfection by G. von Reichenbach and J. G. Repsold, and designed the mural circle in its place. The first instrument of this kind erected at Greenwich in 1812, and ten or twelve others were subsequently constructed for other observatories; but they were ultimately superseded by Troughton's earlier design, the transit circle, by which the two co-ordinates of an object can be determined simultaneously. He also made transit instruments, equatorials, &c.; but his failure to construct an equatorial mounting of large dimensions, and the consequent lawsuit with Sir James South, embittered the last years of his life.

TROUSERS, the name given to the article of dress worn by men, covering each leg separately and reaching from the waist to the foot. The word in its earlier forms is always found without the second *r*, *e.g.* *trouses*, *trouzes*, *trouse*, cf. the Lowland Scots word "trews," and is an adaptation of the French *trousses*, trunk-hose, breeches, the plural of *trousse*, a bundle, pack, truss, from *trousser*, to pack, bundle up, tuck, tie up, girth, of which the origin is doubtful. In English the word "trousers," when it first appears, was used of the leg-garments of the Irish, who wore their breeches or trunk-hose and stockings in one piece, a custom to which there are many allusions in 17th-century literature. Knee-breeches and top-boots for out-of-door wear or stockings for indoor use lasted till the beginning of the 19th century as the regular costume for men. Pantaloons, loose trousers reaching to above the ankle, were worn in Venice by the poorer classes in the 17th century (for the origin of the name see Pantaloon). The characters of the Italian comedy made the style of garment familiar in France, but it was only seen in the fantastic costumes of the ballet. During the reign of Louis XVI. loose pantaloons became fashionable for the morning deshabille of men. Their adoption by the supporters of the Revolution was the origin of the name of *sans-culottes* applied to the revolutionaries. Beau Brummel, in England, was probably the first to make the "pantaloon" popular. A striking feature of his dress were the tight-fitting black trousers reaching to the ankle, where they were buttoned. From this developed the true trousers, cut over the boot at the instep, at first open at the bottom and fastened by loops, later strapped tight under the boot. It is said that the duke of Wellington introduced this latter form after the Peninsular War. They were not recognized as correct for evening wear, and strong opposition was taken against them by the clergy and at the universities (see COSTUME).

TROUT (*Salmo trutta*), a fish closely related to the salmon. Most modern ichthyologists agree in regarding the various North European forms of trout, whether migratory or not, as varieties or races of a highly variable and plastic species, to be distinguished from the salmon by a few more or less constant characters, the most readily ascertainable of which resides in the smaller scales on the back of the caudal region of the body, these being 14 to 16 (rarely 13) in an oblique series between the posterior border of the adipose fin and the lateral line, and in the greater length of the folded anal fin as compared to the depth of the caudal peduncle. The gill-rakers are also usually fewer, 16 to 18 on the anterior branchial arch. The young may be distinguished from salmon-parr by the greater length of the upper jaw, the maxillary bone extending beyond the vertical of the centre of the eye, and in specimens 6 in. long often to below the posterior of the eye. The young are brown or olive above, silvery or golden below, with more or less numerous black and red spots in addition to the parr marks, and, contrary to what is observed in the salmon, black spots are usually present below the lateral line. Except for the gradual disappearance of the parr marks, this coloration is retained in the form known as the brook trout or brown trout (*S. fario*), which is non-migratory, and varies much in size according to the waters it inhabits, in some brooks not growing to more than 8 in., whilst in larger rivers and lakes it may attain a weight of 20 lb or more. The coloration of the young is more strongly departed from in the races known as sea trout (*S. trutta*) and sewin (*S. eriox* or *cambricus*), anadromous forms resembling the salmon in habits, and assuming in the sea a silvery coat, with, however, as a rule, more black spots on the sides below the lateral line.

The principal British races of trout are the following: the northern sea trout (*S. trutta, sensu stricto*), silvery, losing the teeth on the shaft of the vomer in the adult, and migratory like the salmon; the southern sea trout (*S. eriox* or *cambricus*), similar to the preceding, but with the hind margin of the gill-cover more or less produced, the lower bone (suboperculum) projecting beyond the end of the upper (operculum); the brown trout (*S. fario*), non-migratory, usually retaining the teeth on the shaft of the vomer, brown or olive with black and red spots, rarely more silvery, with numerous black spots; the Lochleven trout (*S. levenensis*), distinguished from the preceding by a more silvery coloration, frequent absence of red spots and a pink or red flesh; the estuary trout (*S. gilliventsis* and *S. orcadensis*), large brown trout living in salt water without assuming the silvery coloration; the Gillaroo trout (*S. stomachicus*), in which the membranes of the stomach are conspicuously thicker than in the other trout, more so in adult examples than in young ones. But all these forms are ill-defined and subject to such variations when transported from one locality to another as to render their recognition a matter of insuperable difficulty. The instability of the characters on which *S. levenensis* is based has been conclusively shown by the experiments conducted by Sir James Maitland at Howietoun. Large specimens of migratory trout are often designated as bull-trout, but no definition has ever been given by which this form could be established, even as a race.

Other European varieties are the trout of the Lake of Geneva (*S. lemanus*), of the Lake of Garda (*S. carpio*), of Dalmatia (*S. dentex*), of Hungary (*S. microlepis*), of the Caspian Sea (*S. caspius*), &c. The size of trout varies much according to the waters in which they live, the anadromous forms nearly equalling the salmon in this respect, specimens of over 4 ft. and weighing up to 50 lb being on record.

The habitat of *S. trutta* extends over the whole of Europe, the Atlas of Morocco and Algeria, Transcaucasia, Asia Minor and northern Persia. By the agency of man the species has been thoroughly established in Tasmania and New Zealand, where it thrives in an extraordinary manner, and attains a very large size.

Closely allied species are found in North America, west of the Rocky Mountains, the best known being the rainbow trout (*S. irideus* or *shasta*), which has been introduced into many parts of Europe as well as the eastern states of North America, New Zealand and South Africa. It is more hardy than the English trout, and accommodates itself in almost stagnant waters, and has thus proved a success in many ponds which were regarded as fit for coarse fish only; but in many places it has caused disappointment by going down to the sea, whence it is not known ever to return. It is a handsome trout, bluish or purplish above, silvery or golden below, more or less profusely spotted with black on the body and fins, and with an orange or red lateral band. Its range extends from Alaska to North Mexico. The rainbow trout merges into a larger form, *S. gairdneri*, which resembles the British sea trout.

A remarkable European trout is the short-snouted trout, *S. obtusirostris*, a non-migratory species from Dalmatia, Herzegovina, Bosnia and Montenegro. It has a small mouth with a feeble dentition, resembling that of the grayling. A closely allied form, *S. ohridanus*, has recently been discovered in Macedonia. (G. A. B.)

TROUVÈRE, the name given to the medieval poets of northern and central France, who wrote in the *langue d'oïl* or *langue d'oui*. The word is derived from the French verb *trouver*, to find or invent. The trouvères flourished abundantly in the 12th and 13th centuries. They were court-poets who devoted themselves almost exclusively to the composition and recitation of a particular kind of song, for which the highest society of that day in France had an inordinate fondness. This poetry, the usual subject of which was some refinement of the passion of love, was dialectical rather than emotional. As Jeanroy has said, the best trouvères were those who "into the smallest number of lines could put the largest number of ideas, or at least of those commonplaces which envelop thought in its most impersonal and coldest form." The trouvères were not, as used to be supposed, lovers singing to their sweethearts, but they were the pedants and attorneys of a fantastic tribunal of sentiment. This was more monotonous in the hands of the trouvères than it had been in those of the troubadours, for the latter often employed their art for purposes of satire, religion, humour and politics, which were scarcely known to the poets of the northern language.

The established idea that the poetry of the trouvères was entirely founded upon imitation of that of the troubadours, has been ably combated by Paul Meyer, who comes to the conclusion that the poetry of the north of France was essentially no less original than that of the south. The passage of Raoul Glaber, in which he says that about the year 1000 southern men began to appear in France and in Burgundy, "as odd in their ways as in their dress, and having the appearance of jongleurs," is usually quoted, but although this is valuable contemporary evidence, it proves neither what these "jongleurs" brought from the south nor what the poets of the north could borrow from them. The first appearance of trouvères seems to be much later than this, and to date from 1137, when Eléonore of Aquitaine, who was herself the granddaughter of an illustrious troubadour, arrived in the court of France as the queen of Louis VII. It is recorded that she continued to speak her native language, which would be the Poitiers dialect of the *langue d'oc*. She was queen for fifteen years (1137–1152), and this, no doubt, was the period during which the southern influence was strongest in the literature of northern France. There is not any question that the successive crusades tended to produce relations between the two sections of poetical literature. The great mass of the existing writings of the trouvères deals elaborately and artificially with the passion of love, as it had already been analysed in the *langue d'oc*. But those who are most inclined to favour the northern poets are obliged to confess that the latter rarely approach the grace and delicacy of the troubadours, while their verse shows less ingenuity and less variety. The earliest trouvères, like Cuene de Béthune and Huges de Bersé, in writing their amatory lyrics, were certainly influenced by what troubadours had written, especially when, like Bertrand de Born, these troubadours were men who wandered far and wide, under the glory of a great social prestige. We should know more exactly what the nature of the Provençal influence was if the songs of all the trouvères who flourished before the middle of the 12th century had not practically disappeared. When we become conscious of the existence of the trouvères, we find Cuene de Béthune in possession of the field, a poet of too much originality to be swept away as a mere imitator. At the same time, even Paul Meyer, who has been the great asserter of the independence of the poetry of northern France, is obliged to admit that if, at the end of the 12th century and throughout the 13th, several literary centres were formed where an amatory poetry, full of conventional grace, was held in high honour, it was because several princely courts in the south had set the example. In this sense it cannot be denied that the whole art of the trouvères was secondary and subsidiary to the art of the troubadours.

The poetical forms adopted by the trouvères bore curious and obscure names, the signification of which is still in some cases dubious. As a rule each poem belonged to one of three classes, and was either a *rotruenge*, or a *serventois*, or an *estrabot*. The rotruenge was a song with a refrain; the serventois was, in spite of its name, quite unlike the sirventes of the troubadours and had a more ribald character; the estrabot was allied to the *strambotto* of the Italians, and was a strophaic form "composed of a front part which was symmetrical, and of a tail which could be varied at will" (Gaston Paris). But scholars are still uncertain as to the positive meaning of these expressions, and as to the theory of the verse-forms themselves.

The court poetry of the trouvères particularly flourished under the protection of three royal ladies. Marie, the regent of Champagne, was the practical ruler of that country from 1181 to 1197, and she encouraged the minstrels in the highest degree. She invited Ricaut de Barbezieux to her court, rewarded the earliest songs of Gace Brulé, and discussed the art of verse with Chrétien of Troyes. Her sister, Aélis or Alice, welcomed the trouvères to Blois; she was the protector of Gautier d'Arras and of Le Châtelain de Couci. A sister of the husbands of these ladies, another Aélis, who became the second queen of Louis VII. in 1160, received Cuene de Béthune in Paris, and reproved him for the Picard accent with which he recited his poetry. At the end of the 12th century we see that the refinement and elegance of the court-poets was recognized in the north of France by those who were responsible for the education of princes. A trouvère, Gui de Ponthieu, was appointed tutor to William III. of Macon, and another, Philippe of Flanders, to Philippe Auguste. The vogue of the trouvères began during the third crusade; it rose to its greatest height during the fourth crusade and the attack upon the Albigenses. The first forty years of the 13th century was the period during which the courtly lyrical poetry was cultivated with most assiduity. At first it was a purely aristocratic pastime, and among the principal trouvères were princes such as Thibaut IV. of Navarre, Louis of Blois and John, king of Jerusalem. About 1230 the taste for court poetry spread to the wealthy bourgeoisie, especially in Picardy, Artois and Flanders. Before its final decline, and after the courts of Paris and Blois had ceased to be its patrons, the poetry of the trouvères found its centre and enjoyed its latest successes at Arras. It was here that some of the most original and the most skilful of all the trouvères, such as Jacques Bretel and Adam de la Halle, exercised their art. Another and perhaps still later school flourished at Reims.

About 1280, having existed for a century and a half, the poetical system suddenly decayed and disappeared; the very names of the court-poets were forgotten. During this time the song, *chanson*, had been treated as the most dignified and honourable form of literature, as Dante explains in his *De vulgari eloquentia*. But the song, as the trouvères understood it, was not an unstudied or emotional burst of verbal melody; it was, on the contrary, an effort of the intelligence, a piece of wilful and elaborate casuistry. The poet was invariably a lover, devoted to a married lady who was not his wife, and to whose caprices he was bound to submit blindly and patiently, in an endless and resigned humility. The progress of this conventional courtship was laid down according to certain strict rules of ceremonial; love became a science and a religion, and was practised by the laws of precise etiquette.

The curious interest of the trouvères, for us, lies in the fact that during an age when the northern world was ignorant and brutal, sunken in a rude sensuality, the trouvères advanced a theory of morals which had its absurd and immoral side, but which demanded a devotion to refinement and a close attention to what is reserved, delicate and subtle in personal conduct. They were, moreover, when the worst has been admitted about their frigidity and triviality, refiners of the race, and they did much to lay the foundation of French wit and French intelligence. The trouvères have not enjoyed the advantage of the troubadours, whose feats and adventures attracted the notice of contemporary biographers. Little is known about their lives, and they pass across the field of literary history like a troop of phantoms. Close students of this body of somewhat monotonous poetry have fancied that they detected a personal note in some of the leaders of the movement. It is certainly obvious that Cuene (or Conon) de Béthune had a violence of expression which gives life to his chansons. The delicate grace of Thibaut of Champagne, the apparent sincerity of Le Châtelain de Couci, the descriptive charm of Moniot of Arras, the irony of Richard of Fournival, have been celebrated by critics who have perhaps discovered differences where none exist. It is more certain that Adam de la Halle, the hunchback of Arras, had a superb gift of versification. The *rondel* (published in E. de Coussemaker's edition, 1872) beginning

"A Dieu courant amourettes,
Car je m'en vois
Souspirant en terre estrange!"

marks perhaps the highest point to which the delicate, frosty art of the trouvères attained. Music took a prominent place in all the performances of the trouvères, but in spite of the erudition of de Coussemaker, who devoted himself to the subject, comparatively little is known of the melodies which they used. But enough has been discovered to justify the general statement of Tiersot that "we may conclude that the musical movement of the age of the trouvères was derived directly from the most ancient form of popular French melody." A precious MS. in the Faculty of Medicine of Montpellier contains the music of no fewer than 345 part-songs attributed to trouvères, and an examination of these enables a "pitiless arranger" to divine the air, the primitive, simple and popular melody

The principal authorities on the poetry and music of the trouvères are: H. Binet, *Le Style de la lyrique courtoise en France aux xiime et xiiime siècles* (Paris, 1891); Gaston Paris, *Les Origines de la poésie lyrique en France au moyen âge* (Paris, 1892); A. Jeanroy, *Les Origines de la poésie lyrique en France au moyen âge* (Paris, 1889); Julian Tiersot, *Histoire de la chanson populaire en France*; E. de Coussemaker, *Art harmonique aux xiime et xiiime siècles* (Paris, 1865). The works of the principal trouvères have been edited: those of Le Châtelain de Coucy by F. Michel (1830); of Adam de la Halle by E. de Coussemaker (1872); of Conon de Béthune by Wallensköld (Helsingfors, 1891); of Thibaut IV., king of Navarre, by P. Tarbé (1851). (E. G.)

TROUVILLE, a seaside town of north-western France, in the department of Calvados, on the English Channel, 34 m. N.E. of Caen by rail. Pop. (1906), 5684. Trouville is situated on the slopes of well-wooded hills at the mouth of the Touques on its right bank opposite Deauville. Its fine stretches of sand and excellent bathing, a spacious casino and beautiful villas, are among the attractions which make it the most frequented French resort on the channel. Deauville is well known for its racecourse and villas, exceeding those of Trouville in luxury, but except during the race fortnight in August (*la grande quinzaine*) it is quiet and comparatively deserted. The port shared with Deauville and formed by the Touques is entered by a channel between jetties with a depth at high tide of 18½ ft. This leads on the one side to a tidal harbour, on the other to an outer and an inner basin. Timber, coals and cement are imported. The

London & South Western Railway Company have a daily steamboat service from Havre to Trouville in connexion with their Southampton and Havre boats. Besides trawling and the provisioning of ships, in which Deauville is also engaged, Trouville carries on boat-building and has rope and briquette works.

TROVER (O. Fr. *trover*, to find, mod. *trouver*), or "trover and conversion," the name of a form of action in English law no longer in use, corresponding to the modern action of conversion. It was brought for damages for the detention of a chattel, and differed from detinue in that the latter was brought for the return of the chattel itself. The name trover is due to the action having been based on the fictitious averment in the plaintiff's declaration that he had lost the goods and that the defendant had found them. The necessity for this fictitious averment was taken away by the Common Law Procedure Act 1852. An action of trover lay (as an action of conversion still lies) in every case where the defendant was in possession of a chattel of the plaintiff and refused to deliver it up on request, such refusal being prima facie evidence of conversion. The damages recoverable are usually the value of the chattel converted. In an action for detention of a chattel (the representative of the old action of detinue), the plaintiff may have judgment and execution by writ of delivery for the chattel itself or for its value at his option. An action for conversion or detention must be brought within six years. The corresponding action in Scots law is the action of spuilzie. It must be brought within three years in order to entitle the pursuer to violent profits, otherwise it prescribes in forty years.

TROWBRIDGE, a market town in the Westbury parliamentary division of Wiltshire, England, 97½ m. W. by S. of London by the Great Western railway. Pop. of urban district (1901), 11,526. It is unevenly built on a slope at the foot of which flows the Biss or Mere, a tributary of the Avon. The parish church of St James is a fine Perpendicular building, with a lofty spire, and a beautiful open-work roof over the nave. It was rebuilt on the original plan in 1848. George Crabbe, the poet, was rector from 1813 to 1831.

Trowbridge (*Trubrig*, *Trobrigg*, *Trowbrigge*) was probably mentioned in Domesday under the name of Straburg, a manor held by one Brictric together with Staverton and Trowle, now both included within its limits. The first reference to the "town" of Trowbridge occurs early in the 16th century; previous to that date mention is made of the manor and castle only. The latter, round which the town probably grew up, is said to have been built by the de Bohuns, who obtained possession of the manor by marriage with the daughter of Edward de Sarisbury. Later it passed to William de Longespée, son of Henry II., to the Lancasters, to the protector Somerset (by grant of Henry VIII.) and then to the Rutlands, and Trowbridge is now a non-corporate town. In 1200 John granted a weekly market on Tuesday, Thursday and Saturday; also a yearly fair on the 24th, 25th and 26th of July, on which days it continued to be held until at the end of the 18th century it was changed to the 5th, 6th and 7th of August. The manufacture of woollen cloths has long been the staple trade of Trowbridge. It was introduced before the 16th century, for Leland, writing in the reign of Henry VIII., says: "The town flourisheth by drapery." In 1731 the trade was of some note, and by 1813 had attained such proportions that the whole area of the castle site was sold for the erection of dyeworks, cloth manufactories and other industrial buildings.

TROWEL (Med. Eng. *truel*, O. Fr. *truelle*, Low Lat. *truella*, a variant of *trulla*, diminutive of *trua*, stirring spoon, ladle, Gr. τορύνη, from the root *tar*, to turn round and round; cf. τορεύς, borer), a tool or implement, varying in shape according to the use to which it is put, but consisting of a blade of iron or steel fitted with a handle. The bricklayers' or plasterers' trowel, used for mixing, spreading and smoothing the mortar or plaster, has a flat, triangular, oval or rectangular blade; the gardeners' trowel, for digging plants, laying or mixing mould, &c., has a semi-cylindrical blade. Highly ornamental trowels made of, or decorated with, the precious metals are presented to royal, official or other personages who formally lay the foundation stones of buildings.

TROY, JEAN FRANÇOIS DE (1679–1752), French painter, was born at Paris in 1679. He received his first lessons from his father, himself a skilful portrait painter, who afterwards sent his son to Italy. There his amusements occupied him fully as much as his studies; but his ability was such that on his return he was at once made an official of the Academy, and obtained a large number of orders for the decoration of public and private buildings, executing at the same time a quantity of easel pictures of very unequal merit. Amongst the most considerable of his works are thirty-six compositions painted for the hotel of De Live (1729), and a series of the story of Esther, designed for the Gobelins whilst De Troy was director of the school of France at Rome (1738–1751)—a post which he resigned in a fit of irritation at court neglect. He did not expect to be taken at his word, and was about to return to France when he died on the 24th of January 1752. The life-size painting (Louvre) of the "First Chapter of the Order of the Holy Ghost held by Henry IV.," in the church of the Grands Augustins, is one of his most complete performances, and his dramatic composition, the "Plague at Marseilles," is widely known through the excellent engraving of Thomassin. The Cochins, father and son, Fessard, Galimard, Bauvarlet, Herisset, and the painters Boucher and Parrocel, have engraved and etched the works of De Troy.

TROY and **TROAD.** I. *The Troad.*—The Troad (ἡ Τρῳάς), or the land of Troy, the north-western promontory of Asia Minor. The name "Troad" is never used by Homer—who calls the land, like the city, Τροίη—but is already known to Herodotus. The Troad is bounded on the N. by the Hellespont and the westernmost part of the Propontis, on the W. by the Aegean Sea and on the S. by the Gulf of Adramyttium. The eastern limit was variously defined by ancient writers. In the widest acceptation, the Troad was identified with the whole of western and south-western Mysia, from the Aesepus, which flows into the Propontis, a little west of Cyzicus, to the Caicus, which flows into the Aegean south of Atarneus. But the true eastern boundary is undoubtedly the range of Ida, which, starting from near the south-east angle of the Adramyttian Gulf, sends its north-western spurs nearly to the coast of the Propontis, in the region west of the Aesepus and east of the Granicus. Taking Ida for the eastern limit, we have the definition which, as Strabo says, best corresponds with the actual usage of the name Troad. Ida is the key to the physical geography of the whole region; and it is the peculiar character which this mountain-system imparts to the land west of it that constitutes the real distinctness of the Troad from the rest of Mysia. Nature has here provided Asia Minor with an outwork against invaders from the north-west; and as the Troad was the scene of the struggle between Agamemnon and Priam, so it was in the Troad that Alexander won the battle which opened a path for his further advance.

Natural Divisions.—The length of the Troad from north to south—taking a straight line from the north-west point, Cape Sigeum (Yeni Shehr), to the south-west point, Cape Lectum (Babā Kale)—is roughly 40 m. The breadth, from the middle point of the west coast to the main range of Ida, is not much greater. The whole central portion of this area is drained by the Menderes (anc. *Scamander*), which rises in Ida and is by far the most important river of the Troad. The basin of the Menderes is divided by hills into two distinct parts, a southern and a northern plain. The southern—anciently called the Samonian plain—is the great central plain of the Troad, and takes its modern name from Bairamich, the chief Turkish town, which is situated in the eastern part of it near Ida. From the north end of the plain the Menderes winds in large curves through deep gorges in metamorphic rocks, and issues into the northern plain, stretching to the Hellespont. This is the plain of Troy, which is 7 or 8 m. long, and 2 or 3 m. broad on the average. The hills on the south are quite low, and towards the east the acclivities are in places so gentle as to leave the limits of the plain indefinite. Next to the basin of the Menderes, with its two plains, the best marked feature in the river-system of the Troad is the valley of the Tuzla (anc. *Satniois*). The Tuzla rises in the western part of Mt Ida, south of the plain of Bairamich, from which its valley is divided by hills; and, after flowing for many miles almost parallel with the south coast of the Troad, from which, as

Assus, it is less than a mile distant, it enters the Aegean about 10 m. north of Cape Lectum. Three alluvial plains are comprised in its course. The easternmost of these, into which the river issues from rugged mountains of considerable height, is long and narrow. The next is the broad plain round Assus, which was a fertile source of supply to that city. The third is the plain at the embouchure of the river on the west coast. This was anciently called the Halesian ('Αλήσιον) plain, partly from the maritime salt-works at Tragasae, near the town of Hamaxitus, partly also from the hot salt-springs which exist at some distance from the sea, on the north side of the river, where large formations of rock-salt are also found. Maritime salt-works are still in operation at the mouth of the river, and its modern name (Tuzla = salt) preserves the ancient association. A striking feature of the southern Troad is the high and narrow plateau which runs parallel with the Adramyttian Gulf from east to west, forming a southern barrier to the valley of the Tuzla. This plateau seems to have been formed by a volcanic upheaval which came late in the Tertiary period, and covered the limestone of the south coast with two successive flows of trachyte. The lofty crag of Assus is like a tower standing detached from this line of mountain-wall. The western coast is of a different character. North of the Tuzla extends an undulating plain, narrow at first, but gradually widening. Much of it is covered with the valonia oak (*Quercus aegilops*), one of the most valuable products of the Troad. Towards the middle of the west coast the adjacent ground becomes higher, with steep acclivities, which sometimes rise into peaks; and north of these, again, the seaboard subsides towards Cape Sigeum into rounded hills, mostly low.

Natural Products.—The timber of the Troad is supplied chiefly by the pine forests on Mt Ida. But nearly all the plains and hills are more or less well wooded. Besides the valonia oak, the elm, willow, cypress and tamarisk shrub abound. Lotus, galingale and reeds are still plentiful, as in Homeric days, about the streams in the Trojan plain. The vine, too, is cultivated, the Turks making from it a kind of syrup and a preserve. In summer and autumn water-melons are among the abundant fruits. Cotton, wheat and Indian corn are also grown. The Troad is, indeed, a country highly favoured by nature—with its fertile plains and valleys, abundantly and continually irrigated from Ida, its numerous streams, its fine west seaboard, and the beauty of its scenery. Under Turkish rule, the natural advantages of the land suffice to mitigate the poverty of the sparse population, but have scarcely any positive result.

Early History.—In the Homeric legend, with which the story of the Troad begins, the people called Troes are ruled by a king Priam, whose realm includes all that is bounded by "Lesbos, Phrygia, and the Hellespont" (*Il.* xxiv. 544), *i.e.* the whole "Troad," with some extension of it, beyond Ida, on the north-west. According to Homer, the Achaeans under Agamemnon utterly and finally destroyed Troy, the capital of Priam, and overthrew his dynasty. But there is an Homeric prophecy that the rule over the Troes shall be continued by Aeneas and his descendants. From the "Homeric" hymn to Aphrodite, as well as from a passage in the 20th book of the *Iliad* (75–353)—a passage probably later than the bulk of the book—it is certain that in the 7th or 6th century B.C. a dynasty claiming descent from Aeneas reigned in the Troad, though the extent of their sway is unknown. The Homeric tale of Troy is a poetic creation, for which the poet is the sole witness. The geographical compactness of the Troad is itself an argument for the truth of the Homeric statement that it was once united under a strong king. How that kingdom was finally broken up is unknown. Thracian hordes, including the Treres, swept into Asia Minor from the north-west about the beginning of the 7th century B.C., and it is probable that, like the Gauls and Goths of later days, these fierce invaders made havoc in the Troad. The Ionian poet Callinus has recorded the terror which they caused farther south.

Greek Settlements.—A new period in the history of the Troad begins with the foundation of the Greek settlements. The earliest and most important of these were Aeolic. Lesbos and Cyme in Aeolis seem to have been the chief points from which the Aeolic colonists worked their way into the Troad. Commanding positions on the coast, such as Assus and Sigeum, would naturally be those first occupied; and some of them have been in the hands of Aeolians as early as the 10th century B.C. It appears from Herodotus (v. 95) that about 620 B.C. Athenians occupied Sigeum, and were resisted by the Aeolic colonists from Mytilene in Lesbos, who had already established themselves in that neighbourhood. Struggles of this kind may help to account for the fact noticed by Strabo, that the earlier colonies had often migrated from one site in the Troad to another. Such changes of seat have been, he observes, frequent causes of confusion in the topography.

The chief Greek towns in the Troad were Ilium in the north, Assus in the south and Alexandria Troas in the west. The site of the Greek Ilium is marked by the low mound of Hissarlik ("place of fortresses") in the Trojan plain, about 3 m. from the Hellespont. Exactly at what date it was founded on the top of earlier remains is uncertain (perhaps the 7th century); but it was not a place of any importance till the Hellenistic age. When Xerxes visited the Trojan plain, he "went up to the Pergamon of Priam," and afterwards sacrificed to the Ilian Athena (Herod. vii. 42). Ilion is mentioned among the towns of the Troad which yielded to Dercyllidas (399 B.C.), and as captured by Charidemus (359 B.C.). It possessed walls, but was a petty place, of little strength. In 334 B.C. Alexander, on landing in the Troad, visited Ilium. In their temple of Athena the Ilians showed him arms which had served in the Trojan War, including the shield of Achilles. Either then, or after the battle of Granicus, Alexander directed that the town should be enlarged, and should have the rank of "city," with political independence, and exemption from tribute. The battle of Ipsus (301 B.C.) added north-western Asia Minor to the dominions of Lysimachus, who executed the intentions of Alexander. He gave Ilium a wall 5 m. in circumference, incorporating with it some decayed towns of the neighbourhood, and built a handsome temple of Athena. In the 3rd century B.C. Ilium was the head of a federal league (κοινόν) of free Greek towns, which probably included the district from Lampsacus on the Hellespont to Gargara on the Adramyttian Gulf. Twice in that century Ilium was visited by Gauls. On the first occasion (278 B.C.) the Gauls, under Lutarius, sought to establish a stronghold at Ilium, but speedily abandoned it as being too weak. Forty years later (218 B.C.) Gauls were brought over by Attalus I. to help him in his war against Achaeus. After deserting his standard they proceeded to pillage the towns on the Hellespont, and finally besieged Ilium, from which, however, they were driven off by the troops of Alexandria Troas. At the beginning of the 2nd century B.C. Ilium was in a state of decay. As Demetrius of Scepsis tells us, the houses "had not even roofs of tiles," but merely of thatch. Such a loss of prosperity is sufficiently explained by the incursions of the Gauls and the insecure state of the Troad during the latter part of the 3rd century. The temple of the Ilian Athena, however, retained its prestige. In 192 B.C. Antiochus the Great visited it before sailing to the aid of the Aetolians. In 190 B.C., shortly before the battle of Magnesia, the Romans came into the Troad. At the moment when a Roman army was entering Asia, it was politic to recall the legend of Roman descent from Aeneas. Lucius Scipio and the Ilians were alike eager to do so. He offered sacrifice to the Ilian Athena; and after the peace with Antiochus (189 B.C.) the Romans annexed Rhoeteum and Gergis to Ilium, "not so much in reward of recent services, as in memory of the source from which their nation sprang." The later history of Ilium is little more than that of Roman benefits. A disaster befell the place in 85 B.C., when Fimbria took it, and left it in ruins; but Sulla presently caused it to be rebuilt. Augustus, while confirming its ancient privileges, gave it new territory. Caracalla (A.D. 211–217) visited Ilium, and, like Alexander, paid honours to the tomb of Achilles. In the 4th century, as some rhetorical "Letters" of that age show, the Ilians did a profitable trade in attracting tourists by their pseudo-Trojan memorials. After the 4th century the place is lost to view. But we find from Constantine Porphyrogenitus (911–959) that in his day it was one of the places in the Troad which gave names to bishoprics.

Other Ancient Sites.—Many classical sites in the Troad have been identified with more or less certainty. (For ALEXANDRIA TROAS and ASSUS, see separate articles. *Neandria* seems to be rightly fixed by F. Calvert at Mount Chigri, a hill not far from Alexandria Troas, remarkable for the fine view of the whole Troad which it commands. *Cebrene* has been conjecturally placed in the eastern part of the plain of Bairamich. *Palaeoscepsis* was farther east on the slopes of Ida, while the new *Scepsis* was near the site of Bairamich itself. At the village of Kulakli, a little south of the mouth of the Tuzla, some Corinthian columns and other fragments mark the temple of Apollo Smintheus (excavated in 1866 by Pullan) and (approximately) the site of the Homeric *Chryse*. *Colonae* was also on the west coast, opposite Tenedos. *Scamandria* occupied the site of Eneh, in the middle of the plain of Bairamich, and *Cenchreae* was probably some distance north of it. The shrine of Palamedes, mentioned by ancient writers as existing at a town called *Polymedium*, has been discovered by J. T. Clarke on a site hitherto unvisited by any modern traveller, between Assus and Cape Lectum. It proves to have been a sacred enclosure (*temenos*) on the acropolis of the town; the statue of Palamedes stood on a rock at the middle of its southern edge. Another interesting discovery has been made by Clarke, viz. the existence of very ancient town walls on Gargarus, the highest peak of Ida.

(R. C. J.; D. G. H.)

II. *The Site of Troy.*—Troy is represented now by the important ruins on and about the mound of Hissarlik which underlie those already referred to as surviving from the Hellenistic Ilion. Hissarlik is situated about 3½ m. both from the Dardanelles and from Yeni Keui, which lies on the Aegean coast north of Besika Bay. The famous academic dispute concerning the precise site, which began about A.D. 160 with Demetrius of Scepsis, may now be regarded as settled. After the full demonstration, made in 1893, that remains of a fortress exist on the mound of Hissarlik, contemporary with the great period of Mycenae, and larger than the earlier acropolis town first identified by Schliemann with Ilion, no reasonable person has continued to doubt that this last site is the local habitation of the Homeric story. The rival ruins on the Bali Dagh have been shown to be those of a small hill fort which, with another on an opposite crag, commanded the upper Menderes gorge. It is inconceivable that this fort should have been chosen by poets, generally familiar with the locality, as the scene of the great siege, while in the plain between it and the sea there had lain from time immemorial, and lay still in the Mycenaean age, a much more important settlement with massive fortified citadel.

No site in the Troad can be brought into complete accordance with all the topographical data to be ingeniously derived from the text of Homer. The hot and cold springs that lay just without the gate of "Troy" (*Il.* xxii. 147) are no more to be identified with Bunarbashi, which wells out more than a mile from the Bali Dagh ruins, than with the choked conduits, opened by Schliemann in 1882, to the south of Hissarlik. But the broader facts of geography are recognizable in the modern plain of the Menderes. The old bed of that river is the Scamander, and its little tributary, the Dumbrek Su, is the Simois. In their fork lies Hissarlik or Troy. In sight of it are, on the one side, the peak of Samothrace (xiii. 11–14); on the other, the mass of the Kaz Dagh *Ida* (viii. 52). Hissarlik lies in the plain (xx. 216) less than 4 m. both from the Hellespontine and the Aegean coasts, easily reached day by day by foes from the shore, and possible to be left and regained in a single night by a Trojan visiting the camp of the Greeks (vii. 381–421).

In summarizing what has been found to exist on the mound of Hissarlik in the excavations undertaken there since 1870, it is not advisable to observe the order of the finding, since Schliemann's want of experience and method caused much confusion and error in the earlier revelations. No certainty as to the distinction of strata or their relative ages was possible till Wilhelm Dörpfeld obtained entire control in 1891, after the original explorer's death. There are in all nine strata of ancient settlement,

1. On the virgin soil of the hillock, forming the core of the mound, scanty remains appear of a small village of the late Aegean neolithic period, at the dawn of the Bronze Age, contemporary with the upper part of the Cnossian neolithic bed. This includes what were originally supposed by Schliemann to be two successive primitive settlements. Thin walls of rough stones, bonded with mud, are preserved mainly in the west centre of the mound. No ground plan of a house is recoverable, and there is no sign of an outer fortress wall. In this stratum were found implements in obsidian and other stones, clay whorls, a little worked ivory, and much dark monochrome pottery, either of a rough grey surface or (in the finer examples) treated with resin, highly hand-polished, and showing simple geometric decoration, which was incised and often filled in with a white substance.

2. Superposed on these remains, where they still exist, but comprehending a much larger area, lies a better constructed and preserved settlement. This has been twice rebuilt. It was enclosed by a massive fortress wall of rudely squared Cyclopean character, showing different restorations, and now destroyed, except on the south side of the mound. Double gates at the south-east and south-west are well-preserved. The most complete and most important structures within the citadel lie towards the north. These are two rectangular blocks lying north-west to south-east, side by side, of which the southern and larger shows a *megaron* and vestibule of the type familiar in "Mycenaean" palaces, while the smaller seems a pendant to the larger, like the "women's quarters" at Tiryns and Phylakopi (see AEGEAN CIVILIZATION). Other blocks, whose plans are difficult to bring into inter-relation in their present state of ruin, are scattered over the area, but mainly in the south-west. This is the fortress proclaimed by Schliemann in 1873 to be the Pergamos of Troy. But we know that, while his identifications of Homeric topographical details in these ruins were fanciful, a much larger fortress succeeded to this long before the period treated of in the *Iliad*. The settlement in the second stratum belongs, in fact, to a primitive stage of that local civilization which preceded the Mycenaean; and it is this latter which is recalled by the Homeric poems. The pottery of the second stratum at Hissarlik shows the first introduction of paint, and of the slip and somewhat fantastic forms parallel to those of the pre-Mycenaean style in the Cyclades. The beaked vases, known as *schnabelkannen*, are characteristic, and rude reproductions of human features are common in this ware, which seems all to be of native fabrication. Bronze had come into use for implements, weapons and utensils; and gold and silver make up a hoarded treasure found in the calcined ruins of the fortification wall near one of the gates. But the forms are primitive and singular, and the workmanship is very rude, the pendants of the great diadems being cut out of very thin plate gold. Disks, bracelets and pendants, showing advanced spiraliform ornament, found mainly in 1878, and then ascribed to this same stratum, belong undoubtedly to a higher one, the sixth or "Mycenaean." Rough fiddle-shaped idols, whorls, a little worked ivory and some lead make up a find, of whose early period comparison of objects found elsewhere leaves no sort of doubt. This treasure is now deposited in Berlin.

3, 4, 5. This primitive "Troy" suffered cataclysmal ruin (traces of conflagration are everywhere present), and Hissarlik ceased for a time to have any considerable population. Three small village settlements, not much more than farms, were successively erected on the site; and have left their traces superposed one on another, but they yielded no finds of importance.

6. The mound, however, stood in too important a relation to the plain and the sea to remain desolate, and in due time it was covered again by a great fortress, while a city spread out below. The latter has not yet been explored. The remains of this period on the acropolis, however, have now been examined. A portion of them was first distinguished clearly by Dörpfeld in 1882, but owing to the confusion caused by Schliemann's drastic methods of trenching, the pottery and metal objects, really belonging to this stratum, had come to be confused with those of lower strata; and some grey monochrome ware, obviously of Anatolian make, was alone referred to the higher stratum. To this ware Schliemann gave the name "Lydian," and the stratum was spoken of in his *Troja* (1884) as the "Lydian city."

In 1893, however, excavations were carried out on the south of the mound in the hitherto undisturbed ground outside the limits of the earlier fortress; and here appeared a second curtain wall of massive ashlar masonry showing architectural features which characterize the "Mycenaean" fortification walls at Mycenae itself, and at Phylakopi in Melos. With this wall was associated not only the grey ware, but a mass of painted potsherds of unmistakably "Mycenaean" character; and further search in the same stratum to west and east showed that such sherds always lay on its floor level. The inevitable inference is that here we have a city, contemporary with the mass of the remains at Mycenae, which imported "Mycenaean" ware to supplement its own ruder products. The area of its citadel is larger than the citadel of the second stratum; its buildings, of which a large *megaron* on the south-west and several houses on the east remain, are of much finer construction than those which lie lower. This was the most important city yet built on the mound of Hissarlik. It belonged to the "Mycenaean" age, which precedes the composition of the Homeric poems, and is reflected by them. Therefore this is Homer's Troy.

Its remains, however, having been obliterated on the crown of Hissarlik, almost escaped recognition. When some centuries later a third important city, the Hellenistic Ilion, was built, all the accumulation on the top of the mound was cut away and a terrace made. In this process the then uppermost strata of ruins wholly vanished, their stones being taken to build the new city. The Mycenaean town, however, which had been piled stage upon stage to the summit, descended on the south side a little down the face of the mound; and the remains of its fortifications and houses at that point, lying below the level cut down to by the Hellenistic terrace-makers, were covered by the depositing of rubbish from the crown and again built over. Thus we find them now on the southern slope of the mound only, but have no difficulty in estimating their original extent. Many tombs and a large lower city of this era will doubtless be explored ere long.

7. To "Mycenaean" Troy succeeded a small unfortified settlement, which maintained itself all through the Hellenic age till the Homeric enthusiasm of Alexander the Great called a city again into being on Hissarlik.

8. The Hellenistic Ilion, however, has left comparatively little trace, having been almost completely destroyed in 85 B.C. by Fimbria. Portions of fortifications erected by Lysimachus are visible both on the acropolis (west face chiefly) and round the lower city in the plain. A small Doric temple belongs to the foundation of this city, and a larger one, probably dedicated to Athena, seems to be of the Pergamene age. Of its metopes, representing Helios and a gigantomachia, important fragments have been recovered. Coins of this city are not rare, showing Athena on both faces, and some inscriptions have been recovered proving that Hellenistic Ilion was an important municipality.

9. Lastly about the Christian era, arose a Graeco-Roman city, to which belong the theatre on the south-east slope of the hill and the ornate gateway in the same quarter, as well as a large building on the south-west and extensive remains to north-east. This seems to have sunk into decay about the 5th century A.D.

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III. *The Legend of Troy.*—According to Greek legend, the oldest town in the Troad was that founded by Teucer, who was a son of the river Scamander and the nymph Idaea. Tzetzes says that the Scamander in question was the Scamander in Crete, and that Teucer was told by an oracle to settle wherever the "earth-born ones" attacked him. So when he and his company were attacked in the Troad by mice, which gnawed their bow-strings and the handles of their shields, he settled on the spot, thinking that the oracle was fulfilled. He called the town Sminthium and built a temple to Apollo Smintheus, the Cretan word for a mouse being *sminthius*. In his reign Dardanus, son of Zeus and the nymph Electra, daughter of Atlas, in consequence of a deluge, drifted from the island of Samothrace on a raft or a skin bag to the coast of the Troad, where, having received a portion of land from Teucer and married his daughter Batea, he founded the city of Dardania or Dardanus on high ground at the foot of Mt Ida. On the death of Teucer, Dardanus succeeded to the kingdom and called the whole land Dardania after himself. He begat Erichthonius, who begat a son Tros by Astyoche, daughter of Simois. On succeeding to the throne, Tros called the country Troy and the people Trojans. By Callirrhoe, daughter of Scamander, he had three sons—Ilus, Assaracus and Ganymede. From Ilus and Assaracus sprang two separate lines of the royal house—the one being Ilus, Laomedon, Priam, Hector; the other Assaracus, Capys, Anchises, Aeneas. Ilus went to Phrygia, where, being victorious in wrestling, he received as a prize from the king of Phrygia a spotted cow, with an injunction to follow her and found a city wherever she lay down. The cow lay down on the hill of the Phrygian Atē; and here accordingly Ilus founded the city of Ilion. It is stated that Dardania, Troy and Ilion became one city. Desiring a sign at the foundation of Ilion, Ilus prayed to Zeus and as an answer he found lying before his tent the Palladium, a wooden statue of Pallas, three cubits high, with her feet joined, a spear in her right hand, and a distaff and spindle in her left. Ilus built a temple for the image and worshipped it. By Eurydice, daughter of Adrastus, he had a son Laomedon. Laomedon married Strymo, daughter of Scamander, or Placia, daughter of Atreus or of Leucippus. It was in his reign that Poseidon and Apollo, or Poseidon alone, built the walls of Troy. In his reign also Heracles besieged and took the city, slaying Laomedon and his children, except one daughter Hesione and one son Podarces. The life of Podarces was granted at the request of Hesione; but Heracles stipulated that Podarces must first be a slave and then be redeemed by Hesione; she gave her veil for him; hence his name of Priam (Gr. πρίασθαι, to buy). Priam married first Arisbe and afterwards Hecuba, and had fifty sons and twelve daughters. Among the sons were Hector and Paris, and among the daughters Polyxena and Cassandra. To recover Helen, whom Paris carried off from Sparta, the Greeks under Agamemnon besieged Troy for ten years. At last they contrived a wooden horse, in whose hollow belly many of the Greek heroes hid themselves. Their army and fleet then withdrew to Tenedos, feigning to have raised the siege. The Trojans conveyed the wooden horse into Troy; in the night the Greeks stole out, opened the gates to their friends, and Troy was taken.

See Homer, *Il.* vii. 452 seq., xx. 215 seq., xxi. 446 seq.; Apollodorus ii. 6, 4, iii. 12; Diodorus iv. 75, v. 48; Tzetzes, *Schol. on Lycophron*, 29, 72, 1302; Conon, *Narrat.* 21; Dionysius Halicarn. *Antiq. Rom.* i. 68 seq. The *Iliad* deals with a period of fifty-one days in the tenth year of the war. For the wooden horse, see Homer, *Od.* iv. 271 seq.; Virgil, *Aen.* ii. 13 seq.

The Medieval Legend.—The medieval romance of Troy, the *Roman de Troie*, exercised greater influence in its day and for centuries after its appearance than any other work of the same class. Just as the *chansons de geste* of the 10th century were the direct ancestors of the prose romances which afterwards spread throughout Europe, so, even before Heliodorus and Achilles Tatius, there were quasi-histories, which reproduced in prose, with more or less exactness, the narratives of epic poetry. Long previous to the *'Ηρωικὸς* of Flavius Philostratus (*fl.* 3rd century A.D.) the Trojan War had been the subject of many a prose fiction, dignified with the title of history; but to remodel the whole story almost in the shape of annals, and to give a minute personal description of the persons and characters of the principal actors, were ideas which belonged to an artificial stage of literature. The work of Philostratus is cast in the form of a dialogue between a Phoenician traveller and a vine-grower at Eleus, and is a discourse on twenty-six heroes of the war. A fictitious journal (*Ephemeris*), professing to give the chief incidents of the siege, and said to have been written by Dictys of Crete, a follower of Idomeneus, is mentioned by Suidas, and was largely used by John Malalas and other Byzantine chroniclers. This was abridged in Latin prose, probably in the 4th century, under the title of *Dictys Cretensis de bello Trojano libri VI.* It is prefaced by an introductory letter from a certain L. Septimius to Q. Aradius Rufinus, in which it is stated that the diary of Dictys had been found in his tomb at Cnossis in Crete, written in the Greek language, but in Phoenician characters. The narrative begins with the rape of Helen, and includes the adventures of the Greek princes on the return voyage. With Dictys is always associated Dares, a pseudo-historian of more recent date. Old Greek writers mention an account of the destruction of the city earlier than the Homeric poems, and in the time of Aelian (2nd century A.D.) this *Iliad* of Dares, priest of Hephaestus at Troy, was believed to be still in existence. Nothing has since been heard of it; but an unknown Latin writer, living between 400 and 600, took advantage of the tradition to compile *Daretis Phrygii de excidio Trojae historia*, which begins with the voyage of the Argo. It is in prose and professes to be translated from an old Greek manuscript. Of the two works that of Dares is the later, and is inferior to Dictys. The matter-of-fact form of narration recalls the poem of Quintus Smyrnaeus. In both compilations the gods and everything supernatural are suppressed; even the heroes are degraded. The permanent success, however, of the two works distinguishes them among apocryphal writings, and through them the Troy legend was diffused throughout western Europe. The Byzantine writers from the 7th to the 12th century exalted Dictys as a first-class authority, with whom Homer was only to be contrasted as an inventor of fables. Western people preferred Dares, because his history was shorter, and because, favouring the Trojans, he flattered the vanity of those who believed that people to have been their ancestors. Many MSS. of both writers were contained in old libraries; and they were translated into nearly every language and turned into verse. In the case of both works, scholars are undecided whether a Greek original ever existed (but see DICTYS CRETENSIS). The Byzantine grammarian, Joannes Tzetzes (*fl.* 12th century), wrote a Greek hexameter poem on the subject (*Iliaca*). In 1272, a monk of Corbie translated "sans rime *L'Estoire de Troiens et de Troie* (de Dares) du Latin en Roumans mot à mot" because the *Roman de Troie* was too long. Geoffrey of Waterford put Dares into French prose; and the British Museum has three Welsh MS. translations of the same author—works, however, of a much later period.

The name of Homer never ceased to be held in honour; but he is invariably placed in company with the Latin poets. Few of those who praised him had read him, except in the Latin redaction, in 1100 verses, by the so-called Pindarus Thebanus. It supplied the chief incidents of the *Iliad* with tolerable exactness and was a text-book in schools.

For a thousand years the myth of descent from the dispersed heroes of the conquered Trojan race was a sacred literary tradition throughout western Europe. The first Franco-Latin chroniclers traced their history to the same origin as that of Rome, as told by the Latin poets of the Augustan era; and in the middle of the 7th century Fredegarius Scholasticus (*Rer. gall. script.* ii. 461) relates how one party of the Trojans settled between the Rhine, the Danube and the sea. In a charter of Dagobert occurs the statement, "ex nobilissimo et antiquo Trojanorum reliquiarum sanguine nati." This statement is repeated by chroniclers and panegyrical writers, who also considered the *History of Troy* by Dares to be the first of national books. Succeeding kings imitated their predecessors in giving official sanction to their legendary origin: Charles the Bald, in a charter, uses almost the same words as Dagobert, "ex praeclaro et antiquo trojanorum sanguine nati." In England a similar tradition had been early formulated, as appears from Nennius's *Historia britonum* and Geoffrey of Monmouth. The epic founder of Britain was Brutus, son, or in another tradition, great-grandson, of Aeneas, in any case of the royal house of Troy. The tradition, repeated in Wace's version of Geoffrey, by Matthew Paris and others, persisted to the time of Shakespeare. Brutus found Albion uninhabited except by a few giants. He founded his capital on the banks of the Thames, and called it New Troy. Otto Frisingensis (12th century) and other German chroniclers repeat similar myths, and the apocryphal hypothesis is echoed in Scandinavian sagas. About 1050 a monk named Bernard wrote *De excidio Trojae*, and in the middle of the 12th century Simon Chèvre d'Or, canon of the abbey of Saint-Victor, Paris, followed with another poem in leonine elegiacs on the fall of the city and the adventures of Aeneas, in which the Homeric and Virgilian records were blended.

We now come to a work on the same subject, which in its own day and for centuries afterwards exercised an extraordinary influence throughout Europe. About the year 1184 Benoît de Sainte-More (*q.v.*) composed a poem of 30,000 lines entitled *Roman de Troie*. It forms a true Trojan cycle and embraces the entire heroic history of Hellas. The introduction relates the story of the Argonauts, and the last 2680 verses are devoted to the return of the Greek chiefs and the wanderings of Ulysses. With no fear of chronological discrepancy before his eyes, Benoît reproduces the manners of his own times, and builds up a complete museum of the 12th century—its arts, costumes, manufactures, architecture, arms, and even religious terms. Women are repeatedly introduced in unwarranted situations; they are spectators of all combats. The idea of personal beauty is different from that of the old Greeks; by Benoît good humour, as well as health and strength, is held to be one of its chief characteristics. The love-pictures are another addition of the modern writer. The author speaks enthusiastically of Homer, but he derived his information chiefly from the pseudo-annals of Dictys and Dares, more especially the latter, augmented by his own imagination and the spirit of the age. It is to Benoît alone that the honour of poetic invention is due, and in spite of its obligation for a groundwork to Dictys and Dares we may justly consider the *Roman de Troie* as an original work. From this source subsequent writers drew their notions of Troy, mostly without naming their authority and generally without even knowing his name. This is the masterpiece of the pseudo-classical cycle of romances: and in the Latin version of Guido delle Colonne it passed through every country of Europe.

The *De bello trojano* of Joseph of Exeter, in six books, a genuine poem of no little merit, was written soon after Benoît's work or about the years 1187-1188. At first ascribed to Dares Phrygius and Cornelius Nepos, it was not published as Joseph's until 1620 at Frankfort. It was directly drawn from the pseudo-annalists, but the influence of Benoît was considerable. Of the same kind was the *Troilus* of Albert of Stade (1249), a version of Dares, in verse, characterized by the old severity and affected realism. But these Latin works can only be associated indirectly with Benoît, who had closer imitators in Germany at an early period. Herbort of Fritzlar reproduced the French text in his *Lied von Troye* (early 13th century), as did also Konrad von Würzburg (d. 1287) in his *Buch von Troye* of 40,000 verses, which he himself compared to the "boundless ocean." It was completed by an anonymous poet. To the like source may be traced a poem of 30,000 verses on the same subject by Wolfram von Eschenbach; and Jacques van Maerlant reproduced Benoît's narrative in Flemish. The Norse or Icelandic *Trojumanna saga* repeats the tale with some variations.

In Italy Guido delle Colonne, a Sicilian, began in 1270 and finished in 1287 a prose *Historia trojana*, in which he reproduced the *Roman de Troie* of Benoît, and so closely as to copy the errors of the latter and to give the name of Peleus to Pelias, Jason's uncle. As the debt was entirely unacknowledged, Benoît at last came to be considered the imitator of Guido. The original is generally abridged, and the vivacity and poetry of the Anglo-Norman trouvère disappear in a dry version. The immense popularity of Guido's work is shown by the large number of existing MSS. The French Bibliothèque Nationale possesses eighteen codices of Guido to thirteen of Benoît, while at the British Museum the proportion is ten to two. Guido's *History* was translated into German about 1392 by Hans Mair of Nördlingen. Two Italian translations were made: by Filippo Ceffi (1324) and by Matteo Beliebuoni (1333). In the 14th and the commencement of the 15th century four versions appeared in England and Scotland. The best known is the *Troy Book*, written between 1414 and 1420, of John Lydgate, who had both French and Latin texts before him. An earlier and anonymous rendering exists at Oxford (Bodleian MS. Laud Misc. 595). There is the *Gest Hystoriale of the Destruction of Troy* (Early Eng. Text Soc., 1869-1874), written in a northern dialect about 1390; a Scottish version (15th century) by a certain Barbour, not the poet, John Barbour; and *The Seege of Troy*, a version of Dares (Harl. MS. 525 Brit. Mus.). The invention of printing gave fresh impetus to the spread of Guido's work. The first book printed in English was *The Recuyell of the Hystoryes of Troye*, a translation by Caxton from the French of Raoul Lefèvre. The *Recueil des histoires de Troyes* was "composé par vénérable homme Raoul le Feure prestre chappellain de mon tres redoupté seigneur monseigneur le duc Phelippe de Bourgoingne en l'an de grace 1464," but probably printed in 1474 by Caxton or Colard Mansion at Bruges. It is in three books, of which the first deals with the story of Jupiter and Saturn, the origin of the Trojans, the feats of Perseus, and the first achievements of Hercules; the second book is wholly taken up with the "prouesses du fort Herculez"; the third, "traictant de la generalle destruction de Troyes qui vint a l'ocasion du rauissement de dame Helaine," is little else than a translation of that portion of Guido delle Colonne which relates to Priam and his sons. Two MSS. of the *Recueil* in the Bibliothèque Nationale wrongly attribute the work to Guillaume Fillastre, a voluminous author, and predecessor of Lefèvre as secretary to the duke. Another codex in the same library, *Histoire ancienne de Thèbes et de Troyes*, is partly taken from Orosius. The Bibliothèque Nationale possesses an unpublished *Histoire des Troyens et des Thébains jusqu'à la mort de Turnus, d'après Orose, Ovide et Raoul Lefebre* (early 16th century), and the British Museum a Latin history of Troy dated 1403. There were also translations into Italian, Spanish, High German, Low Saxon, Dutch and Danish; Guido even appeared in a Flemish and a Bohemian dress.

Thus far we have only considered works more or less closely imitated from the original. Boccaccio, passing by the earlier tales, took one original incident from Benoît, the love of Troilus and the treachery of Briseida, and composed *Filostrato*, a parable of his own relations with the Neapolitan princess who figures in his works as Fiammetta. This was borrowed by Chaucer for his *Boke of Troilus and Cresside*, and also by Shakespeare for his *Troilus and Cressida* (1609). One reason why the Round Table stories of the 12th and 13th centuries had a never-ceasing charm for readers of the two following centuries was that they were constantly being re-edited to suit the changing taste. The *Roman de Troie* experienced the same fate. By the 13th century it was translated into prose and worked up in those enormous compilations, such as the *Mer des histoires*, &c., in which the middle ages studied antiquity. It reappeared in the religious dramas called Mysteries. Jacques Millet, who produced *La Destruction de Troie la Grande* between 1452 and 1454, merely added vulgar realism to the original. Writers of chap-books borrowed the story, which is again found on the stage in Antoine de Montchrétien's tragedy of *Hector* (1603)—a last echo of the influence of Benoît.

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TROY, a city and the county-seat of Rensselaer county, New York, U.S.A., at the head of tidewater on the eastern bank of the Hudson river, opposite the mouth of the Mohawk, about 6 m. N. of Albany and about 148 m. N. of New York City. Pop. (1880), 56,747; (1890), 60,956; (1900), 60,651, of whom 14,384 were foreign-born (7348 being Irish, 1796 German and 1498 English) and 400 were negroes; (1910, census), 76,813. Troy is served by the Boston & Maine, the New York Central & Hudson River and the Delaware & Hudson railways, and by interurban electric lines connecting with Saratoga and Lake George on the north, Albany on the south and Schenectady and the cities of the populous Mohawk Valley on the west; it is at the head of river steamboat navigation on the Hudson, and has water communication by means of the Erie and Champlain canals with the Great Lakes and Canada. The site is a level oblong tract extending along the Hudson for 7 m. and reaching back a mile or so from the river to highlands which rise to a height of 400 ft., with Mt Ida (240 ft. above tidewater) forming a picturesque background. The older part of the city and the principal business and manufacturing district occupies the low lands; the newer part, chiefly residential, is built upon the heights. The northern part of the city was the village of Lansingburg (pop. 1900, 12,595) until 1901, when with parts of the towns of Brunswick and North Greenbush it was annexed to

Troy. Opposite Troy on the west bank of the Hudson, and connected with it by bridges, are Cohoes, Watervliet and Waterford. Industrially and commercially they virtually form a part of Troy. Troy is the seat of Rensselaer Polytechnic Institute, founded in 1824 by Stephen van Rensselaer as a "school of theoretical and practical science," incorporated in 1826, and reorganized in 1849 as a general polytechnic institute. It is the oldest school of engineering in the country, and has always maintained a high rank of efficiency. The large gifts (about $1,000,000) to the school made by Mrs Russell Sage in 1907 enabled it to add courses in mechanical and electrical engineering to its course in civil engineering. The institute had 55 instructors and 650 students in 1910. The Emma Willard School, founded as the Troy Female Seminary in 1821 by Mrs Emma Willard (1787–1870),[1] is one of the oldest schools for women in the United States. Other educational institutions include Troy Academy (1834), a non-sectarian preparatory school; La Salle Institute (conducted by the Brothers of the Christian Schools); St Joseph's Academy (Roman Catholic) and St Peter's Academy (Roman Catholic). Noteworthy buildings of a public and semi-public character include the post office, the public library, containing in 1910 43,500 volumes, the Troy Savings Bank building, the city hall, the Rensselaer county court house, a Y.M.C.A. building and St Paul's Episcopal, the Second Presbyterian and St Mary's (Roman Catholic) churches. An area of 175 acres is comprised in the city's parks, the largest of which are Prospect Park and Beman Park. In Oakwood cemetery, 400 acres, are the grave of General George H. Thomas, and a monolithic shaft to the memory of General John Ellis Wool (1784–1869), who served with distinction in the War of 1812 and in the Mexican War, and in the Civil War commanded for a time the Department of Virginia. In Washington Square there is a Soldiers' and Sailors' Monument, 93 ft. high. Altro Park, on an island a short distance down the river, is a pleasure resort in summer.

Two rapid streams, Poesten Kill and Wynants Kill, flowing into the Hudson from the east, through deep ravines, furnish good water-power, which, with that furnished by the state dam across the Hudson here, is utilized for manufacturing purposes. In 1905 the value of Troy's factory product was $31,860,829. Of this $11,271,708 was the value of collars and cuffs (89·5% of the value of the total American product), an industry which gave employment to 49·3% of the wage-earners in Troy, and paid 42·1% of the wages. Closely allied with this industry was shirt-making, with an output valued at $4,263,610. Troy is the market for a fertile agricultural region, and the principal jobbing centre for a large district in north-eastern New York and eastern Massachusetts.

The site of Troy was part of the Van Rensselaer manor grant of 1629. In 1659 it was bought from the Indians, with the consent of the patroon, by Jan Barentsen Wemp, and several families settled here. In 1707 it passed into the hands of Derick van der Heyden, who laid out a large farm. During this early period it was known variously as Ferryhook, Ashley's Ferry and Van der Heyden's Ferry. In 1777 General Philip Schuyler established his headquarters on Van Schaick's Island in the Mohawk and Hudson, then the principal rendezvous of the army which later met Burgoyne at Saratoga. After the close of the war there was an influx of settlers from Rhode Island, Connecticut, New Hampshire and Vermont; a town was laid out on the Van der Heyden farm, and in 1789 the name of Troy was selected in town meeting; and in 1791 the town of Troy was formed from part of Rensselaerwyck. The county-seat was established here in 1793, and Troy was incorporated as a village in 1794 and was chartered as a city in 1816. The first newspaper, *The Farmer's Oracle*, began publication in 1797. In 1812 a steamboat line was established between Troy and Albany. Troy benefited financially by the War of 1812, during which contracts for army beef were filled here. The opening of the Erie Canal in 1825 contributed greatly to Troy's commercial importance. During the Civil War army supplies, ammunition and cannon, and the armour-plate and parts of the machinery for the "Monitor" were made here. The first puddling works were opened in 1839, and Troy was long the centre of the New York iron and steel industry; in 1865 the second Bessemer steel works in the United States were opened here. Troy has three times been visited by severe conflagrations, that of June 1820 entailing a loss of about $1,000,000, that of August 1854 about the same, and that of May 1862, known as "the Great Fire," the destruction of over 500 buildings, and a property loss of some $3,000,000.

See Arthur J. Weise, *History of the City of Troy* (Troy, 1876), and *Troy's One Hundred Years* (Troy, 1891).

TROY, a city and the county-seat of Miami county, Ohio, U.S.A., on the west bank of the Great Miami river, about 65 m. W. of Columbus. Pop. (1890), 4494; (1900), 5881 (234 foreign-born); (1910), 6122. Troy is served by the Cleveland, Cincinnati, Chicago & St Louis and the Cincinnati, Hamilton & Dayton railways, and by the Dayton & Troy and the Springfield, Troy & Piqua electric inter-urban lines. The Miami and Erie Canal, formerly important for traffic, is now used only for power. The principal public buildings include the court house and the city hall, and there are a public library (housed in the city hall) and a children's home. Troy is situated in a good general farming region, of which tobacco is an important crop; and there are various manufactures. The municipality owns and operates the waterworks and electric-lighting plant. The first settlement was made in 1807, and Troy was first chartered as a city in 1890.

TROYES, a town of France, capital of the department of Aube, 104 m. E.S.E. of Paris on the Eastern railway to Belfort. Pop. (1906), 51,228. The town is situated in the wide alluvial plain watered by the Seine, the main stream of which skirts it on the east. It is traversed by several small arms of the river, and the Canal de la Haute-Seine divides it into an upper town, on the left bank, and a lower town on the right bank. The streets are, for the most part, narrow and crooked. It is surrounded by a belt of *boulevards*, outside which lie suburbs. The churches of the town are numerous, and especially rich in stained glass of the Renaissance period, from the hands of Jean Soudain, Jean Macadré, Linard Gonthier and other artists.

St Pierre, the cathedral, was begun in 1208, and it was not until 1640 that the north tower of the façade was completed. With a height to the vaulting of only 98 ft. it is less lofty than other important Gothic cathedrals of France. It consists of an apse with seven apse chapels, a choir with double aisles, on the right of which are the treasury and sacristy, a transept without aisles, a nave with double aisles and side chapels and a vestibule. The west façade belongs to the 16th century with the exception of the upper portion of the north tower; the south tower has never been completed. Three portals, that in the centre surmounted by a fine flamboyant rose window, open into the vestibule. The stained glass of the interior dates mainly from the 15th and 16th centuries. The treasury contains some fine enamel work and lace. The church of St Urban, begun in 1262 at the expense of Pope Urban IV., a native of the town, is a charming specimen of Gothic architecture, the lightness and delicacy of its construction rivalling that of churches built a century later. The glass windows, the profusion of which is the most remarkable feature of the church, date, for the most part, from the years 1265 to 1280. The church of La Madeleine, built at the beginning of the 13th century, and enlarged in the 16th, contains a rich rood-screen by Giovanni Gualdo (1508) and fine stained-glass windows of the 16th century. The church of St Jean, though hidden among old houses, is one of the most picturesque in Troyes. The choir is a fine example of Renaissance architecture and the church contains a high altar of the 17th century, stained glass of the 16th century and many other works of art. St Nicholas is a building of the 16th century with a beautiful vaulted gallery in the interior. The church of St Pantaléon of the 16th century and that of St Nizier, mainly of the same period, contain remarkable sculptures and paintings. St Remi (14th, 15th and 16th centuries) and St Martin-ès-Vignes (16th and 17th centuries), the latter notable for its 17th-century windows, are also of interest. The old abbey of St Loup is occupied by a museum containing numerous collections. The Hôtel Dieu of the 18th century is remarkable for the fine gilded iron railing of its courtyard. Most of the old houses of Troyes are of wood, but some of stone of the 16th century are remarkable for their beautiful and original architecture. Amongst the latter the hôtels de Vauluisant, de Mauroy and de Marisy are specially interesting. The prefecture occupies the buildings of the old abbey of Notre-Dame-aux-Nonnains; the Hôtel-de-ville dates from the 17th century; the savings bank, the theatre and the *lycée* are modern buildings. A marble monument to the Sons of Aube commemorates the war of 1870–71.

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[1] Emma Hart was born in Berlin, Connecticut, became a teacher in 1803, and in 1809 married Dr John Willard of Middlebury, Vermont, where she opened a boarding school for girls in 1814. In 1819 she wrote *A Plan for Improving Female Education*, submitted to the governor of New York state; and in 1821 she removed to Troy. Her son took charge of the school in 1838. She prepared many textbooks and wrote *Journal and Letters from France and Great Britain* (1833). See the biography (1873) by John Lord.

Troyes is the seat of a bishop and a court of assize. Its public institutions include a tribunal of first instance, a tribunal of commerce, a council of trade arbitrators, a chamber of commerce and a branch of the Bank of France. A *lycée*, an ecclesiastical college, training colleges for male and female teachers, and a school of hosiery are its chief educational institutions. There are also several learned societies and a large library. The dominant industry in Troyes is the manufacture of cotton, woollen and silk hosiery, which is exported to Spain, Italy, the United States and South America; printing and dyeing of fabrics, tanning, distilling, and the manufacture of looms and iron goods are among the other industries. The market gardens and nurseries of the neighbourhood are well known. There is trade in the wines of Burgundy and Champagne, in industrial products, in snails and in the dressed pork prepared in the town.

History.—At the beginning of the Roman period Troyes (*Augustobona*) was the principal settlement of the Tricassi, from whose name its own is derived. It owed its conversion to Christianity to Saints Savinian and Potentian, and in the first half of the 4th century its bishopric was created as a suffragan of Sens. St Loup, the most illustrious bishop of Troyes, occupied the episcopal seat from 426 to 479. He is said to have persuaded Attila, chief of the Huns, to leave the town unpillaged, and is known to have exercised great influence in the Church of Gaul. The importance of the monastery of St Loup, which he founded, was overshadowed by that of the abbey of nuns known as Notre-Dame-aux-Nonnains, which possessed large schools and enjoyed great privileges in the town, in some points exercising authority even over the bishops themselves. In 892 and 898 Troyes suffered from the depredations of the Normans, who on the second occasion reduced the town to ruins. In the early middle ages the bishops were supreme in Troyes, but in the 10th century this supremacy was transferred to the counts of Troyes (see below), who from the 11th century were known as the counts of Champagne. Under their rule the city attained great prosperity. Its fairs, which had already made it a prominent commercial centre, flourished under their patronage, while the canals constructed at their expense aided its industrial development. In the 12th century both the counts and the ecclesiastics joined in the movement for the enfranchisement of their serfs, but it was not till 1230 and 1242 that Thibaut IV. granted charters to the inhabitants. A disastrous fire occurred in 1188; more disastrous still was the union of Champagne with the domains of the king of France in 1304, since one of the first measures of Louis le Hutin was to forbid the Flemish merchants to attend the fairs, which from that time declined in importance. For a short time (1419–1425), during the Hundred Years' War, the town was the seat of the royal government, and in 1420 the signing of the Treaty of Troyes was followed by the marriage of Henry V. of England with Catherine, daughter of Charles VI., in the church of St Jean. In 1429 the town capitulated to Joan of Arc. The next hundred years was a period of prosperity, marred by the destruction of half the town by the fire of 1524. In the 16th century Protestantism made some progress in Troyes but never obtained a decided hold. In 1562, after a short occupation, the Calvinist troops were forced to retire, and on the news of the massacre of St Bartholomew fifty Protestants were put to death. The revocation of the Edict of Nantes in 1685 was a severe blow to the commerce of Troyes, which was not revived by the re-establishment of the former fairs in 1697. The population fell from 40,000 to 24,000 between the beginning of the 16th century and that of the 19th century.

See T. Boutiot, *Histoire de Troyes et de la Champagne méridionale* (4 vols., Troyes, 1870–1880); R. Koechlin and J. J. Marquet de Vasselot, *La Sculpture à Troyes et dans la Champagne méridionale au seizième siècle* (Paris, 1900). (R. Tr.)

Counts of Troyes. The succession of the counts of Troyes from the 9th to the 10th century can be established in the following manner. Aleran, mentioned in 837, died before the 25th of April 854. Odo (or Eudes) I. appears as count on the 25th of April 854, and seems to have been stripped of his dignities in January 859. Raoul, or Rudolph, maternal uncle of King Charles the Bald, was count of Troyes in 863 and 864, and died on the 6th of January 866. Odo I. seems to have entered again into possession of the countship of Troyes after the death of Raoul, and died himself on the 10th of August 871. Boso, afterwards king of Provence, received the countship in ward after the death of Odo I. A royal diploma was granted at his request, on the 29th of March 877, to the abbey of Montier-la-Celle in Troyes. Odo II., son of Odo I., became count of Troyes on the 25th of October 877. Robert I., brother of Odo II., was count from 879. He married Gisla, sister of kings Louis III. and Carloman, and was killed by the Northmen in 886 Aleaume, nephew of Robert I., is mentioned in 893. Richard, son of the viscount of Sens Garnier, is styled count of Troyes in a royal diploma of the 10th of December 926. He was living in 931. Herbert I., already count of Vermandois, succeeded Richard, and died in 943. Robert II., one of the five sons of Herbert of Vermandois, is called count of Troyes in an act of the 6th of August 959, and died in August 968. Herbert II. the Old, younger brother of Robert II., succeeded him and died between 980 and 983. Herbert III. the Young, nephew and successor of Herbert II., died in 995. Stephen I., son and successor of Herbert III., was alive in 1019. His successor was his cousin, Odo II., count of Blois. From the 11th century the counts of Troyes, whose domains increased remarkably, are commonly designated by the name of counts of Champagne.

See H. d'Arbois de Jubainville, *Histoire des ducs et des comtes de Champagne* (1859), vol. i.; F. Lot, *Les Derniers Carolingiens*, (1891), pp. 370–377; A. Longnon, *Documents relatifs au comté de Champagne et de Brie* (1904), ii. 9, note. (A. Lo.)

TROYON, CONSTANT (1810–1865), French painter, was born on the 28th of August 1810 at Sèvres, near Paris, where his father was connected with the famous manufactory of china. Troyon was an animal painter of the first rank, and was closely associated with the artists who painted around Barbizon. The technical qualities of his methods of painting are most masterly; his drawing is excellent, and his composition always interesting. It was only comparatively late in life that Troyon found his *métier*, but when he realized his power of painting animals he produced a fairly large number of good pictures in a few years. Troyon entered the *ateliers* very young as a decorator, and until he was twenty he laboured assiduously at the minute details of porcelain ornamentation; and this kind of work he mastered so thoroughly that it was many years before he overcame its limitations. By the time he reached twenty-one he was travelling the country as an artist, and painting landscapes so long as his finances lasted. Then when pressed for money he made friends with the first china manufacturer he met and worked steadily at his old business of decorator until he had accumulated enough funds to permit him to start again on his wanderings.

Troyon was a favourite with Roqueplan, an artist of distinction eight years his senior, and he became one of his pupils after receiving certain tuition from a painter, now quite unknown, named Riocreux. Roqueplan introduced Troyon to Rousseau, Jules Dupré, and the other Barbizon painters, and in his pictures between 1840 and 1847 he seemed to endeavour to follow in their footsteps. But as a landscapist Troyon would never have been recognized as a thorough master, although his work of the period is marked with much sincerity and met with a certain success. It may be pointed out, however, that in one or two pure landscapes of the end of his life he achieved qualities of the highest artistic kind; but this was after lengthy experience as a cattle painter, by which his talents had become thoroughly developed.

In 1846 Troyon went to the Netherlands, and at the Hague saw Paul Potter's famous "Young Bull." From the studies he made of this picture, of Cuyp's sunny landscapes, and brandt's noble masterpieces he soon evolved a new method of painting, and it is only in works produced after this time that Troyon's true individuality is revealed. When he became conscious of his power as an animal painter he developed with rapidity and success, until his works became recognized as masterpieces in Great Britain and America, as well as in all countries of the Continent. Success, however, came too late, for Troyon never quite believed in it himself, and even when he could command the market of several countries he still grumbled loudly at the way the world treated him. Yet he was decorated with the Legion of Honour, and five times received medals at the Paris Salon, while Napoleon III. was one of his patrons; and it is certain he was at least as financially successful as his Barbizon colleagues.

Troyon died, unmarried, at Paris on the 21st of February 1865, after a term of clouded intellect. All his famous pictures are of date between 1850 and 1864, his earlier work being of comparatively little value. His mother, who survived him, instituted the Troyon prize for animal pictures at the École des Beaux Arts. Troyon's work is fairly well known to the public through a number of large engravings from his pictures. In the Wallace Gallery in London are "Watering Cattle" and "Cattle in Stormy Weather"; in the Glasgow Corporation Gallery is a "Landscape with Cattle"; the Louvre contains his famous "Oxen at Work" and "Returning to the Farm"; while the Metropolitan Museum of Art and other galleries in America contain fine examples of his pictures. His "Vallée de la Toucque, Normandy," is one of his greatest pictures; and at Christie's sale-room in 1902 the single figure of a cow in a landscape of but moderate quality fetched £7350. Émile van Marcke (1827–1891) was his best-known pupil

See H. Dumesnil, *Constant Troyon: Souvenirs intimes* (Paris, 1888); A. Hustin, "Troyon," *L'Art*, pp. 77 and 85 (Paris, 1889); Albert Wolff, "Constant Troyon," *La Capitale de l'art* (Paris, 1886); D. C. Thomson, *The Barbizon School of Painters* (London, 1890); "Constant Troyon," *The Art Journal* (1893), p. 22. (D. C. T.)

TRUCE OF GOD, an attempt of the Church in the middle ages to alleviate the evils of private warfare Throughout the 9th and 10th centuries, as the life-benefices of the later Carolingian kings were gradually transformed into hereditary fiefs, the insecurity of life and property increased, for there was no central power to curb the warring local magnates. The two measures which were adopted by the Church to remedy these conditions—the *pax ecclesiae* or *Dei* and the *treuga* or *treva Dei*—are usually both referred to as the Truce of God, but they are distinct in character The latter was a development of the former

The *pax ecclesiae* is first heard of in the year 990 at three synods held in different parts of southern and central France—at Charroux, Narbonne and Puy. It enlisted the immediate support of the regular clergy, particularly the vigorous congregation of Cluny, and of William V. of Aquitaine, the most powerful lord of southern France, who urged its adoption at the Councils of Limoges (994) and Poitiers (999). The peace decrees of these various synods differed considerably in detail, but in general they were intended fully to protect non-combatants; they forbade, under pain of excommunication, every act of private warfare or violence against ecclesiastical buildings and their environs, and against certain persons, such as clerics, pilgrims, merchants, women and peasants, and against cattle and agricultural implements. With the opening of the 11th century, the *pax ecclesiae* spread over northern France and Burgundy, and diocesan leagues began to be organized for its maintenance. The bishop, or count, on whose lands the peace was violated was vested with judicial power, and was directed, in case he was himself unable to execute sentence, to summon to his assistance the laymen and even the clerics of the diocese, all of whom were required to take a solemn oath to observe and enforce the peace. At the Council of Bourges (1038), the archbishop decreed that every Christian fifteen years and over should take such an oath and enter the diocesan militia The idea that peace is a divine institution seems to have given rise to a new name for the peace, the *pax Dei*, or peace of God

The *treuga* or *treva Dei*, the prohibition of every act of private warfare during certain days, goes back at least to the Synod of Elne, held in the Pyrenees in 1027, which suspended all warfare from noon on Saturday till prime on Monday. Like the *pax ecclesiae* it found ardent champions in the regular clergy, especially in Odilo (962–1049), the fifth abbot of Cluny, and soon spread over all France. It penetrated Piedmont and Lombardy in 1041 and Normandy in 1042. By this time the truce extended from the Wednesday evening to the Monday morning in every week and also, in most places, lasted during the seasons of Lent and Advent, the three great vigils and feasts of the Blessed Virgin, and those of the twelve apostles and a few other saints. The *treuga Dei* was decreed for Flanders at the Synod of Thérouanne (1063) and was instituted in southern Italy in 1089, probably through Norman influence. The bishop of Liége introduced it in Germany in 1082, and three years later a synod held at Mainz in the presence of the emperor Henry IV extended it to the whole empire. It does not appear to have secured a firm footing in England, although its general provisions were incorporated in the laws of the land (1130–1154). The popes took the direction of the matter into their own hands towards the end of the 11th century as they realized the necessity of promoting peace among Christians in order to unite them successfully in the crusades against the Mahommedans, and the first decree of the Council of Clermont (1095), at which Urban II. preached the first crusade, proclaimed a weekly truce for all Christendom, adding a guarantee of safety to all who might take refuge at a wayside cross or at the plough. The Truce of God was reaffirmed by many councils, such as that held at Reims by Calixtus II. in 1119, and the Lateran councils of 1123, 1139 and 1179. When the *treuga Dei* reached its most extended form, scarcely one-fourth of the year remained for fighting, and even then the older canons relating to the *pax ecclesiae* remained in force. The means employed for its enforcement remained practically the same: spiritual penalties, such as excommunication, special ecclesiastical tribunals, sworn leagues of peace, and assistance from the temporal power The Council of Clermont prescribed that the oath of adherence to the truce be taken every three years by all men above the age of twelve, whether noble, burgess, villein or serf. The results of these peace efforts were perhaps surprisingly mediocre, but it must be borne in mind that not only was the military organization of the dioceses always very imperfect, but feudal society, so long as it retained political power, was inherently hostile to the principle and practice of private peace. The Truce of God was most powerful in the 12th century, but with the 13th its influence waned as the kings gradually gained control over the nobles and substituted the king's peace for that of the Church.

A few bishops, notably Gerard of Cambrai (1013–1051), seem from the first to have opposed the peace laws of the Church as encroaching on royal authority, but the lay rulers usually co-operated with the ecclesiastical authorities in encouraging and maintaining the Truce of God. In fact, the emperor Henry II. and the French king Robert the Pious discussed the subject of universal peace under church auspices at Monzon in 1023. By the 12th century, however, the ecclesiastical measures had proved ineffectual in coping with private warfare, and secular rulers sought independently to diminish the number and atrocity of private wars within their own domains The provisions of the Truce of God were often incorporated bodily in municipal and district statutes such as the laws of Barcelona (1067) The emperor Henry IV. approved (1085) the extension of the truce to the whole land, and in 1103 royal laws entirely prohibiting private warfare in the empire replaced the Truce of God In France, royalty acquired little by little a preponderant influence over feudalism and used its increased prestige to substitute for the Truce of God the peace of the state Louis VI., Louis VII. and Philip Augustus gradually obtained recognition not only from the petty lords of their own domain but from most of the magnates of the kingdom. Thanks to the moral support and material resources which it found in the ecclesiastical lords of central and northern France, and to the growing popular desire for the suppression of feuds, royalty was able to support its pretension to the general government of the kingdom. Confirming what was doubtless an older custom, Philip Augustus decreed the *quarantaine-le-roi*, which suspended every act of reprisal for at least forty days, and in 1257 Louis IX absolutely forbade all private wars in the crown lands. By the beginning of the 14th century the royal authority had sufficient force to ensure the maintenance of the *Landesfriede*. In England, where the Truce of God does not seem to have acquired a firm footing, state law against private warfare obtained practically from the time of the Norman conquest. At least from Henry I it became an axiom that the law of the king's court stood above all other law and was the same for all.

See L. Huberti, *Studien zur Rechtsgeschichte der Gottesfrieden und Landfrieden*, Bd. i. *Die Friedens-Ordnungen in Frankreich* (Ansbach, 1892), A. Luchaire, "La Paix et la trêve de Dieu," in E. Lavisse's *Histoire de France*, II. 2, pp. 133–138 (Paris, 1901); E. Sémichon, *La Paix et la trêve de Dieu* (2nd ed. 1869); E. Mayer, *Deutsche und französische Verfassungsgeschichte* (1899), vol. i, J. Fehr, *Der Gottesfriede und die katholische Kirche des Mittelalters* (Augsburg, 1861); A. Kluckhohn, *Geschichte des Gottesfriedens* (Leipzig, 1857); K. J. von Hefele, *Conciliengeschichte*, 2nd ed., vol. 4; Du Cange, *Glossarium*, *s.v. Treuga*. The principal French documents on the subject are published in Huberti's book, and those of Germany, Italy and Arles are edited by L. Weiland in the *Monumenta Germaniae historica, constitutiones* i. 596 sqq. (C. H. Ha.)

TRUCK. (1) A name for barter, or commodities used in barter or trade. The word came into English from the French *troq*, mod. *troc*; *troquer*, to barter, is borrowed from Spanish *trocar*, for which several origins have been suggested, such as a Low Latin *travicare*, the supposed original of "traffic" (*q.v.*), or some latinized form of Greek *τρόπος*, turn; it may, on the other hand, be connected with the Greek *τροχός*, wheel. "Truck," in this sense, is chiefly used now in the sense of the payment of the wages of workmen *in kind*, or in any other way than the unconditional payment of money, a practice known as the "truck system." Colloquially, "truck" is used in the general sense of "dealing," in such expressions as "to have no truck with anyone." The "truck system" has taken various forms. Sometimes the workman has been paid with "portion of that which he has helped to produce," whether he had need of it or not, but the more usual form was to give the workman the whole or part of his wages in the shape of commodities suited to his needs. There was also a practice of paying in money, but with an express or tacit understanding that the workman should resort for such goods as he required to shops or stores kept by his employer. The truck system led in many cases to grave abuses and was made illegal by the Truck Acts, under which wages must be paid in current coin of the realm, without any stipulations as to the manner in which the same shall be expended. (See LABOUR LEGISLATION.) (2) From the Late Latin *trochus*, wheel, Greek *τροχός*, we get "truck" in the sense of a wheeled vehicle, such as the hand-barrows used for carrying luggage at a railway station; and the word is used generally for all that portion of railway rolling-stock which is intended for the carriage of goods (see RAILWAYS: *Rolling-stock*). The term is also used of a circular disk of wood at the top of a ship's mast, generally provided with sheaves for the signal halyards.

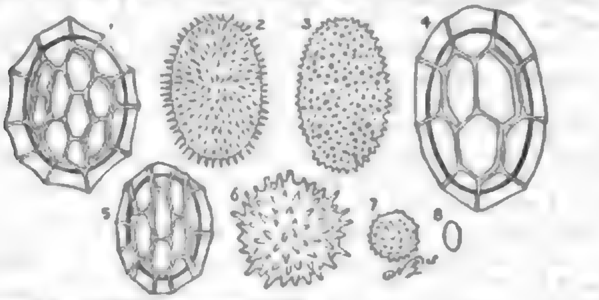
TRUCKLE, a verb meaning to submit servilely or fawningly to another's bidding, to yield in a weak, feeble or contemptible way. The origin is the "truckle bed," a small bed on wheels which could be pushed under a large one. In early times servants or children slept in such beds, placed at the foot of their masters' and parents' bed, but the name first appears as a university word, and was derived direct from Latin *trochlea*, a wheel or pulley-block, Greek *τροχός*, wheel (*τρέχειν*, to run)

TRUEBA, ANTONIO DE (1819–1889), Spanish novelist, was born on the 24th of December 1819 at Montellano (Biscay), where he was privately educated. In 1835 he was sent to learn business at Madrid, but commerce was not to his taste, and, after a long apprenticeship, he turned to journalism. In 1851 he hit the popular taste with *El Cid Campeador* and *El Libro de los cantares*, for the next eleven years he was absorbed by journalistic work, the best of his contributions being issued under the titles of *Cuentos populares* (1862), *Cuentos de color de rosa* (1864), and *Cuentos campesinos* (1865). The pleasant simplicity and idyllic sentimentalism of these collections delighted an uncritical public, and Trueba met the demand by supplying a series of stories conceived in the same ingenuous vein. In 1862 he was appointed archivist and chronicler of the Biscay provinces, he was deprived of the former post in 1870, but was reinstated after the restoration. He died at Bilbao on the 10th of March 1889.

TRUFFLE (from Med. Fr. *trufle*, a variant of *truffe*, generally taken to be for *tufle*, from Lat. *tuber*, an esculent root, a tuber, cf. Ital *tartufo*, *truffle*, from Lat. *terrae tuber*, another Ital. form *tartufola* gave Ger. *Tartoffel*, dissimilated to *Kartoffel*, potato), the name of several different species of subterranean fungi which are used as food. The species sold in English markets is *Tuber aestivum*; the commonest species of French markets is *T. melanosporum*, and of Italian the garlic-scented *T. magnatum*. Of the three, the English species is the least desirable, and the French is possibly the best. The truffle used for Perigord pie (*pâté de foie gras*) is *T. melanosporum*, regarded by some as a dark variety of our British species, *T. brumale*. When, however the stock of *T. melanosporum* happens to be deficient, some manufacturers use inferior species, such as the worthless or dangerous *Choeromyces meandriformis*. Even the rank and offensive *Scleroderma vulgare* (one of the puff-ball series of fungi) is sometimes used for stuffing turkeys, sausages, &c. Indeed, good truffles, and then only *T. aestivum*, are seldom seen in English markets. The taste of *T. melanosporum* can be detected in Perigord pie of good quality. True and false truffles can easily be distinguished under the microscope.

Tuber aestivum, the English truffle, is roundish in shape, covered with coarse polygonal warts, black in colour outside and brownish and veined with white within, its average size is about that of a small apple. It grows from July till autumn or winter, and prefers beech, oak and birch woods on argillaceous or calcareous soil, and has sometimes been observed in pine woods. It grows gregariously, often in company with *T. brumale* and (in France and Italy) *T. melanosporum*, and sometimes appears in French markets with these two species as well as with *T. mesentericum*. The odour of *T. aestivum* is very strong and penetrating, it is generally esteemed powerfully fragrant, and its taste is considered agreeable. The common French truffle, *T. melanosporum*, is a winter species. It is a valuable article of commerce and is exported from France in great quantities. The tubers are globose, bright brown or black in colour, and rough with polygonal warts; the mature flesh is blackish grey, marbled within with white veins. It is gathered in autumn and winter in beech and oak woods, and is frequently seen in Italian markets. The odour of *T. melanosporum* is very pleasant, especially when the tubers are young, then somewhat resembling that of the strawberry; with age the smell gets very potent, but is never considered really unpleasant. The common Italian truffle, *T. magnatum*, is pallid ochreous or brownish buff in colour, smooth or minutely papillose, irregularly globose, and lobed, the interior is a very pale brownish liver colour veined with white. It grows towards the end of autumn in plantations of willows, poplars and oaks, on clayey soil. Sometimes it occurs in open cultivated fields. The odour of the mature fungus is very potent, and is like strong garlic, onion or decaying cheese. *T. brumale*, referred to above, grows in Britain. It is a winter truffle, and is found chiefly under oaks and abele trees from October to December. It is black in colour, globose, more or less regular in shape, and is covered with sharp polygonal warts, the mature flesh is blackish grey marbled with white veins. The odour is very strong and lasts a long time; the taste is generally esteemed agreeable. *Choeromyces meandriformis*, which occurs in Britain, is sometimes sold for *T. magnatum*, the colour of the flesh of both species being somewhat similar. *Scleroderma vulgare*, the "false truffle," is extremely common on the surface of the ground in woods, and is gathered by Italians and Frenchmen in Epping Forest for the inferior dining-rooms of London where continental dishes are served. It is a worthless, offensive, and possibly dangerous fungus. A true summer truffle, *T. mesentericum*, found in oak and birch woods on calcareous clay soil, is frequently eaten on the Continent. It is esteemed equal to *T. aestivum*, of which it is regarded as a variety and probably grows in Britain. Another edible species, *T. macrosporum*, also grows in Britain, in clayey places under young beeches and oaks, on the borders of streams and roads, and sometimes in fields, more rarely it grows in plantations of willow and poplar. It has a strong scent of onions or garlic somewhat similar to *T. aestivum*, but it is less esteemed on account of its toughness and its small size.

Terfezia leonis, a famous truffle of Italy, Algeria, Sardinia, &c., resembles externally a potato. It grows in March, April and May. Some persons eat it in a raw state, sliced and dipped in oil or egg. It is not scented, and its taste is generally considered insipid or soapy. *Melanogaster variegatus*, an ally of the puff-balls, and therefore (like *Scleroderma*) not a true truffle, is sometimes eaten in England and France. It has been, and possibly still is, occasionally sold in England under the name of "red truffle." It is a small ochreous-brown species with a strong aromatic and pleasant odour of bitter almonds. When the plant is eaten raw the taste is sweet and sugary, but when cooked it is hardly agreeable. The odour belonging to many truffles is so potent that their places of growth can be readily detected by the odour exhaled from the ground. Squirrels, hogs and other animals commonly dig up truffles and devour them, and pigs and dogs have long been trained to point out the places where they grow. Pigs will always eat truffles, and dogs will do so occasionally; it is therefore usual to give the trained pig or dog a small piece of cheese or some little reward each time it is successful. Truffles are reproduced by spores, which serve the same purpose as seeds in flowering plants; in true truffles the spores are borne in transparent sacs (asci), from four to eight spores in each ascus. The asci are embedded in vast numbers in the flesh of the truffle. In false truffles the spores are free and are borne on minute spicules or supports. The spores of the chief European truffles, true and false, enlarged five hundred diameters, are shown in the accompanying illustration. Many references to truffles occur in classical authors. The truffle *Elaphomyces variegatus* was till quite recent times used, under the name of Hart's nut or Lycoperdon nut, on account of its supposed aphrodisiac qualities.



Spores of the Chief European Truffles.

1. *Tuber aestivum.*
2. *T. brumale.*
3. *T. melanosporum.*
4. *T. mesentericum.*
5. *T. magnatum.*
6. *Choeromyces meandriformis.*
7. *Scleroderma vulgare.*
8. *Melanogaster variegatus.*

TRUJILLO, or TRUXILLO, a seaport on the Atlantic coast of Honduras, in 15° 54′ N. and 86° 5′ W. Pop. (1905), about 4000. The harbour, an inlet of the Bay of Honduras, is sheltered on the north by the promontory of Cape Honduras; it is deep and spacious, but insecure in westerly winds. Mahogany, dye-woods, sarsaparilla, cattle, hides and fruit are exported; grain, flour, hardware and rum are imported. Trujillo was founded in 1524, and became one of the most prosperous ports of the new world, and the headquarters of a Spanish naval squadron. During the 17th century it was frequently and successfully raided by buccaneers, and thus lost much of its commerce. Still more has in modern times been diverted to Puerto Cortes and the Bay Islands.

TRUJILLO, or TRUXILLO, a city of northern Peru, the see of a bishopric, and capital of the department of Libertad, about 315 m. N.N.W of Lima and 1½ m. from the Pacific coast, in lat. 8° 7′ S., long 79° 9′ W. Pop. (1906, estimate), about 6500. The city stands on the arid, sandy plain (Mansiché, or Chimu), which skirts the coast from Paita south to Santa, a few miles north of the Moche or Chimu river, and at the northern entrance to the celebrated Chimu Valley. North and east are the ruins of an old Indian city commonly known as the Grand Chimu, together with extensive aqueducts and reservoirs. The city is partly enclosed by an old adobe wall built in 1686, and its buildings are in great part also constructed of adobe. The public institutions include a university, two national colleges, one of which is for girls, an episcopal seminary, a hospital and a theatre.

Trujillo was once an important commercial centre and the metropolis of northern Peru, but the short railways running inland from various ports have taken away its commercial importance. The port of Salaverry (with which Trujillo is connected by rail) is about 10 m. south-east, where the national government has constructed a long iron pier. Railways also extend northward to Ascope and eastward to Laredo, Galindo and Menocucho, and a short line runs from Roma, on the Ascope extension, to the port of Huanchaco. The only important manufactures of Trujillo are cigars and cigarettes.

Trujillo was founded in 1535, by Francisco Pizarro, who gave it the name of his native city in Spain. Its position on the road from Tumbes to Lima gave it considerable political and commercial importance, and some reflection of that colonial distinction still remains. It suffered little in the War of Independence, but was occupied and plundered by the Chileans in 1882.

Of the ancient aboriginal city, or group of towns, whose ruins and burial-places cover the plain on every side of Trujillo, comparatively little is definitely known. The extent of these ruins, which cover an area 12 to 15 m. long by 5 to 6 m. wide, demonstrate that it was much the largest Indian city on the southern continent. The principal ruins are 4 m. north of Trujillo, but others lie more to the eastward and still others southward of the banks of the Moche. The great aqueduct, which brought water to the several large reservoirs of the city, was 14 m. long and in some places in crossing the Chimu Valley it had an elevation of 60 ft.

The name of Grand Chimu is usually given to the ruined city, this being the title applied to the chief of the people, who were called the Chimu, or Yuncas. They were a race wholly distinct from the Incas, by whom they were finally conquered. They spoke a different language and had developed an altogether different civilization, and it is not unreasonable to presume that they were related to some earlier race of southern Mexico. Specimens of skilfully wrought ornaments of gold and silver, artistically made pottery, and finely woven fabrics of cotton and wool (alpaca), have been found in their *huacas*, or burial-places. Bronze was known to them, and from it tools and weapons were made. Their extensive irrigation works show that they were painstaking agriculturists, and that they were successful ones may be assumed from the size of the population maintained in so arid a region. Since the Spanish conquest their *huacas* have been opened and rifled, and many of the larger masses of ruins have been extensively mined in search of treasure, but enough still remains to impress upon the observer the magnitude of the city and the genius of the people who built it. Nothing is known of their history or of their political institutions, but these remains of their handiwork bear eloquent testimony that they had reached a degree of development in some respects higher even than that of the Incas.

See E. G. Squier, *Peru* (New York, 1877); and Charles Wiener, *Pérou et Bolivie* (Paris, 1882).

TRUJILLO, a town of Spain, in the province of Caceres; on a hill 25 m. east of Caceres, and on the river Tozo, a sub-tributary of the Tagus. Pop. (1900), 12,512. The surrounding country is rugged, but produces wheat, wine, oils and fruit, besides livestock of all sorts, and much phosphorite. There are valuable forests close to the town. In the oldest part of Trujillo are the remains of a castle said to be of Roman origin, but rebuilt by the Moors and restored in modern times. The Julia tower is also said to be Roman, like much of the fortifications. The Roman name for the town was Turgalium. The principal parish church, Santa Maria, is a fine Gothic structure of the 15th century. Trujillo was a town of importance in the middle ages. Pizarro, the conqueror of Peru, was born here about 1471, and built a palace, which still stands, in the main square of the town.

TRUMBALL, SIR WILLIAM (1639–1716), English politician, was a grandson of William Trumball (d. 1635), who was for sixteen years English resident at Brussels and afterwards a clerk of the privy council. Educated at St John's College, Oxford, young Trumball became a fellow of All Souls and settled down as a practising lawyer in Oxford and in London. He was made chancellor of the diocese of Rochester and was sent to Tangier on public business in 1683, one of his companions on this errand being the diarist Pepys. In 1684 Trumball was knighted by Charles II. and in 1685 he was sent as envoy to France, where he worked hard on behalf of the English Protestants there who were threatened by the Revocation of the Edict of Nantes. In 1685 he became a member of Parliament, in 1687 he went as ambassador to Constantinople, and in 1694 he was made a lord of the treasury. From May 1695 until December 1697 he was a secretary of state under William III. He died on the 14th of December 1716. His son, William Trumball (1708–1760), had an only daughter, who became the wife of the Hon Martin Sandys. She was thus the ancestress of the later marquesses of Downshire.

Many of Trumball's letters are in the British Museum and in the Record Office, London. Trumball was on friendly terms with Pierre Bayle and with Dryden, whom he advised to translate Virgil. He was also very intimate with Pope, whom he influenced in several ways, especially in urging him to make a translation of Homer.

TRUMBULL, JAMES HAMMOND (1821–1897), American scholar, was born in Stonington, Connecticut, on the 20th of December 1821. He studied at Yale, but ill-health prevented his graduation. He was state librarian in 1854–1855, assistant-secretary of state of Connecticut in 1847–1852 and in 1858–1861, and secretary of state in 1861–1866; and was a prominent member of the Connecticut Historical Society, of which he was president in 1863–1889, the National Academy of Science, to which he was elected in 1872, and of other learned societies. He died in Hartford on the 5th of August 1897. He wrote *Historical Notes on some Provisions of the Connecticut Statutes* (1860–1861) and *The True Blue Laws of Connecticut* (1876), and edited *The Colonial Records of Connecticut* (3 vols., 1850–1859). He is better known, however, as a student of the Indian dialects of New England.

He edited Roger Williams's *Key to the Language of America* (1866), and wrote *The Composition of Indian Geographical Names* (1870), *The Best Methods of Studying the Indian Languages* (1871), *Indian Names of Places in . . . Connecticut with Interpretations* (1881) and other works on similar subjects.

TRUMBULL, JOHN (1750–1831), American poet, was born in what is now Watertown, Connecticut, where his father was a Congregational preacher, on the 24th of April 1750. At the age of seven he passed his entrance examinations at Yale, but did not enter until 1763; he graduated in 1767, studied law there, and in 1771–1773 was a tutor. In 1773 he was admitted to the bar, in 1773–1774 practised law in Boston, working in the law-office of John Adams, and after 1774 practised in New Haven. He was state attorney in 1789, a member of the Connecticut Assembly in 1792 and 1800, and a judge of the Superior Court in 1801–1819. The last six years of his life were spent in Detroit, Michigan, where he died on the 10th of May 1831. While studying at Yale he had contributed in 1769–1770 ten essays, called "The Meddler," imitating *The Spectator*, to the *Boston Chronicle*, and in 1770 similar essays, signed "The Correspondent" to the *Connecticut Journal and New Haven Post Boy*. While a tutor he wrote his first satire in verse, *The Progress of Dulness* (1772–1773), an attack in three poems on educational methods of his time. His great poem, which ranks him with Philip Freneau and Francis Hopkinson as an American political satirist of the period of the War of Independence, was *McFingal*, of which the first canto, "The Town-Meeting," appeared in 1776 (dated 1775). This canto, about 1500 lines, contains some verses from "Gage's Proclamation," published in the *Connecticut Courant* for the 7th and the 14th of August 1775. it portrays a Scotch Loyalist, McFingal, and his Whig opponent, Honorius, evidently a portrait of John Adams. This first canto was divided into two, and with a third and a fourth canto was published in 1782. After the war Trumbull was a rigid Federalist, and with the "Hartford Wits" David Humphreys, Joel Barlow and Lemuel Hopkins, wrote the *Anarchiad*, a poem directed against the enemies of a firm central government.

See the memoir in the Hartford edition of Trumbull's *Poetical Works* (2 vols., 1820); James Hammond Trumbull's *The Origin of "McFingal"* (Morrisania, New York, 1868); and the estimate in M. C. Tyler's *Literary History of the American Revolution* (New York, 1897).

TRUMBULL, JOHN (1756–1843), American artist, was born at Lebanon, Connecticut, on the 6th of June 1756, the son of Jonathan Trumbull (1710–1785), governor of Connecticut. He graduated at Harvard in 1773, served in the War of Independence, rendering a particular service at Boston by sketching plans of the British works, and was appointed second aide-de-camp to General Washington and in June 1776 deputy adjutant-general to General Gates, but resigned from the army in 1777. In 1780 he went to London to study under Benjamin West, but his work had hardly begun when the news of the arrest and execution of Major André, who was deputy adjutant-general in the English army, suggested the arrest of Trumbull as having been an officer of similar rank in the Continental army; he was imprisoned for seven months. In 1784 he was again in London working under West, in whose studio he painted his "Battle of Bunker Hill" and "Death of Montgomery," both of which are now in the Yale School of Fine Arts. In 1785 Trumbull went to Paris, where he made portrait sketches of French officers for "The Surrender of Cornwallis," and began, with the assistance of Jefferson, "The Signing of the Declaration of Independence," well-known from the engraving by Asher B. Durand. These paintings, with "The Surrender of Burgoyne," and "The Resignation of Washington," were bought by the United States government and placed in the Capitol at Washington. Trumbull's "Sortie from Gibraltar" (1787), owned by the Boston Athenaeum, is now in the Boston Museum of Fine Arts, and a series of historical paintings, the "Trumbull Gallery," by far the largest single collection of his works (more than 50 pictures), has been in the possession of Yale College since 1831, when Trumbull received from the college an annuity of $1000. His portraits include full lengths of General Washington (1790) and George Clinton (1791), in the city-hall of New York—where there are also full lengths of Hamilton and of Jay; and portraits of John Adams (1797), Jonathan Trumbull, and Rufus King (1800); of Timothy Dwight and Stephen Van Rensselaer, both at Yale; of Alexander Hamilton (in the Metropolitan Museum of Art, New York City, and in the Boston Museum of Fine Arts, both taken from Ceracchi's bust); a portrait of himself painted in 1833; a full length of Washington, at Charleston, South Carolina; a full length of Washington in military costume (1792), now at Yale; and portraits of President and Mrs Washington (1794), in the National Museum at Washington. Trumbull's own portrait was painted by Stuart and by many others. In 1794 Trumbull acted as secretary to John Jay in London during the negotiation of the treaty with Great Britain, and in 1796 he was appointed by the commissioners sent by the two countries the fifth commissioner to carry out the seventh article of the treaty. He was president of the American Academy of Fine Arts in 1816–1825. He died in New York on the 10th of November 1843.

See his *Autobiography* (New York, 1841); J. F. Weir, *John Trumbull, A brief Sketch of His Life, to which is added a Catalogue of his Works* (New York, 1901); and John Durand, "John Trumbull," *American Art Review*, vol. ii. pt. 2, pp. 181–191 (Boston, 1881).

TRUMBULL, JONATHAN (1710–1785), American political leader, was born at Lebanon, Connecticut, on the 12th of October 1710. He graduated at Harvard in 1727, and began the study of theology, but in 1731 engaged in business with his father. He next studied law, was elected to the Assembly in 1773, and held public office almost continuously afterward. He served for seven years in the Assembly, being Speaker for three years, for seventeen years as county judge of Windham county, for twenty-two years (after 1740) as governor's assistant, for two years as deputy-governor (1767–1769), and for three years (1766–1769) as chief justice of the colony. In 1769 he was elected governor and continued in office until his voluntary retirement in 1784. During the War of Independence he was a valued counsellor of Washington. The story that the term "Brother Jonathan," a sobriquet for the United States, originated in Washington's familiar form of addressing him seems to be without any foundation. After the war Trumbull was a strong Federalist. He died in Lebanon on the 17th of August 1785

His public papers have been printed in the Massachusetts Historical Society's *Collections*, 5th series, vols. ix.–x. (Boston, 1885–1888), and 7th series, vols. ii.–iii. (1902). See I. W. Stuart, *Life of Jonathan Trumbull, sen.* (Boston, 1859).

His son JONATHAN (1740–1809) graduated at Harvard in 1759, served in the War of Independence as paymaster-general of the northern department in 1775–1778 and as a military secretary of Washington in 1778–1783, and was a member of the national House of Representatives in 1789–1795, serving as Speaker in 1791–1793, and of the United States Senate in 1795–1796; he was lieutenant-governor of Connecticut in 1796–1798, and governor in 1798–1809. Another son, JOSEPH (1737–1778), was a member of the first Continental Congress (1774–1775), became commissary-general of stores of the Continental army in July 1775 and commissary-general of purchases in June 1777, resigned in August 1777, and from November 1777 to April 1778 was commissioner for the board of war. A grandson of the first Jonathan, JOSEPH (1782–1861), was a Whig representative in Congress in 1834–1835 and in 1839–1843, and was governor of Connecticut in 1849–1850.

TRUMBULL, LYMAN (1813–1896), American jurist and political leader, was born at Colchester, Connecticut, on the 12th of October 1813, and was a grandson of Benjamin Trumbull (1735–1820), a Congregational preacher and the author of a useful *Complete History of Connecticut* (2 vols., 1818). He taught in Georgia, studied law, and was admitted to the bar in 1837. Removing to Belleville, Illinois, in the same year, he was elected to the state House of Representatives as a Democrat in 1840, and in 1841–1843 was secretary of state of Illinois. In 1848–1853 he was a justice of the state Supreme Court, and in 1855–1873 was a member of the United States Senate. Elected as an Anti-Nebraska Democrat, he naturally joined the Republicans, and when this party secured control in the Senate he was made chairman of the important judiciary committee, from which he reported the Thirteenth Amendment to the Constitution of the United States abolishing slavery. Throughout the Civil War he was a trusted counsellor of the president. In the impeachment trial of President Andrew Johnson he was one of the seven Republicans who voted to acquit, and he afterwards returned to the Democratic party. After 1873 he practised law in Chicago, was the Democratic candidate for governor of Illinois in 1880, became a Populist in 1894, and defended the railway strikers in Chicago in the same year. He died in Chicago on the 25th of June 1896.

TRUMP (1) (O. Fr. *trompe*), originally the name of a musical instrument, of which "trumpet" is a diminutive; the term is now chiefly used in the sense of the sound of a trumpet, or a sound resembling it, such as is made by an elephant. It has been usually accepted that the Romanic forms (cf. Span. and Port. *trompa*) represent a corruption of Latin *tuba*, tube. On the other hand a distinct imitative or echoic origin is sometimes assigned. (2) In the sense of a playing card belonging to the suit which beats all other cards of other suits for the period during which its rank lasts, "trump" is a corruption of "triumph." The name was first used of a game of cards, also known as "ruff," which was the parent of the modern game of whist. There are traces in English of an early confusion with a term meaning to deceive or trick, cf. "trumpery," properly deceit, imposture, hence idle talk, gossip, now chiefly used as an adjective, worthless, trivial. This is an adaptation of French *tromper*, to deceive, which, according to the generally received explanation, meant "to play on the trumpet," *se tromper de quelqu'un* being equivalent to play with a person, hence to cheat.

TRUMPET (Fr. *trompette, clairon*; Ger. *Trompete, Klarino, Trummet*; Ital. *tromba, trombetta, clarino*), in music, a brass wind instrument with cup-shaped mouthpiece and a very characteristic tone. It consists of a brass or silver tube with a narrow cylindrical bore except for the bell joint, forming from ⅓ to ¼ of the whole length, which is conical and terminates in a bell of moderate diameter. The tube of the trumpet is doubled round upon itself to form a long irregular rectangle with rounded corners. A tuning slide consisting of two U-shaped cylindrical tubes fitting into each other is interpolated between the bell joint and the long cylindrical joint to which the mouthpiece is attached. The mouthpiece consists of a hemispherical cup with a rim across which the lips stretch. The shape of the cup, and more especially of the bottom, in which is pierced a hole communicating with the main bore, is of the greatest importance on account of its influence on the tone quality and on the production of the higher harmonics (see MOUTHPIECE). The shallower and smaller the cup the more easily are the higher harmonics produced; the sharper the angle at the bottom of the cup the more brilliant and incisive is the timbre, given, of course, the correct style of blowing. The diameter of the cup varies according to the pitch and to the lip-power of the player who chooses one to suit him. See HORN for the laws governing the acoustic properties of brass tubes and the production of sound by means of the lips stretched like a vibrating membrane across the mouthpiece.

There are three principal kinds of trumpets: (1) the natural trumpet, mainly used in cavalry regiments, in which the length of the tube and pitch are varied by means of crooks; (2) the slide and double-slide trumpets, in which a chromatic compass is obtained, as in the trombone, by double tubes sliding upon one another without loss of air; (3) the valve trumpet, similar in its working to all other valve instruments. The first and second of these alone give the true trumpet timbre; the tone of the valve trumpet approximates to that of the cornet, nevertheless, it is now almost universally used.

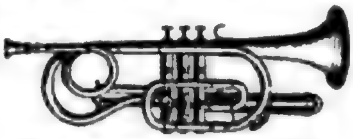
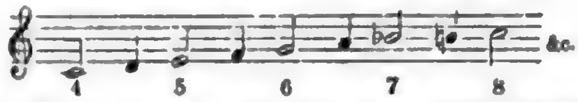
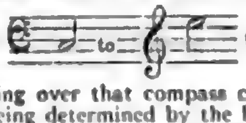


FIG. 1.—Military Trumpet in F (Besson).

In the trumpet the notes of the harmonic series from the 3rd to the 10th or 16th upper partials are produced by the varied tension of the lips and pressure of breath called overblowing. The fundamental and the second harmonic are rarely obtainable, and are therefore left out of consideration; the next octave from the 4th to the 8th harmonics contains only the 3rd, 5th and minor 7th, and is therefore mainly suitable for fanfare figures based on the common chord. The diatonic octave is the highest and its upper notes are only reached by very good players on trumpets of medium pitch. Examination of the scoring for the trumpet before any satisfactory means of bridging over the gaps in the compass had been found, shows how little the composers, and especially Bach, allowed themselves to be daunted by the limited resources at their disposal. A curious phenomenon has been observed[1] in connexion with the harmonic series of the trumpet, when the instrument is played by means of a special clarino mouthpiece (a shallow one enabling the performer to reach the higher harmonics), in which the passage at the bottom of the cup inaugurated by the sharp angle (known as the *grain* in French) is prolonged in *cylindrical* instead of conical bore for a distance of about 10 cm. (4 in.) right into the main tube. This peculiar construction of the mouthpiece, which might be considered insignificant, so upsets the acoustic properties of the tube that extra notes can be interpolated between the legitimate notes of the harmonic series thus:—



The black notes represent the extra notes, which in the next octave transform the diatonic into a chromatic scale.

This phenomenon may perhaps furnish an explanation of some peculiarities in the scoring of Bach and other composers of his day, and also in accounts of certain performances on the trumpet which have read[2] as fairy tales. It is probable that the clarino mouthpiece was one of the secrets of the gilds which has remained undiscovered till now. D. J. Blaikley writes[3]: "I had an opportunity yesterday of trying the trumpet mouthpiece as described by Mahillon with the 'grain' or 'throat,' as we would call it, extended for about 10 cm. and terminating abruptly. With such a mouthpiece, used by itself without any trumpet, I could easily get notes from  that is to say, that a continuous glide ranging over that compass can be made, the pitch at any moment being determined by the lip-pressure, rather than by the small air-column. When such a distorted mouthpiece is fitted to a trumpet, we have a resonator whose proper tones are disturbed and all the notes sounded are capable of being much modified in pitch by the lips. For instance, we may regard the 'd' as either No. 4 sharpened or No. 5 flattened, merely by lip-action, and other notes in the same way."

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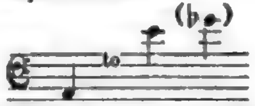
[1] See V. Mahillon, *La Trompette, son histoire, sa théorie, sa construction* (Brussels and London, 1907, pp. 29–30).

[2] See Fétis, *Biographie universelle des musiciens*, "Fantini."

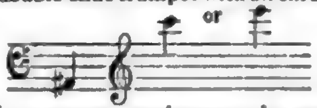
[3] Letter to the present writer, 6th of February 1909.

The compass of the three kinds of trumpets in real sounds is as follows:—

For the natural trumpet with crooks—

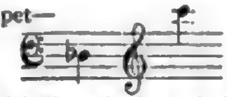


For the slide or double-slide trumpet with all chromatic semitones—



This instrument is a non-transposing one, the music being sounded as written.

For the valve trumpet—



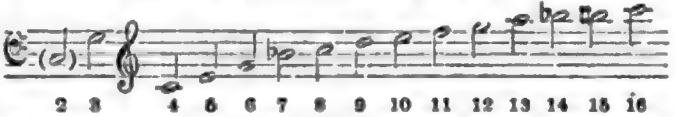
The material of which the tube is made has nothing to do with the production of that brilliant quality of tone by which the trumpet is so easily distinguished from every other mouthpiece instrument; the difference is partly due to the distinct form given to the basin of the mouthpiece, as stated above, but principally to the proportions of the column of air determined by the bore. The difference in timbre between trumpet and trombone is accounted for by the wider bore and differently shaped mouthpiece of the latter instrument.

Tonguing, both double and triple, is used with great effect on the trumpet: this device consists in the articulation with the tongue of the syllables *te-ke* or *ti-ke* repeated in rapid succession for groups of two or four notes and of *te-ke-ti* for triplets.

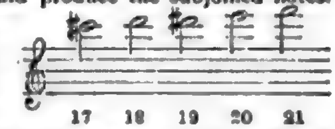
We have no precise information as to the form which the lituus, one of the ancestors of the modern trumpet, assumed during the middle ages, and it is practically unrepresented in the miniatures and other antiquities, though there is a miniature in the Bible, presented in 850 to Charles the Bald, which places the lituus in the hands of one of the companions of King David. We are not, however, warranted in concluding from this that the Etruscan instrument was in use in the 9th century. The lituus or cavalry trumpet of the Romans seems to have vanished with the fall of the Roman Empire, for although the name occasionally finds a place in Latin vocabularies, the instrument and name are both unrepresented in the development of musical instruments of western Europe: its successor, the cavalry trumpet of the 15th and succeeding centuries, was evolved from the straight *busine*, an instrument traced, by means of its name no less than by the delicate proportions of its tube and the shape of the bell, to the Roman buccina (*q.v.*). The straight busines, if we may judge from the presentments made by various artists, were not all made with bores of the same calibre, some having the wider bore of the trombone, others that of the trumpet. They abound in the illuminated MSS. of the 11th to the 14th centuries. The uses to which they are put, as the instruments of angels, of heralds, of trumpeters on horseback and on foot, at court banquets and functions of state, form additional proof of their identity. Fra Angelico (d. 1455) painted angels with trumpets having either straight or zigzag tubes, the shortest being about 5 ft. long. The perfect representation of the details, the exactness of the proportions, the natural pose of the angel players, suggest that the artist painted the instrument from real models.

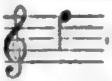
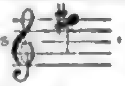
The credit of having bent the tube of the trumpet in three parallel branches, thus creating its modern form, has usually been claimed for a Frenchman named Maurin (1498–1515). But the transformation was really made much earlier, probably in the Low Countries or north Italy; in any case it had already been accomplished in the bas-reliefs of Luca della Robbia intended to ornament the organ chamber of the cathedral of Florence where a trumpet having the tube bent back as just described is very distinctly figured. From the beginning of the 16th century we have numerous sources of information. Virdung[2] cites three kinds of mouthpiece instruments—the *Felttrumet*, the *Clareta*, and the *Thurner Horn*; unfortunately he does not mention their distinctive characters, and it is impossible to make them out by examination of his engravings. Probably the Felttrumet and the Clareta closely resembled each other; but the compass of the former, destined for military signals, hardly went beyond the eighth proper tone, while the latter, reserved for high parts, was like the clarino (see below). The Thurner Horn was probably a kind of clarino or clarion used by watchmen on the towers. The *Trummet* and the *Jäger Trommet* are the only two mouthpiece instruments of the trumpet kind cited by Praetorius.[3] The first was tuned in D at the chamber pitch or "Cammerton," but with the help of a shank it could be put in C, the equivalent of the "chorton" D, the two differing about a tone. Sometimes the Trummet was lowered to B and even B♭. The Jäger Trommet, or "trompette de chasse," was composed of a tube bent several times in circles, like the posthorn, to make use of a comparison employed by Praetorius himself. His drawing does not make it clear whether the column of air was like that of the trumpet; there is therefore some doubt as to the true character of the instrument. The same author further cites a wooden trumpet (*hölzern Trommet*), which is no other than the Swiss Alpenhorn or the Norwegian luur. The shape of the trumpet, as seen in the bas-reliefs of Luca della Robbia, was retained for more than three hundred years: the first alterations destined to revolutionize the whole technique of the instrument were made about the middle of the 18th century. Notwithstanding the imperfections of the trumpet during this long period, the performers upon it acquired an astonishing dexterity.

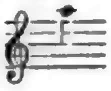
The usual scale of the typical trumpet, that in D, is



Praetorius exceeds the limits of this compass in the higher range, for he says a good trumpeter could produce the subjoined notes. This opinion is shared by Bach, who, in a trumpet solo which ends the cantata "Der Himmel lacht," wrote up to the twentieth harmonic. So considerable a compass could not be reached by one instrumentalist: the trumpet part had therefore to be divided, and each division was designated by a special name.[4] The part that was called principal went from the fifth to the tenth of these tones. The higher region, which had received the name of "clarino," was again divided into two parts: the first began at the eighth proper tone and mounted up towards the extreme high limit of the compass, according to the skill of the executant; the second, beginning at the sixth proper tone, rarely went beyond the twelfth. Each of these parts was confided to a special trumpeter, who executed it by using a larger or a smaller mouthpiece. Some of the members of the harmonic series also received special names; the fundamental or first proper note was called *Flattergrob*, the second *Grobstimme*, the third *Faulstimme*, the fourth *Mittelstimme*.



Playing the clarino differed essentially from playing the military trumpet, which corresponded in compass to that called principal. Compelled to employ very small mouthpieces to facilitate the emission of very high sounds, clarino players could not fail to alter the timbre of the instrument, and instead of getting the brilliant and energetic quality of tone of the mean register they were only able to produce more or less sonorous notes without power and splendour. Apart from this inconvenience, the clarino presented numerous deviations from just intonation. Hence the players of that time failed to obviate the bad effects inevitably resulting from the natural imperfection of the harmonic scale of the trumpet in that extreme part of its compass; in the execution, for instance, of the works of Bach, where the trumpet should give sometimes , and sometimes , the instrumentalist could only command the eleventh proper tone, which is neither the one nor the other of these. Further, the thirteenth proper tone, for which is written, is really too flat, and but little can be done to remedy this defect, since it entirely depends upon the laws of resonance affecting columns of air.



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[1] In the Bibliothèque Nationale at Paris, reproduced in facsimile by Count Auguste de Bastard (Paris, 1883).

[2] *Musica getutscht und aussgezogen* (Basel, 1511).

[3] *Organographia* (Wolfenbüttel, 1619).

[4] *Musicus αὐτοδίδακτος oder der sich selbst informirende Musicus* (Eisel, Erfurt, 1738).

Since the abandonment of the clarino (about the middle of the 18th century) our orchestras have been enriched with trumpets that permit the execution of the old clarino parts, not only with perfect justness of intonation, but with a quality of tone that is not deficient in character when compared with the mean register of the old principal instrument. The introduction of the clarinet or the so-called little clarino, although it is a wood wind instrument played with a reed, is one of the causes which led to the abandonment of the older instrument and may explain the preference given by the composers of that epoch to the mean register of the trumpet. The clarino having disappeared before Mozart's day, he had to change the trumpet parts of Handel and Bach to allow of their execution by the performers of his own time. It was now that crooks began to be frequently used. Trumpets were made in F instead of in D, furnished with a series of shanks of increasing length for the tonalities of E, E♭, D, D♭, C, B, B♭, and sometimes even A.

The first attempts to extend the limited resources of the instrument in its new employment arose out of Hampel's *Inventions-Horn*, in which, instead of fixing the shanks between the mouthpiece and the upper extremity, they were adapted to the body of the instrument itself by a double slide, upon the two branches of which tubes were inserted bent in the form of a circle and gradually lengthened as required. This system was applied to the trumpet by Michael Woegel (born at Rastatt in 1748), whose "invention trumpet" had a great success, notwithstanding the unavoidable imperfection of a too great disparity in quality of tone between the open and closed sounds. It is a curious fact that the sackbut or early trombone was merely a trumpet with a slide, or a draw trumpet, and that it was known as such in England, Scotland, Spain, Holland and Italy. Yet as soon as the powerful family of tenor and bass trombones had been created, the slide trumpet seems to have lost its identity and to have become merged in the alto trombone from which it differed mainly in the form of the bent tube. The slide trumpet appears to have been re-invented in the 18th century according to Johann Ernst Altenburg, or as some writers put it, "the slide was adapted to it from the trombone." It was mentioned in 1700 by Kuhnau[1] Any one wishing to be convinced of this re-incarnation may compare the modern slide-trumpet with the original slide-trumpet or alto sackbut in the *Grimiani Breviary*,[2] a MS of the 15th century, and with E van der Straeten's reproduction[3] of an old engraving by Galle and Stradan from the *Encomium Musices* in which the forms are identical except that in the modern slide-trumpet the bell reaches the level of the U-shaped bottom of the slide.

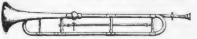
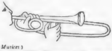


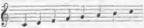
FIG 2—Modern Slide Trumpet F to C (Besson)



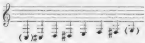
(From the *Encomium Musices*)

FIG 3.—Slide Trumpet 16th century.

The slide trumpet is still used in England in a somewhat modified form. The slide is a short one allowing of four positions In 1889 a trumpet was constructed by Mr W Wyatt with a double slide which gave the trumpet a complete chromatic compass. This instrument, which has the true brilliant trumpet tone, requires delicate manipulation, for the shifts are necessarily very short About 1760 Kölbel, a Bohemian musician,[4] applied a key to the bugle, and soon afterwards the trumpet received a similar addition By opening this key, which is placed near the bell, the instrument was raised a diatonic semitone, and by correcting errors of intonation by the tension of the lips in the mouthpiece the following diatonic succession was obtained



This invention was improved in 1801 by Weidinger,[5] trumpeter to the imperial court at Vienna, who increased the number of keys and thus made the trumpet chromatic throughout its scale.[6] The instrument shown in fig. 4 is in G; the keys are five in number, and as they open one after another or in combination it is possible to connect the second proper tone with the third by chromatic steps, and thus produce the following succession:—



The number of keys was applied to fill up the gaps between the extreme sounds of the interval of a fifth; and a like result was arrived at more easily for the intervals of the fourth, the major third, &c., furnished by the proper tones of 3, 4, 5, &c. But, though the keyed trumpet was a notable improvement on the invention trumpet, the sounds obtained by means of the lateral openings of the tube did not possess the qualities which distinguish sounds caused by the resonance of the air-column vibrating in its entirety. But in 1815 Stölzel made a genuine chromatic trumpet by the invention of the Ventile or piston.[7] The natural-trumpet is now no longer employed except in cavalry regiments.[8] It is usually in E♭. The bass trumpet in E♭, which is an octave lower, is sometimes, but rarely, used. Trumpets with pistons are generally constructed in F, with crooks in E and E♭. In Germany trumpets in the high B♭ with a crook in A are very often used in the orchestra. They are easier for cornet à piston players than the trumpet in F. A quick change trumpet in B♭ with combined tuning and transposing slides, for changing into the key of A, known as the "Proteano" trumpet, has been patented by Messrs Besson & Co. The transposing slide always remains at the correct length, and change of the tuning slide does not necessitate readjustment of the former. This combination slide is fitted to the ordinary valve trumpet as well as to the trumpet with "enharmonic" valves. Mahillon constructed for the concerts of the Conservatoire at Brussels trumpets in the high D, an octave above the old trumpet in the same key. They permit the execution of the high trumpet parts of Handel and J. S. Bach. The bass trumpet with pistons used for Wagner's tetralogy is in E♭, in unison with the ordinary trumpet with crooks of D and C; but, when constructed so as to allow of the production of the second proper tone as written by this master, this instrument belongs rather to the trombones than to the trumpets.

(V. M ; K. S.)

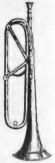


FIG 4—Keyed Trumpet.

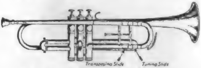


FIG. 5.—Proteano Trumpet in B♭ and A (Besson).

TRUMPET, SPEAKING AND HEARING. The speaking trumpet, though some instrument of the kind appears to have been in earlier use, is connected in its modern form with the name of Athanasius Kircher and that of Sir Samuel Morland, who in 1670 proposed to the Royal Society of London the question of the best form for a speaking trumpet. Lambert, in the *Berlin Memoirs* for 1763, seems to have been the first to give a theory of the action of this instrument, based on an altogether imaginary analogy with the behaviour of light. In this theory, which is still commonly put forward, it is assumed that sound, like light, can be propagated in rays. This, however, is possible only when the aperture through which the wave-disturbance passes into free air is large compared with the wave-length. If the fusiform mouth of the speaking trumpet were half a mile or so in radius, Lambert's theory might give an approximation to the truth. But with trumpets whose aperture is only a foot in diameter at the most the problem is one of diffraction.

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[1] *Der musikalische Quacksalber*, p. 83.

[2] Brit Mus Facsimile, 61, pl 9.

[3] *La Musique aux Pays-Bas*, vi 252

[4] *Versuch einer Anleitung zur heroisch-musikalischen Trompeter- und Pauker-Kunst*, p. 12 (Halle, 1795)

[5] See *Allg. musikal. Ztg.* (November 1802), p. 158, (January 1803) p. 245; and E. Hanslicks, *Gesch des Concertwesens in Wien* (1869), p 119.

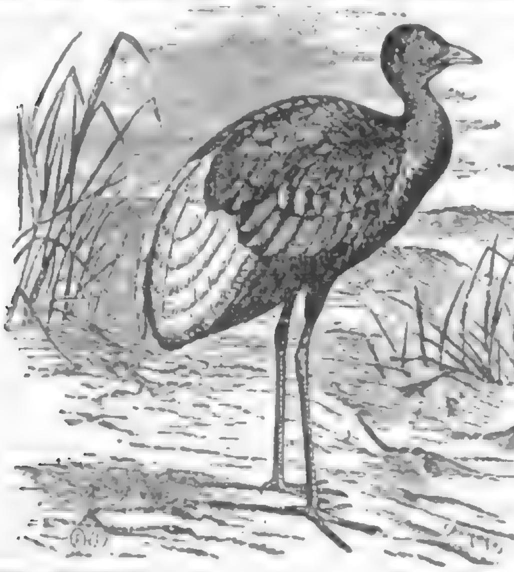
[6] Robert Eitner made a curious confusion between the keyed and valve trumpets (*Klappen- und Ventil-Trompete*). In an article entitled *Wer hat die Ventil-Trompete erfunden?* (*Monatshefte fur Musikwissenschaft*, p 41, Berlin, 1881) he deprives Stolzel of the credit of the invention of the valve in favour of Weidinger, ridiculing the notion that the keyed and the valve trumpets were not *one and the same thing* Following up the idea in his *Tonkunstler Lexikon*, he leaves out Stölzel's name and ascribes to Weidinger the invention of the valve, with a reference to his article.

[7] For this ingenious mechanism, see VALVE; also Gottfried Weber, *Über Ventilhorn und Trompete mit 3 Ventilen*, *Caecilia* xvii 73-104 (Mainz, 1835); and *Allg musikal. Ztg* xxiii. 411 (Leipzig, 1821); also A. Ung, "Verbesserung der Trompete und ähnlicher Instrumente," ibid (1815), xviii 633

[8] For accounts of the early use of the trumpet as a signalling and cavalry instrument in the British army, see Sir Roger Williams, *A Brief Discourse of War*, p 9, &c. (London, 1590), Grose, *Military Antiquities*, ii 41; Sir S. D Scott, *The British Army*, ii. 389–400 (London, 1868), and H. G. Farmer, *Memoirs of the Royal Artillery Band* (London, 1904).

In the hearing trumpet, the disturbance is propagated along the converging tube much in the same way as the tide-wave is propagated up the estuary of a tidal river. In speaking and hearing trumpets alike all reverberation of the instrument should be avoided by making it thick and of the least elastic materials, and by covering it externally with cloth. (See SOUND.)

TRUMPETER, or TRUMPET-BIRD, the literal rendering in 1747, by the anonymous English translator of De la Condamine's travels in South America (p. 87), of that writer's "Oiseau trompette" (*Mém. de l'Acad. des Sciences*, 1745, p. 473), a bird, which he says was called "Trompetero" by the Spaniards of Maynas on the upper Amazons, from the peculiar sound it utters. He added that it was the "Agami" of the inhabitants of Para and Cayenne,[1] wherein he was not wholly accurate, since those birds are specifically distinct, though, as they are generically united, the statement may pass. But he was also wrong, as had been P. Barrère (*France equinoxiale*, p. 132) in 1741, in identifying the "Agami" with the "Macucagua" of Marcgrav, for that is a Tinamou (*q.v.*); and both still more wrongly accounted for the origin of the peculiar sound just mentioned, whereby Barrère was soon after led (*Ornith. Spec. Novum*, pp. 62, 63) to apply to the bird the generic and vulgar names of *Psophia* and "Petteuse," the former of which, being unfortunately adopted by Linnaeus, has ever since been used, though in 1766 and 1767 Pallas (*Miscellanea*, p. 67, and *Spicilegia*, iv. 6), and in 1768 Vosmaer (*Descr. du Trompette Américain*, p. 5), showed that the notion it conveys is erroneous. Among English writers the name "Trumpeter" was carried on by Latham and others so as to be generally accepted, though an author may occasionally be found willing to resort to the native "Agami," which is that almost always used by the French.



(After Mitchell.)

White-winged Trumpeter (*Psophia leucoptera*).

P. L. Sclater and O. Salvin in their *Nomenclator* (p. 141) admit 6 species of Trumpet-Birds: (1) the original *Psophia crepitans* of Guiana; (2) *P. napensis* of eastern Ecuador (which is very likely the original "Oiseau trompette" of De la Condamine); (3) *P. ochroptera* from the right bank of the Rio Negro; (4) *P. leucoptera* from the right bank of the upper Amazons; (5) *P. viridis* from the right bank of the Madeira: and (6) *P. obscura* from the right bank of the lower Amazons near Para. And they have remarked in the Zoological *Proceedings* (1867, p. 592) on the curious fact that the range of the several species appears to be separated by rivers, a statement confirmed by A. R. Wallace (*Geogr. Distr. Animals*, ii. 358); and in connexion therewith it may be observed that these birds have short wings and seldom fly, but run, though with a peculiar gait, very quickly. A seventh species *P. cantatrix*, from Bolivia, has since been indicated by W. Blasius (*Journ. f. Ornith.*, 1884, pp. 203–210), who has given a monographic summary of the whole group very worthy of attention. The chief distinctions between the species lie in colour and size, and it will be here enough to describe briefly the best known of them, *P. crepitans*. This is about the size of a large barndoor fowl; but its neck and legs are longer, so that it is a taller bird. The head and neck are clothed with short velvety feathers; the whole plumage is black, except that on the lower front of the neck the feathers are tipped with golden green, changing according to the light into violet, and that a patch of dull rusty brown extends across the middle of the back and wing-coverts, passing into ash-colour lower down, where they hang over and conceal the tail. The legs are bright pea-green. The habits of this bird are very wonderful, and it is much to be wished that fuller accounts of them had appeared. The curious sound it utters, noticed by the earliest observers, has been already mentioned, and by them also was its singularly social disposition towards man described; but the information supplied to Buffon (*Oiseaux*, iv. 496–501) by Manoncour and De la Borde, which has been repeated in many works, is still the best we have of the curious way in which it becomes semi-domesticated by the Indians and colonists and shows strong affection for its owners as well as for their living property—poultry or sheep—though in this reclaimed condition it seems never to breed.[1] Indeed nothing can be positively asserted as to its mode of nidification; but its eggs, according to C. E. Bartlett, are of a creamy white, rather round, and about the size of bantams'. C. Waterton in his *Wanderings* (Second Journey, chap. iii.) speaks of falling in with flocks of 200 or 300 "Waracabas," as he called them, in Demerara, but added nothing to our knowledge of the species; while the contributions of Trail (*Mem. Wern. Society*, v. 523–532) and as Dr Hancock (*Mag. Nat. History*, 2nd series, vol. ii. pp. 490–492) as regards its habits only touch upon them in captivity.

To the trumpeters must undoubtedly be accorded the rank of a distinct family, *Psophiidae*; but like so many other South-American birds they seem to be the less specialized descendants of an ancient generalized group—perhaps the common ancestors of the *Rallidae* and *Gruidae*. The structure of the trachea, though different from that described in any Crane (*q.v.*), suggests an early form of the structure which in some of the *Gruidae* is so marvellously developed, for in *Psophia* the windpipe runs down the breast and belly immediately under the skin to within about an inch of the anus, whence it returns in a similar way to the front of the sternum, and then enters the thorax. Analogous instances of this formation occur in several other groups of birds not at all allied to the *Psophiidae*. (A. N.)

TRUNK (Fr. *tronc*, Lat. *truncus*, cut off, maimed), properly the main stem of a tree from which the branches spring, especially the stem when stripped of the branches; hence, in a transferred sense, the main part of a human or animal body without the head, arms or legs. It is from this last sense that the term "trunk-hose" is derived. These were part of the typical male costume of the 16th century, consisting of a pair of large puffed and slashed over-hose, reaching from the waist to the middle of the thigh, the legs clad in the long hose being thrust through them; the upper part of the body was covered by the jerkin or jacket reaching to the thigh (see COSTUME). The word "trunk" as applied to the elongated proboscis of the elephant is due to a mistaken confusion of French *trompe*, trump, with "trunk" meaning the hollow stem of a tree. A somewhat obscure meaning of French *tronc*, *i.e.* an alms-box, has given rise to the general use of "trunk" for a form of travellers' luggage.

TRURO, THOMAS WILDE, 1ST BARON (1782–1855), lord chancellor of England, was born in London on the 7th of July

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[1] Not to be confounded with the "Heron Agami" of Buffon (*Oiseaux*, ii. 382), which is the *Ardea agami* of other writers.

[1] In connexion herewith may be mentioned the singular story told by Montagu (*Orn. Dict.*, Suppl. Art. "Grosbeak, White-winged"), on the authority of the then Lord Stanley, afterwards president of the Zoological Society, of one of these birds, which, having apparently escaped from confinement, formed the habit of attending a poultry-yard. On the occasion of a pack of hounds running through the yard, the trumpeter joined and kept up with them for nearly three miles!

1782, being the second son of Thomas Wilde, an attorney. He was educated at St Paul's School and was admitted an attorney in 1805. He subsequently entered the Inner Temple and was called to the bar in 1817, having practised for two years before as a special pleader. Retained for the defence of Queen Caroline in 1820 he distinguished himself by his cross-examination and laid the foundation of an extensive common law practice. He first entered parliament in the Whig interest as member for Newark (1831–1832 and 1835–1841), afterwards representing Worcester (1841–1846). He was appointed solicitor-general in 1839, and became attorney-general in succession to Sir John (afterwards Baron) Campbell in 1841. In 1846 he was appointed chief justice of the common pleas, an office he held until 1850, when he became lord chancellor, and was created Baron Truro of Bowes, Middlesex. He held this latter office until the fall of the ministry in 1852. He died in London on the 11th of November 1855. His son Charles (1816–1891) succeeded as 2nd baron, but on the death of his nephew the 3rd baron in 1899 the title became extinct.

Lord Truro was the uncle of JAMES PLAISTED WILDE, BARON PENZANCE (1816–1899), who was appointed a baron of the court of exchequer in 1860, and was judge of the court of probate and divorce from 1863 to 1872. In 1875 he was appointed dean of the court of arches, retiring in 1899. He was created a peer in 1869, but died without issue, and the title became extinct.

TRURO, the chief town of Colchester county, Nova Scotia, on the Salmon river, near the head of Cobequid Bay, 61 m. from Halifax by rail. Pop. (1901), 5993. It is an important junction on the Intercolonial and Midland railways, and the thriving centre of a lumbering and agricultural district. There are numerous local industries, such as engine and boiler works, carriage factory and milk-condensing factory. It also contains the county buildings and the provincial normal school. The Victoria (or Joseph Howe) Park in the vicinity is of great natural beauty.

TRURO, an episcopal city and municipal borough in the Truro parliamentary division of Cornwall, England, 11 m. N. of Falmouth, on the Great Western railway. Pop. (1901), 11,562. It lies in a shallow valley at the junction of the small rivers Kenwyn and Allen in Truro river, a branch creek of the great estuary of the Fal. It is built chiefly of granite, with broad streets, through the chief of which there flows a stream of water. The episcopal see was founded in 1876, covering the former archdeaconry of Cornwall in the diocese of Exeter; the area including the whole of the county of Cornwall, with a small portion of Devonshire. The cathedral church of St Mary was begun in 1880 from the designs of John Loughborough Pearson, and is among the most important modern ecclesiastical buildings in England. The architect adopted the Early English style, making great use of the dog-tooth ornament. The form of the church is cruciform, but it is made irregular by the incorporation, on the south side of the choir, of the south aisle of the parish church, this portion retaining, by Act of Parliament of 1887, all its legal parochial rights. The design of the cathedral includes a lofty central and two western towers with spires, and a rich west front and south porch; with a cloister court and octagonal chapter-house on the north. Among other noteworthy modern institutions may be mentioned the theological library presented by Bishop Phillpotts in 1856, housed in a Gothic building (1871). The grammar school possesses exhibitions to Exeter College, Oxford. Truro has considerable trade in connexion with the tin mines of the neighbourhood. There are tin-smelting works, potteries, and manufactures of boots, biscuits, jam and clothing. Small vessels can lie at the quays, though the harbour is dry at low water; but large vessels can approach within three miles of the city. The borough is under a mayor, 6 aldermen and 18 councillors. Area, 1127 acres.

At the time of the Domesday Survey Truro (Trueret, Treurok, Treueru) was a comparatively small manor held by Jovin of Count Robert of Mortain. Its municipal charter dates from Richard Lucy the chief justiciar who held the demesne lands and under whom the free burgesses had apparently a grant of sake and soke, toll and team and infangenethef. Reginald earl of Cornwall, by an undated charter, added to these privileges exemption from the jurisdiction of the hundred and county courts and from toll throughout the county. Henry II. confirmed the grant of his uncle the said Reginald. In 1304 Truro was constituted a coinage town for tin. In 1378 the sheriff reported that the town was so impoverished by pestilence, hostile invasions and intolerable payments made to the king's progenitors that it was almost uninhabited and wholly wasted. A similar complaint was preferred in 1401 in consequence of which the fifteenth and tenth amounting to £12 was for the three years ensuing reduced to 50s. The charter of incorporation granted in 1589 provided for a mayor, recorder and steward and a council of twenty capital burgesses and four aldermen. Under it the mayor and burgesses were to enjoy the liberties of infangenethef, utfangenethef, sake, soke, toll, team, thefbote, backberindthef and ordelf; also freedom from toll passage, pontage, murage, fletage, picage, anchorage, stallage, lastage and tollage of Horngeld throughout England except in London; they were, moreover, to be entitled in respect of their markets to pontage, keyage, &c. The assize of bread and ale and wine and view of frankpledge were also granted and a court of piepowder was to regulate certain specified fairs. In 1835 the number of aldermen was increased to six. From 1295 to 1885 Truro enjoyed separate parliamentary representation, returning two members. The charter of 1589 provided that the burgesses should have power by means of the common council to elect them. Such was the procedure from 1589 to 1832 when the burgesses recovered the privilege. Under the Redistribution of Seats Act of 1885 the representation of Truro was merged in the county. No fairs or markets are mentioned prior to 1589 when two markets, on Saturdays and Wednesdays, were provided, also three fairs. Both markets and two of the three fairs are held.

See *Victoria County History: Cornwall*; Canon Donaldson, *Bishopric of Truro* (1902).

TRUSS (from O. Fr. *trusser*, *trosser*, *torser*, *trousser*, to pack, bind, gird up, Low Lat. *tortiare*, formed from *tortus*, twisted, *torquere*, to twist; cf. "torch" and "trousers," also *trousseau*, a bride's outfit, literally a small pack or bundle), a pack or bundle, applied specifically to a quantity of hay or straw tied together in a bundle. A truss of straw contains 36 lb, of old hay 56 lb, of new hay 60 lb. A load contains 36 trusses. The term is also used generally of a supporting frame or structure, especially in the construction of a roof or a bridge. It is thus used as the name of a surgical appliance, a belt with an elastic spring keeping in place a pad used as a support in cases of hernia (*q.v.*).

TRUST COMPANY, the name given to a form of fiduciary corporation, originally adopted in the United States under state laws to accomplish financial objects not specially provided for under the national banking system. The function which gives a trust company its name is to execute trusts for individuals, estates and corporations. In the United States, however, these functions have been extended to include many of those of commercial banks receiving deposits payable on demand and subject to check. The relations between trust companies and their depositors are based, however, upon different principles from those between the bank and its client (see BANKS AND BANKING). The larger trust companies prefer deposit accounts which, even when subject to check, are not actively drawn upon. The fact that they pay interest on such deposits absolves them from the obligation to extend accommodation by way of loans, except upon collateral security. Hence out of the difference in their relations with depositors grows a difference in the character of their investments, which are usually in loans on stock exchange securities and not on commercial paper discounted. In New York they are prohibited from directly discounting commercial paper, but not from buying it. The rate of interest paid on demand deposits is usually

2% for small accounts, and 3% for large accounts; for time deposits it is sometimes more.

In the administration of estates for private individuals, the trust company has taken the place to a large extent of individual attorneys. The trust company has the advantage of corporate responsibility, which involves continuous life, and of proper offices, fire-proof safes, and special employees in each department devoting their time and attention exclusively to their special functions. Investments for estates are limited by law, like savings bank investments, to certain classes of securities, and a trust company has little temptation to violate such laws. It is customary, moreover, for investments of trust funds to be made by authority of the board of directors, thus protecting the estate against the uncertainties of individual judgment.

The trust company has found a special field in America as agent of railway and industrial corporations in the issue, transfer and exchange of securities. For these purposes it has an organized system, tested by experience, more perfect in its operation and less expensive than each corporation could organize for itself separately. As trustee for the bondholders under a railway mortgage, for instance, it becomes the duty of the trust company, in case of default in payment of interest on the bonds, to take steps to foreclose the mortgage and protect the bondholders. Trust companies have sometimes been named as receivers of failed banks.

The big industrial combinations in America have contributed to the business of the trust companies as registrars or transfer agents for capital stock, agents for the issue of bonds and payment of interest thereon, agents for underwriting and distributing new securities, and depositories of securities and cash under plans of reorganization or while held in escrow. In the case of the reorganization of the tobacco companies, in the autumn of 1904, securities aggregating about $600,000,000 passed through the hands of the trust company charged with the work; and while this was the largest single operation of its kind, it is typical of many similar operations resulting from the activity in the creation of new companies in America which bring business to trust companies.

The attractions offered by the trust company to the non-commercial depositor by the payment of interest on his deposit built up the deposit balances of trust companies rapidly after 1896. Their competition in this respect with national banks soon led to an effort to compel trust companies to keep cash reserves against their deposits. This demand was resisted for a while, but in 1903 a rule was made by the New York Clearing House requiring trust companies to keep certain reserves. The alternative was to withdraw from the Clearing House, and this all but a few did. The New York legislature, however, at the session of 1906, passed an act requiring trust companies in New York city to establish within fixed dates reserves of 15% of their deposits, of which only 5% was required to be currency, 5% might be on deposit in another banking institution, and 5% might be kept in certain classes of bonds.

The experience of the panic of 1907 developed several weaknesses in the position of the trust companies, and in New York led a special commission appointed by Governor Hughes to recommend much stronger reserves. The fact that the trust companies relied upon the national banks to meet the heavy demands upon them for currency doubled the strain imposed on the national banks of New York city, and the isolation of the trust companies through their withdrawal from the Clearing House in 1903 made it difficult to bring about co-operation in support of those which were subjected to severe runs. Between the 22nd of August and the 19th of December 1907 the deposits of the trust companies of New York declined by the sum of more than $275,000,000 while deposits in national banks increased about $50,000,000.

The number, resources and activities of trust companies have shown a rapid development. In New York the general law under which companies can be formed without a special act dates only from 1887, but several companies ante-date this law. The following figures[1] from reports made to the comptroller of the currency speak for themselves:—

Trust Companies of the United States.

30th June	Number	Capital.	Individual Deposits.
		$	$
1891	171	79.292,889	355.330,080
1897	251	106,968,253	566,922,205
1900	290	126,930,845	1,028,232,407
1901	334	137.361,704	1,271,081.174
1902	417	179.732,581	1,525,887.493
1903	531	232,807.735	1,589.398.796
1904	585	237.745.488	1,600,322,325
1905	683	243.133,622	1,980,856,737
1906	742	268,384,337	2,008.937.790
1907	794	276,146,081	2,061,623,035

Approximately half of the deposits in United States trust companies are in the state of New York, the number of such companies in New York about the 30th of June 1907, being 88, with a capital of $67,850,000, and deposits of $1,020,678,220. The next highest states in amount of deposits were Pennsylvania, with 328 companies, with capital of $103,953,067 and deposits of $381,397,305; and Massachusetts, with 46 companies, with capital of $16,677,000 and deposits of $179,278,436.

See Kirkbride and Sterrett, *The Modern Trust Company* (New York, 1905). (C. A. C.)

TRUST and **TRUSTEES,** in the law of equity. In Roman and English law alike that legal relation between two or more persons implied in the word *trust* was of comparatively late growth. The trust of English law is probably based upon a combination of the Roman conceptions of *usus* and *fideicommissum.* To *usus* is perhaps due the name as well as the idea of that right over property, co-ordinate with the right of the nominal owner, possessed by the person having the use. To *fideicommissum* appears to be due the name as well as the idea of that confidence reposed in another which is the essence of the modern trust. *Usus* was in Roman law a personal servitude, or right of one person over the land of another, confined to his personal wants and without the right to the produce and profits which *ususfructus* carried. It has little in common with the use of English law but the name and the conception of a dual ownership. The *fideicommissum* is more important (see ROMAN LAW). By the legislation of Justinian the law of *legata* was practically assimilated to that of *fideicommissa.* The only thing that distinguished the one from the other was the mode in which the gift was made: if by words of direct bequest it was a *legatum*, if by precatory words, a *fideicommissum.* It may be noticed, as an illustration of the course afterwards taken by the law in England, that *fideicommissa* in favour of the Church were so far favoured over others that if paid over by mistake they could not be recovered. In addition to *usus* and *fideicommissum*, the Roman division of ownership into quiritary and bonitary (to use words invented at a later time) may perhaps to some extent have suggested the English division into legal and equitable estate. The two kinds of ownership were amalgamated by Justinian. The gradual manner in which the beneficiary became subject to the burdens attaching to the property of which he enjoyed the benefit was a feature common to both the Roman and the English system.

Use in Early English Law.—The use or trust[2] is said to have been the invention of ecclesiastics well acquainted with Roman law, the object being to escape the provisions of the laws against Mortmain by obtaining the conveyance of an estate to a friend on the understanding that they should retain the use, *i.e.* the actual profit and enjoyment of the estate. Uses were soon extended to other purposes. They were found valuable for the defeat of creditors, the avoiding of attainder and the charging of portions. A use had also the advantage of being free from the incidents of feudal tenure: it could be alienated *inter vivos* by secret conveyance, and could be devised by will. In many cases the feoffee[3] to uses, as he was called, or the person seised to the use of another, seems to have been specially chosen on account of his rank and station, which would enable him to defy the common law and protect the estate of his *cestui que use*, or the person entitled to the beneficial enjoyment. The act of 1 Ric. II. c. 9 was directed against the choice of such persons. This alienation of land in use was looked upon with great disfavour by the common law courts, in whose eyes the cestui que use was only a tenant at will. Possibly the ground of their refusal to recognize uses was that the assizes of the king's court could only be granted to persons who stood in a feudal relation to the king. The denial of the right followed the denial of the remedy. The use was on the other hand supported by the court of chancery, and execution of the confidence reposed in the feoffee to uses was enforced by the court in virtue of the general jurisdiction which as a court of conscience it claimed to exercise over breach of faith. Jurisdiction was no doubt the more readily assumed by ecclesiastical judges in favour of a system by which the Church was generally the gainer. A double ownership of land thus gradually arose, the nominal and ostensible ownership—the only one acknowledged in the courts of common law— and the beneficial ownership protected by the court of chancery. The reign of Henry V. to a great extent corresponds with that of Augustus at Rome, as the point of time at which legal recognition was given to what had previously been binding only in honour. The means of bringing the feoffee to uses before the court was the writ of *subpoena*, said to have been invented by John de Waltham, bishop of Salisbury and master of the rolls in the reign of Richard II. By means of this writ the feoffee to uses could be compelled to answer on oath the claim on his cestui que use. The doctrine of the court of chancery as to the execution of a use varied according as there was transmutation of possession or not. In the former case it was unnecessary to prove consideration; in the latter, generally a case of bargain and sale, the court would not enforce the use unless it was executed in law—that is, unless there was a valuable consideration, even of the smallest amount. Where no consideration could be proved or implied, the use resulted to the feoffor. This theory led to the insertion in deeds (especially in the case of the lease and release period of conveyancing) of a nominal consideration, generally five shillings. Lands either in possession, reversion or remainder could be granted in use. Most persons could be feoffees to uses. The king and corporations aggregate were, however, exceptions, and were entitled to hold the lands discharged of the use. On the accession of Richard III., who from his position of authority had been a favourite feoffee, it was necessary to pass a special act (1 Ric. III. c. 5), vesting the lands of which he had been feoffee either in his co-feoffees or, in the absence of co-feoffees, in the cestui que use. The practical convenience of uses was so obvious that it is said that by the reign of Henry VII. most of the land in the kingdom was held in use. The freedom of uses from liability to forfeiture for treason must have led to their general adoption during the Wars of the Roses.[1] The secrecy with which a use could be transferred, contrary as it was to the publicity required for livery of Seisin (*q.v.*) at common law, led to the interference of the legislature on several occasions between the reign of Richard II. and Henry VIII., the general tendency of the legislation being to make the cestui que use more and more subject to the burdens incident to the ownership of land. One of the most important statutes was the Statute of Mortmain (15 Ric. II. c. 5), forbidding evasion of the Statute *De Religiosis* of Edward I. by means of feoffments to uses. Other acts enabled the cestui que use to transfer the use without the concurrence of the feoffee to uses (1 Ric. III. c. 1), made a writ of *formedon* maintainable against him (1 Hen. VII. c. 1), rendered his heir liable to wardship and relief (4 Hen. VII. c. 17), and his lands liable to execution (19 Hen. VII. c. 15). At length in 1535 the famous Statute of Uses (27 Hen. VIII. c. 10) was passed.[2] The preamble of the statute enumerates the mischiefs which it was considered that the universal prevalence of uses had occasioned, among others that by fraudulent feoffments, fines, recoveries and other like assurances to uses, confidences and trusts lords lost their feudal aids, men their tenancies by the curtesy, women their dower, manifest perjuries in trials were committed, the king lost the profits of the lands of persons attainted or enfeoffed to the use of aliens, and the king and lords their rights of year, day and waste, and of escheats of felons' lands. To remedy this state of things it was enacted, *inter alia*, that, where any person was seised of any hereditaments to the use, confidence or trust of any other person by any means, the person having such use, confidence or trust should be seised, deemed and adjudged in lawful seisin, estate and possession of such hereditaments. Full legal remedies were given to the cestui que use by the statute. He was enabled to distrain for a rent-charge, to have action, entry, condition, &c. The effect of this enactment was to make the cestui que use the owner at law as well as in equity (as had been done once before under the exceptional circumstances which led to 1 Ric. III. c. 5), provided that the use was one which before the statute would have been enforced by the court of chancery. For some time after the passing of the statute an equitable as distinct from a legal estate did not exist. But the somewhat narrow construction of the statute by the common law courts in Tyrrel's case[3] (1557) enabled estates cognisable only in equity to be again created. In that case it was held that a use upon a use could not be executed; therefore in a feoffment to A and his heirs to the use of B and his heirs to the use of C and his heirs only the first use was executed by the statute. The use of B being executed in him, that of C was not acknowledged by the common law judges; but equity regarded C as beneficially entitled, and his interest as an equitable estate held for him in trust, corresponding to that which B would have had before the statute. The position taken by the Court of Chancery in trusts may be compared with that taken in Mortgage (*q.v.*). The Judicature Act 1873, while not going as far as the Statute of Uses and combining the legal and equitable estates, makes equitable rights cognisable in all courts. From the decision in Tyrrel's case dates the whole modern law of uses and trusts. In modern legal language use is restricted to the creation of legal estate under the Statute of Uses, trust is confined to the equitable estate of the cestui que trust or beneficiary.

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[1] The table, it may be observed, represents only the number of companies *reporting* and not the number actually in existence. Kirkbride and Sterrett, for example, give the number of trust companies in the United States on the 1st of January 1905 as 1427, or more than twice the number given here for 1905. On this point the comptroller of the Treasury in 1905 said: "In order to obtain this information [from institutions other than national banks] the comptroller is necessarily dependent upon the courtesy of officers of different states, and upon individual banks in states the laws of which states do not provide for compilation of data of this character . . . Each year one or more states formerly without adequate provision for obtaining and compiling reports of banks incorporated under their laws, have through legislative enactment, placed such banks under the supervision of an official whose duty it is to receive and tabulate the reports so required, which information is placed at the disposal of the comptroller. Every year this office is thereby enabled to publish official, and hence more reliable statistics. . . ."

[2] Use seems to be an older word than trust. Its first occurrence in statute law is in 7 Ric. II. c. 12, in the form *oeps.* In Littleton "confidence" is the word employed. The Statute of Uses seems to regard use, trust and confidence as synonymous. According to Bacon, it was its permanency that distinguished the use from the trust.

[3] Feoffment, though the usual, was not the only mode of conveyance to uses. The preamble of the Statute of Uses mentions fines and recoveries, and other assurances.

Uses since 1535.—The Statute of Uses is still the basis of conveyancing. A grant in a deed is still, after the alterations in the law made by the Conveyancing Act 1881, made "to and to the use of A." The statute does not, however, apply indiscriminately to all cases, as only certain uses are executed by it. It does not apply to leaseholds or copyholds, or to cases where the grantee to uses is anything more than a mere passive instrument, *e.g.* where there is any direction to him to sell the property. The seisin, too, to be executed by the statute, must be in another than him who has the use, for where A is seised to the use of A it is a common law grant. The difference is important as far as regards the doctrine of Possession (*q.v.*). Constructive possession is given by a deed operating under the statute even before entry, but not by a common law grant, until actual receipt of rent by the grantee. The operation of the Statute of Uses was supplemented by the Statute of Inrolments and that of Wills (see WILL). The Statute of Inrolments (27 Hen. VIII. c. 16) enacted that no bargain and sale should pass a freehold unless by deed indented and enrolled within six months after its date in one of the courts at Westminster or with the *custos rotulorum* of the county. As the statute referred only to freeholds, a bargain and sale of a leasehold interest passed without enrolment. Conveyancers took advantage of this omission (whether intentional or not) in the act, and the practical effect of it was to introduce a mode of secret alienation of real property, the lease and release, which was the general form of conveyance up to 1845. (See CONVEYANCING.) Thus the publicity of transfer, which it was the special object of the Statute of Uses to effect, was almost at once defeated. In addition to the grant to uses there were other modes of conveyance under the statute which are now obsolete in practice, viz.; the covenant to stand seised and the bargain and sale. Under the statute, as before it, the use has been found a valuable means of limiting a remainder to the person creating the use and of making an estate take effect in derogation of a former estate by means of a shifting or springing use. At common law a freehold could not be made to commence *in futuro*; but this end might be attained by a shifting use, such as a grant (common in marriage settlements) to A to the use of B in fee simple until a marriage, and after the celebration of the marriage to other uses. An example of a springing use would be a grant to A to such uses as B should appoint and in default of and until appointment to C in fee simple. The difficulty of deciding where the seisin was during the suspension of the use led to the invention of the old theory of *scintilla juris*, or continued possibility of seisin in the grantee to uses. This theory was abolished by 23 & 24 Vict. c. 38, which enacted that all uses should take effect by force of the estate and seisin originally vested in the person seised to the uses. The most frequent instances of a springing use are powers of appointment, usual in wills and settlements. There has been much legislation on the subject of powers, the main effect of which has been to give greater facilities for their execution, release or abandonment, to aid their defective execution, and to abolish the old doctrine of illusory appointments.

Trusts.—A trust in English law is defined in Lewin's *Law of Trusts*, adopting Coke's definition of a use, as "a confidence reposed in some other, not issuing out of the land, but as a thing collateral, annexed in privity to the estate of the land, and to the person touching the land, for which *cestui que trust* has no remedy but by *subpoena* in Chancery." The term *trust* or *trust estate* is also used to denote the beneficial interest of the cestui que trust. The term *truster* is not used, as it is in Scotland, to denote the creator of the trust. A trust has some features in common with contract (*q.v.*); but the great difference between them is that a contract can only be enforced by a party or one in the position of a party to it, while a trust can be, and generally is, enforced by one not a party to its creation. It has more resemblance to *fideicommissum*. But the latter could only be created by a testamentary instrument, whilst a trust can be created either by will or *inter vivos*; nor was there any trace in Roman law of that permanent legal relation which is suggested by the position of trustee and cestui que trust. The heir, too, in Roman law was entitled, from A.D. 70 to the reign of Justinian, to one-fourth of a *hereditas fideicommissaria* as against the beneficiary, while the very essence of the trust is its gratuitous character. Trusts may be divided in more than one way, according to the ground taken as the basis of division. One division, and perhaps the oldest, as it rests on the authority of Bacon, is into *simple* and *special*, the first being where the trust is simply vested in a trustee and the nature of the trust left to construction of law, the second where there is an act to be performed by the trustee. Another division is into *lawful* and *unlawful*, and corresponds to Bacon's division into intents or confidences and frauds, covins, or collusions. A third division is into *public* and *private*. A division often adopted in modern textbooks and recognized by parliament in the Trustee Act 1850, is into *express*, *implied* and *constructive*. An express trust is determined by the person creating it. It may be either *executed* or *executory*, the former where the limitations of the equitable interest are complete and final, the latter where such limitations are intended to serve merely as minutes for perfecting the settlement at some future period, as in the case of marriage articles drawn up as a basis of a marriage settlement to be in conformity with them. An implied trust is founded upon the intention of the person creating it; examples of it are a resulting trust, a precatory trust, and the trust held by the vendor on behalf of the purchaser of an estate after contract and before conveyance. In this case the vendor is sometimes called a trustee *sub modo* and the purchaser a cestui que trust *sub modo*. A constructive trust is judicially created from a consideration of a person's conduct in order to satisfy the demands of justice, without reference to intention. The distinction between an implied and a constructive trust is not always very consistently maintained. Thus the position of a vendor towards a purchaser after contract is sometimes called a constructive trust. The present law governing trusts rests upon the doctrines of equity as altered by legislation. The law was consolidated by the *Trustee Act* 1893 and some subsequent amending statutes. Its great importance has led to its becoming one of the most highly developed departments of equity.

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[1] The use, as in later times the trust, was, however, forfeited to the Crown on attainder of the feoffee or trustee for treason.

[2] It was adopted in Ireland exactly a century later by 10 Car. I. c. 1 (Ir.). The law of uses and trusts in Ireland is practically the same as that in England, the main differences being in procedure rather than in substantive law.

Dyer's *Reports*, 155a.

Who may be a Trustee or Cestui que Trust.—The modern trust is considerably more extensive in its operation than the ancient use. Thus the Crown and corporations aggregate can be trustees, and personalty can be held in trust. Provision is made by the Municipal Corporations Act 1882, for the administration of charitable and special trusts by municipal corporations. There are certain persons who for obvious reasons, even if not legally disqualified, ought not to be appointed trustees. Such are infants, lunatics, persons domiciled abroad, felons, bankrupts and *cestuis que trustent*. The appointment of any such person, or the falling of any existing trustee into such a position, is generally ground for application to the court for appointment of a new trustee in his place. Any one may be a cestui que trust except a corporation aggregate, which cannot be a cestui que trust of real estate without a licence from the Crown. For the Public Trustee, see below.

Creation and Extinction of the Trust.—A trust may be created either by act of a party or by operation of law. Where a trust is created by act of a party, the creation at common law need not be in writing. The Statute of Frauds altered the common law by enacting that all declarations or creations of trusts or confidences of any lands, tenements or hereditaments shall be manifested and proved by some writing, signed by the party who is by law enabled to declare such trust, or by his last will in writing, or else they shall be utterly void and of none effect. Trusts arising or resulting by implication or construction of law are excepted, and it has been held that the statute applies only to real estate and chattels real, so that a trust of personal chattels may still be declared by parol. The declaration of a trust by the Crown must be by letters patent. Trusts created by will must conform to the requirements of the Will Act (see WILL). Except in the case of charitable trusts, the cestui que trust must be a definite person. A trust, for instance, merely for keeping up family tombs is void. Alteration of the trust estate by appointment of a new trustee could up to 1860 only be made where the instrument creating the trust gave a power to so appoint, or by order of the court of chancery. But now by s. 10 of the Trustee Act 1893 (superseding Lord St Leonards's Act of 1860 and the Conveyancing Act 1881), the surviving or continuing trustee or trustees, or the personal representative of the last surviving or continuing trustee, may nominate in writing a new trustee or new trustees. On such appointment the number of trustees may be increased. Existing trustees may by deed consent to the discharge of a trustee wishing to retire. Trust property may be vested in new or continuing trustees by a simple declaration to that effect. Also a separate set of trustees may be appointed for any part of the property held on distinct trusts. Trusts created by operation of law are those which are the effect of the application of rules of equity. They include resulting and constructive trusts. A resulting trust is a species of implied trust, and consists of so much of the equitable interest as is undisposed of by the instrument creating the trust, which is said to result to the creator and his representatives. An example is the purchase of an estate in the name of the purchaser and others, or of others only. Here the beneficial interest is the purchaser's. An example of a constructive trust is a renewal of a lease by a trustee in his own name, where the trustee is held to be constructively a trustee for those interested in the beneficial term. Besides being duly created, it is necessary for the validity of the trust that it should be a lawful one. An unlawful trust is one which contravenes the policy of the law in any respect. Examples of such trusts are trusts for a corporation without licence, for a perpetuity, and for purposes subversive of morality, such as trusts for illegitimate children to be hereafter born. Superstitious uses also fall under this head. There are also certain trusts which are avoided by statute under particular circumstances, such as settlements in fraud of creditors (see BANKRUPTCY). The law cannot be evaded by attempting to constitute a secret trust for an unlawful purpose. If an estate be devised by words prima facie carrying the beneficial interest, with an understanding that the devisee will hold the estate in trust for such a purpose, he may be compelled to answer as to the secret trust, and on acknowledgment or proof of it there will be a resulting trust to the heir-at-law. In the case of an advowson suspected to be held for the benefit of a Roman Catholic patron, there is a special enactment to the same effect (see QUARE IMPEDIT). The rules of equity in charitable trusts are less strict than those adopted in private trusts. Charitable trusts must be lawful, *e.g.* they must not contravene the Statutes of Mortmain; but a wider latitude of construction is allowed in order to carry out the intentions of the founder, and they will not be allowed to fail for want or uncertainty of objects to be benefited. The court, applying the doctrine of *cy près* (*q.v.*), will, on failure of the original ground of the charity, apply the funds as nearly as possible in the same manner. On this principle gifts originally made for purely charitable purposes have been extended to educational purposes. Further, trustees of a charity may act by a majority, but ordinary trustees cannot by the act of a majority (unless specially empowered so to do) bind a dissenting minority or the trust property. A trust estate is subject as far as possible to the rules of law applicable to a legal estate of a corresponding nature, in pursuance of the maxim, "Equity follows the law." Thus trust property is assets for payment of debts, may be taken in execution, passes to creditors in bankruptcy, and is subject to dower and curtesy, to the rules against perpetuities, and to the Statutes of Limitation. This assimilation of the legal and equitable estates has been produced partly by judicial decisions, partly by legislation. A trust is extinguished, as it is created, either by act of a party or by operation of law. An example of the former mode of extinction is a release by deed, the general means of discharge of a trustee when the purposes of the trust have been accomplished. Extinction by operation of law takes place when there is a failure of the objects of the trust: *e.g.* if the cestui que trust die intestate without heirs or next of kin, the property, by the Intestates Estates Act 1884, escheats in the same manner as if it were a legal estate in corporeal hereditaments. Equitable interests in real estate abroad are as a rule subject to the *lex loci rei sitae*, and an English court has no jurisdiction to enforce a trust or settle a scheme for the administration of a charity in a foreign country. An English court has, however, jurisdiction to administer the trusts of a will as to the whole real and personal estate of a testator, even though only a very small part of the estate, and that wholly personal, is in England. This was decided by the House of Lords in a well-known case in 1883 (*Ewing* v. *Orr-Ewing*, L.R. 9, A.C. 34).

Rights and Duties of the Trustee.—The principal general properties of the office of trustee are these: (1) A trustee having once accepted the trust cannot afterwards renounce. (2) He cannot delegate it, but an inconvenience which formerly attached to dealings with trustees and trust property, in consequence partly of this rule, and partly of the liability of persons dealing with trustees to see that money paid to them was properly applied, was largely obviated by s. 17 of the Trustee Act 1893 (replacing s. 2 of the Trustee Act 1888), which in effect provides that a trustee may appoint a solicitor to be his agent to receive and give a discharge for any money or valuable consideration or property receivable by the trustee under the trust, by permitting the solicitor to have the custody of and to produce a deed having in the body thereof or endorsed thereon a receipt for the consideration money or other consideration, the deed being executed or the endorsed receipt being signed by the trustee; and a trustee is not chargeable with breach of trust by reason only of his having made or concurred in making any such appointment; and the producing of any such deed by the solicitor is a sufficient authority to the person liable to pay for his paying to the solicitor without the solicitor producing any separate or other direction or authority in that behalf from the trustee. (3) In the case of co-trustees the office must be exercised by all the trustees jointly. (4) On the death of one trustee there is survivorship: that is, the trust will pass to the survivors or survivor. (5) One trustee shall not be liable for the acts of his co-trustee. (6) A trustee shall derive no personal benefit from the trusteeship. The office cannot be renounced or delegated, because it is one of personal confidence. It can, however, be resigned, and legislation has given a retiring trustee large powers of appointing a successor. The liability of one trustee for the acts or defaults of another often raises very difficult questions. A difference is made between trustees and executors. An executor is liable for joining in a receipt *pro forma*, as it is not necessary for him to do so, one executor having authority to act without his co-executor; a trustee can show that he only joined for conformity, and that another received the money. The rule of equity by which a beneficiary who consented to a breach of trust was liable to indemnify the trustees to the extent of his interest has taken definite statutory shape in s. 45 of the Trustee Act 1893 (replacing s. 6 of the Trustee Act 1888), which enacts that when a trustee commits a breach of trust at the instigation or request, or with the consent in writing of a beneficiary, the High Court may, if it thinks fit, and notwithstanding that the beneficiary is a married woman entitled for her separate use and restrained from anticipation, make such order as to the court seems just for impounding all or any part of the interest of the beneficiary in the trust estate by way of indemnity to the trustee. The rule that a trustee is not to benefit by his office is subject to some exceptions. He may do so if the instrument creating him trustee specially allows him remuneration, as is usually the case where a solicitor is appointed. The main duties of trustees are to place the trust property in a proper state of security, to keep it (if personalty) in safe custody, and to properly invest and distribute it. A trustee must be careful not to place himself in a position where his interest might clash with his duty. As a rule he cannot safely purchase from his cestui que trust while the fiduciary relation exists between them. Investments by trustees demand special notice. The Trustee Act 1893 has consolidated the law on this point, and provides, as it were, a code or charter of investment authorizing trustees, unless expressly forbidden by the instrument (if any) creating the trust, to invest trust funds in various modes, of which the more important are as follows: In any of the parliamentary stocks or public funds or government securities of the United Kingdom; on real or heritable securities in Great Britain or Ireland; in stock of the Bank of England or the Bank of Ireland; in India 3½% stock and India 3% stock; in any securities, the interest of which is for the time being guaranteed by parliament; in consolidated stock created by the London County Council; in the debenture or rent-charge or guaranteed or preference stock of any railway company in Great Britain or Ireland incorporated by special act of parliament, and having during each of the ten years last past before the date of investment paid a dividend at the rate of not less than 3% on its ordinary stock; in the debenture stock of any railway company in India, the interest on which is paid or guaranteed by the secretary of state in council of India; in the "B" annuities of the Eastern Bengal, the East Indian and the Sind, Punjab and Delhi railways; and also in deferred annuities—comprised in the register of holders of annuity Class D, and annuities comprised in the register of annuitants Class C of the East Indian Railway Company; in the stock of any railway company in India upon which a fixed or minimum dividend in sterling is paid or guaranteed by the secretary of state in council of India, or upon the capital of which the interest is so guaranteed; in the debenture or guaranteed or preference stock of any company in Great Britain or Ireland established for the supply of water for profit, and incorporated by special act of parliament or by royal charter, and having during each of the ten years last past before the date of investment paid a dividend of not less than 5% per annum on its ordinary stock; in nominal or inscribed stock issued, or to be issued, by the corporation of any municipal borough having, according to the returns of the last census prior to the date of investment, a population exceeding 50,000; or by any county council under the authority of any act of parliament or provisional order; in any of the stocks, funds or securities for the time being authorized for the investment of cash under the control or subject to the order of the High Court. Trustees may from time to time vary any such investments for others of an authorized nature. The statutory power to invest on real securities does not, of course, authorize the purchase of realty; but by s. 5 of the Trustee Act 1893 a power to invest in real securities (in the absence of express provision to the contrary) authorizes investment on mortgage of leasehold property held for an unexpired term of not less than 200 years and not subject to a greater rent than one shilling a year, or to any right of redemption or condition of re-entry except for non-payment of rent.

The position of trustees in respect of what was frequently an undue personal responsibility for the administration of their trust has been much improved by s. 8 of the Trustee Act 1888 (not repealed by the Trustee Act 1893) and s. 3 of the Judicial Trustees Act 1896. Sub-section (1) of the former enactment (with some omissions) runs as follows: "In any action or other proceeding against a trustee or any person claiming through him, except where the claim is founded upon any fraud or fraudulent breach of trust to which the trustee was party or privy, or is to recover trust property, or the proceeds thereof still retained by the trustee, or previously received by the trustee and converted to his use, the following provisions shall apply: (*a*) All rights and privileges conferred by any statute of limitations shall be enjoyed in the like manner and to the like extent as if the trustee or person claiming through him had not been a trustee or person claiming through him. (*b*) If the action or other proceeding is brought to recover money or other property, and is one to which no existing statute of limitations applies, the trustee or person claiming through him shall be entitled to the benefit of, and be at liberty to plead the lapse of time as a bar to such action or other proceeding in the like manner and to the like extent as if the claim had been against him in an action of debt for money had and received." The statutory period of limitation which trustees are thus permitted to plead is the six years fixed as the period of limitation for actions of debt by the Limitation Act 1623. It has been decided on the above section that in the case of a breach of trust consisting of an improper investment of the trust funds, time begins to run in favour of the trustee from the date of the investment. Sub-section (3) of the Judicial Trustees Act 1896 provides that "if it appears to the court that a trustee, whether appointed under that act or not, is or may be personally liable for any breach of trust, whether the transaction alleged to be a breach of trust occurred before or after the passing of that act, but has acted honestly and reasonably, and ought fairly to be excused for the breach of trust and for omitting to obtain the directions of the court in the matter in which he committed such breach, then the court may relieve the trustee either wholly or partly from personal liability for the same." Owing to the generally reduced rate of interest obtainable for money invested on trust securities, the court has in several instances, and even as against defaulting trustees, charged them with interest at 3% per annum (instead of 4%, which was formerly the recognized rate) upon sums found due from them to the trust estate.

Under the old law trustees could not safely advance on mortgage more than two-thirds of the actual value of agricultural land or one-half of the value of houses. This "two-thirds rule" is now made statutory by s. 8 of the Trustee Act 1893, which enacts that "A trustee lending money on the security of any property on which he can lawfully lend shall not be chargeable with breach of trust by reason only of the proportion borne by the amount of the loan to the value of the property at the time when the loan was made, provided that it appears to the court that in making the loan the trustee was acting upon a report as to the value of the property made by a person whom he reasonably believed to be an able practical surveyor or valuer instructed and employed independently of any owner of the property, whether such surveyor or valuer carried on business in the locality where the property is situate or elsewhere, and that the amount of the loan does not exceed two equal third parts of the value of the property as stated in the report, and that the loan was made under the advice of the surveyor or valuer expressed in the report." The same section protects trustees for not investigating the lessor's title when lending on the leasehold security, and for taking a shorter title than they might be otherwise entitled to on the purchase or mortgage of any property, if they act with prudence and caution. By s. 9 (replacing s. 5 of the Trustee Act 1888) trustees who commit a breach of trust by lending more than the proper amount on any property are excused from making good any more than the excess of the actual loan over the sum which they might have properly lent in the first instance.

Rights and Duties of the Cestui que Trust.—These may be to a great extent deduced from what has been already said as to the correlative duties and rights of the trustee. The cestui que trust has a general right to the due management of the trust property, to proper accounts and to enjoyment of the profits. He can as a rule only act with the concurrence of the trustee, unless he seeks a remedy against the trustee himself.

Judicial Trustees.—The Judicial Trustees Act 1896, inaugurated a semi-official system of trusteeship which was new in England, but had been known in Scotland for upwards of 150 years. The general scope of the act is indicated by s. 1 (1), which runs as follows: "Where application is made to the court by or on behalf of the person creating or intending to create a trust, or by or on behalf of a trustee or beneficiary, the court may, in its discretion, appoint a person (in this act called a judicial trustee) to be a trustee of that trust, either jointly with any other person or as sole trustee, and if sufficient cause is shown, in place of all or any existing trustees." The act and the rules made under it (the Judicial Trustees Rules 1897) provide that judicial trustees shall be under the control and supervision of the court as officers thereof, and may be paid for their services out of the trust property. The trust accounts are to be audited annually, and a report thereon made to the court, which has power to order inquiries into transactions connected with the administration of the trust. A judicial trustee may be required to give security, and in any case has to keep the trust account with a bank approved by the court, and deposit title-deeds and other documents of title in such custody as the court directs. Communications between judicial trustees and the court with reference to their duties are permitted to be made with little or no formality, and strict proof of facts may be waived in proper cases. The act may, in short, be described as an attempt to provide for an official check upon the administration of trusts, while avoiding the formality and expense incident to the procedure in an administration action

Public Trustee.—A step further was taken by the Public Trustee Act 1906, which established the office of public trustee. By the act he is a corporation sole, with perpetual succession and an official seal and may sue and be sued under his official title. He may, if he thinks fit, act in the administration of estates of small value; as custodian trustee, or as an ordinary trustee; he may be appointed a judicial trustee, or administrator of a convict's property. The law of trusts generally is applicable to him and he can act either alone or jointly with other persons. He has an absolute discretion as to whether he will accept or not any trust, but cannot decline acceptance on the ground only of the small value of the trust property He cannot accept any trust which involves the management or carrying on of a business, except in certain cases authorized under rules appended to the act. He cannot accept a trust under a deed of arrangement for the benefit of creditors, nor of an insolvent estate, nor one exclusively for religious or charitable purposes. His powers and duties are dealt with by the act under three headings: (1) *In the administration of small estates.*—On the application of any person entitled to apply to the court (*i.e.* the High Court, and as respects trusts within its jurisdiction, the county court) for an order for administration of any estate, the gross value of which is proved to the satisfaction of the public trustee to be less than £1000, he may administer the estate, and must do so if the persons beneficially entitled are persons of small means, unless he sees good reason for refusing. By declaration in writing signed and sealed by him the trust property other than stock vests in him, and the right to transfer or call for the transfer of any stock forming part of the estate, provided that he does not exercise the right of himself transferring stock without the leave of the court; this general provision also does not apply to copyhold, in respect of which he has the same powers to convey them as if he had been appointed under s. 33 of the Trustee Act 1893. Power is given to the court to order, for reasons of economy, that an estate being administered by the court be administered by the public trustee. (2) *As custodian trustee.*—The public trustee, if he consents to act, may be appointed custodian trustee on an application to the court, or by the testator, settlor or other creator of any trust or by a person having power to appoint new trustees. When he is so appointed the trust property is transferred to him as if he were the sole trustee, but the management of the trust property and any discretionary power remain vested in the other trustees. His relations with the managing trustees are further defined by the act. (3) *As an ordinary trustee.*—The public trustee may be appointed trustee, executor, &c., of any will or settlement or instrument of any date either under his official title or other sufficient designation. In a will a sentence to the following effect would be sufficient. "I appoint the Public Trustee executor and trustee of this my will." Where the public trustee has been appointed a trustee of any trust, a co-trustee may retire from the trust under s. 11 of the Public Trustee Act 1893 notwithstanding that there are not more than two trustees, and without such consents as are required by that section. The consolidated fund of the United Kingdom is liable to make good all sums required to discharge any liability which the public trustee, if he were a private trustee, would be personally liable to discharge, except where neither the public trustee nor his officers has contributed to it, and which neither he nor any of his officers could by reasonable diligence have averted. A person aggrieved by any act or omission or decision of the public trustee in relation to any trust may apply to the court, and the court may make such order in the matter as it sees fit. The act contains provisions for the investigation and audit of trust accounts, which may take place on the application of any trustee or beneficiary; if the parties do not agree upon a solicitor and public accountant for the purpose, they are appointed by the public trustee, who has entire discretion over the source from which the expenses are to be defrayed. The fees payable under the act are fixed by the Public Trustee (Fees) Order; they are of two kinds: fees on capital and fees on income. The object of the department is not to make a profit, but merely to pay expenses. Full information as to the machinery and procedure of the office and the requirements necessary to obtain the services of the public trustee are obtainable on application to the Public Trustee Office, Clement's Inn, London.

Scotland.—The history of the law differs considerably from that of England, though perhaps the position of the Scottish trustee is now not very different from that of the trustee in England. The Statute of Uses did not apply to Scotland, since neither that nor any similar legislation was necessary in a system in which law and equity were administered by the same tribunals. Trusts seem to have existed from time immemorial, and have been frequently regulated by statute. The policy of the English Statute of Frauds was no doubt intentionally imitated in the Act 1696, c. 25, enacting that no action of declarator of trust should be sustained as to any deed of trust made for thereafter, except upon a declaration or back-bond of trust lawfully subscribed by the person alleged to be trustee and against whom or his heirs or assignees the declarator should be intended, or unless the same were referred to the oath of the party *simpliciter*. The act does not apply to all cases, but only to those in which by the act of parties documents of title are in the name of a trustee, but the beneficial interest in another. The person creating the trust is called the *truster*, a term unknown in England. On the other hand the term *cestui que trust* is unknown in Scotland. The office of trustee is prima facie gratuitous, as in England, it being considered to fall under the contract of mandate. Some of the main differences between English and Scottish law are these. There is no presumption in Scotland of a resulting trust in favour of a purchaser. A trust which lapses by the failure of a beneficiary goes to the Crown as *ultimus heres*. The office of trustee is not a joint office, therefore there is no right of survivorship, and on the death of a trustee the survivors are incompetent to act, unless a certain number be declared or presumed to be a *quorum*, or the office be conferred on trustees and the accedors and survivors of them. . Sometimes the concurrence of one trustee is rendered absolutely necessary by his being named *sine qua non*. The Court of Session may appoint new trustees, but generally appoints a judicial factor. There has been a considerable amount of legislation, chiefly in the direction of extending the powers of trustees and of the court in trust matters. The powers of investment given to trustees are much the same as those allowed in England.

United States.—In New York and many other States uses and trusts have been abolished (with certain exceptions), and every estate, subject to those exceptions, is deemed a legal right cognisable in courts of law. Some of these exceptions are implied trusts and express trusts to sell land for the benefit of creditors, to sell, mortgage or lease lands for the benefit of legatees, or for the purpose of satisfying any charge thereon, to receive the rents and profits of lands and apply them to the use of any person during the life of such person or any shorter term, or to receive such rents and profits, and accumulate the same within the limits allowed by the law. Some states allow the creation of trusts (other than those arising by implication or operation of law) only by means of will or deed. Where the trust is of real estate, the deed must generally be registered. Forms of deeds of trust are given in the Statutes of Virginia and other states. The English doctrine of *cy près* is being adopted in many states. A public trustee as a corporation sole exists in some states. A trustee under American law is generally entitled to compensation for his services. Spendthrift trusts, *i.e.* those under which the enjoyment of income bequeathed by will in such a way as to prevent creditors of the beneficiary from reaching it before it gets into his hands, are generally supported (*Nichols* v *Eaton*, 91 United States Reports, 713). A "voting trust" is a concerted transfer of their shares in a corporation by a majority of the shareholders to trustees to hold and vote on them for a specified period for the purpose of securing the adoption or continuance of a certain line of corporate action. Any shareholder may recede from such an arrangement and reclaim his stock

AUTHORITIES.—The principal authority is Lewin's *Law of Trusts*; other treatises are those of Godefroi and Underhill. For American Law see Perry *On Trusts*. The principal authority on charitable trusts is Tudor. For the history may be consulted Bacon, *Law Tracts*; Reading, *On the Statute of Uses*; Gilbert, *On Uses*; Sanders, *On Uses and Trusts*, Spence, *Equitable Jurisdiction*, i. 435; Digby, *Hist. of the Law of Real Property*, chs. vi., vii.

TRUSTS, in Economics. The word "trusts," as used here, includes all those aggregations of capital engaged in productive industry that, by virtue of their industrial strength, have or are supposed to have some monopolistic power. Legal monopolies, as such, and natural monopolies are excluded, although it is frequently true that the trusts are aided by and sometimes control natural monopolies. Trusts are here considered to be identical with the so-called "capitalistic monopolies." As "trusts" started in America, the subject will be considered here first from the point of view of American experience.

While it is probably true that trusts are a product of evolution, it is desirable to analyse and explain that conception in some detail if we are to understand their industrial significance. Competition, especially among industries managed on a great scale, often makes modern business unprofitable. Commercial men have been thus compelled in some way to modify former methods of doing business. So long as most industries were run on a small scale, the differences in the ability and the facilities of the various competitors were so great that only those at the lower end of the scale of excellence were forced out of the business—this to the general advantage of industrial society. The great mass of producers remained vigorously competing with one another, some making larger, others smaller profits, but all except a few at the lower margin making at least a living. Under modern business conditions competitors are often, relatively speaking, few in number, of substantially equal ability, and controlling substantially equal facilities for managing the business economically. Consequently, in such circumstances, modern competition differs greatly from that form which was familiar to the earlier economists. Among competitors of such great resources, the struggle may last long after the business has become unprofitable to all before any will fail. Among competitors so nearly equal in strength, the entire industry may be very seriously injured by competition before enough are forced out to affect materially the severity of the competition.

The dictum of Stephenson, that "where combination is possible, competition is impossible," has a much wider application now than in the early days of railways. The modern facilities for the transportation of goods, for the rapid transmission of intelligence by fast mail, and especially for the instantaneous exchange of information by the telegraph and telephone, have made it possible to manage easily a large business, however widely separated its different plants or establishments may be. In the middle of the 19th century or thereabouts, on account of the lack of these facilities, management of such institutions would often have been impossible. Many of the advantages of combinations are entirely dependent upon these modern facilities, and on that account these facilities may be said to be an occasion, if not a cause, of the trusts.

Two Kinds of Trust Industries.

If the product of an industry is of such a nature that its quality is substantially uniform and can be readily tested by purchasers, especially if the goods are such that they are ordinarily sold in large quantities, the competition between rival establishments must almost of necessity be a competition in price. Sugar refining, oil refining, the distilling of spirits, the manufacture of salt, are such industries. The standard quality is readily tested, and the manufacturer who can offer the standard product at the lowest price effects a sale. Industries manufacturing comparatively inexpensive articles for the retail trade, put them up in packages which become well known to customers, and those industries whose goods are sold under brands or trade-marks, or in some other form so that they are familiar to buyers, afford an example of competition of an entirely different kind When the reputation of a certain brand of goods of this nature becomes established, consumers make no further efforts to test its quality, and the retail price often becomes a customary price. If a manufacturer of such goods finds his trade injured by a rival, his most effective means of competition will often be, not a lowering of the price, but an increase of the outlay on advertising. Soap, baking-powder, photographic cameras for general use, and of late years certain brands of coffee, patent medicine, and other drugs of similar nature, are examples of this class. Those industries in which the competition becomes a matter of cutting of prices can by combination remove rivals from the field, and then put prices up to a remunerative rate. Competitors in industries of the second class by combination can save many of the costs of selling, and thus without any increase in the price of the product may save enough of the cost to make the business profitable.

Some of the advantages of combination over competition which have led to the organization of trusts may be enumerated.—

Savings from Combination.

1. The cost of selling may be greatly lessened. As has been intimated, competition in the case of industries of the second class named above leads to very expensive advertising in order to effect sales. An examination of the pages of any of the American magazines, with a thought as to the amount charged for the use of these advertising pages (from one hundred to as high as even four hundred dollars, or from £20 to £80, per page for a single insertion in some of the magazines with the largest circulation) will convince one of the cost of such competitive advertising. The expense involved in making attractive show-windows in stores or shops, and in calling the attention of the public to popular wares by posters scattered about the country and by legends painted on rocks, on buildings along the lines of railways, &c., are other common examples.

2. The salaries of commercial travellers, together with their hotel and travelling expenses, are of a similar nature. This competitive advertising in many cases does not increase to any noteworthy extent the consumption of the products in question, but merely attracts customers from one manufacturer to another. Combination among establishments that do this costly advertising saves a large part of the expense without lessening materially the quantity of goods sold.

3. If different manufacturing establishments, scattered throughout the country, are brought under one management, it will be possible for orders for goods to be received at one central office, and then to be distributed to the federated establishments, so that goods can be despatched to customers in each case from the nearest establishment. In this way freight expenses may be very greatly lessened, cross freights over the same territory being substantially eliminated. A single establishment supplying all of its customers would often be compelled to deliver much longer distances at greatly increased expense.

4. The entire profit of an establishment frequently depends upon the skill of the manager. When many different establishments are organized into one, it is possible to select the most skilful manager of all and to put him in charge of the combination, thus securing in many cases, if the trust includes practically all of the establishments in the entire industry, the ablest manager in the country for them all. It is of course true that as an establishment increases in size, or as a combination increases the number of its branches, especially if they are widely scattered, it becomes impossible for the manager to give his personal supervision to the details of management of each institution. An executive officer of the highest skill, however, will so select his subordinates, so direct their work, and so infuse into them his own spirit, that, under careful inspection, comparatively little will be lost from his inability to be present personally in each separate establishment. In the larger combinations frequent reports, often daily, are made from each concern, giving in detail the quantity of the output, the quality of the goods, the exact cost of the different processes of manufacture; so that it is possible to compare continually each of them with all of the others; to detect the special weakness of each, and in this way to remedy any slight defects in any one establishment, and to bring all nearly up to the highest level of productive capacity.

5. Each business manager is likely to have some special excellence in his methods of management. One will be particularly skilful in the technique of manufacturing; another in the organization of the business; a third in selling goods, and so on. By combining many establishments into one, it is possible so to distribute this managerial skill that each superintendent will be given the department for which he is peculiarly fitted, and the whole establishment will thus get the benefit, not merely of the best executive ability at the head, but also of the best managing skill at the head of each separate department. In many cases it is probable that as much is saved in this way as in any other.

6. Besides this distribution of skill of the managers, it is sometimes equally beneficial to distribute the various products of the combination among the different plants. For example, in the manufacture of hoop and bar iron the products are turned out in great varieties of size, probably from seventy-five to a hundred. Wholesale dealers in sending their orders to the mills are likely to call for from ten to fifty different kinds. If these orders go to an establishment which has but one large mill, it may be necessary, in order to execute the order, to change the rolls in the mill several times, causing thus a waste of power, of time and of energy. If several establishments are combined, each can be equipped for certain sizes. When, in these circumstances, a large order is received, to each establishment will be sent that part of the order which it is especially equipped to fulfil, and thus, without any changes of rolls or stoppage of machinery, the separate sizes can be made. The same principle holds of course in nearly all lines of work, in some to a greater degree than in others; but in the manufacture of hoop and bar iron a saving from this source amounting to from a dollar to a dollar and a half, or from 4s. to 6s., per ton is sometimes made.

7 The advantage of unifying in one establishment the manufacture of products somewhat allied in nature appears also in selling goods. If customers can buy all of the various kinds of related goods in one establishment, much of their time and energy will be saved. Some of the larger combinations, therefore, in order to make this saving for their customers and thus to be sure of retaining their orders, add to their plant facilities for making products which a smaller establishment could hardly manufacture. For example, the Distilling Company of America, which controls probably 90% of the entire product of corn spirits, found it to its advantage to add to its plant several rye distilleries, and to purchase a number of the leading brands of whiskies for consumption as beverages, in order that they might supply the needs along different lines of practically all dealers in spirits and whiskies, in this way saving for themselves many customers who otherwise might have been lost

8. The mere size of an establishment and its ability to supply at any time on short notice any order, however large, gives it also an advantage in retaining custom. A concern that controls only

from 5 to 10% of the entire output of a country in any special line of goods might at times find it impossible to supply goods promptly. Large customers who might thus be embarrassed are more ready to deal regularly with an establishment controlling 75 to 90% of the output, if they can in this way be sure of having their orders attended to promptly. It is stated that the American Sugar Refining Company on this account has been able to secure, with considerable regularity, one-sixteenth of a cent a pound more on its refined sugars than the independent refiners, the latter being frequently compelled to cut their prices to that extent in order to make sales.

9. Owing to the fact that the introduction of goods into new markets, especially into foreign markets, is a matter of time, expenditure of energy, and of money, the large establishment with great capital has in this particular also a decided advantage. The Standard Oil Company, and American Tobacco Company, and other similar establishments, have thus been able to open up new markets in Europe, in Japan, China and other portions of the Far East more readily by far than individual producers along those lines could have done. This stimulus to the foreign trade acts also beneficially to the domestic trade, inasmuch as the exportation of part of the product tends to keep prices somewhat higher at home, and as the added demand for the raw material influences its price, thus creates a demand for labour along many lines.

10. The combination also frequently saves for its stockholders considerable sums from its wiser dealing with credits, and this in a way also that is beneficial to the entire business community. When competition is very severe among different establishments, the managers, in order to increase their sales, will not infrequently grant credit somewhat unwisely. The combination controlling a large part of the market is not so tempted, and moreover has the power to bring needed pressure to bear upon delinquent debtors more readily, so that losses from bad debts are much less frequent.

Besides the special savings that serve as reasons for the formation of combinations, certain special favours at times lead to their formation.

Special Favours to Combinations.

1. The protective tariff is most frequently cited as such a favour. By the protection which a protective duty gives against foreign competition, it doubtless often furnishes the occasion for the formation of trusts. If a large amount of capital is tempted into the industry through the profits promised by the tariff, and therefore competition among the various establishments becomes fierce, it is much easier for them to form a combination with the certainty of good profits, provided the domestic competition can be overcome, if they are certain that foreign competition also is to be excluded. On the other hand, it would hardly be right to speak of the tariff as in this case the direct cause. In other industries not protected by the tariff the same fierce competition leads to the formation of combinations. The tariff is simply an encouraging condition. The removal of the tariff would not destroy the combination unless it destroyed the industry at the same time; but, on the other hand, the removal of a protective tariff might very easily prevent the abuses of exorbitant prices which might be exacted by a combination protected by the tariff.

2. It is doubtless true that combinations have a good many times been encouraged by special discriminating rates of freight granted by the railways or other transportation agencies. There is, of course, a certain economic advantage to the railways in having goods despatched in large quantities by consigners who are able to supply their own cars, loading and unloading facilities, &c. Railways on that account often prefer to deal with large firms, and, other things being equal, are willing to give them some special rates. These concerns also are likely to have rather better credit than the smaller ones, so that dealing with them ensures prompt pay and cheaper collection of accounts. The competition among the different railways also for the freights which an important customer can furnish leads to cutting of the rates in their favour. These special rates, however, whether justified from the business point of view or not, are beyond any question from the social point of view, often a very grave injury. A manufacturer who receives these special favours can build up a business substantially monopolistic in its extent, whereas his rival of equal or even of greater ability, and equally skilful as a manufacturer, would be ruined if he did not receive like rates. The injustice of such discriminations and their evil effects on the community have been recognized by legislatures and courts in America, and they are practically universally forbidden. It remains beyond question true that they are, notwithstanding, very frequently granted.

Promotion.

In recent years in the United States there can be little question that the formation of the great combinations has been much encouraged by the opportunities, which promoters were able to seize, of making for themselves large profits. The movement towards combination was so fully recognized and the advantages in many cases so palpable, that a well-informed and skilful promoter was often able to persuade a large proportion of the manufacturers in some special industry to combine. In preparing the plan for such combination, the promoter has in many cases seen to it that he himself first bought the properties which he could very shortly turn over to the combination at high rates of profit; or else he has been able to persuade the new corporation to issue large amounts of stock, of which considerable proportions were given to him in return for his services. It has been true in many cases that these securities have been speculative in nature, but nevertheless the promoter has often reaped in this way large rewards. The possibility of this profit has doubtless stimulated his activity in urging the combinations.

The Underwriter.

Associated with the promoter in the organization of these combinations have usually been bankers or other financiers who stood ready, for an amount of stock or other promised profit sufficiently large to compensate them for their risk, to furnish to the combinations cash sufficient to start the business and to provide other needed capital. Usually the form of underwriting employed has been this: A promoter engaged in the formation of a combination and needing a certain fixed sum in cash, would make an arrangement with a bank to sell to it at a price agreed upon such portions of a named amount of stock as were not disposed of to other customers before a certain fixed date. For example, the bank might agree to furnish one million dollars in cash (£200,000) in return for say four millions of stock (£800,000), or to purchase itself at a fixed price all the remainder of the $4,000,000 stock unsold at the date agreed upon, the bank itself to become the sales agent. In those circumstances the bank would naturally use its best endeavours to sell the four millions of stock to other customers at the price agreed upon, say twenty-five dollars, or £5, per share. So far as it failed of disposing of the entire amount, it would take the remainder itself. For taking these risks, naturally the bank has almost invariably asked a very high commission, and not infrequently it has been asserted that the managers of the banks have been given a special bonus for themselves privately, in addition to the rates of profits granted the bank.

The Basis of Capitalization.

These large amounts of stock that are paid to the promoter and the financier for the purpose of bringing about the organization of a large trust, lead, of course, to what is called over-capitalization. What the proper basis of capitalization for a manufacturing industry should be, is a matter that cannot perhaps easily be determined by a definite principle which shall be applicable in every case. The laws that have been most strict on the subject attempt to limit the capitalization to the "actual cash value" of the business, by that being understood at times simply the cost of the plant itself with the running cash capital needed. On the other hand, most business men think that it is a wiser plan, and on the whole equally just, to capitalize a business on the basis of its earning capacity, regardless of what the plant may have cost. When, as has been frequently the case of late years, in addition to this cash value of the plant and the cash itself which may have been paid in, large sums of stock are issued also for properties which may be in themselves highly over-valued, and for the services of the promoter, the financier and others, we can see that the capitalization must be far above what may ordinarily be considered a paying basis. On the other hand, if the element of monopoly enters into the business to any noteworthy extent, the prices of the product may be kept so high that fair dividends may be paid even on this high capitalization. That the tendency towards increasing the capital has been very strong there can be no question, and a penalty is apt to be paid for this somewhat reckless financiering. As soon as a slight depression in business comes, so that it is perfectly evident not merely that dividends cannot be paid on the common stock, but that in all probability both the deferred stock and the bonds, if any have been issued, will also have to go without interest, it may be necessary to reorganize many of these combinations and to start them anew on a much lower capitalization.

The Industrial Manager.

When the person organizing the combination is himself an active business man, and has the intention of himself directing the affairs of the combination, another element besides that of personal profit very frequently enters into the problem. Most strong men like to take responsibility and to be dominant in affairs. When, owing to the advantages of combination that have been enumerated above, the prospect of a virtual monopoly seems certain, provided due skill in management is exercised, it is natural that the manager should wish to bring about the combination in order that he may himself have the satisfaction of being in substantially absolute control of the entire industry in a country, or possibly even in the world. The ambition thus to dominate in a great industry is akin to that of a statesman, and there can be little question that this pride of power and the desire to control the destinies of others has been a more or less conscious element in the formation of many of the most successful and most skilfully managed combinations.

The Forms of Combination.

1. The form of combination which has ordinarily been first adopted has been some kind of agreement with reference to maintaining prices, or to paying wages, or to dividing the territory for the distribution of the product, or similar questions. Experience has shown that, generally speaking, such agreements are not likely to be kept in good faith for a long period.

2. In order to make the combination more permanent in its nature, the form of the trust, technically so called, was adopted. Under this form of combination, the stockholders of the various constituent companies of the trust place their stock in the hands of a small board of trustees, giving to these trustees an irrevocable power of attorney to vote the stock as they see fit, or in accordance with specific instructions given at the beginning. The title to the stock itself remains in the original holder, with the right to sell or pledge or dispose of it as he sees fit, but without the power of recalling his right to vote. In return for this stock thus deposited with the trustees, the trustees have ordinarily issued trust certificates, which are in themselves negotiable and take the place of the stock. Inasmuch as the holding of the voting power of the majority of the stock of each of the different constituent companies gave to the trustees absolute power of election of directors, and consequently the power of guiding harmoniously the affairs of all of the plant entering into the combination regardless of the will of the stockholders, the United States courts held that the corporations entering into such an agreement had gone beyond their powers, and that such a trust was illegal. Owing chiefly to these hostile decisions of the courts, this form of trust was abandoned, and new forms, which still, however, leave the power of unified direction in the hands of a few men, were adopted.

3. After the trusts were declared illegal, it was usual, when a combination was formed, to organize a new corporation which bought all of the properties of the constituent members of the trust. These constituent companies then dissolved, and the one great corporation owning all of the properties remained.

4. The form that now seems to be much in favour approaches in its general nature more closely to that of the original trust. Under this form a corporation is organized for the special purpose of buying and owning all, or a controlling share, of the stocks of each one of the constituent companies. The separate companies are then managed technically independently, the dividends of the separate corporations are all paid to the parent corporation as the stockholder owning all of the stocks, and these dividends are the source of profits of the new corporation. The officers in this parent corporation, of course, vote the stocks of the separate companies, and thus absolutely control.

The Trust and Wages.

From the savings which it is possible for the combinations to make, it would seem possible for them to pay higher rates of wages to those remaining in their employment than it was possible for the constituent companies to do. In certain instances, especially when the combination has first been made, wages have been increased. On the whole, however, it is probable that as yet the wage-earners have succeeded in getting an increase of wages in circumstances substantially similar to those under which their wages would be increased by single corporations. An increase of wages comes only through pressure on their part. Under a prosperous condition of industry it is possible, without materially lowering profits, to increase the wages.

Certain classes of employés, especially superintendents and commercial travellers, are less needed by the combinations, and consequently the total sum of wages paid to these classes by the combination is less than that formerly paid by the constituent companies. On the other hand, the number of employés of these classes being less than before, the average wage has, in certain cases at least, been increased. Owing to the fact that competitive selling is in certain cases largely done away with, it has in some, perhaps in many, cases been possible for fewer travelling salesmen, of less skill and with lower wages, to do the work than before the combination, so that not merely has the total expense been lessened, but also the average salary paid to those retained in the business.

In case of disputes arising between the combination and the operatives, the position of the combination is stronger than that of an individual corporation. It is possible to close one or two works where troubles have arisen, and to transfer orders to the other works without any material injury to the business, provided the closing of the one or two establishments is not for too long a period. Such instances have occurred. On the other hand, labour organizations are also rapidly increasing in strength, and their leaders are of the opinion that within a comparatively short time they will be so thoroughly organized in all of the chief industries that a strike can be instituted and supported not merely in one or two establishments, but throughout the entire industry. Whenever this condition of affairs shall have been reached, the employés will be substantially on an equality with their employers in such cases of conflict, so that the advantage now resting with the combination will be largely removed. In certain industries this condition seems already to have been reached.

Prices.

From the sources of savings that were enumerated before, it is evident that it would be possible for a combination either to increase the prices paid for raw materials, or to lower the prices of its finished products. Experience, however, seems to show beyond question that whenever the combinations are powerful enough to secure a monopolistic control it has usually been the policy to increase the prices above those which obtained during the period of competition preceding the formation of the combination. Inasmuch, however, as an attempt to increase prices to any great extent, so as to secure very high profits, would certainly result in tempting new capital into the field, it has been the general experience that prices have either been increased only comparatively little after the combination was formed, or else that competition entering the field has comparatively soon forced a lowering of prices to substantially the former competitive rates. It should be noted, however, that inasmuch as combinations have very frequently been formed only after a period of competition so fierce that practically all the competitors were running at a loss, it is hardly just to speak of a combination placing its prices above "competitive rates" unless one defines what is meant exactly by that expression. Whenever they have put their prices above the competitive rates existing just before the combination, it may mean that they have put their prices back to rates that will allow medium profits instead of losses, and not above rates that would be normal in the case of small competitors.

Legislative Remedies.

It will have been noted from what has been said that the excellences of the combination consist largely in the savings that have already been enumerated. The evils are: (1) The losses to investors through the acts of the promoters and financiers at the time of the organization of the combinations, and through the speculation in the stocks which is at times carried on by the directors of the combinations themselves. (2) The losses to the wage-earners from the power that sometimes exists of forcing wages rather lower than it would be possible for a single corporation or manufacturer to do, and also from the discharge of certain classes of employés whose services are no longer needed, such as commercial travellers. It should be remarked of the latter case, however, that the injury is a personal one to those men that are discharged, but that it results in a saving to the community, and, therefore, presumably to the wage-earning class as a whole in the long run. (3) A further injury at times to the consumer arises, as has been suggested, from the increase in price. Other evils come through the power that is sometimes exercised by combinations in the corruption of legislatures; in the control over industries of such a nature that it tends to destroy the spirit of individual activity and independence on the part of many persons who would otherwise enter business independently; and evils also come through the increased force of any improper or dishonourable business practices, since this added force for evil is given to any combination by virtue of its greater influence in the community. It is not intended to convey the impression that managers of combinations are less moral than other business men, but merely that whenever they are dishonourable in their practices the influence reaches more widely.

The chief remedies for these evils enumerated would seem to be more rigid laws with reference to the methods of incorporation and to the responsibility of directors to stockholders and to the public. This can perhaps best be brought about through greater publicity in both of these directions, probably under the inspection of government officials. The other line of remedies would seem to be the removal of special favours granted to these combinations either by the government or by railways or other bodies so situated that they can distribute favours to the larger combinations.

The Movement Towards Consolidation.

The movement towards consolidation of industries in the United States began to be noticeable soon after the Civil War (1861–65), but it had not reached noteworthy proportions, excepting in connection with the railways, until within the last twenty years of the 19th century. During the later years many consolidations were made, the largest number during the years 1898–1900. From what has been said earlier, it is evident that certain classes of industries, especially those that require the investment of fixed capital to large amounts, are especially adapted for combination. Very little tendency towards consolidation is found in the farming industry, and, relatively speaking, little in industries that require the investment of but small capital. It is perhaps, however, not too much to say that in nearly all lines of industry which from their nature are adapted for consolidation combinations more or less firm have been made during the last few years. It is probable that as time passes we shall have many of these combinations reorganized, and that in many lines of industry there will be further consolidation of present combinations.

Experience has shown that when combinations are made in industries that from their nature do not seem well suited for consolidation, failure follows. In many individual instances corporation lawyers, who have had much practice in forming combinations, advise their clients in lines of business especially fitted for competition not to enter a combination, but to remain independent, assuring them that an individual is able to compete in such lines of industry with any combination, however large. Such advice, of course, would not be given were the industry one which was well adapted for consolidation.

European Experience.

Great Britain.—The tendency towards consolidation has been for several years very noticeable in Great Britain, although the form has been rather that of a *pool* or *ring* than that of a trust or of a single large corporation. In the coal and milling industries there have been agreements; and, particularly in London and other distributing centres, these selling combinations have been able at times to control the market. This has also been true with reference to certain kinds of provisions, such as the bacon imported from Denmark.

Of late years there has been a marked tendency towards the formation of large corporations that buy up a very large proportion of competing manufacturing plant, and in this way secure at least a temporary monopoly of the market. The Salt Union was formed along these lines, but this has not proved successful, owing probably to the fact that new sources of supply were discovered. The dyeing industries in Bradford and in Yorkshire have been consolidated, so that in certain respects they have an absolute monopoly of the business, and in most directions of over 90% of it. The calico printers, the fine cotton spinners, the thread manufacturers, the bleachers, and others connected with the cotton manufacturing industries in Great Britain, have nearly all been brought together into large corporations which control from 90% upwards of the entire business. Similar combinations in cement, wall-paper, soap, tobacco and other trades have been formed. Most of these large corporations have been in existence for such a short time that one cannot yet judge accurately regarding their permanent success. Many of them seem to have been over-capitalized and their dividends have not always met shareholders' anticipations. There has been no active popular movement against consolidation in England, and the government has passed no laws opposed to it. Parliament, however, has passed stringent amendments to the Companies Acts, changes enforcing publicity regarding the organization of all limited liability companies and their methods of management. The amended law is expected to prevent most of the abuses of the combinations.

Germany.—Germany seems to be peculiarly the home of combinations so far as Europe is concerned. In 1897 Liefmann, writing regarding combinations in Germany, was able to mention combinations which were international in their scope in forty-one different branches of industry. Of combinations that were confined to Germany alone he mentioned 345, although many of them were in the same line of industry; for example, he found 80 combinations in different branches of the iron industry, 82 in the chemical industries, 38 in the textiles, and so on. Of that number he thought that definite information could be secured, but he was of the opinion that very many more of less importance existed, and had excluded from his reckoning all of those that were purely local, as for example those among the breweries in the different cities, as well as those among firms engaged merely in trade. The form of combination in Germany is ordinarily that merely of contracts among independent establishments (*Cartels, Kartells*) regulating the amount of output for each, and in certain cases also the prices. As in Austria and in France, a central selling bureau for all the members of the combination is frequently found. The most successful combinations have been those among the coal-miners in western Germany and the four or five in the leading branches of iron manufacture, also in western Germany. Others of somewhat similar rank have been organized, one, for example, in the sugar industry, which includes both refiners and producers, and another among the manufacturers of spirits. The former, following that among the Austrian sugar manufacturers, is somewhat peculiar in that the refiners guarantee to the producers of raw sugar a fixed price for their output so far as the sugar is intended for the home market, the refiners expecting to recoup themselves from the consumers through the monopolistic power which they possess. The law does not seem to be hostile to these combinations. Contracts that are immoral in their nature are, of course, non-enforceable. But the courts have, on the whole, not taken an attitude inimical to the larger combinations, and the government seems at times to have been inclined to favour them. In one or two cases where the government is itself a producer, as of soda, it is a member of a combination. Indeed, a Prussian minister in a speech in the Landtag has expressed himself favourably regarding the coal and iron combinations. The facts seem to show that the coal combination, at any rate, has used its power of fixing prices in a conservative way, and it has at times held prices somewhat lower than they probably would have been had free competition existed in that industry. So long as the combinations are managed conservatively, and so long as the government is able to secure a careful supervision over them, it is not to be expected that there will be much hostility in Germany on the part of the government.

France.—The number of combinations in France is probably much less than in Great Britain or Germany. In the penal code there has been a provision for many years against monopoly brought about by unfair means, and in one or two rather prominent instances there seem to have been convictions under this article. Consequently, the agreements that have been made, so far as they are intended to control prices, are usually kept secret. There have been, however, notably in the case of the iron industries, agreements made among the leading manufacturers, under which the proportion of output assigned to each was fixed. A single selling bureau has also in such cases been established, which receives all orders and fixes the prices for all of the different establishments concerned. So far this form of organization, although in certain localities it seems to have secured monopolistic power has not been successfully attacked in the courts. For several years it has been supposed that a similar agreement existed among the sugar refiners. They themselves, however, acknowledge only an agreement regarding the amount of the output which shall be assigned to each, and deny any agreement as to prices. Of course an agreement regarding output would be likely to have a material effect upon prices. Somewhat similar combinations exist among the petroleum refiners, the porcelain makers, and some few others. The government has taken no active steps in the matter, but popular opinion seems to be awakening somewhat.

Austria.—In Austria the development of combinations has been very marked. The most successful combination, on the whole, as well as one of the earliest, has been that of the iron industry. The sugar industry, however, including both refiners and producers of the raw sugar, and the petroleum industry, are also combinations of great power. The form of these combinations is ordinarily that of an agreement regarding both output and prices. In some instances a central selling bureau fixes the prices, in others the market is divided, while in others still other forms of agreements of many kinds which serve to secure a monopoly are found. The movement has spread very rapidly indeed, until, in the opinion of many writers in Austria, practically all branches of industry, in which agreements for the lessening of competition will prove advantageous, are now largely controlled by combinations. The courts of Austria have, on the whole, shown themselves hostile to the movement. Contracts for the division of the market, for the assignment of fixed proportions of the entire output to different establishments, the fixing of prices, &c., are declared void and will not be enforced by the courts. This adverse action, however, does not seem to have affected very materially the tendency towards combination, although it has perhaps tended somewhat to encourage the formation of large corporations which should purchase all of the separate plant in any one industry. This tendency, again, is checked by the fact that the corporation law requires publicity in business, and that the taxes are heavier on corporations than on private firms, both as regards the legal rate and the certainty of collection. A government commission has recommended recognition of the combinations by law and their careful supervision and regulation by government authority. (J. W. J.)

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TRUXTUN, THOMAS (1755–1822), American naval officer, was born at Jamaica, Long Island, on the 17th of February 1755. He went young to sea, and during the War of Independence was first persuaded to serve in a royal ship. But having been wounded in an action with a privateer manned by his countrymen, it is said that he declared he would never fight them again. Henceforth he commanded a succession of privateers sent out to cruise against British trade and transports—the "St. James," the "Mars," the "Independence." He had the reputation of being uniformly successful in all engagements with British vessels. When the independence of the United States was recognized he returned to trade with a high reputation as a seaman. He was the author of a treatise on longitude and latitude, of a "System of masting a 44-gun frigate," and was an advocate for the foundation of a national navy. When the United States navy was reconstituted in 1798 he was one of the original corps of six captains. During the last years of the 18th and first of the 19th century American commerce was subject to much intolerable interference on the part of the French as well as of the British naval officers. It was against the first that Truxtun rendered the services which have made him a prominent personage in the history of the United States navy. In February 1799 he was captain of the United States "Constellation" (36) and on the 19th of that month he captured the French "L'Insurgente" (36). In the following year, and while still in command of the "Constellation," he fought the French "Vengeance" (40), and drove her into Curaçao. The crippled state of his own ship, which had lost her mainmast, prevented him from taking possession of the enemy. In 1802 he was to have sailed in command of the squadron sent against the Barbary pirates, but a difference having occurred between him and the navy department in regard to the appointment of a captain to his flagship, his remonstrance against the official decision of the authorities was treated as a resignation, which it was apparently not meant to be, and he was not employed any further. He died at Philadelphia on the 5th of May 1822.

TRYON, DWIGHT WILLIAM (1849–), American artist, was born at Hartford, Connecticut, on the 13th of August 1849. At the age of twenty-five he left his position as a clerk in a Hartford publishing house to devote himself entirely to art, and two years afterwards went to Paris, where he became a pupil of the École des Beaux Arts, under J. de la Chevreuse, Charles Daubigny and A. Guillemet. A skilful landscape painter, New England provided his best subjects. He first exhibited at the Salon in 1881, and in the same year returned to the United States, settling first in New York City; in 1882–1886 he was director of the Hartford School of Art, and in 1886 became professor of art at Smith College. He became a member of the Society of American Artists (1882), a National Academician (1891), and a member of the American Water Color Society. He won numerous medals and prizes at important exhibitions, among his pictures being "Daybreak," "Moonlight" and "Early Spring, New England."

TRYON, SIR GEORGE (1832–1893), British admiral, a younger son of Thomas Tryon, of Bulwick Park, Northamptonshire, was born on the 4th of January 1832. He entered the navy in 1848, on board Lord Dundonald's flagship on the North American station; was subsequently in the "Vengeance" with Lord Edward Russell in the Black Sea; was landed for service with the naval brigade; and was made a lieutenant in November, but dated back to the 21st of October 1854. From 1855 to 1858 he was in the "Royal Albert" flagship of Sir Edmund Lyons; and from 1858 to 1860 in the royal yacht, which gave him his promotion to commander on the 25th of October 1860. From 1861 to 1864 he was commander of the "Warrior," the first British sea-going ironclad; from 1864 to 1866 he commanded the "Surprise" gun-vessel in the Mediterranean; and was promoted to be captain on the 11th of April 1866. In 1867 he was sent out as director of transports and store ships for the Abyssinian expedition, a post which involved a great deal of hard work in a sweltering and unhealthy climate. He discharged his duties exceedingly well, but his health broke down, and he returned to England a helpless invalid. From 1871 to 1873 he was private secretary to Mr Goschen, then first lord of the admiralty; and from 1874 to 1877 commanded the "Raleigh" in India with the Prince of Wales, and later in the Mediterranean. In the years 1878–1881 he had command of the "Monarch," one of the Mediterranean fleet under Sir Geoffrey Hornby and Sir Beauchamp Seymour, afterwards Lord Alcester. He was subsequently for two years secretary of the admiralty; and for three years more, on his promotion in April 1884 to the rank of rear-admiral, commander-in-chief on the Australian station. On his return in June 1887 he was made K.C.B.; afterwards he was for three years superintendent of reserves, in which capacity it fell to him to command one of the opposing fleets during the summer manœuvres, when he showed marked ability and originality of ideas. In 1889 he was promoted to be vice-admiral; and in August 1891 was appointed to command the Mediterranean fleet, which under him—following the example of his old chief, Sir Geoffrey Hornby—became very distinctly an evolutionary and, in that sense, experimental squadron. Some of his methods were afterwards said to be dangerous; but those which were most severely criticized do not appear to have had anything to do with the lamentable accident which ended Tryon's career. On the 22nd of June 1893, the fleet being then off Tripoli on the coast of Syria, in two columns, Tryon made the signal to invert the course, the ships turning inwards in succession. By a fatal error, the psychological cause of which has never been explained, he ignored the patent fact that the two columns were so near each other that the manœuvre, as ordered, must entail the most serious risk, if not certainty, of collision. And, in fact, the two leading ships did come into collision, with the result that the "Victoria," Tryon's flagship, was cut open and sank in a few minutes. Tryon and 358 officers and men were drowned.

See the *Life*, by Rear-Admiral C. C. Penrose-FitzGerald.

TRYON, THOMAS (1634–1703), English humanitarian, was born at Bilbury near Cirencester on the 6th of September 1634. He had but little schooling, spending his youth first in spinning and carding and then as a shepherd. In 1652 he went to London, apprenticed himself to a hatter, and accepted his master's Anabaptist principles until he read the works of Jacob Behmen. He now lived a very ascetic life, though he married and became a prosperous merchant. In 1682 he began to publish his views in support of vegetarianism and abstinence from alcohol and tobacco. He detested war, and in this and his mysticism resembled the early Quakers. He died on the 21st of August 1703.

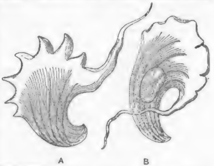
His best known book, *The Way to Health* (1691), which much impressed Benjamin Franklin, was a second edition of *Health's Grand Preservative; or, The Women's Best Doctor* (London, 1682). He wrote on many other subjects, *e.g.* the education of children, the treatment of negro slaves, the way to save wealth, and dreams and visions. Some scanty autobiographical memoirs were published in 1705.

TRYON, WILLIAM (1729–1788), American colonial governor, was born at Norbury Park, Surrey, England, in 1729. In 1757, when he was a captain of the First Foot Guards, he married a London heiress with a dower of £30,000. In 1764 he was appointed lieutenant-governor of North Carolina, upon Arthur Dobbs's death in 1765 became governor *pro tem.*, and in December of the same year received his commission as governor. Like many other pre-Revolutionary officials in America, he has generally been pictured by American writers as a tyrant. In reality, however, he seems to have been tactful and considerate, an efficient administrator, who in particular greatly improved the colonial postal service, and to have become unpopular chiefly because, through his rigid adherence to duty, he obeyed the instructions of his superiors and rigorously enforced the measures of the British government. By refusing to allow meetings of the Assembly from the 18th of May 1765 to the 3rd of November 1766, he prevented North Carolina from sending representatives to the Stamp Act Congress in 1765. To lighten the stamp tax he offered to pay the duty on all stamped paper on which he was entitled to fees. With the support of the law-abiding element he suppressed the Regulator uprising in 1768–71, caused partly by the taxation imposed to defray the cost of the governor's fine mansion at New Bern (which Tryon had made the provincial capital), and executed seven or eight of the ringleaders, pardoning six others. From 1771 nominally until the 22nd of March 1780 he was governor of New York. While he was on a visit to England the War of Independence broke out, and on the 19th of October 1775, several months after his return, he was compelled to seek refuge on the sloop of war "Halifax" in New York Harbour, but was restored to power when the British took possession of New York City in September 1776, though his actual authority did not extend beyond the British lines. In 1777, with the rank of major-general, he became commander of a corps of Loyalists, and in 1779 invaded Connecticut and burned Danbury, Fairfield and Norwalk. In 1780 he returned to England, and in 1782 was promoted to be lieutenant-general. He died in London on the 27th of January 1788.

See Marshal D. Haywood, *Governor William Tryon and his Administration in the Province of North Carolina* (Raleigh, North Carolina, 1903).

TRYPANOSOMES, or HAEMOFLAGELLATES, minute Protozoan parasites, characterized by the possession of one or two flagella and an undulating membrane, and specially adapted for life in the blood of a vertebrate.[1] Of late years considerable progress has taken place in our knowledge of these organisms, research upon them having been stimulated by the realization of their extreme importance in medical parasitology. Not only has the number of known forms been greatly multiplied, but the study of the biology and life-history of the parasites has been attended in some cases with remarkable and unexpected results.

Historical.—The first observation of a trypanosome is usually ascribed to Valentin (55), who in 1841 announced his discovery of certain amoeboid parasites in the blood of a trout. In the two or three years following several other observers recorded the occurrence of similar haematozoa in various fishes. The generic name of *Trypanosoma* was conferred by Gruby in 1843 upon the well-known parasite of frogs. E. Ray Lankester (18) subsequently described this same form (under the name of *Undulina ranarum*) and was the first to indicate the presence of a nucleus in the cell-body. To Mitrophanow (1883–1884) and Danilewsky (1885–1889) we owe the first serious attempts to study the comparative anatomy of these haematozoa. Trypanosomes were first met with in cases of disease by Griffith Evans, who in 1880 found them in the blood of horses suffering from surra in India. In 1894 (Sir) David Bruce discovered the celebrated South African parasite (*T. brucei*) in cattle and horses laid low with nagana or the tsetse-fly disease; and this worker subsequently demonstrated, in a brilliant manner, the essential part played by the tsetse-fly in transmitting the parasites. The credit for first recognizing a trypanosome in human blood, and describing it as such, must undoubtedly be assigned to G. Nepveu (1898). Trypanosomes were next seen in human blood



(From Lankester.)

FIG. 1.[2]—*Undulina ranarum*, Lankester, 1871. In B the nucleus is shown.

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[1] *Trypanophis*, although lacking (so far as is known) a haemal habitat, is included here, since it is undoubtedly closely related to *Trypanoplasma*.

[2] The illustrations in this article are from H. M. Woodcock's "Trypanosomes," in the *Quarterly Journal of Microscopical Science*.

in Senegambia in 1901, in a European suffering from intermittent fever. Forde discovered the parasites, but was uncertain of their nature; he shewed them to E. Dutton, who (11) gave this form the name of *Trypanosoma gambiense*. A year later A. Castellani (6) found the organisms (most probably the same species) in the cerebro-spinal fluid of patients suffering from sleeping-sickness in Uganda; and it has since been conclusively proved by Sir David Bruce and D. Nabarro (4) that they are the true cause of that dreadful malady.

More important, from the standpoint of protozoology, than these interesting medical discoveries have been the investigations by A. Laveran and F. Mesnil (20–24), L. Léger (30–35), S. Prowazek (47), F. Schaudinn (50) and others, upon numerous tolerated (*i.e.* non-pathogenic) forms; these researches supply, indeed, practically all the material facts on which to base an account of the Haemoflagellates at the present day.

Occurrence.

Trypanosomes are harboured by members of all the chief classes of vertebrates with the exception of cyclostomes. By far the greater number of hosts are furnished by fishes, birds and mammals. Among batrachians the parasites have been found, up till now, only in frogs; and among reptiles their occurrence has only been observed in one or two solitary instances (*T. damoniae*, fig. 3 J). Data with regard to the frequency with which individual species occur, in any kind of host, are as yet somewhat scanty; in one or two cases the parasites are fairly common, *T. lewisi*, for example, being met with in a considerable percentage of sewer-rats throughout the world.

In considering the occurrence of Trypanosomes in mammals, careful distinction must be drawn between natural or true hosts, which are tolerant of the parasites, and casual ones, which are unaccustomed and unadapted to them. A Trypanosome usually produces markedly harmful effects upon gaining an entry into animals which have never been, by their distribution, liable to its invasion previously. Such a state of affairs is produced by the march of civilization into the "hinterlands" of the various colonies, when man, together with the numerous domesticated animals which accompany him, is brought into proximity to big game, &c., and, what is equally important, into the zone of the particular blood-sucking insects which prey upon the same.

Very many of the common domestic mammals can be successfully infected (either thus accidentally or else on purpose) with different "pathogenic" Trypanosomes, to which they succumb more or less readily, but they cannot be regarded as the natural hosts of those Trypanosomes. In dealing with disease-causing forms, the more narrowly the original source of the parasite concerned is defined, the closer do we get to the true vertebrate host or hosts. In the case of the nagana-parasite, various Antilopidae (*e.g.* the gnu, bushbuck and koodoo) can certainly lay a strong claim to the honour. The capybara, again, is most probably the native host of *T. equinum* of mal de caderas of horses in South America. Similarly with regard to the many other pathogenic Trypanosomes now known, there is undoubtedly, in each case, some indigenous wild animal tolerant of that particular form, which serves as a "latent source of supply" to strange mammals.

Transmission; Alternation of Hosts.

The transmission of the parasites from one vertebrate individual to another is effected, in the great majority of cases,[1] by a blood-sucking invertebrate, and by this means alone. The "carrier" of a Trypanosome of warm-blooded vertebrates is, in all instances so far described, an insect, generally a member of the Diptera; in the case of parasites of cold-blooded vertebrates the same rôle is usually played by an ichthyobdellid leech (piscine forms), but possibly, now and again, by an *Ixodes* (amphibian or reptilian forms).

Until lately it remained quite uncertain, however, whether the invertebrate merely conveys the Trypanosomes or whether it is a true alternate host, one *i.e.* in which definite stages of the parasite's life-cycle are undergone. Schaudinn (50), who investigated certain avian Trypanosomes, considered the latter view to be correct, and believed that the carrier—in this instance a gnat—is indeed the definitive host, *i.e.* the one in which sexual conjugation occurs. Many other workers have since studied the subject and, so far as the parasites of fishes are concerned, there can be little doubt, thanks to the researches of E. Brumpt (5*a*), L. Léger (32, 33) and others, that leeches are true alternate hosts for these forms, in which certain phases of the life-cycle are normally undergone.

We cannot write quite so confidently with regard to the relation of the various pathogenic Trypanosomes to Tsetse-flies (*Glossinae*). In the first place experiment has shown that biting-flies, other in all probability than the true, natural hosts, may at times transmit the parasites—as it were—accidentally, if, after feeding on an infected animal, they are allowed to bite a fresh one within a limited time. One very helpful factor in determining which is the principal carrier of any form is the coincidence of the zone of a particular insect with that of any disease. By this means it has been ascertained with practical certainty that, among the family of Tsetse-flies (*Glossinae*) for instance, at least four species are the natural carriers of different Trypanosomes. Of these perhaps the best-known is *G. palpalis*, of Equatorial Africa, whose bite transmits the human parasite (*T. gambiense*). Nevertheless, the fact, commented upon by several observers, that even here an infected fly is only infectious for a comparatively short period suggests that this species of fly, at any rate, is not the true alternate host in which the life-cycle of that particular Trypanosome is completed. However, indications furnished by Koch (16*a*) point in this connexion to *G. fusca*. Lastly, before leaving this interesting and important subject, F. Stuhlmann's work (54*a*) on developmental phases of *T. brucii*, the nagana parasite in *G. fusca* and *G. tachinoides*, does render it probable that the pathogenic forms also have true invertebrate hosts.

Habitat: Effects on Host.

Schaudinn had fully described the relations of certain avian Trypanosomes to their invertebrate host, *Culex pipiens* (females). The distribution of the parasites in the gnat is closely connected with the process of digestion. The Trypanosomes ultimately overrun practically all parts of the body, sometimes not even the ova escaping. Thus true hereditary infection of a succeeding generation of gnats may be brought about. The life of the parasites while in the insect is characterized by an alternation of active periods, during which multiplication goes on, with resting-periods, when the Trypanosomes become attached to the epithelial cells of the host. According to S. Prowazek (47), the behaviour of *T. lewisi* in a louse (*Haematopinus*) is, in its main features, similar.

On gaining an entry into the blood of a vertebrate the organisms pass rapidly into the general circulation, and are thus carried all over. Considering them first in a tolerant host, the trend of observation is to show that they are never abundant, but on the contrary usually somewhat scarce. One reason for this scarcity is to be sought in connexion with the fact that multiplicative stages are very rarely met with, at any rate in the general circulation. The parasites are frequently more numerous in the spleen, bone-marrow, kidneys, &c., than elsewhere, and it has been found that multiplication goes on rather more actively in the capillaries of these organs.

The Trypanosomes, in the active phase, are of course always free in the blood plasma (interglobular). In the majority of cases it is very uncertain whether they actually come into relation with the blood corpuscles or not. Schaudinn has stated, however, that *Trypanomorpha* becomes, in certain phases, attached to a red blood-corpuscle (ectoglobular), and, in others, penetrates inside one and eventually destroys it (endoglobular); while his other avian parasite, *Trypanosoma ziemanni*, apparently draws up into itself the white corpuscle (leucocyte) to which it becomes attached. In addition, there are two or three obervations to hand which shew that piscine, amphibian and mammalian Trypanosomes may also become attached. Probably most forms possess a resting, attached phase at some period or other, in the invertebrate, if not in the vertebrate host.

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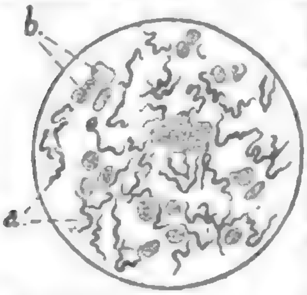
[1] *Trypanosoma equiperdum*, the cause of dourine in horses and asses, is apparently only conveyed by the act of coitus. This direct mode of transmission is most likely a secondary acquirement.

Considering now the Trypanosomes in an unaccustomed, mammalian host, they may either remain infrequent or rare (sometimes, indeed, being unnoticed until shortly before death), or, on the other hand, they may soon become numerous and go on increasing (fig. 2). In the latter case the disease is acute and rapidly fatal; in the former it is more chronic and lasts much longer, often several months. The main features of *trypanosomosis*, or illness caused by a Trypanosome, show a general agreement, whichever variety is considered; one symptom may be, of course, more marked than another in any particular case. Death is due either to weakness and emaciation (in chronic cases), or to blocking of the cerebral capillaries by the parasites (where these are abundant), or to disorganization of the nervous system (paraplegic and sleeping-sickness cases).



(After Doflein.)

FIG. 2.—*Trypanosoma equiperdum* (of dourine), in the blood of a rat eight days after inoculation.
a, Parasites.
b, Blood-corpuscles.

In post-mortem examination, the most obvious pathological lesion is hypertrophy of the spleen, which may be very pronounced; the lymphatic glands in the neck, inguinal region, &c., are also often greatly swollen. These are undoubtedly the organs which react most strongly to the parasites, and their enlarged condition is to a great extent due to their enhanced activity in elaborating blood-corpuscles and leucocytes to cope with the enemy. Ingestion and dissolution of the Trypanosomes by phagocytes has frequently been observed; and it is probable also that the haematopoietic organs secrete some substance which exerts a harmful action on the parasites, and causes them to undergo involution and assume weird-looking "amoeboid" and "plasmodial" forms.

Agglomeration.

A peculiar feature in the behaviour of the parasites, which is most probably caused by unfavourable biological conditions in the host, is that known as agglomeration. The process is readily brought about artificially by the addition of sera or chemical solutions to blood containing the parasites. Agglomeration consists in the grouping or union together of several Trypanosomes around a common centre; this leads to the formation of rosette-like clusters, or even of large masses composed of several rosettes. The end by which the parasites join is typically, in the case of *Trypanosoma*, the non-flagellate (anterior) end. If a favourable change in the surrounding medium sets in, the Trypanosomes are able to undergo the reverse process, namely disagglomeration; the parasites liberate themselves and the rosette is dissolved.

Morphology.

Trypanosomes vary greatly with regard to size; even in one and the same species this variation is often noticeable, especially under different conditions of life. The common *Trypanosoma rotatorium* of frogs (fig. 4, A and B) is, taking it all in all, one of the largest forms so far described. Its length (inclusive of the flagellum) varies from 40–60 μ, while its greatest width (including the undulating-membrane) is from 8–30 μ; in the very wide individuals breadth is gained more or less at the expense of length. Conversely, *T. gambiense*, the human parasite (fig. 3 C), is one of the smallest forms known, its average size being about 21–23 μ by 1½–2 μ.

There is equally great diversity in respect of form. Typically, the body is elongated and spindle-shaped; it is usually more or less curved or falciform (fig. 3, A–D), and tends to be slightly compressed laterally. It may be, however, anything from extremely slender or vermiform (fig. 3, H) to squat and stumpy (fig. 3, G, 4, A). Moreover, apart from the fact that a full-grown adult, ready to divide, is in many cases much plumper than a young adult (cf. *T. lewisi*, fig. 6, A and B), there can be no doubt that considerable polymorphism also sometimes occurs (*e.g. T. rotatorium*). In many cases, at any rate, this indicates a difference in sexuality; and it is particularly necessary to bear this factor in mind when considering the avian Trypanosomes, where, perhaps, the extremes of form are to be met with. That one and the same species may appear entirely different in different phases of the life-history is manifest on comparing, for instance, the chief "forms" of *Trypanosoma siemanni* described by Schaudinn. The asexual or indifferent type (fig. 3, H) is extremely thread-like, greatly resembling, in fact, a *Spirochaete*; on the other hand, both male and female individuals have the form of a very wide spindle.

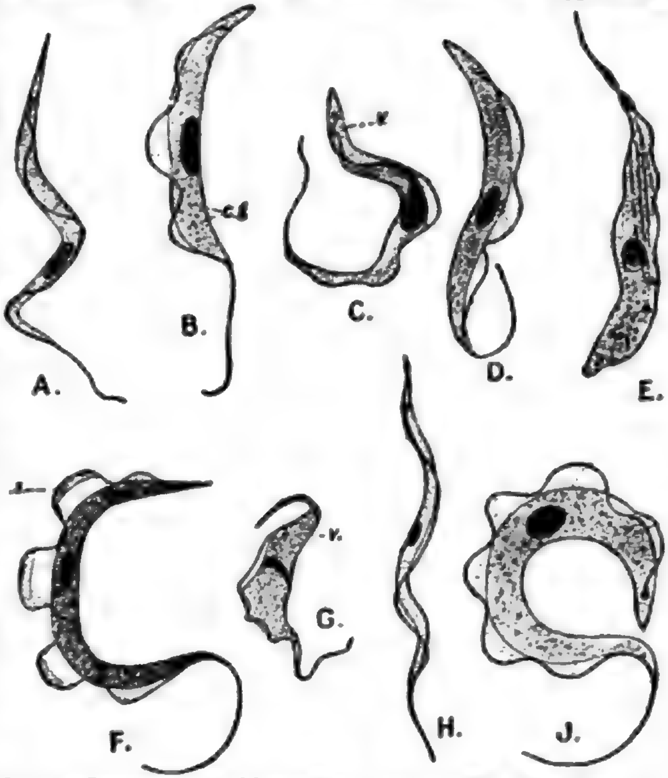


FIG. 3.—Representative Mammalian, Avian and Reptilian Trypanosomes, to illustrate the chief morphological characters.
A, *Trypanosoma lewisi*, after Bradf. and Plimmer.
B, *T. brucei*, after Lav. and Mesnil.
C, *T. gambiense* (blood, T-fever), after Bruce and Nabarro.
D, *T. equinum*, after Lav. and Mesnil.
E, *Trypanomorpha* (*Trypanosoma*) *noctuae*, after Schaud.
F, *Trypanosoma avium*, after Lav. and Mesnil.
G, Hanna's Trypanosome from Indian pigeons.
H, *T. siemanni*, after Schaud.
J, *T. damonia*, after Lav. and Mesnil.
c.g, Chromatoid grains; *v*, vacuole; *l.s*, fold or striation.

In *Trypanoplasma* and *Trypanophis* there are two flagella, inserted into the body very close to the anterior end (fig. 4, F and G). One flagellum is entirely free and directed forwards; the other at once turns backwards and is attached to the convex or dorsal side of the body for the greater part of its length. In all other Trypanosomes there is only one flagellum, which is invariably attached to the body in the same manner as the posterior one of biflagellate forms. This flagellum, however, is most probably not to be considered homologous in all cases. (See Woodcock, *loc. cit.*)

In *Trypanomorpha* (fig. 3, E), which is to be derived from a Herpetomonadine type, the single, anterior flagellum of the ancestral parasite has been drawn backwards along one side of the body and now originates in the posterior half. Hence in this genus the end bearing the free part of the flagellum is the anterior one. The genus *Trypanosoma*, in which are included at present the great majority of Trypanosomes, is rather to be regarded as derived from a Heteromastigine ancestor, such as *Trypanoplasma*, by the loss of the anterior flagellum. Hence in this type the single flagellum represents the posteriorly-directed one of *Trypanoplasma*, and the end at which it becomes free is the hinder end. The point of origin of the flagellum in *Trypanosoma* is usually near the anterior end, but may vary considerably (cf. figs.); and its free portion may be very short or lacking.

Along the dorsal side runs the characteristic fin-like expansion of the body, the undulating-membrane, which is the organella principally concerned in locomotion. This always begins at the place where the attached flagellum emerges from the body; and its free edge is really constituted by the latter, which forms a flagellar border. The membrane is usually more or less sinuous in outline, and is sometimes thrown into broad folds (fig. 3, F and J). Distally it thins away concurrently with the body.

Minute Structure.

The body appears to be in all cases naked. A differentiation of the peripheral cytoplasm in the form of an ectoplasmic layer has been described in one or two instances, and it seems probable that in most Trypanosomes there is such a layer, although only poorly developed, as a rule, around the body generally. On the other hand, the undulating-membrane is largely if not entirely an ectoplasmic development. This is usually much clearer and more hyaline than the general cytoplasm. In many forms deep-staining grains or granules, of a chromatoid nature and of varying size, are to be seen in the cytoplasm. In most cases these granules are, if not confined to, chiefly distributed in the posterior (flagellate) half of the body (figs. 3, B, D and E, 4. E and G). In certain Trypanosomes a well-defined, usually oval vacuole is often, though not constantly, to be observed, situated at a varying distance from the anterior end (figs. 3 and C, G, 4, F) There is no reason to doubt that this vacuole is a normal cell-constituent, for it has been described in parasites in quite normal surroundings and conditions.

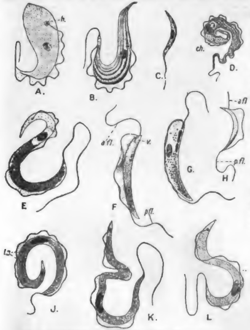


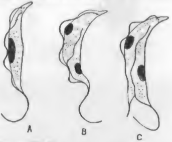
FIG. 4.—Representative Amphibian and Piscine Trypanosomes.
A,B, *Trypanosoma rotatorium*, after Lav. and Mesnil.
C, *T. inopinatum*, after Serg.
D, *T. karyozeukton*, after Dutt. and Todd.
E, *T. nelspruitense*, after Lav. and Mesnil.
F,G, *Trypanoplasma borreli* (living and stained), after Léger.
H, *T. cyprini*, after Plehn.
J, *Trypanosoma soleae*, after Lav. and Mesnil.
K, *T. granulosum*, after Lav. and Mesnil.
L, *T. remaki*, var. *magna*, after Lav. and Mesnil.
h, Clear zone or halo around kinetonucleus.
ch, Chain of chromatic rodlets running from trophonucleus to kinetonucleus.
a.fl, Anterior flagellum;
p.fl, Posterior flagellum;
l.s, Longitudinal striations (myonemes);
v, Cytoplasmic vacuole.

A Trypanosome always possesses two distinct nuclear bodies, one the *trophonucleus*, regulating the trophic life of the cell, the other, the *kinetonucleus*, directing its locomotor activities. The recent investigations of Schaudinn and Prowazek (11. c) have shown that, in some forms at any rate, the finer structure and detailed development of the nuclear apparatus is extremely complex. Not only is there an intimate correspondence in this respect between the two principal organellae, but the flagellar apparatus itself is really of nuclear origin and remains closely connected with the kinetonucleus (cf. fig. 7). In most cases, however, little beyond the position and general appearance of the nuclei has been so far made known. The trophonucleus is usually situated somewhere about the middle of the body. The kinetonucleus is typically near the anterior end; but in a few instances it lies more centrally (*e.g. T. inopinatum, T. rotatorium*, fig. 4, A–C); in *Trypanomorpha* it is in the posterior half of the body (fig. 3, E).

In certain forms the occurrence of prominent myonemes or muscle-fibrillae has been described, and, moreover, a nuclear origin assigned to them also. In *Trypanomorpha* they are confined to the undulating-membrane (fig. 3, E), but in other cases—*Trypanosoma ziemanni, T. lewisi, T. brucei*, and *T. soleae*—they are arranged laterally, half running down each side of the body (fig. 4, J). In *Trypanoplasma borreli* there is only a single myoneme on either side.

Multiplication.

All Trypanosomes are capable of binary longitudinal fission, and this appears to be the chief method of multiplication. The division of the nuclear apparatus is the first to take place (fig. 5, A). The kinetonucleus more often leads the way, but sometimes either kinetonucleus or trophonucleus may do so indifferently. The duplication of the flagellum begins at its proximal end, that which is in relation with the kinetonucleus. Until recently the process has been considered as an actual longitudinal splitting of the flagellum, following upon the separation of the two daughter-kinetonuclei. Both Schaudinn (in the case of *Trypanomorpha*) and Prowazek (in the case of *Trypanosoma lewisi* and *T. brucei*), have found, however, that the new flagellum is developed quite independently and laid down alongside the old one. It is at present somewhat uncertain, therefore, in what cases actual splitting occurs. The same applies equally to the formation of the undulating-membrane. If the flagellar border splits, the membrane doubtless divides also; but where the flagellum is a new formation the membrane will be too. The division of the cytoplasm in most forms is equal or sub-equal, and two approximately equal daughter-Trypanosomes result (fig. 5, C). In some instances (*e.g. T. equinum, T. equiperdum*) the longitudinal fission is apparently multiple, three or even four descendants being produced simultaneously.



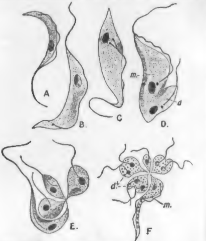
(After Lav and Mesnil.)
FIG. 5.—Stages in Binary Longitudinal Fission of *Trypanosoma brucei*

T. lewisi differs from most Trypanosomes in that the cytoplasm divides in a very unequal manner (fig 6). The process is more comparable to budding, since the larger or parent individual may produce, successively, more than one "daughter", moreover, the daughter-individuals may subdivide before separating, the whole family remaining attached by the non-flagellate (anterior) end (fig. 6, F). In this type of division it may be noted that the kinetonucleus comes to lie alongside the trophonucleus, or even passes to the other side of it (*i.e.* nearer the flagellar end) Easily derivable from this method is the other one characteristic of *T. lewisi*, viz. segmentation. The chief difference is that in the latter no parent-individual is distinguishable, a rosette of many equal daughter-parasites being formed.

The small Trypanosomes resulting from either of these modes of division differ from typical adults by their stumpy, pyriform shape, the position of the kinetonucleus near the flagellar end of the body, and the absence, during the first part of their youth, of an undulating-membrane. At this period they have, in fact, what may be termed a "pseudo-Herpetomonadine" aspect. These young individuals can themselves multiply by equal binary fission, giving rise to little fusiform parasites; with growth, these gradually assume the adult appearance.

Development and Life-cycle.

Comprehensive researches (1905, seq.) have made it evident that Trypanosomes have a much more varied and complex development and life-history than was previously supposed. This has now been found to be the case in widely-differing parasites, occurring in widely-different hosts. The following examples have been investigated: *Trypanosoma lewisi* (also, but much less completely, *T. brucei*),[1] among mammalian forms, described by Prowazek (47); *T. ziemanni* and *Trypanomorpha noctuae*, among avian parasites, described by Schaudinn (50); *Trypanosoma inopinatum*, among batrachian forms, described by A. Billet (1*a* and 2), *T. barbatulae* and *Trypanoplasma varium*, described by Léger (32 and 33), and *T. borreli*, by G. Keysselitz (16), from fishes; also several other piscine Trypanosomes have their development phases in leeches worked on by Brumpt (5*a*). In addition, a Trypanosome whose vertebrate host is yet unknown (*T. grayi*) has been studied in detail by Minchin (41*a*).



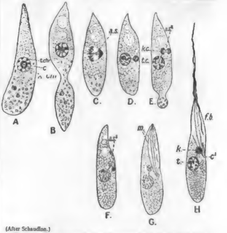
(A–E, after Lav. and Mesnil; F, after Wasiel and Senn.)

FIG. 6.—Unequal Division and "Budding" process in *T. lewisi*. *m*, Parent-individual; *d*, Daughter-individual; *d'*, Daughter-individual dividing.

It is impracticable here to consider fully all the various developmental phases and modifications of the life-cycle described as occurring in the above parasites. In view, however, of the great interest excited by Schaudinn's work on avian parasites, as well as on account of the far-reaching importance of his conclusions to the study of the Haematozoa, a brief summary of his celebrated research is necessary.

According to Schaudinn's account, he was dealing with two separate Trypanosome parasites of the Little Owl (*Athene noctua*), viz. *Trypanomorpha* (*Trypanosoma*) *noctuae* and *Trypanosoma* (*Spirochaete*) *ziemanni*. The latter organism, in certain phases, very closely resembles a *Spirochaete*. In the blood of the owl resting, intracellular phases of both parasites alternate with active trypaniform ones; and, when in the former condition, Schaudinn considers that the parasites are identical with what have been formerly regarded as distinct Haemosporidia, *Halteridium* and a *Leucocytozoon* respectively. In other words, he considers that these two Haemosporidian forms are really only phases in the life-history of particular Trypanosomes. To this life-cycle belongs the formation of sexual individuals and their conjugation on arrival in the gnat (*Culex*); the process is described as agreeing in the main, in both cases, with what has already been made known by MacCallum for another species of *Halteridium*. The male gametes, it may be noted, are said to possess the essential characters of a Trypanosome. The motile copula or ookinete formed in the gnat gives rise to one of three types of Trypanosome individual: indifferent, male or female. The development of an indifferent ookinete into an indifferent Trypanosome is shown in fig. 7, from which it will be seen that the cytological details are very complex. The indifferent parasites exhibit an alternation of resting, attached phases with active periods, during which they multiply actively and become very abundant in the insect. The male forms, which are very small and the homologues of the microgametes developed in the blood, appear to die off soon. The female Trypanosomes, on the other hand, grow to a large size, laying up a store of reserve nutriment. They are very sluggish and do not divide. They are the most resistant to unfavourable conditions of environment, and are able, by a process of parthenogenesis, to give rise to ordinary, indifferent forms again, which can repopulate the gnat.

So far as regards the remarkable connexion between Trypanosomes and Haemosporidia indicated by Schaudinn, this has met with a great deal of criticism on the part of Novy and McNeal among others, and it must be admitted that up to 1909 no definite corroboration can be said to have been brought forward. Again, the spirochaetiform *Trypanosoma* (*T. ziemanni*) described may have been really a true *Spirochaete*, *i.e.* a Bacterium. In short, it is quite possible Schaudinn did not sufficiently distinguish between the life-cycles of four distinct parasites of the Little Owl: a Trypanosome, a *Spirochaete*, a *Halteridium* and a *Leucocytozoon*; though, on the other hand, this is by no means proved. However this may be, the research of subsequent workers—*e.g.* Brumpt (5*a*), Léger (32, 33), Keysselitz (16), Prowazek (47), Minchin (41b) and others—has undoubtedly shown that much of Schaudinn's scheme of the life-history of a Trypanosome is well-founded. It is certain, for instance, that the three types of form which he discovered, viz. indifferent, male or female, can be recognized in many cases, often in the vertebrate, but always more sharply differentiated in the invertebrate. Moreover, it is very probable that conjugation occurs soon after the arrival of the parasites in their specific invertebrate host; and this act may perhaps give rise to an aflagellar copula, which is gregariniform and comparable to an ookinete. Different investigators, it may be noted, have described various



(After Schaudinn.)

FIG. 7.—Development of an Ookinete (of *Halteridium*) into an indifferent Trypanosome (*Trypanomorpha*).

A–D shows the formation of the two nuclear elements (trophonucleus and kinetonucleus) from the definitive nucleus (synkaryon) of the ookinete.

E–H shows the formation of the myonemes and the flagellar border (flagellum) of the undulating membrane, by means of a greatly elongated nuclear-spindle.

t.chr,	Trophonuclear chromosome.
k.chr,	Kinetonuclear do.
c,	Centrosomic granule.
a.s,	First axial spindle.
*a.s*², *a.s*³,	Second and third do.
t,	Trophonucleus.
k,	Kinetonucleus.
k.c,	Kinetonuclear centrosome.
t.c,	Trophonuclear centrosome.
m,	Myonemes.
f.b,	Flagellar border of undulating-membrane (3rd axial spindle).
c.³,	Its proximal centrosome (its distal one vanishing as such).

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[1] *T. brucei* has also been studied in a Tsetse-fly (*G. fusca*) by Stuhlmann (54*a*).

complicated nuclear changes and divisions undergone by Trypanosomes; these are considered, in many cases, to represent some kind of parthenogenesis.

A very interesting modification of the life-cycle of a Trypanosome which must be mentioned has been made known by Minchin, in his account of *T. grayi*, in a tsetse-fly (*G. palpalis*). Unfortunately the vertebrate host of this form is not yet known. Certain individuals of a particular character form definite rounded cysts in the rectum of the fly; in this condition, the only sign of Trypanosome structure is afforded by the two nuclei, which remain separate. These cysts are doubtless for dispersal by way of the anus, and the vertebrate host is in all likelihood infected by the mouth and alimentary canal. This reveals a quite novel mode by which infection with a Trypanosome may be brought about; so far, however, *T. grayi* remains the only known example.

Classification.

As remarked in the section on morphology, the Trypanosomes as a whole are preferably regarded as including two entirely distinct groups, Monadina and Heteromastigia.

Sub-order Monadina

Family: Trypanomorphidae, Woodcock.—Haemoflagellates derived from a uniflagellate, Herpetomonadine form, in which the point of insertion of the single (anterior) flagellum into the body has travelled backwards from the anterior end for a greater or less distance, the flagellum itself having become, concurrently, attached to the body for a portion of its length by means of an undulating membrane.

Genus *Trypanomorpha*, Woodcock, 1906.—With the characters of the family. The only species yet known is the type species, *T. noctuae* (Celli and San Felice). [Syn. *Trypanosoma n.* (C. & S.F.), Schaud. = *Halteridium n.* (C. & S.F.)]. See figs. 3, E, 7. Vertebrate host, *Athene noctua*, Little Owl; invertebrate host, *Culex pipiens*.

There are, in addition, other forms, which are probably to be placed in this family, but which are not yet sufficiently well known for their systematic position to be settled. It is, for instance, quite likely that certain Herpetomonadine parasites described by Léger (29, 34) from various blood-sucking insects are really only stages in the life of a Haemoflagellate. Some of these are placed by Léger in a newly discovered genus, *Crithidia*.

Sub-order Heteromastigina

Family: Trypanosomatidae, Doflein.—Flagellates, in the great majority of instances haemal parasites, derived from a biflagellate, *Bodo*-like type, in which the posteriorly-directed (trailing) flagellum is always present and attached to the body by an undulating membrane, of which it constitutes the thickened edge. The other, the anterior flagellum, may or may not persist.

Genus *Trypanoplasma*, Lav. and Mesnil, 1902.—The anterior flagellum is present. Both flagella are inserted close together, near the anterior end of the body. Two sub-groups may be distinguished. In one, exemplified by *T. borreli* (fig. 4, F and G) from the rudd and minnow, the anterior flagellum is well-developed, and the free parts of both are of about equal length. In the other, exemplified by *T. cyprini* (fig. 4, H) from carp, the anterior flagellum is much shorter than the free part of the posterior one, and evidently tending to disappear. Known invertebrate hosts for different species are *Hemiclepsis* and *Piscicola*, leeches.

Genus *Trypanophis*, Keysselitz, 1904.—The body resembles that of *Trypanoplasma* in general appearance, but the locomotor apparatus does not appear to be so well-developed, especially in *T. grobbeni*. The anterior flagellum is longer than the free part of the posterior one. The species included are not, so far as is known, haemal parasites. *T. grobbeni* occurs in the coelenteric cavity of various Siphonophora.

An interesting form, "*Trypanoplasma*" *intestinalis*, which resembles both the above genera, occurs in the alimentary canal of *Box boops*. Probably this is not a haemal parasite, and lacks an alternate host.

Genus *Trypanosoma*, Gruby, 1843.—(Principal synonyms: *Undulina*, Lank., 1871; *Herpetomonas*, Kent, 1880, only in part; *Paramoecioides*, Grassi, 1881; *Haematomonas*, Mitrophan, 1883.) There is no anterior flagellum. The point of insertion of the attached (posterior) flagellum into the body, and, consequently, the commencement of the undulating membrane may be almost anywhere in the anterior half of the body, but is usually near the extremity.

Among the more important and better-known forms are the following:—

Parasitic in mammals: *T. lewisi* (Kent), the well-known natural Trypanosome of rats (figs. 3, A, 6, A); *T. brucii*, Plim. and Bradf., the cause of nagana among cattle, horses, &c., in South Africa (fig. 3, B); *T. evansi*, Steel, the cause of surra to horses in Indo-Burmah; *T. equiperdum*, Dofl., the cause of dourine in horses in Algeria and other regions of the Mediterranean littoral; *T. equinum*, Voges, causing mal de caderas or "hip-paraplegia" in South America (fig. 3, D); *T. theileri*, Lav., a very large form, the cause of galziekté or bile-sickness to cattle in the Transvaal; and *T. gambiense*, Dutton (syn. *T. ugandense*, Castellani, *T. castellanii*, Kruse), the cause of human trypanosomosis in central Africa, which becomes sleeping-sickness when the organisms penetrate into the cerebro-spinal fluid (fig. 3, C).

Parasitic in birds: *T. avium* (Danil., Lav. emend.), probably the form to which Danilewsky's original investigations related, parasitic in owls and (according to Novy and McNeal) also in other birds (fig. 3, F); *T. johnstoni*, Dutt. and Todd, a very spirochaetiform type, from little birds (*Estrelda*) in Senegambia; and Hanna's peculiar wide species from Indian birds, with a remarkably tapering anterior end (fig. 3, G). Lastly, there is *T. ziemanni*, Lav., [syn. *Spirochaete z.* (Lav.), Schaud, "*Haemamoeba*" *z.*, Lav., the "Leucocytozoon" of Danil.], from various owls, and *Culex pipiens*, whose life-history has been described by Schaudinn (fig. 3, H). (As above mentioned, this form may not be a true Trypanosome.)

Only one reptilian form is well known, *T. damoniae*, Lav. and Mesn., from a tortoise, *Damonia reevesii* (fig. 3, J). Parasitic in batrachia: *T. rotatorium*, Mayer (syn. *Amoeba r.*, Mayer, July 1843, *T. sanguinis*, Gruby, November 1843, *Undulina ranarum*, Lank., 1871), the best-known parasite of frogs, which exhibits remarkable polymorphism (fig. 4, A and B); *T. mega* and *T. karyozeukton*, Dutt. and Todd, even larger than *T. r.* (fig. 4, D), with peculiar cytological differentiation, may be only sub-species; *T. inopinatum*, Sergent, and *T. nelspruitense*, Lav., also from frogs (fig. 4, C). Parasitic in fishes: *T. remaki*, Lav. and Mesnil, from pike, a relatively small form (fig. 4, L); *T. barbatulae*, Léger, from loach; *T. granulosum*, Lav. and Mesnil, a very long vermiform parasite, from eels (fig. 4, K); *T. soleae*, Lav. and Mesnil, from soles, with a relatively small flagellum (fig. 4, J); and *T. scyllii* and *T. rajae*, from those Elasmobranchs, both very large forms, described by Lav. and Mesnil.

The Leishman-Donovan-Wright Bodies.

Undoubtedly closely allied to the Haemoflagellates, although no actual trypaniform phase has yet been observed, are the important parasites usually known as the "Leishman-Donovan" bodies, without some consideration of which an account of the Haemoflagellates would hardly be complete. These bodies are constantly found in certain tropical fevers (*e.g.* dum-dum fever, kala-azar) particularly prevalent throughout Indo-Burma, of which they are generally held to be the cause. They were discovered by W. Leishman in 1900, but before his first account of them (36) was published they were also seen quite independently by C. Donovan. Moreover, organisms very similar to these (morphologically, indeed, the two sorts appear scarcely distinguishable) are found in various sores or ulcers (*e.g.* Delhi boil, Oriental sore, "bouton d'Alep") to which people in different parts of the East are liable. These were first described by J. H. Wright (58).

The chief distinction between the parasites in the two cases is in their habitat. In the one case they are entirely restricted to the neighbourhood of the boil or ulcer, whereas in the other there is a general infection of the body, the organisms spreading to all parts and being met with in the spleen, liver, bone-marrow, &c., and (rarely) in the peripheral circulation. The parasites are either free or intracellular. In the latter case they invade cells of a leucocytic or phagocytic character as a rule; Leishman's form is particularly abundant in large macrophageal cells originating from the vascular endothelium of the spleen (fig. 8, I. *M*).

The parasites themselves are very minute and usually ovoid or pyriform in shape (fig. 8, I. *a*), the latter being, perhaps, the most typical. The splenic type is somewhat smaller than Wright's parasite; the former, when pear-shaped, is from 3½ to 4 μ in length by 1½ to 2 μ in width, the latter being about 4 μ by 3 μ (fig. 8, III.). The body is probably not limited by any distinct membrane. The cytoplasm is finely granular and fairly uniform in character. The most interesting point about the morphology is the fact that two chromatic bodies, of very unequal size, are almost invariably to be recognized. The larger nuclear body, which corresponds to the trophonucleus of a Trypanosome, is usually round or oval; the smaller one, representing a kinetonucleus, has the form either of a little rod or of a round grain, and is generally separate from the larger nucleus.

The parasites multiply in two ways—(*a*) by binary fission, and (*b*) by multiple division or segmentation. The principal stages in the first method are well known (fig. 8, I. *b*); they offer strong resemblance to the process in *Piroplasma*. Multiple division has not yet been so satisfactorily made out. It appears to conform more or less to the radial or rosette type of multiplication, enlarged rounded parasites, with a varying number of nuclei (up to about eight) uniformly arranged near the periphery, having been often noticed (fig. 8, I. *c* and IV. *b*). The details of the process are somewhat differently described, however, by different observers.

Laveran and Mesnil (27) gave the name *Piroplasma donovani* to

Leishman's form,[1] and there is no doubt that the parasites are closely allied to that type of organism. This does not, however, preclude in any way the supposition that they—equally with certain other Haemosporidia—represent, nevertheless, only a phase of a complete life-cycle; and this supposition has in fact been definitely proved to be true by the work of Rogers (48). Rogers cultivated the parasites obtained from cases of kala-azar in artificial media, and found that what were unmistakably flagellate stages developed in the cultures at different intervals (fig. 8, IV. *e, f, g*). These forms were elongated and spindle-like; and to one end of the body, near which the smaller nuclear element was situated, a well-developed flagellum was attached. Since then many other workers have obtained similar stages [see Leishman and Statham (38), Christophers (7)]; but however slender and Trypanosome-like the flagelliform parasites may appear, up till now no indications of an undulating membrane nave been seen, and the kinetonuclear element is never far from the insertion of the flagellum.

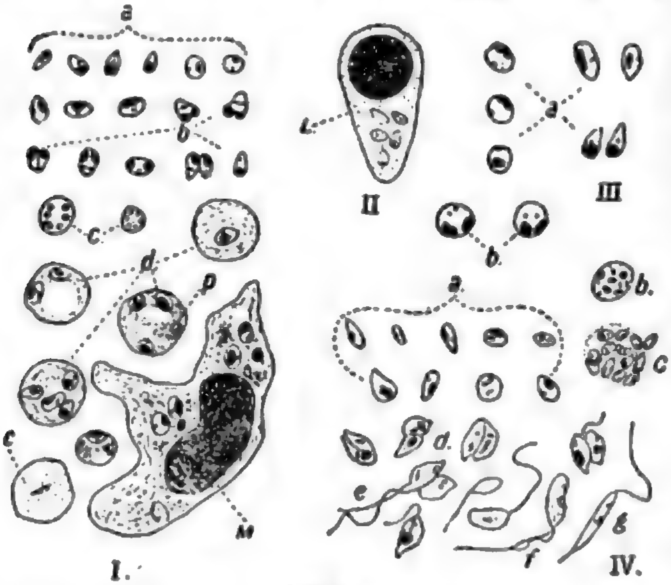

Fig. 8.

I. *Piroplasma* (*Leishmania*) *donovani*, Lav. and Mesnil.
a, Typical pear-shaped or oval forms; *b*, various stages in longitudinal division; *c*, nuclear division preparatory to multiple fission; *d*, endoglobular forms, in red blood-corpuscles (*p*=pigment grains); *e*, bacillary form of the parasite in a corpuscle; *M*, large macrophageal cell with many parasites (after Donovan).
II. Uninuclear leucocyte (*L*) containing several parasites (after Lav. and Mesnil).
III. *P.* (*Helcosoma*) *tropicum* (Wright).
a, Single individuals; *b*, dividing forms (from Mesnil, mostly after Wright).
IV. *P. donovani* in cultures of different ages.
a, Ordinary forms of varying sizes; *b c*, stages in multiple division; *d*, binary fission; *e, f, g*, flagellate forms (after Rogers).

Nevertheless, the general appearance and structure of these motile forms so greatly resemble that of a Herpetomonad, or of the "pseudo-Herpetomonadine" forms of a Trypanosome which are obtained in cultures, that it cannot be doubted that the "Leishman-Donovan-Wright" bodies are closely connected with the Haemoflagellates. That being so, it is quite possible that, in normal conditions and circumstances, these parasites also possess, at some period of the life-cycle, a trypaniform phase. Nothing definite is yet known with regard to the transmission of the parasites by an alternate invertebrate host, although there is presumptive evidence in favour of this supposition.[2]

Supposed Connexion of the Spirochaetae with Trypanosomes.

A word or two must be said in conclusion with reference to the supposed connexion of the *Spirochaetae* with the Trypanosomes. In Schaudinn's great memoir he regarded *Trypanosoma ziemanni* as possessing, in certain phases, the actual characteristics of a *Spirochaete* as then known; and, further, he was inclined to think that other *Spirochaetae* (*e.g. S. obermeieri* of relapsing fever) were also only phases in the life-cycle of a particular Haemoflagellate. As a result of his more recent investigations on *S. plicatilis* (the type-species of Ehrenberg) and other forms (51), he finds, however, that this is not the case, but that the organisms exemplified by *S. plicatilis* are to be widely separated from the Trypanosomes, and placed rather with the Bacteria. In addition, it is most probable that, at any rate, certain other spirilliform parasites, *e.g. S. balbianii, S. refringens*, agree fundamentally in structure with the type-species.

On the other hand, evidence has lately been brought forward to show that certain parasites which greatly resemble a *Spirochaete* are really related to the Trypanosomes. This is the case with the celebrated organism first described by Schaudinn and E. Hoffmann (52) from essential syphilitic lesions, and now known as *Treponema* (*Spirochaete*) *pallida*, Schaud. F. Krzysztalowicz and M. Siedlecki have published an important account (17) of this parasite, which they consider possesses a true trypaniform phase, and for which they have proposed the name *Trypanosoma luis*. This view requires, however, corroboration. Nevertheless the resemblance between the biology of this organism in relation to syphilis (as regards mode of infection, habitat, &c.) and that of *Trypanosoma equiperdum*, the cause of dourine or "horse-syphilis," may not be without significance.

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[1] R. Ross (49), regarding the parasites as a quite different kind of Sporozoan, termed them *Leishmania*; and Wright named his variety from tropical ulcers *Helcosoma tropicum*.

[2] Patton (*Sci. Mem. India*, No. 27, 1907) has brought forward evidence to show that the bed-bug (*Cimex macrocephalus*) is the invertebrate host.

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TSAIDAM, or more correctly TSĂDUM, a depression, or self-contained shallow basin in the N.E. of Tibet, crossed by 37° N. and stretching from 92° to 97°. It is separated from the high plateau of Tibet by the Burkhan-Buddha range, and on the N.E. it is bounded by the eastward continuation of the Astin-tagh ranges, which there consist of four, namely, the lower and upper ranges, and a subsidiary chain flanking the lower range on the north and another subsidiary chain flanking the upper range on the south (see KUEN-LUN).

The valleys which divide the east ranges of the Kuen-Lun system terminate, or rather merge in, the sandy desert basin of Tsaidam; amongst them the Kakir valley between the upper Astin-tagh and the Akato-tagh and the Kum-kol valley between the Kalta-alagan and the range I. of the Arka-tagh (see KUEN-LUN). Tsaidam lies at an altitude of 11,400 ft. or about 3000 ft lower than the Kum-kol lakes, and receives from the valley in which they lie the river Chulak-akkan or Tsagan tokhoy, which rises probably on the north slope of the Shapka-monomakha Mountain, one of the culminating summits in the region north of the Arka-tagh range. "It is very possible that the north-west of Tsaidam, which is perfectly unknown, is broken up into several separate basins. The south-east part of the same great expanse also appears to consist of several smaller basins rather than of one single great basin, each possessing its own salt lake; but then these smaller basins are undoubtedly separated from one another by remarkably low and insignificant thresholds or swellings."[1] The north-east part of the basin consists of a network of basins, which admit of being grouped in four divisions—Sărtăng or Serteng, Makhai, Tsădam or Tsaidam, and Kurlyk or Tosun. The characteristic feature of each of these is that which is found in so many of the valleys of the Tibetan borderland, namely, a pair of linked lakes, one containing salt water and the other fresh water. The only inhabitants of Tsaidam are Mongols—Sărtăng Mongols in the north and Tajinur Mongols in the south. The south-east part of the region is drained by the Holuzun-nor or Baïn-gol, an affluent of the upper Hwang-ho or Yellow River of China. The Sărtăng basin is drained by the Khalting-gol and its tributary the Holuin-gol, which rise in the Humboldt and Ritter Mountains and empty into the lake of Sukhain-nor.

TSANA, a lake of North-East Africa, chief reservoir of the Abai or Blue Nile. Tsana lies between 11° 36′ and 12° 16′ N. and 37° 2′ and 37° 40′ E., filling a central depression in the Abyssinian highlands. It is about 5690 ft. above the sea, but from 2500 to 3000 ft. below the mountain plateau which encircles it. Its greatest length is 47 m., its greatest breadth 44 m., and it covers, approximately 1100 sq. m., having a drainage area, including the lake surface, of some 5400 sq. m. In shape it may be compared to a pear, the stem being represented by the escaping waters of the Abai. The shores of the lake are well defined, generally flat, and bordered by reeds, but at places the mountains descend somewhat abruptly into the water. Elsewhere the land rises in gentle undulations, except at the mouths of the larger tributary streams, where are alluvial plains of considerable size. At the south-east end the lake forms a bay about eleven miles long, and from three to eight miles across, and from this bay the Abai issues. The whole of the coast-line is considerably indented and many narrow promontories jut into the lake. The island of Dek (8 m. long by 4 broad) is in the south-western part of the lake. Near it is the smaller island of Dega, whilst numerous islets fringe the shores.

Lake Tsana is fed by three large rivers and by many petty streams. The chief tributary is the Abai, which enters the lake at its south-west corner through a large papyrus swamp. This river, and the Abai or Blue Nile which issues from the lake, are regarded as one and the same stream and a current is observable from the inlet to the outlet. Next in importance of the affluents are the Reb and Gumara, which run in parallel courses and enter the lake on its eastern side. The outlet of the lake is marked by openings in a rocky ledge, through which the water pours into a lagoon-like expanse. Thence it issues by two or three channels, with a fall of about 5 ft. in a succession of rapids. These channels unite within a couple of miles into one river—the Abai with a width of 650 ft. After passing a large number of rapids in the first sixteen miles of its course the Abai enters a deep gorge by a magnificent fall—the Fall of Tis Esat—the water being confined in a channel not more than 20 ft. across and falling 150 ft. in a single leap. The gorge is spanned by a stone bridge built in the 17th century. From this point the Abai makes its way through the mountains to the plains of Sennar, as described in the article NILE.

The average annual rainfall in the Tsana catchment area is estimated at 3¼ ft., and the volume of water received by the lake yearly at 6,572,000,000 of cubic metres. More than half of this amount is lost by evaporation, the amount discharged into the river being placed at 2,924,000,000 cubic metres. The seasonal alteration of the lake level is not more than 5 ft. The rainy season lasts from the beginning of June to the end of September. During this period the discharge from the lake is, it appears, little greater than in the dry season, the additional water received going to raise the lake level. Thus the rise in the Blue Nile, in its lower course, would seem to be independent of the supply it derives from its source.

Tsana has been identified with the *Coloe Palus* of the ancients, which although placed 12° too far south by Ptolemy was described by him as a chief reservoir of the Egyptian Nile and the source of the *Astapos*, which was certainly the Blue Nile. In 1625 it was visited by the Portuguese priest Jeronimo Lobo, and in 1771 by James Bruce. Dr. Anton Stecker, in 1881, made a detailed examination of the lake, enabling the cartographers to delineate it with substantial accuracy. By the Portuguese of the 17th century the lake was styled Dambia, and this name in the slightly altered form of Dembea was in use until towards the close of the 19th century. By many Abyssinians the lake is called Tana, but the correct Amharic form is Tsana.

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[1] Sven Hedin, *Scientific Results of a Journey in Central Asia, 1899–1902*, iii. 344 (Stockholm, 1905–1907).

See Nile and Abyssinia, and the authorities there cited. The British Blue Book, *Egypt*, No. 2, 1904, contains a special report (with maps) upon Lake Tsana by Mr C. Dupuis, of the Egyptian Irrigation Service. In the *Boll. soc. geog. italiana* for December 1908 Captain A. M. Tancredi gives the results (also with maps) of an Italian expedition to the lake. (W. E. G.; F. R. C.)

TSAR, or Czar, the title commonly given both abroad and in Russia itself to the sovereign of Russia, whose official style is, however, "Emperor and Autocrat" (*Imperator i Samovlastityel*). In its origin the word *tsar* seems to have connoted the same as *imperator*, being identical with the German *Kaiser* in its derivation from the Latin Caesar. In the old Slavonic Scriptures the Greek *βασιλεὺς* is always translated *tsar*, and this title was also given to the Roman Emperor. The old Russian title for a sovereign was *knyas*, prince, or *veliky knyas*, grand prince. The title *tsar* was first adopted by the Slavonic peoples settled in the Balkan peninsula, who were in close touch with the Eastern emperor; thus it was used by the medieval Bulgarian kings. It penetrated into Russia as a result of the growing intercourse between old Muscovy and Constantinople, notably of the marriage alliances contracted by Russian princes with the dynasty of Basil the Macedonian; and it was assumed by the Muscovite princes who revolted from the yoke of the Mongols. The other *tsars* were gradually ousted by those of Moscow, and the modern Russian emperors inherit their title of *tsar* from Ivan III. (1462–1505), or perhaps rather from his grandson Ivan IV. (1533–1584) who was solemnly crowned *tsar* in 1547.

Throughout, however, the title *tsar* was used, as it still is in popular parlance, indifferently of both emperors and kings, being regarded as the equivalent of the Slavonic *krol* or *kral* (Russ. *korol*, Magyar, *király*), a king, which had been adopted from the name of Charlemagne (Germ. *Karl*, Lat. *Carolus Magnus*). This use being equivocal, Peter the Great, at the peace of Nystad (November 2, 1721), assumed the style of *imperator*, an exotic word intended to symbolize his imperial dignity as the equal of the western emperor. This new style was not, however, recognized by the powers until the time of Catherine II., and then only on the express understanding that this recognition did not imply any precedency or superiority of the Russian emperor over other sovereigns. Henceforth, whatever popular usage might be, the title *tsar* was treated officially as the equivalent of that of king. Thus the Russian emperor is tsar (king) of Poland and of several other parts of his dominions. Thus, too, the prince of Bulgaria, on assuming the royal style, took the title of tsar of Bulgaria.

The title "White Tsar," applied to the Russian emperor and commonly quoted as though it had a poetic or mystic meaning, is a translation of a Mongol word meaning "independent" (cf. the feudal "blanch tenure," *i.e.* a tenure free from all obligation of personal service).

The wife of the tsar is *tsaritsa*. In former times the title *tsarevich* (king's son) was borne by every son of a tsar; but the word has now fallen out of use. The heir to the throne is known as the *tsesarevich* or *cesarevich* (*q.v.*), *i.e.* son of Caesar, the other Imperial princes bearing the old Russian title of *veliky knyas* (grand duke; *q.v.*).

TSARITSYN, a town of Russia, in the government of Saratov, situated on the right bank of the Volga, where it suddenly turns towards the south-east, 40 m. distant from the Don. Pop. (1900), 67,650. Tsaritsyn is the terminus of a railway which begins at Riga and, running south-eastwards, intersects all the main lines which radiate from Moscow to the south. It is also connected by rail with Kalach on the Don, where merchandise from the Sea of Azov is disembarked. Corn from middle Russia for Astrakhan is transferred from the railway to boats at Tsaritsyn; timber and wooden wares from the upper Volga are unloaded here and sent by rail to Kalach; and fish, salt and fruits sent from Astrakhan by boat up the Volga are here unloaded and despatched by rail to the interior of Russia. The town has grown rapidly since the completion of the railway system, and has a large trade in petroleum from Baku. Tsaritsyn is also the centre of the trade in the mustard of Sarepta, Dubovka and the neighbourhood. The fisheries are important. The buildings of the town include a public library, and the church of St John (end of 16th century), a fine specimen of the architecture of its period. Here are iron, machinery and brick works, tanneries, distilleries, and factories for jam, mustard and mead. Market gardening is an important industry.

A fort was erected here in the 16th century to prevent the incursions of the free Cossacks and runaway serfs who gathered on the lower Volga, as also the raids of the Kalmucks and Circassians. In 1606 Tsaritsyn took part in the rising in favour of the false Demetrius, and Stenka Razin took the town in 1670. The Kalmucks and Circassians of the Kubañ attacked it repeatedly in the 17th century, so that it had to be fortified by a strong earthen and palisaded wall, traces of which are still visible.

TSARSKOYE SELO, a town of north Russia, in the government of St Petersburg, and an imperial residence, 15 m. by rail south of the capital. Pop. (1885), 15,000; (1897), 22,353. The town stands on the Duderhof Hills and consists (1) of the town proper, surrounded by villages and a German colony, which are summer resorts for the inhabitants of St Petersburg; and (2) of the imperial parks and palaces. The former is built on a regular plan, and its houses nearly all stand in gardens. The cathedral of St Catherine is a miniature copy of that at Constantinople. The imperial parks and gardens cover 1680 acres; the chief of them is the "old" garden, containing the "old palace," built (1724) by Rastrelli and gorgeously decorated with mother-of-pearl, marbles, amber, lapis lazuli, silver and gold; the gallery of Cameron adorned with fine statues and entrance gates; numerous pavilions and kiosks; and a bronze statue (1900) of the poet Pushkin. A second palace, the Alexander, was built by Catherine II. in 1792, and has in its park an historical museum and an arsenal.

When Peter the Great took possession of the mouth of the Neva, a Finnish village, Saari-mois, stood on the site now occupied by the town, and its Russified name Sarskaya was changed into Tsarskoye when Peter presented it to his wife Catherine. It was especially embellished by the tsaritsa Elizabeth. Under Catherine II., a town, Sophia, was built close by, but its inhabitants were transferred to Tsarskoye Selo under Alexander I. The railway connecting the town with St Petersburg was the first (1838) to be constructed in Russia.

TSCHAÏKOVSKY, PETER ILICH (1840–1893), Russian composer, born at Votkinsk, in the province of Vyatka, on the 7th of May 1840, was the son of a mining engineer, who shortly after the boy's birth removed to St Petersburg to assume the duties of director of the Technological Institue there. While studying in the school of jurisprudence, and later, while holding office in the ministry of justice, Tschaïkovsky picked up a smattering of musical knowledge sufficient to qualify him as an adept amateur performer. But the seriousness of his musical aspiration led him to enter the newly founded Conservatorium of St Petersburg under Zaremba, and he was induced by Anton Rubinstein, its principal, to take up music as a profession. He therefore resigned his post in the ministry of justice. On quitting the Conservatorium he was awarded a silver medal for his thesis, a cantata on Schiller's "Ode to Joy." In 1866 Tschaïkovsky became practically the first chief of the recently founded Moscow Conservatorium, since Serov, whom he succeeded, never took up his appointment. In Moscow Tschaïkovsky met Ostrovskiy, who wrote for him his first operatic libretto, *The Vojevoda*. After the Russian Musical Society had rejected a concert overture written at Rubinstein's suggestion, Tschaïkovsky in 1866 was much occupied on his *Winter Day Dreams*, a symphonic poem, which proved a failure in St Petersburg but a success at Moscow. In 1867 he made an unsuccessful début as conductor. Failure still dogged his steps, for in January 1869 his *Vojevoda* disappeared off the boards after ten performances, and subsequently Tschaïkovsky destroyed the score. The *Romeo and Juliet* overture has been much altered since its production by the Russian Musical Society in 1870, in which year the composer once more attempted unsuccessfully an operatic production, St Petersburg rejecting his *Undine*. In 1871 Tschaïkovsky was busy on his cantata for the opening of the exhibition in celebration of the bicentenary of Peter the Great, his opera *The Oprischnik*, and a textbook of harmony, which latter was adopted by the Moscow Conservatorium authorities. At Moscow in 1873 his incidental music to the *Snow Queen* failed, but some success came next year with the beautiful quartet in F. During these years Tschaïkovsky was musical critic for two journals, the *Sovremennaya Lietopis* and the *Russky Vestnik*. On the death of Serov he competed for the best setting of Polovsky's *Wakula the Smith*, and won the first two prizes. Yet on its production at St Petersburg in November 1876 this work gained only a *succès d'estime*. Since then it has been much revised, and is now known as *The Little Shoes*. Meanwhile the Second Symphony and the *Tempest* fantasia had been heard, and the pianoforte concerto in B flat minor completed. This was first played by von Bülow in Boston, Massachusetts, some time later, and was entirely revised and republished in 1889. At last something like success came to Tschaïkovsky with the production of *The Oprischnik*, in which he had incorporated much of the best of *The Vojevoda*. The Third—or Polish—Symphony, four sets of songs, the E-flat quartet (dedicated to the memory of Lamb), the ballet "The Swan Lake," and the "Francesca da Rimini" fantasia, all belong to the period of the late 'seventies—the last being made up of operatic fragments. Tschaïkovsky in 1877 first began to work on the opera of *Eugen Onegin*. With the production of this work at the Moscow Conservatorium in March 1879 real success first came to him. The story, by Pushkin, was a familiar one, and the music of Tschaïkovsky was not so extravagant in its demands as had been the music of his earlier operas.

Meanwhile the more personal side of the composer's career had been given a romantic touch by his acquaintance with his lifelong benefactress, Mme von Meck, and his deplorable fiasco of a marriage. In 1876 he had aroused the interest of Nadezhda Filaretovna von Meck (1831–1894), the wife (left a widow in 1876) of a wealthy railway engineer and contractor. She had a large fortune and she began by helping the composer financially in the shape of commissions for work, but in 1877 this took the more substantial shape of an annual allowance of £600. The romance of their association consisted in the fact that they never met, though they corresponded with one another continually. In 1890 Mme von Meck (who died two months after the composer, of progressive nervous decline), imagining herself—apparently a pure delusion—to be ruined, discontinued the allowance; and though Tschaïkovsky was then no longer really in need of it, he failed to appreciate the pathological reason underlying Mme von Meck's condition of mind, and was deeply hurt. The wound remained unhealed, and the correspondence broken, though on his death-bed her name was on his lips. Her connexion with his life was one of its dominating features. His marriage was only a brief and misguided incident. Tschaïkovsky married Antonina Ivanovna Milyukova on the 6th of July 1877, but the marriage rapidly developed into a catastrophe, through no fault of hers but simply through his own abnormality of temperament; and it resulted in separation in October. He had become taciturn to moroseness, and finally quitted Moscow and his friends for St Petersburg. There he fell ill, and an attempt to commit suicide by standing chin-high in the river in a frost (whereby he hoped to catch his death from exposure) was only frustrated by his brother's tender care.

With his brother, Tschaïkovsky went to Clarens to recuperate. He remained abroad for many months, moving restlessly from one place to another. In 1878 he accepted (but later resigned) the post of director of the Russian musical department at the Paris Exhibition, completed his Fourth Symphony and the Italian *Capriccio*, and worked hard at his "1812" overture, more songs, the second pianoforte concerto, and his "Liturgy of St Chrysostom," an interesting contribution to the music of the Eastern Church. The work was confiscated for some time by the intendant of the imperial chapel, on the ground that it had not received the imprimatur of his predecessor Bortniansky in due accordance with a ukaz of Alexander I. Bortniansky was dead, but his successor was obstinate. Finally the work was saved from destruction by an official order. Tschaïkovsky returned only for a short time to Moscow. Thence he went to Paris. In 1879 he wrote his *Maid of Orleans* (produced in 1880) and his first suite for orchestra. In 1881 died Nicholas Rubinstein—to whose memory Tschaïkovsky dedicated the trio in A minor. During the next five years Tschaïkovsky travelled, and worked at *Manfred* and *Hamlet*, the operas *Mazeppa* and *Charodaïka*, the Mozartian suite and the fine Fifth Symphony. During a great part of the time he lived in retirement at Klin, where his generosity to the poor made him beloved. His operas *The Queen of Spades* and the one-act *Iolanthe* were feeble by comparison with his earlier works; more effective, however, were the ballets *Sleeping Beauty* and *Casse-noisette*. In 1893 Tschaïkovsky sketched his Sixth Symphony, now known as the *Pathetic*, a work that has done more for his fame in foreign lands than all the rest of his works. This was the year in which the composer conducted a work of his own at Cambridge on the occasion of his receiving the honorary degree of Doctor of Music. In the same year, on the 6th of November, he died from an attack of cholera at St Petersburg.

Tschaïkovsky's work is unequal. In dramatic compositions he lacked point precisely as Anton Rubinstein lacked point. But in the invention of broad, sweeping melody Tschaïkovsky was far ahead of his compatriot. Among his songs and smaller pianoforte works, as in his symphonies and quartets, are passages of exquisite beauty. The best of Tschaïkovsky's work is more distinctly Russian than that of most of his compatriots; it is not German music in disguise, as is so much of the music by Rubinstein and Glazounow, and it is not incoherently ferocious, like so much of the music by Balakirev.

See Mrs Rosa Newmarch's *Tchaïkovsky* (1900) supplemented in 1906 by her condensed English edition of the *Life and Letters*, which appeared in Russian in 1901 in three volumes, edited by Modeste Tschaïkovsky, the composer's brother.

TSCHUDI, or SCHUDY, the name of one of the most distinguished families of the land of Glarus, Switzerland. It can be traced back as a peasant, not a noble, race to 1289, while after Glarus joined the Swiss Confederation in 1352 various members of the family held high political offices at home, and were distinguished abroad as soldiers and in other ways.

In literature, its most eminent member was GILES or AEGIDIUS TSCHUDI (1505–1572), who, after having served his native land in various offices, in 1558 became the chief magistrate or *landammann*, and in 1559 was ennobled by the emperor Ferdinand, to whom he had been sent as ambassador. Originally inclined to moderation, he became later in life more and more devoted to the cause of the counter-Reformation. It is, however, as the historian of the Swiss Confederation that he is best known; by incessant wanderings and unwearied researches amongst original documents he collected material for three great works, which therefore can never wholly lose their value, though his researches have been largely corrected by those of more recent students. In 1538 his book on Rhaetia, written in 1528, was published in Latin and in German—*De prisca ac vera Alpina Rhaetia*, or *Die uralt wahrhafftig Alpisch Rhätia*. The historical reputation of Giles Tschudi has suffered very much owing to recent researches. His inventions as to the early history of the Swiss Confederation are described under TELL. His statements and documents relating to Roman times and the early history of Glarus and his own family had long roused suspicion. Detailed examination of late years has proved beyond the shadow of a doubt that he not merely claimed to have copied Roman inscriptions that never existed, and amended others in a most arbitrary fashion, but that he deliberately forged a number of documents with a view to pushing back the origin of his family to the 10th century, thus also entirely misrepresenting the early history of Glarus, which is that of a democratic community, and not (as he pretended) that of a preserve of several aristocratic families. Tschudi's historical credit is thus hopelessly ruined, and no document printed or historical statement made by him can henceforward be accepted without careful verification and examination. These discoveries have a painful interest and importance, since down to the latter part of the 19th century Swiss historical writers had largely based their works on his investigations and manuscripts.

For a summary of these discoveries see G. v. Wyss in the *Jahrbuch* of the Historical Society of Glarus (1895), vol. xxx., in No. 1 (1894), of the *Anzeiger f. schweizerische Geschichte*, and in his *Geschichte d. Historiographie in d. Schweiz* (1895), pp. 196, 201, 202. The original articles by Vögelin (Roman inscriptions) appeared in vols. xi., xiv. and xv. (1886–1890) of the *Jahrbuch f. schweizer Geschichte*, and that by Schulte (Glarus) in vol. xviii. (1893) of the same periodical. For the defence, see a weak pamphlet, *Schulte u. Tschudi* (Coire, 1898), by P. C. v. Planta.

Tschudi's chief works were not published until long after his death. The *Beschreibung Galliae Comatae* appeared under Gallati's editorship in 1758, and is mainly devoted to a topographical, historical and antiquarian description of ancient Helvetia and Rhaetia, the latter part being his early work on Rhaetia revised and greatly enlarged. This book was designed practically as an introduction to his magnum opus, the *Chronicon helveticum*, part of which (from 1001 to 1470) was published by J. R. Iselin in two stately folios (1734–1736); the rest consists only of rough materials. There exist two rather antiquated biographies of Tschudi by I. Fuchs (2 vols., St Gall, 1805) and C. Vogel (Zürich, 1856), but his extensive complete correspondence has not yet been printed.

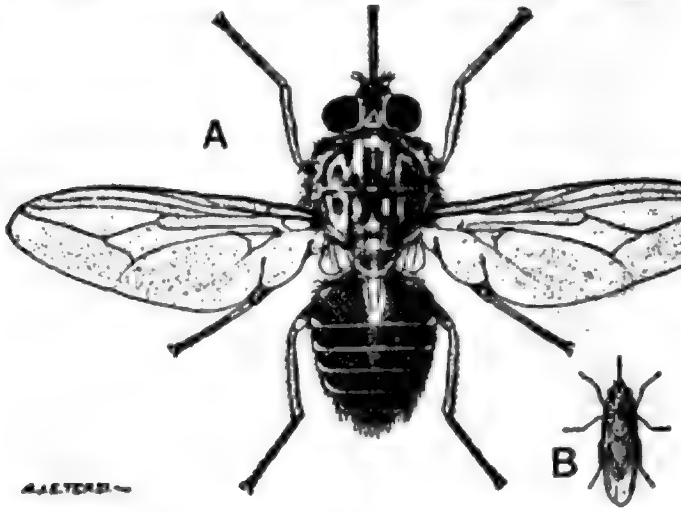
Subjoined is a list of other prominent members of the family. DOMINIC (1596–1654) was abbot of Muri and wrote a painstaking work, *Origo et genealogia gloriosissimorum comitum de Habsburg* (1651). JOSEPH, a Benedictine monk at Einsiedeln, wrote a useful history of his abbey (1823). The family, which became divided in religious matters at the Reformation, also includes several Protestant ministers: JOHN HENRY (1670–1729), who wrote *Beschreibung des Lands Glarus* (1714); JOHN THOMAS (1714–1788), who left behind him several elaborate MSS. on the local history of Glarus; and JOHN JAMES (1722–1784), who compiled an elaborate family history from 900 to 1500, and an account of other Glarus families. JOHN LOUIS BAPTIST (d. 1784), who settled in Metz and contributed to the *Encyclopédie*, and FREDERICK (1820–1886), the author of *Das Thierleben der Alpenwelt* (1853), were distinguished naturalists. Among the soldiers may be mentioned CHRISTOPHER (1571–1629), a knight of Malta and an excellent linguist, who served in the French and Spanish armies; while the brothers LOUIS LEONARD (1700–1779) and JOSEPH ANTHONY (1703–1770) were in the Neapolitan service. VALENTINE (1499–1555), the cousin of Giles, was, like the latter, a pupil of Zwingli, whom he afterwards succeeded as pastor of Glarus, and by his moderation gained so much influence that during the thirty years of his ministry his services were attended alike by Romanists and Protestants. The best-known member of the family in the 19th century was IWAN (1816–1887), author of an excellent guide-book to Switzerland, which appeared first (1855) under the name of *Schweizerführer*, but is best known under the title (given in 1872 to an entirely recast edition) of *Der Tourist in der Schweiz*. (W. A. B. C.)

TSĔNG KUO-FAN (1811–1872), Chinese statesman and general, was born in 1811 in the province of Hunan, where he took in succession the three degrees of Chinese scholarship. In 1843 he was appointed chief literary examiner in the province of Szechuen, and six years later was made junior vice-president of the board of rites. When holding the office of military examiner (1851) he was compelled by the death of his mother to retire to his native district for the regulation mourning. At this time the Taiping rebels were overrunning Hunan in their conquering career, and had possessed themselves of the cities and strongholds on both shores of the Yangtse-kiang. By a special decree Tsĕng was ordered to assist the governor of the province in raising a volunteer force, and on his own initiative he built a fleet of war junks, with which he attacked the rebels. In his first engagement he was defeated, but, happily for him, his lieutenants were more successful. They recovered the capital, Chang-sha, and destroyed the rebel fleet. Following up these victories of his subordinates, Tsĕng recaptured Wuchang and Hanyang, near Hankow, and was rewarded for his success by being appointed vice-president of the board of war. In 1853 other triumphs led to his being made a baturu (a Manchu order for rewarding military prowess), and to his being decorated with a yellow riding-jacket. Meanwhile, in his absence, the rebels retook Wuchang and burnt the protecting fleet. The tide quickly turned, however, and Tsĕng succeeded in clearing the country round the Poyang lake, and subsequently in ridding the province of Kiangsu of the enemy. His father died in 1857, and after a brief mourning he was ordered to take supreme command in Cheh-kiang, and to co-operate with the governor of Fukien in the defence of that province. Subsequently the rebels were driven westwards, and Tsĕng would have started in pursuit had he not been called on to clear the province of Ngan-hui of rebel bands. In 1860 he was appointed viceroy of the two Kiang provinces and Imperial war commissioner. At this time, and for some time previously, he had been fortunate in having the active support of Tso Tsung-t'ang, who at a later period recovered Kashgar for the emperor, and of Li Hung-Chang. Like all true leaders of men, he knew how to reward good service, and when occasion offered he appointed the former to the governorship of Cheh-kiang and the latter to that of Kiangsu. In 1862 he was appointed assistant grand secretary of state. At this time the Imperial forces, assisted by the "Ever-victorious Army," had checked the progress of the rebellion, and Tsĕng was able to carry out a scheme which he had long formulated of besieging Nanking, the rebel headquarters. While Gordon, with the help of Li Hung-Chang, was clearing the cities on the lower waters of the Yangtse-kiang, Tsĕng drew closer his besieging lines around the doomed city. In July 1864 the city fell into his hands, and he was rewarded with the rank and title of marquis and the right to wear the double-eyed peacock's feather. After the suppression of the Taipings the Nienfei rebellion, closely related to the former movement, broke out in Shantung, and Tsĕng was sent to quell it. Success did not, however, always attend him on this campaign, and by Imperial order he was relieved of his command by Li Hung-Chang, who in the same way succeeded him in the viceroyalty of Chihli, where, after the massacre of Tientsin (1870), Tsĕng failed to carry out the wishes of his Imperial master. After this rebuff he retired to his viceroyalty at Nanking, where he died in 1872.

Tsĕng was a voluminous writer. His papers addressed to the throne and his literary disquisitions are held in high esteem by the scholars of China, who treasure as a memorial of a great and uncorrupt statesman the edition of his collected works in 156 books, which was edited by Li Hung-Chang in 1876. (R. K. D.)

TSETSE-FLY (*Tsetse*, an English rendering of the Bantu *nsi-nsi*, a fly), a name applied indiscriminately to any one of the eight species of *Glossina*, a genus of African blood-sucking Diptera (two-winged flies, see DIPTERA), of the family Muscidae. Tsetse-flies are of great economic and pathological importance as the disseminators of tsetse-fly disease (nagana) and sleeping sickness. These maladies are caused by minute unicellula animal parasites (*haematozoa*) of the genus *Trypanosoma* (see TRYPANOSOMES); and recent investigations have shown that, under normal conditions, the particular species of *Trypanosoma* concerned (*T. brucei*, in the case of nagana, and *T. gambiense* in that of sleeping sickness) are introduced into the blood of susceptible animals or man only by the bite of one or other of the species of tsetse. (See PARASITIC DISEASES). The names of the recognized species of tsetse-flies are as follows: *Glossina palpalis* (see fig.); *G. pallicera*; *G. morsitans*; *G. tachinoides*; *G. pallidipes*; *G. longipalpis*; *G. fusca*; and *G. longipennis*. A ninth so-called species, described in 1905 from specimens from Angola, is not really distinct from *G. palpalis* but appears to be identical with the sub-species *G. palpalis wellmani*.

In appearance tsetse are somewhat narrow-bodied flies, with a prominent proboscis, which projects horizontally in front of the head, and with the wings in the resting position closed flat one over the other like the blades of a pair of scissors (see fig., B). The latter characteristic affords an infallible means for the recognition of these insects, since it at once serves to distinguish them from any blood-sucking flies with which they might otherwise be confused. The coloration of tsetse-flies is sombre and inconspicuous; the brownish or greyish-brown thorax usually exhibits darker longitudinal markings, and when the insect is at rest the abdomen or hinder half of the body is entirely concealed by the brownish wings. In some species the abdomen is of a paler colour and marked with sharply defined, dark brown bands, which are interrupted on the middle line. The length of the body, exclusive of the proboscis, which measures about a line to a line and a half, varies according to the species from 6 or 8 millimetres in the case of *G. tachinoides*, to about 11½ millimetres in that of *G. fusca* or *longipennis*; the closed wings, however, project beyond the body and thus increase its apparent length. *G. palpalis*, the disseminator of sleeping sickness (see fig.), is about 9½ millimetres in length and is the darkest of all the tsetse-flies, though the dark brown abdomen has pale lateral triangular markings and usually at least an indication of a pale longitudinal median stripe. In all tsetse-flies the proboscis in the living insect is entirely concealed by the palpi, which are grooved in their inner sides and form a closely fitting sheath for the piercing organ; the base of the proboscis is expanded beneath into a large onion-shaped bulb, which is filled with muscles. The head of the insect contains a muscular pharynx by means of which the blood from the wound inflicted by the proboscis (labium) is pumped into the alimentary canal and the so-called sucking-stomach. The tip of the proboscis is armed with a complicated series of chitinous teeth and rasps, by means of which the fly is enabled to pierce the skin of its victim; as usual in Diptera the organ is closed on the upper side by the labrum, or upper lip, and contains the hypopharynx or common outlet of the paired salivary glands, which are situated in the abdomen. The proboscis of tsetse-flies is without the paired piercing stilets (mandibles and maxillae) possessed by other blood-sucking Diptera, such as the female horse-flies and mosquitoes.



For the anatomy of the tsetse see E. A. Minchin, *Proc. Roy. Soc.* lxxvi. 531-547.

Tsetse-flies are restricted to Africa, where they occur in suitable localities throughout the greater portion of the tropical region, although not found either in the Sahara or in the veld country of the extreme south. For practical purposes the northern limit of *Glossina*, as at present known, may be shown on the map by drawing a line from Cape Verde to the Nile a little to the south-east of El Obeid, and thence to the coast of Somaliland at 4° N.; while the southern boundary of the genus may similarly be represented by the Cunene river, in the south of Angola, and a line thence to the north-eastern end of St Lucia lake, in Zululand. Within the area thus defined tsetse-flies are not found continuously, however, but occur only in small tracts called "belts" or "patches," which, since cover and shade are necessities of life to these insects, are always situated in forest, bush or banana plantations, or among other shady vegetation. In South and Central Africa, at any rate, "fly-belts" are usually met with in damp, hot, low-lying spots on the margins of water-courses, rivers and lakes, and seldom far from water of some kind. It appears, however, that in this respect the habits of the different species show a certain amount of variation; thus, while *G. palpalis* exhibits an especial fondness for water and haunts more or less dense cover at the water's edge, recent observations in German East Africa show that *G. fusca* is in no way connected with water, but is much more frequently encountered at a distance from it. Similarly the oft-repeated assertion that there is a definite connexion between tsetse-flies and big game, especially the buffalo (*Bubalus caffer*), in that the former are dependent upon the latter for their continued existence, is certainly not true as regards *G. palpalis*, although in South Africa there can be no question that the extermination of big game has been followed or accompanied by the disappearance of tsetse from many localities in which they formerly abounded.

As a rule tsetse-flies are most active during the warmer hours of the day, but they frequently bite at night, especially by moonlight. The blood-sucking habit is common to both sexes, and the abdomen, being capable of great expansion, is adapted for the periodical ingestion of an abundant food-supply. The act of feeding, in which the proboscis is buried in the skin of the victim nearly up to the bulb, is remarkably quick, and in thirty seconds or less the abdomen of the fly, previously flat, becomes swollen out with blood like a berry. Stuhlmann's experiments with *G. fusca* show that the insect is able to ingest considerably more than (sometimes more than twice) its own weight of blood, which would appear to be the only food, and must be drawn from the tissues of a victim. Specimens of *G. fusca*, even though fasting and kept for days in absolutely dry air, could never be induced to imbibe water, sugar-cane juice or extravasated blood. The reproduction of tsetse-flies is highly remarkable; instead of laying eggs or being ovoviviparous the females deposit at intervals of about a fortnight or three weeks a single full-grown larva, which forthwith buries itself in the ground to a depth of several centimetres, and assumes the pupal state. The practical importance of this peculiar life-history is very great, since larvae thus protected cannot easily be destroyed. It is important to note that although sleeping sickness (of which the chief foci are at present the Congo Free State and Uganda) has hitherto been associated with one particular species of *Glossina*, it has been shown experimentally both that other tsetse-flies are able to transmit the parasite of the disease, and that *G. palpalis* can convey kindred parasites which are fatal to domestic animals. Since, moreover, it is believed that at least five species of *Glossina* are carriers of nagana, it may well be that *all* tsetse-flies can disseminate both nagana and sleeping sickness. (E. E. A.)

TSHI, TCHWI, CHI, or OJI, a group of Negro peoples of the Gold Coast (*q.v.*). The chief of these are the Ashanti, Fanti, Akim and Aquapem. Their common language is the Tshi, from which they gain their family name.

TSU-SHIMA ("the island of the port"), an island belonging to Japan, situated about midway between Korea and the island of Iki, so that the two islands were used as places of call in former times by vessels plying between Japan and Korea. Tsu-shima lies about 34° 20′ N., 129° 20′ E. The nearest point of the Korean coast is 48 m. distant. It has an area of 262 sq. m. and a population of 39,000. It is divided at the waist by a deep sound (Asaji-ura), and the southern section has two hills, Yatachi-yama and Shira-dake, 2130 ft. and 1680 ft. high respectively, while the northern section has Ibeshi-yama and Mi-take, whose heights are 1128 ft. and 1598 ft. The chief town is Izu-hara. The Mongol armada visited the island in the 13th century and committed great depredations. In 1861 an attempt was made by Russia to obtain a footing on the island. The name of the battle of Tsu-shima is given to the great naval engagement of the 27th and 28th of May 1905, in which the Russian fleet under Admiral Rozhdestvensky was defeated by the Japanese under Admiral Togo.

TUAM, a market town and episcopal city of Co. Galway, Ireland, 20 m. directly N.N.E. of Galway on the Limerick & Sligo branch of the Great Southern & Western railway. Pop. (1901), 3012. An abbey was founded here towards the end of the 5th century, and in the beginning of the 6th an episcopal see by St Jarlath. The Protestant archbishopric of Tuam was lowered to a bishopric on the death of Archbishop Power Le Poer Trench in 1839, and united with that of Killala and Achonry. It is, however, a Roman Catholic archbishopric. The Protestant cathedral is also the parish church, and was to a great extent rebuilt *c.* 1861 from plans by Sir Thomas Deane. Only the chancel of the old church remains, but its red sandstone arch is a remarkably fine example of Norman work; it dates from the middle of the 12th century. The modern Roman Catholic cathedral is Perpendicular in style and cruciform in plan. The interior is elaborately decorated. The cross of Tuam, re-erected in modern times, bears inscriptions in memory of Turlogh O'Conor, king of Ireland, and O'Hoisin, successively (1128) abbot of St Jarlath's Abbey and archbishop (1152) of Tuam, when the see was raised. St Jarlath's Roman Catholic college, usually called the New College, is a seminary founded in 1814 for the education of priests. To the west are the archbishop's palace and a convent of

Presentation nuns. The town has a considerable retail trade, and is a centre for the disposal of agricultural produce. Tuam received its first charter from James I. Before the union in 1800 it returned two members to the Irish Parliament.

TUAREG, or Tawarek (more properly Tawarik, the collective form of *tarki*, from Arabic *terek*, to give up), the name given to the western and central Saharan Berber peoples, in reference possibly to their abandonment of Christianity or their early home in Mauretania. They call themselves *Imoshagh* ("the noble people"), another form of Amazigh. They inhabit the desert from Tuat to Timbuktu and from Fezzan to Zinder. The Tuareg country covers about 1,500,000 sq. m., less than 3000 acres of which are cultivated. There are only some half-dozen commercial places in the whole Sahara to which the Tuareg resort. These are the centres from which the trade routes radiate, Wargla, Timbuktu, Ghat, Ghadames, Murzuk and Insalah.

The Tuareg, at any rate the noble class, are regarded as among the purest of the Berber stocks, but with the adoption of Islam they have become largely Arabized in manners and customs, though the nomad Tuareg preserve in singular purity the Tamashek dialect of the Berber language. Their general colour is the reddish yellow of southern Europeans, the uncovered parts of the body being, however, darker through exposure. Their hair is long, black, and silky, beards black and thin; eyes black, sometimes blue; noses small; hands delicate, but bodies muscular. They are a tall people, the chiefs being especially noted for their powerful build. They dress generally in a black tunic (some tribes wear white), trousers girt with a woollen belt, and wear as turban a cloth called *litham*, the end of which is drawn over the face, allowing nothing to be seen but the eyes and the tip of the nose. The purpose of this is to protect the throat and lungs from the sand. These cloths are dark blue or white: the former being worn most by the nobles, the latter by the common people. To this difference of colour is due the terms "black" and "white" Tuareg. The Tuareg seldom remove their masks or face-cloths. Even abroad they wear them, and have been seen so dressed in the streets of Paris. The Arabs call them "People of the Veil."

The Tuareg are divided into five main tribes or confederations of tribes: the Azgar (Asjer) about Ghat and Ghadames; the Kelui around Air; the Hoggar (Ahaggar) in the mountains of that name and in the centre of the Sahara; the Awellimiden in the desert north and east of Timbuktu; and the Arrerf Ahnet, a recent offshoot of the Hoggars living in the Adrar'n Ahnet region north-west of the Hoggar massif. Owing to their nomadic life their political organization is not so democratic as that of other Berber peoples; chiefs and the members of the popular assembly are nominally elective; practically, however, the office of chief is hereditary in a ruling family. On a chief's death the office goes, with the approval of the tribesmen, to the eldest son of his eldest sister, in no case to any of his sons. The Tuareg are nominally Mahommedans, and belong to the Malikite section of the Sunnites. The Senussite sect, however, has many adherents, but more because of the Tuareg hatred of foreigners than from devoutness. A very few perform, by way of Tripoli, the pilgrimage to Mecca. They have not many mosques, and these are merely small stone enclosures a few feet high, with a niche at one end towards Mecca. There are a number of desert monasteries, huge camps pitched in a circle. Here the marabout lives surrounded by his followers, shifting the "monastery" as the requirements of his flocks compel. In these monasteries many Tuareg children receive their education.

Socially the Tuareg are divided into five classes, viz.: *Thaggaren* or nobles; Marabouts or priests; *Imghad* or serfs; *Ireghenaten* or cross-breeds; and the slaves. The nobles are all pure-blooded, and provide the tribal chiefs. They do no manual work, but almost live in the saddle, either convoying those caravans which have paid blackmail for safe passage, or making raids on trade-routes or even outlying Arab settlements. Before the French occupation they sometimes penetrated into the very heart of Algeria and Tunisia. Among the Imghad serfdom is hereditary, and whole tribes are vassals to the nobles. They cannot be sold or freed like slaves, though they may be inherited. Most of them have practical independence and act as "squires" to the nobles on their pillaging expeditions. The cross-breeds are the descendants of mixed marriages between the nobles and serfs. These follow their mother's status. The slaves are chiefly Sudanese negroes. They are well treated and are practically members of the Tuareg family, but the Tuareg never intermarry with them. The Tuareg weapons are a straight two-edged sword about 4 ft. long, a dagger bound to the left forearm by a leather ring, and a slender iron lance some 9 ft. long barbed for about a foot. On his right arm the Tuareg warrior wears a heavy stone to give increased weight to his lance and sword-play or to parry blows. Muskets are common, no noble or freedman being without one. Besides this the Tuareg carry leathern shields. In hunting, wooden missiles like boomerangs are used. Among the low-caste hill tribes of Hoggar bows and arrows are the only weapons.

Little is known of the history of the Tuareg. The name is that given them by the Arabs. They are the descendants of those Berbers who were driven into the desert by the great Arab invasion of North Africa in the 11th century. Ibn Khaldûn in the 14th century locates them to the south and west of Tunisia. They were constantly at war with the Arabs on the north, and the Negro peoples of the Sudan on the south. For their relations with the French, with whom they came into contact after the conquest of Algeria, see Sahara.

Authorities.—H. Duveyrier, *Les Touaregs du Nord* (Paris, 1864); Lieut. Hourst, *The Exploration of the Niger* (Eng. trans., London, 1898), pp. 199–249; W. J. Harding King, *A Search for the Masked Tuaregs* (London, 1903); M. Benhazera, *Six Mois chez les Touareg du Ahaggar* (Algiers, 1908); Lieut. C. Jean, *Les Touareg du sud-est: l'Air, leur rôle dans la politique saharienne* (Paris, 1909); E. Doutté, *Magie et religion dans l'Afrique du nord* (Algiers, 1909); "Essai de transcription méthodique des noms de lieux touareg" in *Bull. soc. géog. d'Alger* (1908).

TUAT, a Berber word [1] sometimes applied generally to all the oases in the western part of the Algerian Sahara, *i.e.* between 2° W. and 2½° E. 26° and 30° N., sometimes restricted to a particular group which borders the east side of Wad Mzaud between 26½° and 27½° N. According to the first usage Tuat includes the oases of Gurara in the north and Tidikelt in the south with the important centre of Insalah. The three groups are spoken of collectively by the French as the Tuat archipelago. The district is comparatively fertile, being formed of recent alluvium extending along the base of the Tademait plateau (Cretaceous), and produces dates and some cereals and vegetables. The wadi Saura (known in its lower course as the Messaud), formed by the junction of the wadis Zusfana and Ghir, marks the north-western boundary of the oases. After the winter rains in the Atlas it carries a considerable body of water in its upper course, but lower down its channel is choked by sand. Works were undertaken (1909) by the French to keep open the channel as it passes Tuat proper. At Gurara water is obtained from springs brought to the surface by the outcrop of impervious Devonian rocks. There is an extensive *sebkha* or salt lake at Gurara. The oases support a comparatively large population. The separate *ksurs* or hamlets, of which the district is said to contain over 300, are in Tuat proper placed close together. The political centre of Tuat is the oasis of Timmi, which has some forty ksurs. All the ksurs are strongly fortified, the walls of the citadels being of immense thickness. The whole region has been formed into an administrative unit known as *territoire des oasis sahariennes*, and comprising a native commune subdivided into the annexes of Tuat, Gurara and Tidikelt. In 1906 the commune had a population of 134 Europeans and 49,873[2] natives, of whom 112 enjoyed municipal rights. There were four places with over 2000 inhabitants: Adrar (Timmi), 2686, and Zaniet-Kunta, 3090, in Tuat; Insalah, 2837, in Tidikelt; and Timimun, 2330, in Gurara. Nine other places had between 1000 and 2000 inhabitants. By race (excluding the troops) there were 19,654 Arabs, 5470 Berbers, 4374 negroes, 191 Jews (professing Islam) and 19,412 persons of mixed blood. The district is of importance as commanding the routes southwards to Timbuktu from both Morocco and Algeria, and it is thus a great centre of trade. The oases appear to have been inhabited from a very early period. According to tradition numbers of Jews migrated thither in the 2nd century A.D. They were the predominant element in the oases when the conquests of Sidi Okba drove the Zenata south (7th century). These Berbers occupied Tuat and, to a large extent, absorbed the Jewish population. The Arabs took possession of the oases in the 10th century and imposed Islam upon the people. Thereafter the region was governed by Zenata Berbers or by Arab chieftains. In the 14th century the sultan of Morocco occupied the oases, which remained in political dependence upon Morocco. In the 17th century, however, the sovereignty of the sultan had become almost nominal and this state of quasi-independence continued. The treaty of 1845 between Morocco and France left the question of the possession of Tuat, Gurara and Tidikelt unsettled. After the murder in 1881 of the members of the Flatters mission—a French expedition sent into the Sahara—a measure concerted at Insalah, several of the Tuat headmen sought Moroccan protection, fearing the vengeance of France. A chief calling himself the Moroccan pasha established himself at Timmi, but Morocco took no active step to assert her sovereignty. In 1899 a French scientific mission, under Colonel Flamand, was despatched to the oasis of Tidikelt. The French were attacked by the natives (Dec. 28, 1899), whom they defeated, and the next day Insalah was occupied. This was the beginning of a serious campaign in which the French suffered severe losses, but by March 1901 the whole of the fortified places in the three oases had been captured. To cut off the oases from Morocco the town of Igli, 140 m. north-west of Gurara, was also annexed by the French (April 5, 1900). Igli (pop. 1057 in 1906) occupies an important position, being placed at the junction of the wadi Zusfana and the wadi Ghir. The French were not, however, left in peaceable possession of their newly acquired territory. Attacks by the nomad tribes, Moroccan and others, were made on the line of communications, and during 1903 the French troops suffered serious losses. To punish the tribes the town of Figig was bombarded by the French (June 8, 1903). On the 2nd of September following a band of nomads attacked, at a place called El Mungar, the escort of a convoy going to Taghit. After maintaining the fight 7½ hours the French were reinforced and their enemies drew off. Out of 115 combatants the French lost 38 killed and 47 wounded.

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[1] The etymology of the word is doubtful; it is used in the sense of an inhabited district—hence an oasis.

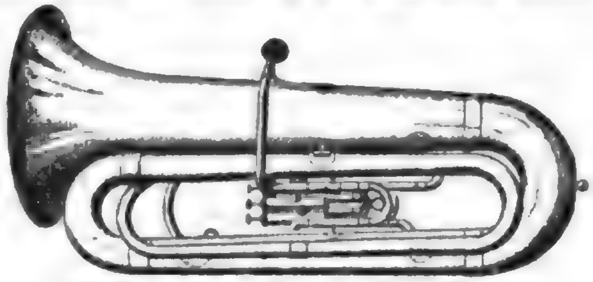
[2] By a clerical error the native population in the census returns is given as 60,497.

To consolidate their position the French authorities determined to connect the oases with the Algerian Sahara proper by carriage roads and railways. One road goes north-east to El Golea, 150 m. distant from Insalah; another north from Igli to a post called Beni Ounif, 2½ m. south of Figig, to which point the railway from Ain Sefra, in the Oranese Sahara, was carried in 1903. The continuation of this railway to Igli was begun in the following year.

Major A. G. Laing visited the Tuat territory in 1825 on his way to Timbuktu, but his papers were lost. The next European to visit Tuat was Gerhard Rohlfs, who described his explorations and investigations in *Tagebuch seiner Reise durch Marokko nach Tuat, 1864* (Gotha, 1865) and *Reise durch Marokko . . . Exploration der Oasen von Tafilet, Tuat und Tidikelt* . . . (Bremen, 1868). A. G. P. Martin's *Les Oasis sahariennes* (Algiers, 1908) gives an account of the history and economic condition of the oases. Consult also Commandant E. Laquière, *Les Reconnaissances du Général Servière dans les oasis sahariennes* (Paris, 1902), a valuable monograph by an officer who took part in the operations in 1900–1901; E. F. Gautier, *Sahara algérien* (Paris, 1908), and various contributions by G. B. M. Flamand in *La Géographie* and *Annales géographiques* for 1900, *Comptes rendus* (1902), *Bull. géog. hist. et descriptive* (1903), &c. (F. R. C.)

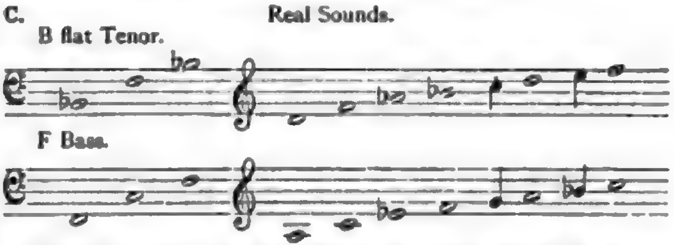
TUBA, in music. The tubas—bombardon, helicon, euphonium (Fr. *tuba, sax-tuba, bombardon*; Ger. *Tuben, Tenor-bass, Bombardon, Kontrabasstuba, Helikon*; Ital. *basstuba, bombardone*)—are a family of valved instruments of powerful tone forming the tenor and bass of the brass wind. In the orchestra these instruments are called tubas; in military bands euphonium (tenor), bombardon and helicon (bass).

The modern tubas owe their existence to the invention of valves or pistons (Ger. *Ventile*) by two Prussians, Stölzel and Blümel, in 1815. The tubas are often confounded with the baritone and bass of the saxhorns, being like them the outcome of the application of valves to the bugle family. There is, however, a radical difference in construction between the two types: given the same length of tubing, the fundamental octave of the tubas is an octave lower than that of the saxhorns, the quality of tone being besides immeasurably superior. This difference is entirely due to the proportions of the truncated cone of the bore and consequently of the column of air within. By increasing the calibre of the bore in proportion to the length of the tube it was found that the fundamental note or first sound of the harmonic series was easily obtained in a full rich quality, and by means of the valves, with this one note as a basis, a valuable pedal octave is obtained, absent in the saxhorns. Prussia has not adopted these modifications; the bass tubas with large calibre, which have long been introduced into the military bands of other countries and retained in that country, are founded on the original model invented in 1835 by Wieprecht and Moritz, a specimen of which is preserved in the museum of the Brussels Conservatoire. The name "bass tuba" was bestowed by Wieprecht upon his newly invented bass with valves, which had the narrow bore afterwards adopted by Sax for the saxhorns. The evolution of the modern tubas took place between 1835 and 1854 (see VALVES).



BB♭ Bombardon or Contrabass Tuba (Besson).

The instruments termed Wagner tubas are not included among the foregoing. The Wagner tubas are really horns designed for Wagner in order to provide for the *Nibelungen Ring* a complete quartet having the horn timbre. The tenor tuba corresponds to the tenor horn, which it outwardly resembles, having its tube bent in rectangular outline and being played by means of a funnel-shaped mouthpiece. The bore of the Wagner tenor and tenor-bass tubas, in B♭ and F, is slightly larger than in the horn, but much smaller than in the real tubas. The bell, funnel-shaped as in the German tubas, is held to the right of the performer, the valves being fingered by the left hand. There are four valves, lowering the pitch respectively 1 tone, ½ tone, 1½ tone, 2 tones (or 2½ tones). The harmonic series is the same for both instruments, the notation being as for the horn in C.



N.B.—The black notes are difficult to obtain strictly in tune as open notes.

By means of the valves the compass is extended downwards an octave for each instrument. The timbre of the tenor tuba is only slightly more metallic and less noble than that of the French horn with valves. Many motives in the *Ring* are given out by the quartet of horns and Wagner tubas.

The modern tuba finds its prototype as well as the origin of the name in the Roman tuba (the Greek *salpinx*), definite information concerning which is given by Vegetius.[1] Compared with the other military service instruments of the Romans, the *buccina* and *cornu*, the tuba was straight and was used to sound the charge and retreat, and to encourage and lead the soldiers during action; it was sounded at the changing of the guard, as the signal to begin and leave off work, &c. The tuba is represented, together with the buccina and cornu, on Trajan's column in the scenes described by Vegetius.

During the middle ages the tuba was as great a favourite as the busine (see BUCCINA and TRUMPET), from which it may readily be distinguished by its marked conical bore and absence of bell. It is recorded that King Frederick Barbarossa gave an order on the 14th of January 1240 in Arezzo for four tubas of silver and for slaves to be taught to play upon them.[2] During the middle ages the Latin word *tuba* is variously translated, and seems to have puzzled the compilers of vocabularies, who often render it by *trumba* (Fr. *trompe*). (K. S.)

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[1] *De re militari*, iii. 5 and ii. 7.

[2] Dr Alwin Schultz, *Höfisches Leben*, i. 560, note 3.

TUBE (Lat. *tuba*), a pipe or hollow cylinder. Tubes play an important part in engineering and other works for the conveyance of liquids or gases, and are made of diverse materials and dimensions according to the purpose for which they are intended, metal pipes being of the greatest consequence. According to the process of manufacture metal tubes may be divided into seamed and seamless. One of the earliest uses of seamed wrought-iron tubes was for gun-barrels, and formerly these were made by taking a strip of wrought iron, bending it so that the edges overlapped and then welding by hammering, with or without the aid of grooved swages. The development of gas lighting increased the demand for tubes, and in 1824 James Russell introduced the butt-welded tube, in which the edges of the skelp are not made to overlap, but are brought into closest possible contact and the welding is effected in a double swage, having corresponding grooves of the diameter of the tube required; this method required no mandrel as did those previously in use. The following year saw another improvement in making these pipes, when Cornelius Whitehouse effected a butt weld by drawing the bent skelp through a die. Stronger tubes are obtained by using grooved rollers instead of a die, the skelp being mounted on a mandrel. This is the method commonly adopted at the present day for making this class of tube. Seamed tubes, especially of copper and brass, are made by brazing or soldering the edges of the skelp. Another method is to bend the edges so that they interlock, the contact being perfected by rolling. Seamless tubes, which are stronger than those just described, are made by drawing a bloom of the metal perforated by an axial hole or provided with a core of some refractory material, or, in certain cases, by forcing the plastic metal by hydraulic pressure through an appropriate die. The seamless steel tube industry is now of great dimensions owing to the development of steam engineering. Another type of seamless tube is the cast-iron tube, usually of large diameter and employed for gas and water mains; these pipes are made by casting.

TUBERCULOSIS. The word "tuberculosis," as now used, signifies invasion of the body by the tubercle bacillus, and is applied generally to all morbid conditions set up by the presence of the active parasite. The name is derived from the "tubercles" or "little lumps" which are formed in tissues invaded by the bacillus; these were observed and described long before their real nature or causation was known. (For an account of the organism, which was discovered by Koch in 1882, see PARASITIC DISEASES.) The bacillus attacks every organ and tissue of the body, but some much more frequently than others. The commonest seats of tuberculous disease are the lungs, lymphatic glands, bones, serous membranes, mucous membranes, intestines and liver. Before the discovery of the bacillus its effects in different parts of the body received separate names and were classified as distinct diseases. For instance, tuberculosis of the lung was called "consumption" or "phthisis," of the bones and lymphatic glands "struma" or "scrofula," of the skin "lupus," or the intestinal glands "tabes mesenterica." Some of these names are still retained for convenience, but the diseases indicated by them are known to be really forms of tuberculosis. On the other hand, there are "tubercles" which are not caused by the tubercle bacillus, but by some other source of irritation, including various parasitic organisms, some of which closely resemble the tubercle bacillus. To these forms of disease, which are not as yet well understood, the term pseudo-tuberculosis has been given. Lastly, the word "tubercular" is still sometimes applied to mere lumpy eruptions of the skin, which have no connexion with tuberculosis or pseudo-tuberculosis.

Pathology.—The effects of tuberculosis on the structures attacked vary greatly, but the characteristic feature of the disease is a breaking-down and destruction of tissue. Hence the word "phthisis," which means "wasting away" or "decay," and was used by Hippocrates, accurately describes the morbid process in tuberculosis generally, as well as the constitutional effect on the patient in consumption. According to the most recent views, the presence and multiplication of the bacilli excite by irritation the growth of epithelioid cells from the normal fixed cells of the tissue affected, and so form the tubercle, which at first consists of a collection of these morbidly grown cells. In a typical tubercle there is usually a very large or "giant" cell in the centre, surrounded by smaller epithelioid cells, and outside these again a zone of leucocytes. The bacilli are scattered among the cells. In the earliest stages the tubercle is microscopic, but as several of them are formed close together they become visible to the naked eye and constitute the condition known as miliary tubercle, from their supposed resemblance to millet seeds. In the next stage the cells forming the tubercle undergo the degenerative change known as "caseation," which merely means that they assume in the mass an appearance something like cheese. In point of fact, they die. This degeneration is believed to be directly caused by a toxin produced by the bacilli. The further progress of the disease varies greatly, probably in accordance with the resisting power of the individual. In proportion as resistance is small and progress rapid the cheesy tubercles tend to soften and break down, forming abscesses that burst when superficial and leave ulcers, which in turn coalesce, causing extensive destruction of tissue. In proportion as progress is slow the breaking-down and destructive process is replaced by one in which the formation of fibrous tissue is the chief feature. It may be regarded as Nature's method of defence and repair. In tuberculosis of the lungs, for instance, we have at one end of the scale acute phthisis or "galloping consumption," in which a large part or even the whole of a lung is a mass of caseous tubercle, or is honeycombed with large ragged cavities formed by the rapid destruction of lung tissue. At the other end we have patches or knots of fibrous tissue wholly replacing the original tubercles or enclosing what remains of them. Such old encapsuled tubercles may undergo calcareous degeneration. Between these extremes come conditions which partake of the nature of both in all degrees, and exhibit a mixture of the destructive and the healing processes in the shape of cavities surrounded by fibrous tissue. Such intermediate conditions are far more common than either extreme; they occur in ordinary chronic phthisis. The term "fibroid phthisis" is applied to cases in which the process is very chronic but extensive, so that considerable cavities are formed with much fibrous tissue, the contraction of which draws in and flattens the chest-wall. Tuberculosis commonly attacks one organ or part more than another, but it may take the form of an acute general fever, resembling typhoid in its clinical features. "Acute miliary tuberculosis" is a term generally used to indicate disseminated infection of some particular organ—usually the lungs or one of the serous membranes—in which the disease is so severe and rapid that the tubercles have not time to get beyond the miliary state before death occurs. Tuberculosis is exceedingly apt to spread from its original seat and to invade other organs. The confusing multiplicity of terms used in connexion with this disease is due to its innumerable variations, and to attempts to classify diseases according to their symptoms or anatomical appearances. Now that the cause is known, and it has become clear that different forms of disease are caused by variations in extent, acuteness and seat of attack, the whole subject has become greatly simplified, and many old terms might be dropped with advantage.

Tuberculosis in the Lower Animals.—Most creatures, including worms and fishes, are experimentally susceptible to tuberculosis, and some contract it spontaneously. It may be called a disease of civilization. Domesticated animals are more susceptible than wild ones, and the latter are more liable in captivity than in the natural state. Captive monkeys, for instance, commonly die of it, and of birds the most susceptible are farmyard fowls, but it is practically unknown in animals in the wild state. In cattle coming chiefly from the plains (*United States Bureau of Animal Industry Reports*, 1900–1905) the number found diseased was only 0·134% in 28,000,000. Of the domesticated animals, horses and sheep are least, and cattle most, affected; pigs, dogs and cats occupy an intermediate position.

The percentage of tuberculous animals recorded at the slaughterhouses of Berlin in 1892–1893 was as follows: Cows and oxen, 15·1; swine, 1·55; calves, 0·11; sheep, 0·004. Similar records at Copenhagen in 1890–1893 give the following result: Cows and oxen, 17·7; swine, 15·3; calves, 0·2; sheep, 0·0003. The order of the animals is the same, and it is confirmed by other slaughterhouse statistics; but the discrepancies between the figures indicate considerable variation in frequency, and only allow general conclusions to be drawn. A striking fact is the comparatively small amount of tubercle in calves. It shows, as Nocard has pointed out, that heredity cannot play an important part in the transmission of bovine tuberculosis. The infrequency of the disease in sheep is attributed to the open-air life they lead, and no doubt that is an important factor. The more animals and persons are herded together and breathe the same air in a confined and covered space, the more prevalent is tuberculosis among them. Stefansky found the disease in 5% of the rats caught in Odessa, and Lydia Rabinowitch obtained similar results in rats caught in Berlin. But there are evidently degrees of natural resistance also. Horses are more confined than cattle in the United Kingdom, yet they are far less affected; and on the other hand, cattle running free in the purest air may take the infection from others. Professor McEacharn of Montreal states that he has seen tuberculosis prevalent in ranch cattle, few of which were ever under a roof, ranging on the foothills of the Rocky Mountains in Montana. In cows and monkeys the lungs are chiefly affected; in horses and pigs the intestine and abdominal organs.

The relation between human and animal tuberculosis has been much debated. The bacillus in man very closely resembles that found in other mammalia, and they were considered identical until Koch threw doubt on this view at the British Congress on Tuberculosis in 1901. The British government thereupon appointed a royal commission to inquire into the relations of human and animal tuberculosis. The second interim report of the commission was issued in 1907, and the conclusions arrived at in it are: "That there seems to be no valid reason for doubting the opinion, never seriously doubted before 1901, that human and bovine bacilli belong to the same family. On this view the answer to the question, Can the bovine bacillus affect man? is obviously in the affirmative. The same answer must also be given to those who hold the theory that human and bovine tubercle bacilli are different in kind, since the 'bovine kind' are readily to be found as the causal agents of many fatal cases of human tuberculosis." The commission also found that there is an essential unity not only in the nature of the morbid processes induced by human and bovine tubercle bacilli, but also in the morphological characteristics exhibited by the tubercle bacilli which cause these processes. The conclusions of the members of the Paris Congress on Tuberculosis, held in 1905, are: "That human tuberculosis can be transferred to the bovine animal, and that what is termed the bacillus of bovine origin can be discovered in the human subject, and that there is a possibility that they may be varieties of one species."

Distribution and Mortality.

The distribution of tuberculosis is universal, and it is coincident with the existence of the human race in the habitable regions of the globe. Its comparative absence in the Arctic regions seems more due to the sparsity of population than to climatic effect. Indeed, it has been shown that climate has much less effect in its prevalence than has been formerly thought to be the case, the conclusion of Hirsch being that "the mean level of the temperature has no significance for the frequency or rarity of phthisis in any locality." The nature of the occupations and the density of population in any given area tend to its increase or otherwise, and the comparative immunity enjoyed by uncivilized races is due to their open-air life and to the sanitary advantages derived from the comparatively frequent changes of the sites of their camps and villages. Segregation of these races in fixed areas has shown an increased incidence of tuberculosis, and when living under civilized conditions they fail to exhibit any natural immunity. Altitude has an apparent influence on the frequency of phthisis, the rarity of the disease at high altitudes in Switzerland having been demonstrated, and a like protective influence is enjoyed by certain elevated districts in Mexico, notwithstanding the insanitary conditions of the towns thereon. The protection afforded by the altitude is alleged to be due to the dryness of the atmosphere, its freedom from impurities and the increased solar radiation. While no race is exempt from tuberculosis, certain races afford a greater case incidence. E. Baldwin states that the mortality from consumption in recently immigrated races in the United States is much greater than in those of longer residence. It was found that among those whose mothers were of foreign birth the rate was—in Russians 71·8, Germans 167, Scottish 172·5, French 187·7 and Irish 339·6, while in native-born Americans it was 112·8. The well-known susceptibility of the Irish has been attributed to the moisture of the climate, under-feeding, and the residual inferiority of a population drained by the emigration of a large number of able-bodied adults. That there is some added factor is shown by the fact that the above mortality of 339 in those having Irish mothers, in 1901, was greater by 31% than that of the Irish in Ireland at the same period. The Jews are said to show a relative immunity, but the matter requires further investigation. The factor which seemingly has the most constant influence on the mortality from tuberculosis is density of population. A high rate of mortality occurs in connexion with overcrowding and bad ventilation in cities, and it is proved that the death-rate from this disease is considerably lower in the country than in the towns. In addition, when we consider that it does not occur in epidemics or at certain seasons, but is constantly active, it will easily be seen that no other disease is so destructive to the human race. At the Tuberculosis Congress, held in Paris in 1905, it was stated by Kayserling that one-third of all deaths and one-half the sickness amongst adults in Germany was due to tuberculosis.

In 1908 the mortality from all forms of tuberculosis in England and Wales was, according to the registrar-general's returns, 56,080, less by 3455 than the average of the previous five years, being equal to 10·8% of the mortality from all causes, while in Ireland in 1909 14% of the total mortality was assigned to it.

The following table gives the comparative mortality from pulmonary tuberculosis for certain fixed years together with the estimated population of certain selected countries:—

	Estimated Population in Years.			Mortality from Pulmonary Tuberculosis.		
	1892.	1900.	1907.	1892.	1900.	1907.
England and Wales	29,760,842	32,249,187	34,945,600	43,323	42,987	39,839
Ireland	4,633,808	4,468,501	4,377,064	10,048	10,076	8,828
German Empire	47,125,446	52,624,706	61,994,743	113,720	108,827	97,555
France	38,360,000	38,900,000	39,222,000	31,080	34,357	40,304
Norway	2,010,000	2,211,300	2,305,700	3,358	4,249	4,656
Italy	30,665,662	32,346,366	33,776,087	39,715*	41,733*	41,968*
Holland	4,645,660	5,159,347	5,709,755	8,906	8,451	7,403
Belgium	6,195,355	6,693,548	7,317,561	10,491	9,117	7,377
Switzerland	3,002,263	3,299,939	3,525,290	5,785	6,692	6,063

* In Italy the mortality given is for all forms of tuberculosis.

We thus see there is a general tendency to decrease in the death-rate, with the possible exception of France and Norway. In England the decrease has been most marked, having fallen from 3457 per million living in 1851–1860, or 15·6% of all deaths, to 1583 per million living, or a mortality of 10·8% of the death-rate from all causes for all ages and sexes.

Death-rate of Tuberculosis per million living in England and Wales.

	1860.	1870	1880.	1890.	1900.	1908.
Males	3300	3300	2900	2700	2200	1800
Females	3300	3000	2500	2100	1600	1350
Both Sexes	3300	3150	2700	2400	1900	1583

In English counties containing populations of 100,000 or over the highest rates were—in 1908—London, 1806; Lancashire, 1848; Northumberland, 1947; Carnarvonshire, 2025; and Carmarthenshire, 2328 per million living. Of the fifteen counties in England and Wales with the highest tuberculosis mortalities, no fewer than seven are Welsh. Cardiganshire, with 2270 for both sexes, has a rate nearly double that of England.

According to the United States census of 1900, the death-rate from tuberculosis in the area chosen for registration which embraced ten registration states, namely, Connecticut, Maine, District of Columbia, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Rhode Island and Vermont, and 153 registration cities outside these states, was:—

	Number of Deaths from Tuberculosis.	Death-rate per 100,000.
1890	48,236	245·4
1900	54,898	190·5

The returns of the mortality statistics of the United States for the year 1908 cover an area of 17 states, the district of Columbia and 74 registration cities, representing an aggregate population of 45,028,767, or 51·8 % of the total estimated population of the United States.

Mortality from Tuberculosis in the United States in given areas.

Annual Average, 1901–1905.	Tuberculosis (all forms), 62,835.	Pulmonary Phthisis, 55,151.	Number Tuberculosis (all forms) per 100,000 of the population, 193·2.
1904	66,797	58,763	201·6
1905	65,352	56,770	193·6
1906	75,512	65,341	184·2
1907	176,650	66,374	183·6
1908	78,289	67,376	173·9

In the United States tuberculosis of the lungs forms from 86 to 87 % of all cases. The death-rate, as we see, is steadily decreasing. It is, however, difficult to estimate the ravages of the disease in that country owing to the fact that rather less than half the United States is still unprovided with an adequate system of registration.

The following was the death-rate from tuberculosis (all forms) per 100,000 of the population of the chief cities of the United States during 1908:—

New Orleans	298·3
Sacramento, California	294·3
Washington	264·0
Baltimore	249·9
Jersey City	241·1
New York	234·4
Philadelphia	234·1
Saratoga Springs, New York	232·2
Indianapolis	222·6
Boston, Massachusetts	219·1
St Louis	188·3
Chicago	180·7
Kansas City	172·9
Cleveland, Ohio	142·4
Pittsburg, Pennsylvania	139·2
Detroit	122·5
St Paul, Minnesota	111·8

The returns in the United States show a high rate of mortality from tuberculosis amongst the coloured population, the negro being particularly susceptible to pulmonary phthisis; the death-rate from this cause is nearly double that amongst whites.

Age and Sex.—The most complete information under this heading is derived from the English records. "In both sexes," says Dr Tatham, "the real liability to phthisis begins somewhere between the fifteenth and the twentieth year. Among males it attains its maximum at age 45–55, when it reaches 3173 per million living. Among females it attains its maximum (2096) at age 35-45. In both sexes the rate rapidly declines after the attainment of its maximum. Practically the incidence of pulmonary phthisis is upon the ages from 15 to 75 years, very old people and young children being comparatively exempt. According to recent experience, females seem to be rather *less liable* than males to death by phthisis at ages under 5 years, *more liable* at the age of 5–20, and again *less liable* at subsequent ages." These observations, it must be noted, refer only to consumption. The comparative immunity of the very young does not extend to all forms of tuberculous disease. On the contrary, tuberculosis of the bowels and mesentéric glands (tabes mesenterica), tuberculous peritonitis and tuberculous meningitis are pre-eminently diseases of childhood. The tables at foot of page show in detail the relative incidence of pulmonary phthisis at different ages, and the steady diminution of the disease in England and Wales since 1850.

Occupation has a marked influence on the prevalence of pulmonary tuberculosis. The comparative mortality figures for various occupations are taken from the supplement to the registrar-general's 65th annual Report, and show the incidence of pulmonary phthisis, agriculturists being taken at 100 for purposes of comparison.

Occupied Males: England and Wales.

Highest.		*Lowest.*	
Tin miner	816	Coal miner	89
Copper miner	574	Chemical manufacturer	98
Scissors maker	533	Carpenter, joiner	150
File maker	387	Artist	156
General shopkeeper	387	Blacksmith	158
Brush maker	325	Worsted manufacturer	159
Furrier	316	Baker	165
Printer	300	Bricklayer	194
Chimney sweep	284	Cotton manufacturer	197
Hatter	280	Tailor	248

The high incidence in the first group will be seen chiefly to affect those occupations where there is dust (scissors and file makers and furriers). The high mortality amongst general shopkeepers can only be ascribed to continuous indoor occupation. Coal miners enjoy an unexplained immunity.

Dr Von Körösy has tabulated the result of seventeen years' observation in Budapest, which is an excessively tuberculous town. His figures include both males and females above fifteen years of age, and extend to 106,944 deaths. The field of observation is evidently very different from those which furnished the statistics already given. His results are: (1) *Males*—printers 606, butlers 520, shoemakers 494, dyers 493, millers 492, joiners 485, tinkers and locksmiths 484, masons 467, labourers 433, tailors 418, bakers 398, drivers 370, servants 360, carpenters 339, officials 336, butchers 333, innkeepers 272, merchants 253, lawyers 205, physicians 118, capitalists 106; (2) *Females*—servants 353, day labourers (? char-women) 333, washerwomen 314, gardeners 269, capitalists 42. The inmates of lunatic asylums, who are classed among the

ENGLAND AND WALES

Tuberculous Phthisis.—Mortality in several Periods, 1851–1899.

Annual Rate per Million Living.

MALES.

Period.	AGES.										
	All Ages.	Under 5 Years.	5—	10—	15—	20—	25—	35—	45—	55—	65—
1851–1860	2579	1329	525	763	2399	4052	4031	4004	3830	3331	2389
1861–1870	2467	990	431	605	2190	3883	4094	4166	3861	3297	2024
1871–1880	2209	783	340	481	1675	3092	3699	4120	3860	3195	1924
1881–1885	1927	584	274	372	1381	2467	3246	3726	3567	2937	1800
1886–1890	1781	521	234	318	1212	2222	2842	3436	3446	2904	1845
1891–1895	1634	467	197	260	1075	2026	2548	3268	3205	2686	1572
1896–1899	1521	403	140	195	908	1841	2341	3110	3173	2627	1530
1900–1904	1479	366	149	182	799	1643	2147	2811	3130	2560	1309
1903–1907	1385	359	138	163	743	1472	2022	2573	2945	2498	1316
1908	1310	205	134	161	676	1858	2114	1964	2000	1830	1061

FEMALES.

Period.	AGES.										
	All Ages.	Under 5 Years.	5—	10—	15—	20—	25—	35—	45—	55—	65—
1851–1860	2774	1281	620	1293	3516	4288	4575	4178	3121	2383	1635
1861–1870	2483	947	477	1045	3112	3967	4378	3900	2850	2065	1239
1871–1880	2028	750	375	846	2397	3140	3543	3401	2464	1777	1093
1881–1885	1738	553	350	749	2006	2596	3070	2927	2197	1541	995
1886–1890	1497	483	307	658	1626	2075	2552	2563	1936	1490	966
1891–1895	1303	421	260	561	1428	1740	2155	2305	1742	1294	800
1896–1899	1141	334	201	410	1165	1547	1862	2096	1597	1242	787
1900–1904	1042	316	203	417	1002	1274	1593	1807	1481	1136	670
1903–1907	975	308	194	391	959	1194	1488	1643	1382	1075	666
1908	931	229	192	441	1270	1438	1761	1407	1156	945	654

"unoccupied," suffer excessively from tubercle. According to Dr Mott, pathologist to the London County Council, tuberculous lesions are found in more than one-third of the bodies of inmates examined post mortem. The majority contract the disease in the asylums.

Heredity.

Medical opinion has undergone a great change with regard to the influence of heredity. The frequent occurrence of consumption among members of the same family used to be explained by assuming the existence of a tuberculous "diathesis" or inherent liability to consumption which "ran in families" and was handed down from one generation to another. As the real nature of the disease was not understood, the inherited diathesis was regarded as a sort of latent or potential consumption which might develop at any time and could hardly be avoided. The children of consumptive parents had the "seeds" of the disease in them, and were thought to be doomed with more or less certainty. Great importance was therefore attached to heredity as a factor in the incidence of tuberculosis. The discovery that it is caused by a specific parasitic infection placed the question in a different light, and led to a more careful examination of the facts, which has resulted in a general and increasing tendency to minimize or deny the influence of heredity. At the Berlin Congress on Tuberculosis in 1899 Virchow pronounced his disbelief in the theory on pathological grounds. "I dispute this heredity absolutely," he said. "For a course of years I have been pointing out that if we examine the bodies of infants newly born, who have had no life apart from the mother, we find no tuberculosis in them. I am convinced that what looked like tuberculosis in the newly born was none of it tuberculosis. In my opinion there is no authenticated case of tubercle having been found in a dissected newly-born infant." Observations on animals similarly tend to disprove the existence of congenital tuberculosis (Nocard). The theory that the germs may remain latent in the offspring of tuberculous parents (Baumgarten) is unsupported by evidence. The occurrence of disease in such offspring is ascribed to infection by the parents, and this view is confirmed by the fact that the incidence in consumptive families is greater on female children, who are more constantly exposed to home infection, than on the male (Squire). The statistical evidence, so far as it goes, points in the same direction. It is even denied that the children of consumptives are specially predisposed.

Density of Population and Overcrowding.

Recognition of the communicability of tuberculosis has directed attention to the influence of conditions in which people live massed together in close proximity. The prevalence of the disease in large centres of population has already been noted, and the influence of aggregation is no doubt considerable; but it does not always hold good. The distribution in England and Wales does not correspond with density of population, and some purely rural districts have a very high mortality. Broadly, however, the rural counties have a low mortality, and those containing large urban populations a high one. In France in the department of the Oise, in purely industrial villages, the mortality from pulmonary phthisis is from 56 to 61 per 10,000; in a village in which part of the population worked in the fields and part in factories the mortality was 46 per 10,000; and in purely agricultural villages it ranged from 0 to 10 per 10,000.

The following table is taken from the Supplement to the Registrar-General's 65th Report for England and Wales:—

	All occupied Males.		Occupied Males (London).		Occupied Males (industrial districts).		Occupied Males (agricultural districts).	
	1900–1902.	1890–1892.	1900–1902.	1890–1892.	1900–1902.	1890–1892.	1900–1902.	1890–1892.
All Causes	100	119	119	143	121	156	72	86
Tuberculous Phthisis.	100	122	156	183	115	147	71	90

It will be noted that the rate in the agricultural districts is low compared to the industrial districts or purely urban district chosen. There is obviously a close relation between density of population and the prevalence of phthisis. Comparing phthisis with other diseases in relation to overcrowding, the same authority found that "while associated with overcrowding is a tendency of the population to die from disease generally, this tendency is especially manifested in the case of phthisis, and is not manifested in the case of every disease."

Other Conditions.—Poverty, insufficient food and insanitary dwellings are always more or less associated with overcrowding, and it is difficult to distinguish the relative influence of these factors. An analysis of 553 deaths in Edinburgh according to rentals in 1899 gave these results: under £10, 230; from £10 to £20, 190; above £20, 106 (Littlejohn); but the corresponding population is not stated. An investigation of selected houses in Manchester gave some interesting results (Coates). The houses were divided into three classes: (1) infected and dirty; (2) infected but clean; (3) dirty but not infected; infected meaning occupied by a tuberculous person. Dust was taken from all parts of the rooms and submitted to bacteriological tests. The conclusions may be summarized thus: The effects of overcrowding were not apparent; a large cubic space was found to be of little avail if the ventilation was bad; the beneficial effects of light and fresh air were markedly shown even in the dirtiest houses; ordinary cleanliness was found not sufficient to prevent accumulation of infectious material in rooms occupied by a consumptive; no tuberculous dust was found in dirty houses in which there was no consumption. The upshot is to emphasize the importance of light and air, and to minimize that of mere dirt. This is quite in keeping with earlier investigations, and particularly those of Dr Tatham on back-to-back houses. Darkness and stuffiness are the friends of the tubercle bacillus.

So much has the question of cleanliness, and of housing in a sanitary district, to do with the prevalence of the disease, that the following table taken from the Report of the Registrar-General for Ireland for the year 1909 shows the marked class incidence in all forms of tuberculosis.

Distribution of Tuberculosis Mortality by Classes in Ireland, 1909.

	All forms of Tuberculosis.	Pulmonary Phthisis.	Other forms of Tuberculosis.
Professional and independent class	1·41	0·64	0·77
Middle class, civil service and smaller officials	1·82	1·30	0·52
Large traders, business managers	1·59	1·04	0·55
Clerks	2·92	2·33	0·59
Householders in 2nd-class localities	2·52	1·85	0·67
Artisans	2·94	2·23	0·71
Petty shopkeepers and other traders	3·85	3·00	0·85
Domestic servants	1·31	1·04	0·27
Coach and car drivers, and vanmen	4·24	3·06	1·18
Hawkers, porters and labourers	4·83	2·88	1·95

In relation to the last two classes the effect of exposure and also of alcoholic excess must be added to overcrowding and privation. The low rate noticeable for domestic servants must be ascribed to the better food and housing they enjoy while in situations. In Hamburg the mortality was 10·7 per 10,000 in those whose income rose above 3500 marks, 39·3 where the income was 900 to 1200 marks, and 60 per 10,000 where the income fell below that figure.

It is now generally accepted that tubercle bacilli may enter the body by various paths. At the International Congress on Tuberculosis held in Vienna in 1907 Weichselbaum summarized the channels of infection in pulmonary tuberculosis as follows: (1) By inhalation directly into the bronchioles and pulmonary alveoli, or by way of the bronchial glands through the blood and lymph channels into the lung. (2) Through the mucous

Path of Infection.

membrane of the nose, mouth or tonsils into the neighbouring lymphatic glands, and thence through the blood or lymph into the lungs. (3) By ingestion of tubercle bacilli into the lower part of the gastro-intestinal tract in the food; thence the bacilli may pass through the lining membrane, infect the neighbouring glands and pass by the blood or lymph stream to the lungs. (4) By penetration of other mucous membranes (such as the conjunctival or urogenital) or through the skin. (5) Possible, though very rare, placental infection.

Tubercle bacilli may not produce any anatomical lesion at the point of entrance, or they may remain latent for a very long time; and it has been experimentally proved that they may pass through mucous membranes and leave no trace of their progress. As reported to the Royal Commission, the introduction of bacilli into the alimentary canal is not necessarily followed by the development of tuberculosis. The writings of Von Behring have led to renewed attention being paid to intestinal infection, particularly through the milk supply. Von Behring suggests that the bacillus itself may become modified in the human body.

Prevention.

Measures for the prevention of tuberculosis may be divided into two classes: (1) general; (2) special. Great attention has been paid to the latter since the infectious nature of the disease was established. The former include all means by which the conditions of life are improved among the mass of the people. The most important of these are probably housing and food supply. The reduction of the disease recorded in England is attributed to the great changes which have gradually taken place in such conditions since, say, 1850. Wages have been raised, food cheapened, housing improved, protection afforded in dangerous trades, air spaces provided, locomotion increased, the ground and the atmosphere have been cleaned and dried by sanitary means. In addition to these general measures is the provision of consumption hospitals, which act by segregating a certain amount of disease. Yet all these things, beneficial as they may be, do not wholly account for the reduction, for, if the records can be trusted, it was in progress before they had made any way or had even been begun. This observation, coupled with the apparently general tendency to diminution among civilized races, suggests the operation of some larger agency. The theory of acquired resistance, which has been already mentioned, would explain the diminution; and it is also in keeping with other facts, such as the great susceptibility of savage races, which have not been long exposed to tuberculosis, and the results of laboratory experiments in artificial immunity. The point is of great importance, and deserves careful attention; for if the theory be correct, the special measures for preventing tuberculosis, which are occupying so much attention, may eventually have unexpected results. Their general aim is the avoidance of infection, and they include (1) the provision of special institutions—hospitals, sanatoria and dispensaries; (2) the prevention of spitting; (3) the notification of consumption; (4) the administrative control of tuberculosis in animals; (5) the dissemination of popular knowledge concerning the nature of the disease.

The greatest stress is laid upon the prevention of spitting, because the germs are contained in the sputum of consumptive persons, and are scattered broadcast by expectoration. The sputum quickly dries, and the bacilli are blown about with the dust. There is no question that infection is so conveyed. The Manchester scientific experiments, mentioned above, are only one series out of many which prove the infectivity of dust in the proximity of consumptive persons, and they are confirmed by actual experience. Several cases are recorded of healthy persons having contracted the disease after occupying rooms in which consumptive persons had previously lived. It is a legitimate inference that spitting in public is an important means of disseminating tuberculosis, though it may be noticed that international prevalence by no means corresponds with this disgusting practice, which is a perfect curse in Great Britain, and far more common both there and in the United States than on the continent of Europe. Prohibition of spitting under a statutory penalty is attended with certain difficulties, as it is obviously impossible to make any distinction between tuberculous and other persons; but it has been applied in New York and elsewhere in America, and some local authorities in Great Britain have adopted by-laws to check the practice. Another means of controlling dangerous sputa is more practicable, and probably more effective, namely, the use of pocket spittoons by consumptive persons. Convenient patterns are available, and their use should always be insisted on, both in public and in private. The most effective way of destroying the sputa is by burning. For this purpose spittoons of papier mâché and of turf have been successfully used in the Vienna hospitals (Schrötter). When glass spittoons are used the contents can be sterilized by disinfectants and passed down the drain.

Notification is of great service as an aid to practical measures of prevention. It has been applied to that purpose with good results in several cities and states in America, and in some towns in Great Britain. New York has made the most systematic use of it. Voluntary notification was adopted there in 1894, and in 1897 it was made compulsory. The measures linked with it are the sanitary supervision of infected houses, the education of the people and the provision of hospitals. In England, Manchester has led the way. Voluntary notification was adopted there in 1899: it was at first limited to public institutions, but in 1900 private practitioners were invited to notify their cases, and they heartily responded. In Sheffield notification was made compulsory by a local act in 1904 for a limited period, and was found so valuable that the period was extended in 1910. The objects aimed at are to visit homes and instruct the household, to arrange and provide disinfection, to obtain information bearing on the modes of infection, to secure bacteriological examination of sputum, and to collect information to serve as a basis of hospital provision. Disinfection is carried out by stripping off paper, previously soaked with a solution of chlorinated lime (1¼ oz. to the gallon), and washing the bare walls, ceiling, floor and everything washable with the same solution. This is found effective even in very dirty houses. In clean ones, where the patients have not been in the habit of spitting about the rooms, it is sufficient to rub the walls with bread-crumb and wash the rest with soap and water. Clothing, bedding, &c., are disinfected by steam. The advantages of these sanitary measures are obvious. Notification is no less important as a step towards the most advantageous use of hospitals and sanatoria by enabling a proper selection of patients to be made. It is compulsory throughout Norway, and is being adopted elsewhere, chiefly in the voluntary form. In 1908 the Prevention of Tuberculosis (Ireland) Act was passed, which conferred on local authorities the right to make notification compulsory in their districts, and provided that certain sections of the Public Health (Ireland) Act 1878 and the Infectious Diseases Prevention Act 1890 should apply to tuberculosis. By this act also the county councils were enabled to establish hospitals and dispensaries for the treatment of tuberculosis and were empowered to borrow money or levy a poor rate for the erection of sanatoria for the treatment of persons from their respective counties suffering from the disease.

The prevalence of tuberculosis in cattle is of importance from the point of view of prevention of the probability that abdominal tuberculosis, which is a very fatal form of the disease in young children, and has not diminished in prevalence like other forms, is caused by the ingestion of tuberculous milk. Whether it be so or not, it is obviously desirable that both meat and milk should not be tuberculous, if it can be prevented without undue interference with commercial interests. Preventive measures may be divided into two classes. They may deal merely with the sale of meat and milk, or they may aim at the suppression of bovine tuberculosis altogether. The former is a comparatively easy matter, and may be summed up in the words "efficient inspection." The latter is probably impracticable. If practicable, it would be excessively costly, for in many herds one half the animals or even more are believed to be tuberculous, though not necessarily the sources of tuberculous food. Unless the danger is proved to be very much greater than there is any reason to suppose, "stamping out" may be put aside. Efficient inspection involves the administrative control of slaughter-houses, cowsheds and dairies. The powers and regulations under this head vary much in different countries; but it would be useless to discuss them at length until the scientific question is settled, for if the reality of the danger remains doubtful, oppressive restrictions, such as the compulsory slaughter of tuberculous cows, will not have the support of public opinion. Whatever measures may be taken for the public protection, individuals can readily protect themselves from the most serious danger by boiling milk; and unless the source is beyond suspicion, parents are recommended, in the present state of knowledge, so to treat the milk given to young children.

A great deal has been done in most countries for the dissemination of popular knowledge by forming societies, holding conferences and meetings, issuing cheap literature, and so forth. It is an important item in the general campaign against tuberculosis, because popular intelligence and support are the most powerful levers for setting all other forces in motion. In Ireland, where an attempt had been made to deal with the question by arousing the interest of all classes, tuberculosis exhibitions have been held in nearly every county, together with lectures and demonstrations organized by the Women's National Health Association, and an organized attempt was made in the autumn of 1910 in England, by a great educational campaign, to compel the public to realize the nature of the disease and the proper precautions against it.

Diagnosis and Treatment.

The improved outlook in regard to the arrest or so-called "cure" of tuberculosis is mainly derived from the improved methods of diagnosis, thus enabling treatment to be undertaken at an earlier and therefore more favourable stage of the disease. The physical signs in early stages of the lung affection are often vague and inconclusive. A means of diagnosis has therefore been sought in the use of tuberculin. The methods are three: (1) The subcutaneous injection method of Koch; (2) the cutaneous method of Von Pirquet, (3) the conjunctival method of Wolff-Eisner and Calmette. The first method depended on the reaction occurring after an injection of "old tuberculin." It is unsuitable in febrile conditions, and has now been relegated to the treatment of cattle, where it has proved invaluable. In Von Pirquet's method a drop of old tuberculin diluted with sodium chloride is placed on a spot which has been locally scarified. The presence of tuberculosis is demonstrated by a local reaction in which a hyperaemic papule forms, surrounded by a bright red zone. Reaction occurs in tuberculosis of the bones of joints and skin. Von Pirquet in 1000 cases obtained a reaction in 88% of the tuberculous, and 10% of those clinically non-tuberculous. In the latter there may have been latent cases of tuberculosis. In the conjunctival or opthalmo-reaction of Calmette and Wolff-Eisner the instillation of a drop of a dilute solution of tuberculin into the conjunctiva is followed in the tuberculous subject by conjunctivitis. The reaction generally appears in from 3 to 12 hours, but may be delayed to 48. In a series of cases observed by Audeond a positive reaction was obtained in 95% of 261 obviously tuberculous cases and in 8·3 % of 303 cases which presented no clinical symptoms. Very advanced cases fail to react to any of these tests, as do general miliary tuberculosis and tuberculous meningitis. As well as the three methods mentioned above the occurrence of a "negative phase" in the phagocytic power of the leucocytes following an injection of Koch's tuberculin T.R. may be said to be diagnostic of tuberculosis. Another valuable aid in diagnosis is that of the X-rays. By their help a pulmonary lesion may be demonstrated long before the physical signs can be obtained by ordinary examination.

To discuss at all fully the treatment of the various forms of tuberculosis or even of consumption alone would be quite beyond the scope of this article. It must suffice to mention the more recent points. The open-air treatment of consumption has naturally attracted much attention. Neither the curability of this disease nor the advantages of fresh air are new things. Nature's method of spontaneous healing, explained above, has long been recognized and understood. There are, indeed, few diseases involving definite lesions which exhibit a more marked tendency to spontaneous arrest. Every case, except the most acute, bears signs of Nature's effort in this direction; and complete success is not at all uncommon, even under the ordinary conditions of life. Perhaps it was not always so: the ominous character popularly attributed to consumption may once have been justified, and the power of resistance, as we see it now, may be the result of acquired immunity or of the gradual elimination of the susceptible. However this may be, the natural tendency to cure is undoubtedly much assisted by the modern system of treatment, which makes pure air its first consideration. The principle was known to Sydenham, who observed the benefit derived by consumptives from horse exercise in the open air; and about 1830 George Boddington proposed the regular treatment of patients on the lines now generally recognized. The method has been most systematically developed in Germany by the provision of special sanatoria, where patients can virtually live in the open air. The example has been followed in other countries to a certain extent, and a good many of these establishments have been provided in Great Britain and elsewhere; but they are, for the most part, of a private character for the reception of paying patients. Germany has extended these advantages to the working classes on a large scale. This has been accomplished by the united efforts of friendly and philanthropic societies, local authorities, and the state; but the most striking feature is the part played by the state insurance institutes, which are the outcome of the acts of 1889 and 1899, providing for the compulsory insurance of workpeople against sickness and old age. The sanatoria have been erected as a matter of business, in order to keep insured members off the pension list, and they are supported by the sick clubs affiliated to the institutes. They number forty-five, and can give three months' treatment to 20,000 patients in the year. The clinical and economic results are said to be very encouraging. In about 70% of the cases the disease has been so far arrested as to enable the patients to return to work.

In England, where more than 14 millions of the population belong to friendly societies, it is estimated that the sick pay of consumptive members costs three times as much as the average sick pay to members dying of other causes. An effort has been made by the National Association for the Establishment and Maintenance of Sanatoria for Workers Suffering from Tuberculosis to establish such sanatoria, together with training for suitable work during convalescence, the gradual resumption of wage-earning being resumed while in touch with the medical authorities.

The important features of the sanatorium treatment are life in the open air, independently of weather, in a healthy situation, rest and abundance of food. The last has been carried to rather extravagant lengths in some institutions, where the patients are stuffed with food whether they want it or not. The sanatorium movement on the German model is rapidly extending in all countries. For those who are able to do so advantage may be taken of the combined sanatorium and sun treatment. In certain high altitudes in Switzerland, which are favoured by a large amount of sunshine and a small percentage of moisture, much benefit has been derived from the exposure of the unclothed body to the sun's rays. The power of the sun in high altitudes is so great that the treatment can be continued even when the snow is on the ground. Not only is the sun-treatment applicable to pulmonary tuberculosis, but also to the tuberculosis of joints, even in advanced cases. The treatment has to a great extent replaced surgical procedure in tuberculosis of joints, but it requires to be persevered in over a considerable period of time. It should be remembered that the benefits of fresh air are not confined to sanatoria. If the superstitious dread of the outer air, particularly at night, could be abolished in ordinary life, more would be done for public health than by the most costly devices for eluding microbes. Not only consumption, but the other respiratory diseases, which are equally destructive, are chiefly fomented by the universal practice of breathing vitiated air in stuffy and overheated rooms. The cases most suitable for the treatment are those in an early stage. Other special institutions for dealing with consumption are hospitals, in which England is far in advance of other countries, and dispensaries; the latter find much favour in France and Belgium.

In Great Britain the pioneer work as regards the establishment of tuberculosis dispensaries was the establishment of the Victoria Dispensary for Consumption in Edinburgh in 1887, where the procedure is similar to that in Dr Calmette's dispensaries in France. In connexion with the dispensary home visits are made, patients suitable to sanatoria selected, advanced cases drafted to hospitals, bacteriological examinations made, cases notified under the voluntary system, and the families of patients instructed. There is an urgent need for the multiplication of such dispensaries throughout the United Kingdom. The recent act providing for the medical inspection of schools has done much to sort out cases of tuberculosis occurring in children, and to provide them with suitable treatment and prevent them from becoming foci for the dissemination of the disease. In Germany special open-air schools, termed forest-schools, are provided for children suffering from the disease, and an effort is being made in England to provide similar schools.

Of specific remedies it must suffice to say that a great many substances have been tried, chiefly by injection and inhalation, and good results have been claimed for some of them. The most noteworthy is the treatment by tuberculin, first introduced by Koch in 1890, which, having sunk into use as a diagnostic reagent for cattle, received a new lease of life owing to the valuable work done by Sir Almroth Wright on opsonins. The tuberculins most in use are Koch's "old" tuberculin T.O., consisting of a glycerin broth culture of the tubercle bacilli, and Koch's T.R. tuberculin, consisting of a saline solution of the triturated dead tubercle bacilli which has been centrifuged. This latter is much in use, the dosage being carefully checked by the estimation of the tuberculo-opsonic index. The injections are usually unsuitable to very advanced cases. Marmorek's serum, the serum of horses into which the filtered young cultures of tubercle bacilli have been injected, and in which a tuberculo-toxin has been set free, has proved very successful. Behring's Tulase is a tuberculin preparation formed by a process of treating tubercle bacilli with chloral, and Béreneck's tuberculin consists of a filtered bouillon culture treated with orthophosphoric acid. The variety of cases to which these treatments are suitable can only be estimated from a careful consideration of each on its own merits.

In the treatment of tuberculous lesions, the surgeon also plays his part. Tuberculosis is specially prone to attack the spongy bone-tissue, joints, skin (*lupus*) and lymphatic glands—especially those of the neck. Recognizing the infective nature of the disease, and knowing that from one focus the germs may be taken by the blood-stream to other parts of the body, and so cause a general tuberculosis, the surgeon is anxious, by removing the primary lesion, to cut short the disease and promote immediate and permanent convalescence. Thus, in the early stage of tuberculous disease of the glands of the neck, for instance, these measures may render excellent service, but when the disease has got a firm hold, nothing short of removal of the glands by surgical operation is likely to be of any avail. The results of this modern treatment of tuberculous disease of the skin and of the lymphatic glands has been highly gratifying, for not only has the infected tissue been completely removed, but the resulting scars have been far less noticeable than they would have been had less radical measures been employed. One rarely sees now a network of scars down the neck of a child, showing how a chain of tuberculous glands had been allowed to work out their own cure. A few years ago, however, such conditions were by no means unusual.

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TUBEROSE. The cultivated tuberose (*Polianthes tuberosa*) is a plant allied to the Mexican agaves, and is a native of the same country. The tuberous root-stock sends up a stem 3 ft. in height, with numerous lanceolate leaves and terminal racemes of waxy white funnel-shaped very fragrant flowers. Each flower is about 1½ in. long, with a long tube and a six-parted limb. The stamens are six in number, emerging from the upper part of the tube, and bear linear anthers. The ovary is three-celled, and the ovoid fruit is crowned by the persistent flower. The plant is largely grown in the United States and at the Cape of Good Hope for export to England, as it is found that imported bulbs succeed better than those grown in the United Kingdom. The double-flowered form is that principally grown. Cultivated plants require a rich soil, considerable heat, and, at first, abundance of water.

TÜBINGEN, a town of Germany, in the kingdom of Württemberg, picturesquely situated on the hilly and well-wooded banks of the Neckar, at its junction with the Ammer and Steinlach, 22 m. south of Stuttgart by road and 43 m. by rail. Pop. (1905), 16,809. The older town is irregularly built and unattractive, but the newer suburbs are handsome. The most conspicuous building is the old ducal castle of Hohentübingen, built in 1507–1535 on a hill overlooking the town, and now containing the university library of 460,000 volumes, the observatory, the chemical laboratory, &c. Among the other chief buildings are the quaint old *Stiftskirche* (1469–1483), a Gothic building containing the tombs of the rulers of Württemberg, the new *aula* and numerous institutes of the university, all of which are modern, and the town-hall dating from 1435 and restored in 1872. The university possesses a very important library. A monument was erected in 1873 to the poet Johann Ludwig Uhland (1787–1862), who was born and is buried here, and another, in 1881, to the poet Johann Christian Friedrich Hölderlin (1770–1843). Tübingen's chief claim to attention lies in its famous university, founded in 1477 by Duke Eberhard of Württemberg. Melanchthon was a lecturer here (1512–1518). The university adopted the reformed faith in 1534, and in 1537 a Protestant theological seminary, a residential college—the so-called Stift—was incorporated with it. In 1817 a Roman Catholic theological faculty was added, with a seminary called the *Konvikt*, and there are now also faculties of law, medicine, philosophy, political economy and natural science. The leading faculty has long been that of theology, and an advanced school of theological criticism, the founder and chief light of which was F. C. Baur, is known as the Tübingen school. The university was attended in 1908 by 1891 students and had a teaching staff of over 100. The commercial and manufacturing industries of the town are slight. Printing, book-selling, the manufacture of surgical and scientific instruments, chemicals, gloves and vinegar, and the cultivation of hops, fruit and vines are among the leading occupations of the inhabitants. The country in the neighbourhood of Tübingen is very attractive; one of the most interesting points is the former Cistercian monastery of Bebenhausen, founded in 1185, and now a royal hunting-château.

Tübingen is mentioned as a strong fortress in 1078, and was ruled from 1148 by counts palatine. In 1342 it was purchased by the count of Württemberg, whose descendants afterwards acquired the title of duke. The treaty of Tübingen is the name given in German history to an arrangement made in 1514 between Duke Ulrich and his subjects, by which the latter acquired various rights and privileges on condition of relieving the former of his debts. The town was captured by the Swabian League in 1519, by Turenne in 1647, and again in 1688 by the French, who destroyed the walls.

See Eifert, *Geschichte und Beschreibung der Stadt und Universität Tubingen* (Tübingen, 1849); Maier, *Die Musenstadt Tubingen* (Tübingen, 1904); *Tübingen und seine Umgebung* (Tübingen, 1887–1889).

TUBUAI, or **Austral Islands**, an archipelago in the south Pacific Ocean, between 21° 49′ and 27° 41′ S., 144° 22′ and 154° 51′ W., to the south of the Society Islands, with a total land area of 110 sq. m., belonging to France. They form a curved broken chain from north-west to south-east which includes four principal islands: Tubuai (area 40 sq. m.), Vavitao or Ravaivai, Rurutu or Oheteroa, Rapa or Oparo, and Rimitara, with Maretiri or the Bass Islands, and other islets. Tubuai, Vavitao and Rapa are volcanic and reach considerable elevations (2100 ft. in Rapa). The islands are well watered and fertile, producing coco-nut palms, arrowroot and bananas; but they lie too far south for the bread fruit to flourish. The natives belong to the Polynesian race; they were once much more numerous than now, the present population not exceeding 2000. A Tahitian dialect is spoken in the western islands; in Rapa, however, which with the Bass Islands lies detached from the rest, to the south, the language is akin to that of the Rarotongans in the Cook Islands. There are remarkable ancient stone platforms and walls, massively built, on the summits of some of the peaks in Rapa, they resemble the terraces in Easter Island (Rapanui), which is believed to have been peopled from Rapa. The scattered islands of the Tubuai archipelago were discovered at different times. Captain Cook visited Rurutu in 1769 and Tubuai in 1777; Rapa was discovered by George Vancouver in 1791, Vavitao perhaps in 1772 by the Spaniards who attempted to colonize Tahiti, and certainly by Captain Broughton in 1791. The islands never attracted much attention from Europeans, and the French protection and subsequent annexation were carried out spasmodically between the middle of the 19th century and 1889.

TUCKER, ABRAHAM (1705–1774), English moralist, was born in London, of a Somerset family, on the 2nd of September 1705, son of a wealthy city merchant. His parents dying during his infancy, he was brought up by his uncle, Sir Isaac Tillard. In 1721 he entered Merton College, Oxford, as a gentleman commoner, and studied philosophy, mathematics, French, Italian and music. He afterwards studied law at the Inner Temple, but was never called to the bar. In 1727 he bought Betchworth Castle, near Dorking, where he passed the remainder of his life. He took no part in politics, and wrote a pamphlet, "The Country Gentleman's Advice to his Son on the Subject of Party Clubs" (1755), cautioning young men against its snares. In 1736 Tucker married Dorothy, the daughter of Edward Barker of East Betchworth, cursitor baron of the exchequer. On her death in 1754, he occupied himself in collecting together all the letters that had passed between them, which, we are told, he transcribed twice over under the title of "The Picture of Artless Love." From this time onward he occupied himself with the composition of his chief work, *The Light of Nature Pursued*, of which in 1763 he published a specimen under the title of "Free Will." The strictures of a critic in the *Monthly Review* of July 1763 drew from him a pamphlet called *Man in Quest of Himself, by Cuthbert Comment* (reprinted in Parr's *Metaphysical Tracts*, 1837), "a defence of the individuality of the human mind or self." In 1765 the first four volumes of his work were published under the pseudonym "Edward Search." The remaining three volumes appeared posthumously. His eyesight failed him completely in 1771, but he contrived an ingenious apparatus which enabled him to write so legibly that the result could easily be transcribed by his daughter. In this way he completed the later volumes, which were ready for publication when he died on the 20th of November 1774.

His work embraces in its scope many psychological and more strictly metaphysical discussions, but it is chiefly in connexion with ethics that Tucker's speculations are remembered. In some important points he anticipates the utilitarianism afterwards systematized by Paley, who expresses in the amplest terms his obligations to his predecessor. "Every man's own satisfaction" Tucker holds to be the ultimate end of action; and satisfaction or pleasure is one and the same in kind, however much it may vary in degree. This universal motive is further connected, as by Paley, through the will of God, with the "general good, the root where out all our rules of conduct and sentiments of honour are to branch."

The *Light of Nature* was republished with a biographical sketch by Tucker's grandson, Sir H. P. St John Mildmay (1905), 7 vols. (other editions 1834, 1836, &c.), and an abridged edition by W. Hazlitt appeared in 1807. See James Mackintosh, *Dissertation on the Progress of Ethical Philosophy* (Edinburgh, 1832); and specially Sir Leslie Stephen, *English Thought in the 18th Century*, iii. 119–130.

TUCKER, CHARLOTTE MARIA (1821–1893), English author, who wrote under the pseudonym "A.L.O.E." (a Lady of England), was born near Barnet, Middlesex, on the 8th of May 1821, the daughter of Henry St George Tucker (1771–1851), a distinguished official of the East India Company. From 1852 till her death she wrote many stories for children, most of them allegories with an obvious moral, and devoted the proceeds to charity. In 1875 she left England for India to engage in missionary work, and died at Amritsar on the 2nd of December 1893.

TUCKER, JOSIAH (1712–1799), English economist and divine, the son of a small Welsh farmer, was born at Laugharne, Carmarthenshire, in 1712. He was educated at St John's College, Oxford, and became successively a curate and rector in Bristol. This led him to take considerable interest in politics and trade, and during the greater portion of a long life he poured out a succession of pamphlets on these matters. He was appointed dean of Gloucester in 1758. He died on the 4th of November 1799, and was buried in Gloucester Cathedral. His *Important Questions on Commerce* (1755) was translated into French by Turgot.

TUCSON (possibly from Piman *styuk-son*, "dark or brown spring," pronounced *Tooson*), a city and the county-seat of Pima county, Arizona, U.S.A., on the Santa Cruz river, in the S.E. part of the state, about 130 m. S.E. of Phoenix. Pop. (1880), 7007; (1890), 5150; (1900), 7531 (2352 foreign-born, chiefly from Mexico); (1910), 13,193. It is served by the Southern Pacific and the Twin Buttes railways, the latter connecting with the mines of the Twin Buttes district, about 27 m. south by east, and with the Randolph lines in Mexico. The city lies about 2360 ft. above the sea in a broad valley sheltered by mountains 5000–9000 ft. high. Its climate, characteristic of southern Arizona, attracts many invalids and winter visitors. Tucson is the seat of the university of Arizona (1891; non-sectarian, coeducational), which is organized under the Morrill Acts; in 1909 it had 40 instructors and 201 students. At Tucson also are a desert botanical laboratory (owning a tract of some 1000 acres about 1 m. west of the city) established by the Carnegie Institution of Washington, St Joseph's Academy (Roman Catholic); a Roman Catholic cathedral, the Tucson Mission (Presbyterian), a boarding school for Indians, the San Xavier Mission for Indians (Roman Catholic) and a Carnegie library. In 1900 Tucson became the see of a Roman Catholic bishop. The surrounding country is arid and unproductive except where irrigated; but the soil is very rich, and Tucson is the centre of one of the oldest farming and ranching districts of the state. The Southern Pacific railway has division headquarters and repair shops here.

Tucson is first heard of in history in 1699, conjecturally, as an Indian rancheria or settlement; and in 1763 certainly as a *visita*, in that year temporarily abandoned, of the Jesuit mission of San Xavier del Bac, founded between 1720 and 1732, 9 m. south of what is now Tucson; in 1776 it was made a presidio (San Augustin del Tugison), or military outpost, and although a few Spaniards may possibly have lived there before, the foundation of Tucson as a Spanish town dates from this time. It was never after abandoned during the Indian wars. In 1848 it had 760 inhabitants. The abandonment by the Mexicans in 1848 of the mission towns of Tamacacori (a *visita* of Guevavi, a mission founded in the first third of the 18th century) and the presidio at Tubac (established before 1752) increased its importance. Tucson lay within the territory acquired by the United States by the Gadsden Purchase in 1853; it was occupied by the United States in 1856. Fort Lowell, 7 m. north-east of the city, was built as a protection against the Apache Indians in 1873; it was abandoned in 1891. In the earlier days of Territorial history Tucson was the political centre of Arizona. Here were held in August 1856 a convention that demanded a Territorial government from Congress, another in April 1860 that organized a provisional government independently of Congressional permission, and others in 1861 that attempted to cast in the lot of Arizona with the Confederate states. Tucson was occupied by the Confederates in February 1862 and by the Union forces in May. It was the Territorial capital from 1867 to 1877. Its prosperity fluctuated with the fortunes of the surrounding mining country. Tucson was incorporated as a town in 1877, and chartered as a city in 1883.

TUCUMAN, a northern province of Argentina, bounded N. by Salta, E. by Santiago del Estero, S. and W. by Catamarca. Area, 8926 sq. m. Pop. (1895), 215,742; (1904, estimated) 263,079. The Sierra de Aconquija is on the western frontier of the province and there is also broken country in the north, but in the east the country is flat, alluvial and very fertile. The only large river is the Salí, or Dulce, which receives a large number of small streams from the Sierra de Aconquija and flows through Santiago del Estero to the Porongos lagoons on the frontier of Cordoba. The exports are sugar, rum (*aguardiente*), timber, hides, leather, fruit and Tafi cheese made in an upland valley of the Aconquija.

TUCUMAN, or SAN MIGUEL DE TUCUMAN, a city of Argentina, capital of the province of Tucuman, on the right bank of the Salí, or Dulce river, 780 m. by rail N.W. of Buenos Aires, in lat. 26° 50′ S., long. 64° 35′ W. Pop. (1895), 34,305; (1904, estimated) 55,000. The climate is warm and enervating, with no great seasonal variation during the year except in the rainfall, which falls almost wholly between September and April. The temperature averages about 67°, with a maximum of 104°. Malarial diseases, especially "chucho" (fever and ague), are common. Tucuman is laid out in regular squares, and still retains many of its old characteristics, low buildings enclosing large courts (*patios*), with large rooms, thick walls, and tile roofs. The more noteworthy edifices and institutions of Tucuman are the "matriz" church, Merced church, cabildo, national college, normal school, the Belgrano theatre, hospital, public library, courts of justice, post office, and sundry charitable institutions.

Tucuman was founded in 1565 by Diego Villaruel at the confluence of the Salí and Monteros rivers, but frequent inundations led to a removal to its present site in 1585. In 1680 it succeeded Santiago del Estero as the capital of the province of Tucuman, then under the government of the Spanish viceroy at Lima. The province of Tucuman then extended from Jujuy south to Cordoba. In 1776 the viceroyalty of La Plata was created and Tucuman was transferred to its jurisdiction. In 1816 a convention of delegates from the La Plata provinces met in Tucuman and signed (July 9th) an act of independence, which formally dissolved all ties with the mother country.

TUDELA, a town of northern Spain, in the province of Navarre, on the Saragossa-Logroño and Tudela-Tarazona railways, and on the right bank of the river Ebro, which is here joined by its tributary the Queiles. Pop. (1900), 9499. The Ebro is here crossed by a massive and ancient bridge of 19 arches. Most of the public buildings, such as the town-hall, bull-ring, hospitals and schools, are modern; but there is a Romanesque collegiate church, Santa Maria, which was founded in 1135 and consecrated in 1188. This church is one of the most perfect in northern Spain, the sculptured doorways and cloisters being especially fine. There are many sawmills in the town, and an active timber trade; the manufactures of cloth, linen, spirits, preserved fruit, pottery, &c., and the trade in grain, wine and oil are of less importance. Tudela, the Roman *Tutela*, was occupied by the Moors in the 8th century, and taken from them by Alphonso I. of Aragon in 1114. The town was an episcopal see from 1783 to 1851. In 1808 the Spanish forces under Generals Castaños and Palafox were twice defeated here by the French under Marshal Lannes.

TUDOR (FAMILY). The house of Tudor, which gave five sovereigns to England, is derived by all the Welsh genealogists from Ednyfed Vychan of Tregarnedd in Anglesey, who is named in 1232 as steward of Llywelyn, prince of North Wales, and seven years later, as an arbitrator in a convention to which Davydd, the son of Llywelyn, was a party. His pedigree has been traced from Marchudd ap Cynan and beyond him, according to the veracious Lewys Dwnn, from Brutus, the great-grandson of Aeneas. Gronw, or Gronwy, one of his younger sons, had Trecastell for his portion. Tudor, son of Gronw, who lived to be called Tudor Hen or the old Tudor, founded the Carmelite friary in Bangor and was grandfather of Tudor Vychan ap Gronw of Trecastell, who is said to have assumed the style of a knight, and to have had that rank confirmed to him by Edward III.

This Tudor Vychan was the father of four sons, of whom the eldest, Gronw Vychan, was in favour with the Black Prince and with Richard II. He was forester of Snowdon and steward of the bishop of Bangor's lordship in Anglesey. He died in 1382, an infant son being heir to his lands in Penmynydd, whose sister carried them to her husband Gwylym ap Gmffydd of Penrhyn. Gronw Vychan, whom a bard calls "a pillar of the court· the ardent pursuer of France," was probably the warrior whose effigy remains in the church at Penmynydd.

Gronw's brothers Gwylym and Rhys served Richard II. as captains of archers. Their youngest brother, Meredydd ap Tudor, escheator of Anglesey in 1392 and, like Gronw, an officer of the household of the bishop of Bangor, is said to have slain a man and fled to the wild country about Snowdon. He was the father of Owen ap Meredydd, commonly called Owen Tudor, a squire who appears at the court of the infant king Henry VI. By all accounts he was a goodly young man: the chroniclers dwell upon the beauty which attracted the queen mother. She gave the handsome squire a post in her household. About 1428 or 1429, it must have been common knowledge that the presumptuous Welshman and the daughter of Charles VI. of France were living as man and wife. There is no direct evidence for their marriage. An act had but lately been passed for making it a grave offence to marry with the queen dowager without the royal consent: this act is said to have been afterwards cut out from the statute book. Richard III. denounced his rival Richmond as the son of a bastard, but it must be remembered that Richard was ready to foul the memory of his own mother in order to say the same of the young Edward V. But no one yet has found time or place of Owen Tudor's marriage with Catherine of France.

Five children were born to them, the sons being Edmund and Jasper and another son who became a monk. In 1436, a date which suggests that Bedford had been Owen's protector, the influence of Gloucester was uppermost. In that year the queen dowager was received within Bermondsey Abbey, where she died in the following January. Her children were taken from her, and Owen Tudor "the which dwelled with the said queen" was ordered to come into the king's presence. He had already seen the inside of Newgate gaol, and he would not obey without a safe conduct. When he had the safe conduct sent him he came up from Daventry and went at once to sanctuary at Westminster, whence even the temptations of the tavern would not draw him. Allowed to go back to Wales, he was retaken and lodged again in Newgate. He broke prison again, with his chaplain and his man, the sheriffs of London having a pardon in 1438 for the escape from gaol of "Owen ap Tuder, esquire," and he returned to his native Wales. When Henry VI. came of full age he made some provision for his step-father, who took the red rose and fought manfully for it. But Mortimer's Cross was his last battle (Feb. 4, 1460/1). He fell into the hands of the Yorkists, who beheaded him in Hereford market place and set up his head on the market cross. Thither, they say, came a mad woman who combed the hair and washed the face of this lover of a queen, setting lighted wax torches round about it.

His eldest son Edmund of Hadham, born about 1430 at Hadham in Herts, one of his mother's manors, was brought up with his brothers by the abbess of Barking until he was about ten years old. The king then took them into his charge. Edmund was a knight in 1449 and in 1453 he was summoned as earl of Richmond, his patent, dated the 6th of March 1452/3, giving him precedence next to the dukes. He was declared of legitimate birth, and in 1455 the royal favour found him a wife in the Lady Margaret, daughter of John Beaufort, duke of Somerset. But he died the next year, and his only child, afterwards Henry VII., was born on the 28th of January 1456/7, three months after his death.

Edmund's younger brother, Jasper Tudor, survived him many years. Jasper was knighted in 1449 and, about the date of Edmund's patent, was created earl of Pembroke. He bore the royal arms of France and England, differenced with a blue border charged with the royal martlets of the Confessor's fabulous shield, and the same was formerly to be seen upon his Garter stall-plate of 1459. He fought at St Albans in 1455 for the king who had advanced him, and two years later we find him strengthening the defences of Tenby. In 1460 he seized and took Denbigh, where the queen joined him after Northampton. He shared the defeat in 1461 at Mortimer's Cross, where his father the Welsh squire was taken and beheaded, and left the country in 1462. In 1465 he made a last descent upon Wales, to be driven off by William Herbert, who was rewarded with his earldom of Pembroke, already forfeited by attainder. But he was an obstinate and loyal partisan. He came back again with Warwick in 1470 and was hurrying to join the queen when Tewkesbury was fought and lost. After many adventures he carried off his young nephew Richmond to Brittany. The two came back together in 1485. After Bosworth, Jasper was created duke of Bedford and restored to his earldom, the earl-marshalship being given him in 1492. He lived to fight at Stoke in 1487 against Lincoln and Simnel his puppet and to be one of the leaders of the host that landed in France in 1492. He died in 1495 leaving no issue by his wife Catherine, the widow of the second duke of Buckingham and a daughter of Richard Widvile, Earl Rivers. But his bastard daughter Ellen is said to have been mother of Stephen Gardiner, bishop of Winchester. (O.Ba.)

TUDOR FLOWER, or Cresting, an architectural ornament much used in the Tudor period on the tops of the cornices of screen work, &c., instead of battlements. It consists generally of a flat, upright leaf standing on stems.

TUDOR PERIOD, in architecture, the later development of medieval architecture which followed the Perpendicular and, although superseded by the Elizabethan and the Renaissance styles, still retained its hold on English taste, portions of the additions to the various colleges of Oxford and Cambridge being still carried out in the Tudor style down to the middle of the 18th century. In church architecture the principal examples are Henry VII.'s Chapel at Westminster (1503), King's College Chapel, Cambridge, and St George's Chapel, Windsor; and the old schools at Oxford; and in domestic work, Eltham Palace, Kent; Oxburgh Hall, Norfolk; King's College, Aberdeen; Layer Marney Hall, Essex; the manor house at East Barsham, Norfolk; and Ford's Hospital, Coventry. It was a further debasement of the Perpendicular style, and the four-centred arch was its principal feature; some of the most remarkable examples of the bow-window belong to this period; the mouldings are more spread out and the foliage becomes more natural.

TUFF (Ital. *tufo*), a rock consisting of volcanic ashes, the ejectamenta of craters in a state of eruption. The products of a volcanic eruption may be classified into three groups: (*a*) steam and other gases, (*b*) lavas, (*c*) ashes. The ashes have not been burnt in any way though they resemble cinders in appearance: they are merely porous, slaggy pieces of lava which have been tossed into the air by outbursts of steam and have become vesicular by the expansion of the gases within them while they were still plastic.

Among the loose beds of ash which cover the slopes of many volcanoes, three classes of materials are represented. In addition to true ashes (*a*) of the kind above described, there are lumps of the old lavas and tuffs (*b*) forming the walls of the crater, &c., and which have been torn away by the violent outbursts of steam, pieces of sedimentary rocks (*c*) from the deeper parts of the volcano, which were dislodged by the rising lava, and are often intensely baked and recrystallized by the heat to which they have been subjected. In some great volcanic explosions nothing but materials of the second kind were emitted, as at Bandaisan in Japan in 1888. There have been many eruptions also at which the quantity of broken sedimentary rocks mingled with the ashes is very great; as instances we may cite the volcanoes of the Eifel and the Devonian tuffs, known as "Schalsteins," in Germany. In the Scotch coalfields some old volcanoes are plugged with masses consisting entirely of sedimentary débris: in such a case we must suppose that no lava was ejected, but the cause of the eruption was the sudden liberation and expansion of a large quantity of steam. These accessory or adventitious materials, however, as distinguished from the true ashes, tend to occur in angular fragments; and when they form a large part of the mass the rock is more properly a "volcanic breccia" than a tuff. The ashes vary in size from large blocks twenty feet or more in diameter to the minutest impalpable dust. The large masses are called "bombs"; they have mostly a rounded, elliptical or pear-shaped form, owing to rotation in the air while they were still viscous. Many of them have ribbed or nodular surfaces, and sometimes (at Volcano and Mont Pelé) they have a crust intersected by many cracks like the surface of a loaf of bread. Any ash in which they are very abundant is called an agglomerate (*q.v.*).

In those layers and beds of tuff which have been spread out over considerable tracts of country and which are most frequently encountered among the sedimentary rocks, smaller fragments preponderate greatly and bombs more than a few inches in diameter may be absent altogether. A tuff of recent origin is generally loose and incoherent, but the older tuffs have been, in most cases, cemented together by pressure and the action of infiltrating water, making rocks which, while not very hard, are strong enough to be extensively used for building purposes (*e.g.* in the neighbourhood of Rome). If they have accumulated subaerially, like the ash beds found on Etna or Vesuvius at the present day, tuffs consist almost wholly of volcanic materials of different degrees of fineness with pieces of wood and vegetable matter, land shells, &c. But many volcanoes stand near the sea, and the ashes cast out by them are mingled with the sediments that are gathering at the bottom of the waters. In this way ashy muds or sands or even in some cases ashy limestones are being formed. As a matter of fact most of the tuffs found in the older formations contain admixtures of clay, sand, and sometimes fossil shells, which prove that they were beds spread out under water.

During some volcanic eruptions a layer of ashes several feet in thickness is deposited over a considerable district, but such beds thin out rapidly as the distance from the crater increases, and ash deposits covering many square miles are usually very thin. The showers of ashes often follow one another after longer or shorter intervals, and hence thick masses of tuff, whether of subaerial or of marine origin, have mostly a stratified character. The coarsest materials or agglomerates show this least distinctly; in the fine beds it is often developed in great perfection.

Apart from adventitious material, such as fragments of the older rocks, pieces of trees, &c., the contents of an ash deposit may be described as consisting of more or less crystalline igneous rocks. If the lava within the crater has been at such a temperature that solidification has commenced, crystals are usually present. They may be of considerable size like the grey, rounded leucite crystals found on the sides of Vesuvius. Many of these are very perfect and rich in faces, because they grew in a medium which was liquid and not very viscous. Good crystals of augite and olivine are also to be obtained in the ash beds of Vesuvius and of many other volcanoes, ancient and modern. Blocks of these crystalline minerals (anorthite, olivine, augite and hornblende) are common objects in the tuffs of many of the West Indian volcanoes. Where crystals are very abundant the ashes are called "crystal tuffs." In St Vincent and Martinique in 1902 much of the dust was composed of minute crystals enclosed in thin films of glass, because the lava at the moment of eruption had very nearly solidified as a crystalline mass. Some basaltic volcanoes, on the other hand, have ejected great quantities of black glassy scoria which, after consolidation, weather to a red soft rock known as palagonite; tuffs of this kind occur in Iceland and Sicily. In the Lipari Islands and Hungary there are acid (rhyolitic) tuffs, of pale grey or yellow colour, largely composed of lumps and fragments of pumice. Over a large portion of the sea bottom the beds of fine mud contain small, water-worn, rounded pebbles of very spongy volcanic glass; these have been floated from the shore or cast out by submarine volcanoes, and may have travelled for hundreds of miles before sinking; it has been proved by experiment that some kinds of pumice will float on sea-water for more than a year. The deep sea-deposit known as the "red clay" is largely of volcanic origin and might be suitably described as a "submarine tuff-bed."

For petrographical purposes tuffs are generally classified according to the nature of the volcanic rock of which they consist; this is the same as the accompanying lavas if any of these were emitted during an eruption, and if there is a change in the kind of lava which is poured out, the tuffs also indicate this equally clearly. *Rhyolite tuffs* contain pumiceous, glassy fragments and small scoriae with quartz, alkali felspar, biotite, &c. In Iceland, Lipari, Hungary, Nevada, New Zealand, recent tuffs of this kind occur. The broken pumice is clear and isotropic, and when the particles are very small they have often crescentic, sickle-shaped, or biconcave outlines, showing that they are produced by the shattering of a vesicular glass; this is sometimes described as ash-structure. In the ancient rocks of Wales, Charnwood, the Pentland Hills, &c., similar tuffs are known, but in all cases they are greatly changed by silicification (which has filled them with opal, chalcedony and quartz) and by devitrification. The frequent presence of rounded corroded quartz crystals, such as occur in rhyolitic lavas, helps to demonstrate their real nature. *Trachyte tuffs* contain little or no quartz but much orthoclase and oligoclase felspar with often biotite, augite and hornblende. In weathering they often change to soft red or yellow "clay-stones," rich in kaolin with secondary quartz. Recent trachyte tuffs are found on the Rhine (at Siebengebirge), in Ischia, near Naples, Hungary, &c. *Andesitic tuffs* are exceedingly common. They occur along the whole chain of the Cordilleras and Andes, in the West Indies, New Zealand, Japan, &c. In the Lake district, North Wales, Lorne, the Pentland Hills, the Cheviots and many other districts of Britain, ancient rocks of exactly similar nature are abundant. In colour they are red or brown; their scoriae fragments are of all sizes from huge blocks down to minute granular dust. The cavities are filled up with many secondary minerals, such as calcite, chlorite, quartz, epidote, chalcedony: but in microscopic sections the nature of the original lava can nearly always be made out from the shapes and properties of the little crystals which occur in the decomposed glassy base. Even in the smallest details these ancient tuffs have a complete resemblance to the modern ash beds of Cotopaxi, Krakatoa and Mont Pelée. *Basaltic tuffs* are also of wide spread occurrence both in districts where volcanoes are now active and in lands where eruptions have long since ended. In the British Isles they are found in Skye, Mull, Antrim and other places, where there are Tertiary volcanic rocks; in Scotland, Derbyshire, Ireland among the carboniferous strata; and among the still older rocks of the lake district, southern uplands of Scotland and Wales. They are black, dark green or red in colour; vary greatly in coarseness, some being full of round spongy bombs a foot or more in diameter, and, being often submarine, may contain shale, sandstone, grit and other sedimentary material, and are occasionally fossiliferous. Recent basaltic tuffs are found in Iceland, the Faeroes, Jan Mayen, Sicily, Vesuvius, Sandwich Islands, Samoa, &c. When weathered they are filled with calcite, chlorite, serpentine and, especially where the lavas contain nepheline or leucite, are often rich in zeolites, such as analcite, prehnite, natrolite, scolecite, chabazite, heulandite, &c. *Ultra-basic* tuffs are by no means frequent; their characteristic is the abundance of olivine or serpentine and the scarcity or absence of felspar. In this class the peridotite, breccias or kimberlites of the diamond-fields of South Africa may perhaps be placed (see DIAMOND). The principal rock is a dark bluish green serpentine (blue-ground) which when thoroughly oxidized and weathered becomes a friable brown or yellow mass (the "yellow-ground"). Besides olivine and augite (chrome diopside) there occur crystals of hypersthene, brown mica, garnet (Cape ruby), magnetite, ilmenite and kyanite, together with crystalline blocks of garnet, augite and olivine (which some petrographers have called eclogites). Many lumps of shale are embedded in the breccia, and some have supposed that the diamonds are due to the ultra-basic magma dissolving carbon, which subsequently crystallized as the rock cooled down. Many of the crystals are broken, and as the rock fragments also are angular, rather than rounded, the kimberlite is more properly an ultra-basic breccia than a tuff.

In course of time other changes than weathering may overtake tuff deposits. Sometimes they are involved in folding and become sheared and cleaved. Many of the green slates of the lake district in Cumberland are fine cleaved ashes. In Charnwood forest also the tuffs are slaty and cleaved. The green colour is due to the large development of chlorite. Among the crystalline schists of many regions green beds or green schists occur, which consist of quartz, hornblende, chlorite or biotite, iron oxides, felspar, &c., and are probably recrystallized or metamorphosed tuffs. They often accompany masses of epidiorite and hornblende-schists which are the corresponding lavas and sills. Some chlorite-schists also are probably altered beds of volcanic tuff. The "Schalsteins" of Devon and Germany include many cleaved and partly recrystallized ash-beds, some of which still retain their fragmental structure though their lapilli are flattened and drawn out. Their steam cavities are usually filled with calcite, but sometimes with quartz. The more completely altered forms of these rocks are platy, green chloritic schists; in these, however, structures indicating their original volcanic nature only sparingly occur. These are intermediate stages between cleaved tuffs and crystalline schists.

Tuffs are not of much importance in an economic sense. The peperino, much used at Rome and Naples as a building stone, is a trachyte tuff. Puzzuolana also is a decomposed tuff, but of basic character, originally obtained near Naples and used as a cement, but this name is now applied to a number of substances not always of identical character. In the Eifel a trachytic, pumiceous tuff called trass (*q.v.*) has been extensively worked as a hydraulic mortar.

(J. S. F.)

TUGELA ("Startling"), a river of south-east Africa, the largest in Natal. It drains, with its tributaries, an area of about 8000 sq. m. The river valley is some 190 m. in length, the river, which has an exceedingly sinuous course is fully 300 m. long. It rises, at an altitude of nearly 11,000 ft. in the Drakensberg mountains on the eastern face of the Mont aux Sources, down which it leaps in a nearly perpendicular fall of 1800 ft.

The river, which starts its race to the ocean with a north-east course, soon bends more directly east, and, with many windings north and south, maintains this general direction across the tableland of north Natal until its junction with the Buffalo river, when it turns south. On its northern bank in its upper course are the heights of Spion Kop and Vaal Kranz, and on its southern bank, 56 m. east in a direct line from its source, is the village of Colenso, all three places being the scene of ineffectual attempts (Dec. 1899–Feb. 1900) by the British troops under General Sir Redvers Buller to dislodge the Boers who blocked the road to Ladysmith. Below Colenso are more waterfalls, and above the river is Pieter's Hill, the storming of which by the British, on the 27th of February 1900 at length led to the relief of Ladysmith. Six miles lower down the Tugela receives the Klip, which rises in the Drakensberg near Van Reenen's Pass and flows by Ladysmith. Another northern tributary is the Sunday's river, which rises in the Biggarsberg. From the south the river is increased by several affluents, the chief being the Mooi (Beautiful) river. The Tugela-Mooi confluence is 44 m. south-east of Colenso at the base of the Biggarsberg. Seven miles farther down the Tugela joins the Buffalo river, the united stream retaining, however, the name Tugela. The Buffalo has its origin in the Drakensberg near Majuba Hill and flows south with, also, a general trend to east. In its course, which is very winding, it receives numerous tributaries, one of them being the Ingogo, a small stream whose name recalls the fight on its banks on the 8th of February 1881, between British and Boers. The chief affluents are the Ingagani (from the south-west) and the Blood (from the north-east), the last-named so called after the defeat of the Zulu king Dingaan, on the 16th of December 1838, by the Boers under Andries Pretorius, when the river ran red with the blood of the Zulus. Eighteen miles in a direct line below the Blood confluence is Rorke's Drift, or ford across the river, and some 12 m. south-east of the drift is the hill of Isandhlwana, both places rendered famous in the Zulu War of 1878–79. The junction with the Tugela is 30 m. in a direct line, farther south, the Buffalo river in that distance passing through a wooded and hilly region.

Below the confluence of the two streams the Tugela flows south-east in a deep channel between lofty cliffs, or through wild, stone-strewn valleys until it reaches the narrow coast belt. Its mouth is nearly closed by a sand bar, formed by the action of the ocean. The Tugela is thus useless for navigation. About 6 m. above the mouth are two forts, Pearson and Tenedos, built by the British in 1879, during the war with the Zulus, to guard the passage of the river. Generally fordable in the winter months, the Tugela is, after the heavy rains of summer, a deep and rapid river. It is crossed, some 5 m. above the forts, by a railway bridge—the longest bridge in South Africa. From the junction of the Blood river with the Buffalo, that stream and subsequently the Tugela form the boundary between Natal and Zululand.

TUGGURT, a town in the Wadi Ghir, Algerian Sahara, 127 m. S. of Biskra. Tuggurt, which has a population (1906) of 2073, was formerly surrounded by a moat, which the French filled up. The town is entered by two gates. Just within the northern gate is the market place, which contains the chief mosque. The surrounding oasis is very fertile. It has about 9000 inhabitants and contains about 200,000 date palms. From Tuggurt a road 75 m. long leads across the desert north-east to El Wad (*q.v.*).

Some 12 m. south-west at the desert end of the Wadi Ghir is the oasis and town of Temacin (pop. 2120), one of the chief centres of the Mussulman fraternity of Tidianes.

TUG-OF-WAR, a contest between two teams composed of one or more persons, each team striving to pull the other in its own direction by means of a rope held by the hands alone. Some rules allow the "anchor-men," who hold the ends of the rope, to fasten it to their persons. A ribbon or handkerchief is tied round the middle of the rope, and others at a distance, usually, of one yard on each side of it. That team loses which allows itself to be pulled more than one yard from its original position. The British army teams are usually composed of ten men each, but the number varies in different parts of the world. The rules of the modern Olympic Games recognize teams of five. When a tug-of-war takes place out of doors the men, or at least the "anchors," are allowed to dig holes in the ground for their feet; when indoors cleats are bolted to the floor as braces.

TUGUEGARAO, a town and the capital of the province of Cagayan, Luzon, Philippine Islands, on the Grande de Cagayan River, about 60 m. from its mouth. Pop. (1903), 16,105. Many of Tuguegarao's buildings—government, religious, business and residential—are of stone or brick. There are a Dominican college for boys, a convent school for girls, and good public schools, including a high school. The river is navigable to Tuguegarao for vessels of light draught; the Cagayan Valley is the great tobacco-producing region of the Philippines; and Tuguegarao is an important shipping point for tobacco. Local business is largely in the hands of Chinese merchants; Spanish and German companies control the exportation of tobacco. The town was settled in 1774, and the old church and bell tower are still standing. The local dialects are Cagayan, and, of less importance, Ilocano and Tagalog.

TUKE, the name of an English family, several generations of which were celebrated for their efforts in the cause of philanthropy.

William Tuke (1732–1822) was born at York on the 24th of March 1732. His name is connected with the humane treatment of the insane, for whose care he projected in 1792 the Retreat at York, which became famous as an institution in which a bold attempt was made to manage lunatics without the excessive restraints then regarded as essential. The asylum was entirely under the management of the Society of Friends. Its success led to more stringent legislation in the interests of the insane.

His son Henry Tuke (1755–1814) co-operated with his father in the reforms at the York Retreat. He was the author of several moral and theological treatises which have been translated into German and French.

Henry's son Samuel Tuke (1784–1857), born at York on the 31st of July 1784, greatly advanced the cause of the amelioration of the condition of the insane, and devoted himself largely to the York Retreat, the methods of treatment pursued in which he made more widely known by his *Description of the Retreat near York*, &c. (York, 1813). He also published *Practical Hints on the Construction and Economy of Pauper Lunatic Asylums* (1815). He died at York on the 14th of October 1857.

Samuel's son James Hack Tuke (1819–1896) was born at York on the 13th of September 1819. He was educated at the Friends' school there, and after working for a time in his father's wholesale tea business, became in 1852 a partner in the banking firm of Sharples and Co., and went to live at Hitchin in Hertfordshire. For eighteen years he was treasurer of the Friends' Foreign Mission Association, and for eight years chairman of the Friends' Central Education Board. But he is chiefly remembered for his philanthropic work in Ireland, which was in a great measure the result of a visit to Connaught in 1847, and of the scenes of distress which he there witnessed. In 1880, accompanied by W. E. Forster, he spent two months in the West of Ireland distributing relief which had been privately subscribed by Friends in England. Letters descriptive of the state of things he saw were published in *The Times*, and in his pamphlet, *Irish Distress and its Remedies* (1880), he pointed out that Irish distress was due to economic rather than political difficulties, and advocated state-aided land purchase, peasant proprietorship, light railways, government help for the fishing and local industries, and family emigration for the poorest peasants. From 1882 to 1884 he worked continuously in Ireland superintending the emigration of poor families to the United States and the Colonies. The failure of the potato crop in Ireland in 1885 again called forth Tuke's energy, and on the invitation of the government, aided by public subscription, he purchased and distributed seed potatoes in order to avert a famine. To his reports of this distribution and his letters to *The Times*, which were reprinted under the title *The Condition of Donegal* (1889), were due in a great measure the bill passed for the construction of light railways in 1889 and the Irish Land Act which established the Congested Districts Board in 1891. He died on the 13th of January 1896.

See *Report of the Select Committee of the House of Commons* (1815–1816); Dr Conolly, *Treatment of the Insane without Mechanical Restraints* (1856); Dr Hack Tuke, *Chapters in the History of the Insane in the British Isles* (1882).

Daniel Hack Tuke (1827–1895), younger brother of James Hack Tuke, was born at York on the 19th of April 1827. In 1845 he entered the office of a solicitor at Bradford, but in 1847 began work at the York Retreat. Entering St Bartholomew's Hospital in London in 1850, he became a member of the Royal College of Surgeons in 1852, and graduated M.D. at Heidelberg in 1853. In 1858, in collaboration with J. C. Bucknill, he published a *Manual of Psychological Medicine*, which was for many years regarded as a standard work on lunacy. In 1853 he visited a number of foreign asylums, and later returning to York he became visiting physician to the York Retreat and the York Dispensary, lecturing also to the York School of Medicine on mental diseases. In 1859 ill health obliged him to give up his work, and for the next fourteen years he lived at Falmouth. In 1875 he settled in London as a specialist in mental diseases. In 1880 he became joint editor of the *Journal of Mental Science*. He died on the 5th of March 1895.

Among his works were *Illustrations of the Influence of the Mind on the Body* (1872); *Insanity in Ancient and Modern Life* (1878); *History of the Insane in the British Isles* (1882); *Sleepwalking and Hypnotism* (1884); *Past and Present Provision for the Insane Poor in Yorkshire* (1889); *Dictionary of Psychological Medicine* (1892).

TUKULOR (Tuculers), the name, by some said to be the French *tout-couleur*, for the negro half-castes of Senegal, who are principally of Fula-Wolof descent. By others the word is identified with Tacurol, an old name of the country, which took the form of Tacurores in the Portuguese writers of the 16th century. The Tukulor are settled chiefly in the Damga, Futa, Toro and Dimar districts of Senegal, and are remarkable for their fanaticism as Mahommedans. An intelligent, energetic and fierce people, they offered strenuous opposition to the conquest of their country by the French in the latter half of the 19th century.

TULA, a government of central Russia, bounded by the governments of Moscow on the N., Ryazañ on the E., Tambov and Orel on the S., and Kaluga on the W. Area, 11,950 sq. m.; pop. (1906 estimate), 1,662,600. It is intersected from S.W. to N.E. by a gently undulating plateau, 950 to 1020 ft. in altitude, which separates the drainage area of the Oka from that of the Don.

The government is divided into twelve districts, the chief towns of which are Tula, Bogoroditsk, Alexin, Byelev, Epifan, Efremov, Kashira, Krapivna, Novosil, Odoyev, Chern and Venev. Only 2.4% of the aggregate area is considered as unavailable for cultivation, the remainder being distributed as follows: peasants, 48½%; nobility, 32½%; other private landowners, 11%; crown, towns, &c., 2%. Agriculture is the chief occupation. Petty trades and domestic industries (*e.g.* the making of tea-urns, brass wares, harmoniums, &c.) have always flourished. The principal factory establishments are machinery works, hardware factories, flour-mills, sugar works and distilleries. Coal is extracted, as also pyrites and iron ore. Metallurgy is a growing industry.

Before the Slav immigration the territory of Tula was inhabited by Mordvinians in the north and by Meshcheryaks in the south. The Slavs who occupied the Oka were soon compelled to pay tribute to the Khazars. Subsequently the territory on the Oka belonged to the principality of Chernigov. In the 14th century part fell under the rule of Ryazañ and

Moscow, while the rest was under Lithuanian dominion till the 15th century.

TULA, a town of Russia, capital of the government of the same name, 120 m. by rail S. of Moscow, in the broad but low, marshy and unhealthy valley of the Upa. Pop. (1882), 63,500, (1901), 109,352. It is an old town of Old Russia, but its growth began only towards the end of the 18th century after the manufacture of arms had commenced. The chief branch of industry is the making of rifles, next in importance comes the manufacture of *samovars* (tea-urns). Tula is an episcopal see of the Orthodox Greek Church. The public buildings include two cathedrals and an industrial museum.

The town is first mentioned in 1147, but its former site seems to have been higher up the Tulitsa. Its wooden fort was replaced in 1514–1521 by a stone *kreml*, or citadel, which still exists. Tsar Boris Godunov founded a gun factory here in 1595, and in 1632 a Dutchman, Winius, established an iron foundry. Tsar Michael Alexis and Peter the Great, especially the last-named, took great interest in the gun factories, and large establishments were built in 1705 and 1714.

TULCEA, or TULTCHA, the capital of the department of Tulcea, Rumania, on the right bank of the Danube, 42 m. from its mouth at Sulina. Pop (1900), 18,800, including many Russians, Turks, Greeks and Jews. There is no railway within 20 m., and the surrounding country is barren and desolate. The principal commerce is in fish and grain. Wool is also exported to France, and hides to Turkey. Sheep-farming is carried on among the mountains.

TULIP (*Tulipa*), a genus of bulbous herbs belonging to the Liliaceae. The species are found wild along the northern shores of the Mediterranean, in the Levant, Armenia, Caucasus, Northern Africa, Persia, and sporadically across North and Central Asia to Japan. The cup-shaped flowers have six regular segments in two rows, as many free stamens, and a three-celled ovary with a sessile stigma, which ripens into a leathery many-seeded capsule. The species are numerous, and are distinguished one from another by the scales of the bulb being woolly or smooth on the inner surface, by the character of the flower-stalks, by the filaments being hairy or otherwise, and by other characters. Owing to the great beauty of the flowers they have been favourites in European gardens for two or three centuries, and have been crossed and recrossed till it has become almost impossible to refer the plants to their original types. The early flowering "Van Thol" tulips, the segments of which are mostly scarlet with yellow edges, are derived from *T. suaveolens*, a native of the Caspian region. *T. Gesneriana*, a native of Armenia and central Russia, is the origin of some of the later flowering varieties. *T. pubescens*, which is probably a hybrid between the two species just named, is the source of some of the early flowering kinds known as Pottebakker, &c *T. oculus-solis* and *T. Clusiana* are lovely species, natives of southern Europe, and *T. silvestris*, with elegant yellow flowers, is a doubtful native of England. More recently, owing to the exertions of Russian naturalists, a large number of new species have been discovered in Turkestan, and introduced into Europe. Some of these are very beautiful, and render it probable that by intercrossing with the older species still further difficulties will be presented in the way of identification. These difficulties are further enhanced by the fact that, quite apart from any cross-breeding, the plants, when subjected to cultivation, vary so greatly in the course of two or three years from the original species from which they are directly descended that their parentage is scarcely recognizable. This innate power of variation has enabled the florist to obtain, and ultimately to "fix," so many remarkable varieties. At the present day tulips of all kinds are much more extensively grown than at any previous period. Not only are millions of bulbs cultivated in Holland for export every year, but thousands are now also grown for the same purpose in the Channel Islands, more particularly in Guernsey. Of late years tulips have become very popular in America, and an extensive trade is now done between the U.S.A. and Europe. The enormous prices once given for rare varieties of tulip bulbs no longer obtain, though, even now, two and three guineas are asked for special bulbs. It must, however, be remembered that the "tulipomania" of the 17th century was really a form of gambling, in which admiration of the flower and interest in its culture were very secondary matters. Tulips were introduced into the Low Countries in the 16th century from Constantinople and the Levant.

The florists' varieties of tulips, which have sprung from *Tulipa Gesneriana*, are arranged in separate classes named bizarres, bybloemens and roses, according to their colour and marking. Tulips are readily raised from seeds, and the seedlings when they first flower (after about 7 years cultivation) are of one colour—that is, they are self-coloured. Judged by the florists' rules, they are either good or bad in form, and pure or stained (white or yellow) at the base, the badly formed and stained flowers are thrown away, while the good and pure are grown on, these being known as "breeder" tulips. The breeder bulbs and their offsets may grow on for years producing only self-coloured flowers, but after a time, which is varied and indefinite, some of the progeny "break," that is, produce flowers with the variegation which is so much prized. The flower is then said to be "rectified"; it is a *bizarre* when it has a yellow ground marked with purple or red, a *bybloemen* when it has a white ground marked with violet or purple, or a *rose* when it has a white ground marked with rose colour. One of the most important of the properties of a fine florists' tulip is that the cup should form, when expanded, from half to a third of a hollow ball, the six divisions of the perianth being broad at the ends, and smooth at the edges, so that the divisions may scarcely show on indenture. Another is that the ground colour should be clear and distinct, whether white or yellow. The least stain at the base of the flower, technically called the "bottom," would render a tulip comparatively valueless. What are called "feathered" flowers are those which have an even close feathering, forming an unbroken edging of colour all round, "flamed" flowers being those which have a beam or bold mark down the centre, not reaching to the bottom of the cup.

Tulips flourish in any good garden soil that has been deeply dug or trenched and manured the previous season. To secure perfect drainage and greater warmth a fair quantity of sand or grit should be present. Fresh manure should be avoided, but the remains from an old hot-bed or mushroom bed may be incorporated. The best time to plant is in September and October, the bulbs being buried about 6 in. deep and the same distance apart. The best effects are produced in formal beds by planting the same variety in each, to secure the plants being of the same height and in flower simultaneously. In mixed flower borders, mixed varieties may be planted. After planting the space between the rows of tulips may be planted with such plants as forget-me-nots, wallflowers, silenes, violas, double white arabis, polyanthuses, &c., to obtain beautiful colour combinations in spring.

Propagation.—Tulips are usually increased by offsets, which most varieties produce in fairly large numbers. These are taken off and sown in drills, like seed They are usually strong enough to flower the third year from this sowing. Some varieties produce offsets sparingly and must be increased by seed—a slow and uncertain method. New varieties are raised from seed. (The colour variation in the flowers of seedlings is discussed above.) Seeds are sown in boxes or cold frames, in light sandy soil, and the young plants are allowed to remain undisturbed until the second year. They are then lifted and treated like offsets, being sown thinly in beds out of doors. They usually flower in about the seventh year. The soil in which tulips are propagated should be sandy, free working and thoroughly drained. A warm sheltered position is a necessity.

Cultivation Out of Doors.—Planting is best effected during September, October and early November. It is usual thoroughly to dig and manure the ground in preparation. Holes 6 to 8 in. apart and 5 in. deep are then made with a dibber. Sometimes a little loose earth or sand is put in to the depth of about 1 in., and the bulbs laid singly thereon, the holes being closed by the dibber and the whole raked over. Valuable varieties are planted at about the same depth, with a trowel, a little sand being placed around them.

Unless seed is required, the young capsules should be removed as soon as the perianth has withered, to conserve the strength of the bulb. The plants should be left until the leaves begin to wither, unless it becomes necessary to lift them to make way for other plants. When lifted they should be laid thinly in a well shaded, airy spot to dry The tops can then be removed and the bulbs sorted and stored thinly in trays in a cool dry place. Rare bulbs may be wrapped singly in tissue paper for storing.

In Pots and Forcing.—The early flowering varieties should be potted as early in September as practicable, later batches for succession being potted during October. Pots 5 and 6 in. in diameter are the most convenient. The tops should be covered with ½ in. of soil, and about half an inch left for water. The soil should be a light and fairly rich compost, comprising about 2 parts loam, 1 part decayed manure or horse droppings that have been thoroughly sweetened, 1 part leaf mould and half a part of sand. Pot firmly, and plunge the pots in several inches of ashes out of doors, to protect the bulbs from frost. As soon as growth commences at the top and a fair amount of roots are formed they may be introduced into gentle heat, in batches according to the need and the amount of stock available. For market a slightly different method is adopted. The bulbs are placed in long shallow boxes, plunged in soil or ashes in the open air, and are later introduced as required into heat in semi-darkness, and are afterwards transferred to benches in the forcing houses where they flower. Bulbs which have been forced are of no further value for that particular purpose. If planted in borders and shrubberies, however, they will continue to bear fairly good blossoms in the open air for several seasons.

Varieties.—The following varieties are among the most useful for bedding and pot culture.

Early Single Flowering Kinds:—

Name.	Colour.	Height.
Duc van Thol	Various	6 in.
Adelaine	Rose Carmine	7 „
Artus	Dark Scarlet	8 „
Bacchus	Dark Crimson	7 „
Belle Alliance	Crimson Scarlet	8 „
Canary Bird	Yellow	10-12
Chrysolora	Yellow	9 „
Cottage Maid	Pink and White	12 „
Duchess de Parma	Orange Crimson	10 „
Gold Finch	Golden Yellow	12 „
Joost van Vondel	Crimson, flaked White	9 „
Keisers Kroon	Scarlet and Yellow, superb flower	10 „
La Reine	White (when forced) and Pink.	9 „
Lac van Rhijn	Rosy Violet	9 „
Ophir d'Or	Golden Yellow	8 „
Pottebakker	Scarlet, White, Yellow vars.	12 „
Primrose Queen	Primrose.	9 „
Proserpine	Rosy Carmine, superb flower	9 „
Rose Gris de lin	White and Pink	9 „
Thomas Moore	Terra-cotta	9 „
White Hawk	Pure White	10 „
Yellow Prince	Yellow	8 „

Early Double Flowering Kinds:—

Name.	Colour.	Height.
Duc van Thol	Red, edged Yellow	6 in.
Alba Maxima	Pure White	9 „
Couronne d'Or	Yellow and Orange	9 „
Gloria Solis	Orange Crimson	9 „
Imperator rubrorum	Crimson Scarlet	9 „
La Candeur	Pure White	9 „
Leonardo da Vinci	Crimson and Gold	8 „
Tournesol	Scarlet and Yellow	8 „

Late Single Flowering Kinds:—

These are tall-growing hardy kinds, suitable for herbaceous borders where they can be left undisturbed. With them may be associated what are now popularly known as "Darwin" tulips, beautiful long-stemmed kinds with self colours, and the "Cottage" or "May-flowering" tulips, all easily grown in ordinary garden soil.

Name.	Colour	Name	Colour
Bouton d'Or	Golden Yellow	Gesneriana	Bright Scarlet.
Caledonia	Orange Scarlet	Gesneriana lutea	Yellow.
Columbus	Yellow and Vermilion.	Picotee	White, edged Pink
Fulgens	Violet Crimson.	The Fawn.	Dove Colour.

Parrot Tulips.—This late flowering group is supposed to be derived from the curious green and yellow striped *T. viridiflora*. The flowers are mostly heavy and drooping, petals brightly coloured, the edges being curiously notched and waved.

Name.	Colour.	Name.	Colour
Rubra Major	Dark Red.	Lutea Major	Yellow, Crimson and Green
Mark Graaf	Yellow, striped Scarlet	MonstreRouge	Crimson
Perfecta	Yellow, Scarlet and Green.		

TULIP-TREE, *Liriodendron tulipifera* (Nat. Ord. Magnoliaceae), a North American tree of great beauty, with peculiarly four-lobed, truncate leaves and solitary tulip-like sweet-scented flowers, variegated with green, yellow and orange. It is hardy in England, but while young it requires protection from cold, cutting winds. In habit it resembles a somewhat stiff-growing plane tree, and becomes fully as large. It does not flourish in the atmosphere of towns. It thrives best in deep sandy loam, and is propagated by seeds.

TULL, JETHRO (1674–1741), English agricultural writer and farmer, was born at Basildon, Berkshire, in 1674, probably in March. He entered St John's College, Oxford, in 1691, and was called to the bar at Gray's Inn in 1699 but never practised. In that year he married and began farming on his father's land at Howberry, near Wallingford, and here about 1701 he invented and perfected his machine drill and began experiments in his new system of sowing in drills or rows sufficiently wide apart to allow for tillage by plough and hoe during almost the whole period of growth. In 1709 he moved to a farm near Hungerford and from 1711 to 1714 travelled in France and Italy, making careful observations of the methods of agriculture in those countries which aided and confirmed his theories as to the true use of manure and the importance of "pulverizing" the soil. He did not publish any account of his agricultural experiments or theories until 1731, when his *Horse-hoeing Husbandry* appeared. This was followed by *The Horse-hoeing Husbandry, or an Essay on the Principles of Tillage and Vegetation*, by J. T., in 1733. He was attacked in the agricultural periodical *The Practical Husbandman and Farmer* and accused of plagiarizing from such earlier writers as Sir A. Fitzherbert, Sir Hugh Plat (1552–1611?), Gabriel Plattes (*fl.* 1638) and John Worlidge (*fl.* 1669–1698). Tull answered in various smaller works forming additions to his main work. He died on the 21st of February 1741.

Many editions of his *Horse-hoeing Husbandry* were published subsequently, and in 1822 William Cobbett edited it. It was translated into French, notably by H. L. Duhamel Dumonceau (1700–1782), the naturalist and agriculturalist, in 1753–1757 (see AGRICULTURE).

TULLAMORE, a market town and the county town of King's County, Ireland, on the Grand Canal and a branch of the Great Southern & Western railway, by which it is 58 m. W. by S. of Dublin. Pop. (1901), 4639. The town is the seat of the county assizes, has a court house and other county buildings, and is governed by an urban district council. There is considerable trade in agricultural produce, and brewing and distilling are carried on. Charleville park is a fine demesne, and there are several small ruined castles in the neighbourhood, notably Shragh Castle, dating from 1588.

TULLE, a town of central France, capital of the department of Corrèze, 58 m. S.S.E. of Limoges by rail. Pop. (1906), of the town, 11,741; of the commune, 17,245. The town extends along the narrow valley of the Corrèze, its streets here and there ascending the hill-slopes on either side by means of stairways. Tulle is the seat of a bishop. Of its 12th-century cathedral, once attached to an abbey, only the porch and nave remain, the choir and transept having been destroyed in 1793, but there is a tower of the 13th century with a fine stone steeple of the 14th century. The neighbouring cloister (12th and 13th century) has been restored. The abbot's house (15th century) has a carved doorway and well-preserved windows. Other curious old houses are to be seen in the vicinity of the cathedral. The prefecture of Tulle is a sumptuous building of 1869 surrounded by gardens. The town has tribunals of first instance and of commerce, a lycée for boys, training colleges for both sexes, a chamber of commerce and a branch of the Bank of France. Its principal industry is the manufacture of small-arms, established in 1690, and now carried on by the state under the direction of the artillery authorities. At its busiest times the factory has employed 3000 hands. The well-known cascades of Gimel formed by the Montane are near Tulle.

Tulle (*Tutela*) owed its importance in the middle ages to the abbey of St Martin, founded in the 7th or 8th century. The abbacy was raised to the rank of bishopric in 1317. The town was taken by the English in 1346 and was subsequently ravaged by the Black Death. It was again conquered by the English in 1369; but, when the inhabitants succeeded in freeing themselves, they were exempted from all imposts by Charles V. The Protestants tried in vain to seize Tulle in 1577, but were successful in 1585.

TULLE, a term restricted in England to a fine bobbin-net of silk, used for veils, scarves, millinery purposes, and trimmings of ladies' dresses, &c. The French used the word to mean all machine-made lace the basis of which is the intertwisted network made on the bobbin-net machine. The word is derived from the town of Tulle in France.

TULLOCH, JOHN (1823–1886), Scottish theologian, was born at Bridge of Earn, Perthshire, in 1823, and received his university education at St Andrews and Edinburgh. In 1845 he became minister of St Paul's, Dundee, and in 1849 of Kettins, in Strathmore, where he remained for six years. In 1854 he was appointed principal of St Mary's College, St Andrews. The appointment was immediately followed by the appearance of his Burnet prize essay on *Theism*. At St Andrews, where he held also the post of professor of systematic theology and apologetics, his work as a teacher was distinguished by several features which at that time were new. He lectured on comparative religion and treated doctrine historically, as being not a fixed product but a growth. From the first he secured the attachment and admiration of his students. In 1862 he was appointed one of the clerks of the General Assembly, and from that time forward he took a leading part in the councils of the Church of Scotland. In 1878 he was chosen moderator of the Assembly. He did much to widen the national church. Two positions on which he repeatedly insisted have taken a firm hold—first, that it is of the essence of a church to be comprehensive of various views and tendencies, and that a national church especially should seek to represent all the elements of the life of the nation; secondly, that subscription to a creed can bind no one to all its details, but only to the sum and substance, or the spirit, of the symbol. For three years before his death he was convener of the church interests committee of the Church of Scotland, which had to deal with a great agitation for disestablishment. He was also deeply interested in the reorganization of education in Scotland, both in school and university, and acted as one of the temporary board which settled the primary school system under the Education Act of 1872. He died at Torquay on the 13th of February 1886.

Tulloch's best-known works are collections of biographical sketches of the leaders of great movements in church history, such as the Reformation and Puritanism. His most important book, *Rational Theology and Christian Philosophy* (1872), is one in which the Cambridge Platonists and other leaders of dispassionate thought in the 17th century are similarly treated. He delivered the second series of the Croall lectures, on the *Doctrine of Sin*, which were afterwards published. He also published a small work, *The Christ of the Gospels and the Christ of History*, in which the views of Renan on the gospel history were dealt with; a monograph on *Pascal* for Blackwood's Foreign Classics series; and a little work, *Beginning Life*, addressed to young men, written at an earlier period.

See the *Life* by Mrs Oliphant.

TULLUS HOSTILIUS, third legendary king of Rome (672–640 B.C.). His successful wars with Alba, Fidenae and Veii shadow forth the earlier conquests of Latian territory and the first extension of the Roman domain beyond the walls of Rome. It was during his reign that the combat between the Horatii and Curiatii, the representatives of Rome and Alba, took place. He is said to have been struck dead by lightning as the punishment of his pride.

Tullus Hostilius is simply the duplicate of Romulus. Both are brought up among shepherds, carry on war against Fidenae and Veii, double the number of citizens, organize the army, and disappear from earth in a storm. As Romulus and Numa represent the Ramnes and Tities, so, in order to complete the list of the four traditional elements of the nation, Tullus was made the representative of the Luceres, and Ancus the founder of the Plebs. The distinctive event of this reign is the destruction of Alba, which may be regarded as an historical fact. But when and by whom it was destroyed is uncertain—probably at a later date, by the Latins, and not by the Romans, who would have regarded as impious the destruction of their traditional mother-country.

See Livy i. 22–31; Dion. Halic. iii. 1–35; Cicero, *de Republica*, ii. 17. For a critical examination of the story see Schwegler, *Römische Geschichte*, bk. xii.; Sir G. Cornewall Lewis, *Credibility of early Roman History*, ch. 11; W. Ihne, *Hist. of Rome*, vol. i.; E. Pais, *Storia di Roma*, vol. i. (1898); O. Gilbert, *Geschichte und Topographie der Stadt Rom im Altertum*, ii. (1885); G. F. Schömann, "De Tullo Hostilio rege romano" in his *Opuscula*, i. 18-49; also ROME: *Ancient History*.

TULSA, a city (and co-extensive township) and the county-seat of Tulsa county, Oklahoma, U.S.A., on the Arkansas river, about 110 m. N.E. of Guthrie. Pop. (1900), 1390; (1907), 7298 (638 negroes); (1910) 18,182. Tulsa is served by the Atchison, Topeka & Santa Fé, the St Louis & San Francisco, the Midland Valley, the Missouri, Kansas & Texas, and the Arkansas Valley & Western railways. The city is situated on the old boundary line between Indian Territory and Oklahoma Territory, where the boundaries of the Cherokee, Creek and Osage nations intersected. It is on an elevation from the rolling prairie, which commands a fine view over the valley of the Arkansas. Tulsa is the seat of Henry Kendall College (Presbyterian, 1894), removed hither from Muskogee in 1907; it was named in honour of Henry Kendall (1815–1892), who from 1861 until his death was secretary of the board of Home Missions of the Presbyterian Church. The city is a trading centre for a rich oil, gas and coal region and a grain, cotton and live-stock-country. Natural gas is used for manufacturing purposes; among the manufactures are glass and cotton-seed oil products. Tulsa was founded in 1887, was first chartered as a city in 1902, and in 1908 adopted a commission form of government.

TULSĪ DĀS (1532–1623), the greatest and most famous of Hindī poets, was a Sarwariyā Brahman, born, according to tradition, in A.D. 1532, during the reign of Humāyūn, most probably at Rājāpur in the Bāndā District south of the Jumna. His father's name was Ātmā Rām Sukal Dubē; that of his mother is said to have been Hulasī. A legend relates that, having been born under an unlucky conjunction of the stars, he was abandoned in infancy by his parents, and was adopted by a wandering *sādhū* or ascetic, with whom he visited many holy places in the length and breadth of India; and the story is in part supported by passages in his poems. He studied, apparently after having rejoined his family, at Sūkarkhēt, a place generally identified with Sōrōṅ in the Etah district of the United Provinces, but more probably the same as Varāhakshētra[1] on the Gogra River, 30 m. W. of Ajōdhyā (Ayōdhyā). He married in his father's lifetime, and begat a son. His wife's name was Ratnāwalī, daughter of Dīnabandhu Pāṭhak, and his son's Tārak. The latter died at an early age, and Tulsī's wife, who was devoted to the worship of Rāma, left her husband and returned to her father's house to occupy herself with religion. Tulsī Dās followed her, and endeavoured to induce her to return to him, but in vain; she reproached him (in verses which have been preserved) with want of faith in Rāma, and so moved him that he renounced the world, and entered upon an ascetic life, much of which was spent in wandering as a preacher of the necessity of a loving faith in Rāma. He first made Ajōdhyā (the capital of Rāma and near the modern Fyzābād) his headquarters, frequently visiting distant places of pilgrimage in different parts of India. During his residence at Ajōdhyā the Lord Rāma is said to have appeared to him in a dream, and to have commanded him to write a *Rāmāyana* in the language used by the common people. He began this work in the year 1574, and had finished the third book (*Āranya-kāṇḍ*), when differences with the Vairāgī Vaishnavas at Ajōdhyā, to whom he had attached himself, led him to migrate to Benares, where he settled at Asī-ghāṭ. Here he died in 1623, during the reign of the emperor Jahāngīr, at the great age of 91.

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[1] This is the view of Baijnāth Dās, author of the best life of Tulsī Dās. At Sōrōṅ there is no tradition connecting it with the poet. Varāhakshētra and Sūkar-khēt have the same meaning (*Varāha* = *Sūkara*, a wild boar).

The period of his greatest activity as an author synchronized with the latter half of the reign of Akbar (1556–1605), and the first portion of that of Jahāngīr, his dated works being as follows: commencement of the *Rāmāyan*, 1574; *Rām-satsaī*, 1584; *Pārbatī-mangal*, 1586; *Rāmāgyā*, 1598; *Kabitta Rāmāyan*, between 1612 and 1614. A deed of arbitration in his hand, dated 1612, relating to the settlement of a dispute between the sons of a land-owner named Ṭōḍar, who possessed some villages adjacent to Benares, has been preserved, and is reproduced in facsimile in Dr Grierson's *Modern Vernacular Literature of Hindustan*, p. 51. Ṭōḍar (who was not, as formerly supposed, Akbar's finance minister, the celebrated Rāja Ṭōḍar Mall) was his attached friend, and a beautiful and pathetic poem[1] by Tulsī on his death is extant. He is said to have been resorted to, as a venerated teacher, by Mahārāja Mān Singh of Jaipur (d. 1618), his brother Jagat Singh, and other powerful princes; and it appears to be certain that his great fame and influence as a religious leader, which remain pre-eminent to this day, were fully established during his lifetime.

Tulsī's great poem, popularly called *Tulsī-krit Rāmāyan*, but named by its author *Rām-charit-mānas*, "the Lake of Rāma's deeds," is perhaps better known among Hindūs in upper India than the Bible among the rustic population in England. Its verses are everywhere, in this region, popular proverbs; an apt quotation from them by a stranger has an immediate effect in producing interest and confidence in the hearers. As with the Bible and Shakespeare, his phrases have passed into the common speech, and are used by every one (even in Urdū) without being conscious of their origin. Not only are his sayings proverbial: his doctrine actually forms the most powerful religious influence in present-day Hinduism; and, though he founded *no* school and was never known as a *guru* or master, but professed himself the humble follower of his teacher, Narhari-Dās,[2] from whom as a boy in Sūkar-khēt he heard the tale of Rāma's doings, he is everywhere accepted as an inspired and authoritative guide in religion and conduct of life.

The poem is a rehandling of the great theme of Vālmīkī, but is in no sense a translation of the Sanskrit epic. The succession of events is of course generally the same, but the treatment is entirely different. The episodes introduced in the course of the story are for the most part dissimilar. Wherever Vālmīki has condensed, Tulsī Dās has expanded, and wherever the elder poet has lingered longest, there his successor has hastened on most rapidly. It consists of seven books, of which the first two, entitled "Childhood" (*Bāl-kāṇḍ*) and "Ayōdhyā" (*Ayōdhyā-kāṇḍ*), make up more than half the work. The second book is that most admired. The tale tells of King Dasarath's court, the birth and boyhood of Rāma and his brethren, his marriage with Sītā, daughter of Janak king of Bidēha, his voluntary exile, the result of Kaikēyī's guile and Dasarath's rash vow, the dwelling together of Rāma and Sītā in the great central Indian forest, her abduction by Rāvan, the expedition to Lankā and the overthrow of the ravisher, and the life at Ajōdhyā after the return of the reunited pair. It is written in pure Baiswārī or Eastern Hindī, in stanzas called *chaupāīs*, broken by *dōhās* or couplets, with an occasional *sōraṭhā* and *chhand*—the latter a hurrying metre of many rhymes and alliterations. Dr Grierson well describes its movement:—

> "As a work of art, it has for European readers prolixities and episodes which grate against occidental tastes, but no one can read it in the original without being impressed by it as the work of a great genius. Its style varies with each subject. There is the deep pathos of the scene in which is described Rāma's farewell to his mother: the rugged language depicting the horrors of the battle-field—a torrent of harsh sounds clashing against each other and reverberating from phrase to phrase; and, as occasion requires, a sententious, aphoristic method of narrative, teeming with similes drawn from nature herself, and not from the traditions of the schools. His characters, too, live and move with all the dignity of an heroic age. Each is a real being, with a well-defined personality. Rāma, perhaps too perfect to enlist all our sympathies; his impetuous and loving brother Lakshman; the tender, constant Bharat; Sītā, the ideal of an Indian wife and mother; Rāvan, destined to failure, and fighting with all his demon force against his destiny—the Satan of the epic—all these are characters as lifelike and distinct as any in occidental literature."

A manuscript of the *Ayōdhyā-kāṇḍ*, said to be in the poet's own hand, exists at Rājāpur in Bānda, his reputed birthplace. One of the *Bāl-kāṇḍ*, dated *Sambat* 1661, nineteen years before the poet's death, and carefully corrected, it is alleged by Tulsī Dās himself, is at Ajōdhyā. Another autograph is reported to be preserved at Malihābād in the Lucknow district, but has not so far as known, been seen by a European. Other ancient MSS. are to be found at Benares, and the materials for a correct text of the Rāmāyan are thus available. Good editions have been published by the *Khaḍga Bilās* press at Bānkipur (with a valuable life of the poet by Baijnāth Dās), and by the *Nāgarī Prachārinī Sabhā* at Allahabad (1903). The ordinary bāzār copies of the poem, repeatedly reproduced by lithography, teem with interpolations and variations from the poet's language. An excellent translation of the whole into English was made by the late Mr F. S. Growse, of the Indian Civil Service (5th edition, Cawnpore, 1891).

Besides the "*Lake of Rāma's deeds*," Tulsī Dās was the author of five longer and six shorter works, most of them dealing with the theme of Rāma, his doings, and devotion to him. The former are (1) the *Dōhābalī*, consisting of 573 miscellaneous *dōhā* and *sōraṭhā* verses; of this there is a duplicate in the *Rām-satsaī*, an arrangement of seven centuries of verses, the great majority of which occur also in the *Dōhābalī* and in other works of Tulsī; (2) the *Kabitta Rāmāyan* or *Kabittābalī*, which is a history of Rāma in the *kabitta*, *ghanākshari*, *chhappāī* and *sawaiyā* metres; like the *Rām-charit-mānas*, it is divided into seven *kāṇḍs* or cantos, and is devoted to setting forth the majestic side of Rāma's character; (3) the *Gīt-Rāmāyan*, or *Gītābalī*, also in seven *kāṇḍs*, aiming at the illustration of the tender aspect of the Lord's life; the metres are adapted for singing; (4) the *Krishnāwalī* or *Krishna gītābalī*, a collection of 61 songs in honour of Krishna, in the Kanaujī dialect: the authenticity of this is doubtful; and (5) the *Binay Pattrikā*, or "Book of petitions," a series of hymns and prayers of which the first 43 are addressed to the lower gods, forming Rāma's court and attendants, and the remainder, Nos. 44 to 279, to Rāma himself. Of the smaller compositions the most interesting is the *Vairāgya Sandīpanī*, or "Kindling of continence," a poem describing the nature and greatness of a holy man, and the true peace to which he attains. This work has been translated by Dr Grierson in the *Indian Antiquary*, xxii. 198–201.

Tulsī's doctrine is derived from Rāmānuja through Rāmānand. Like the former, he believes in a supreme personal God, possessing all gracious qualities (*saguṇa*), not in the quality-less (*nirguṇa*) neuter impersonal *Brahman* of Sankarāchārya; this Lord Himself once took the human form, and became incarnate, for the blessing of mankind, as Rāma. The body is therefore to be honoured, not despised. The Lord is to be approached by *faith* (*bhakti*)—disinterested devotion and surrender of self in perfect love, and all actions are to be purified of self-interest in contemplation of Him. "Show love to all creatures, and thou wilt be happy; for when thou lovest all things, thou lovest the Lord, for He is all in all." The soul is from the Lord, and is submitted in this life to the bondage of works (*karma*); "Mankind, in their obstinacy, keep binding themselves in the net of actions, and though they know and hear of the bliss of those who have faith in the Lord, they attempt not the only means of release. Works are a spider's thread, up and down which she continually travels, and which is never broken; so works lead a soul downwards to the Earth, and upwards to the Lord." The bliss to which the soul attains, by the extinction of desire, in the supreme home, is not absorption in the Lord, but union with Him in abiding individuality. This is emancipation (*mukti*) from the burthen of birth and rebirth, and the highest happiness.[3]

Tulsī, as a *Smārta Vaishnava* and a Brahman, venerates the whole Hindu pantheon, and is especially careful to give Siva or Mahādēva, the special deity of the Brahmans, his due, and to point out that there is no inconsistency between devotion to Rāma and attachment to Siva (*Rāmāyan, Lankākāṇḍ, Dōhā* 3). But the practical end of all his writings is to inculcate *bhakti* addressed to Rāma as the great means of salvation—emancipation from the chain of births and deaths—a salvation which is as free and open to men of the lowest caste as to Brahmans.

The best account of Tulsī Dās and his works is contained in the papers contributed by Dr Grierson to vol. xxii. of the *Indian Antiquary* (1893). In Mr Growse's translation of the *Rām-charit-Mānas* will be found the text and translation of the passages in the *Bhaktamālā* of Nābhājī and its commentary, which are the main original authority for the traditions relating to the poet. Nābhājī had himself met Tulsī Dās; but the stanza in praise of the poet gives no facts relating to his life; these are stated in the *ṭīkā* or gloss of Priyā Dās, who wrote in A.D. 1712, and much of the material is legendary and untrustworthy. Unfortunately, the biography of the poet, called *Gōsāīn-charitra*, by Bēnīmādhab Dās, who was a personal follower and constant companion of the Master, and died in 1642, has disappeared, and no copy of it is known to exist. In the introduction to the edition of the *Rāmāyan* by the *Nāgarī Prachārinī Sabhā* all the known facts of Tulsī's life are brought together and critically discussed. For an exposition of his religious position, and this place in the popular religion of northern India, see Dr Grierson's paper in the *Journal of the Royal Asiatic Society*, July 1903, pp. 447–466. (C. J. L.)

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[1] See *Indian Antiquary*, xxii. 272 (1893).

[2] Narhari-Dās was the sixth in spiritual descent from Rāmānand, the founder of popular Vaishnavism in northern India (see article HINDOSTANI LITERATURE).

[3] The summary given above is condensed from the translation by Dr Grierson, at pp. 229–236 of the *Indian Antiquary*, vol. xxii., of the fifth *sarga* of the *Satsaī*, in which work Tulsī unfolds his system of doctrine.

TULU, or Tuluva, a language of the Dravidian family, found chiefly in the South Kanara district of Madras. It has no literature, nor has it been adopted for official use even where it is spoken by the majority of the population. In 1901 the total number of speakers of Tulu exceeded half a million.

TUMBLER, that which "tumbles," *i.e.* falls or rolls over or down. The O. Eng. *tumbiare*, of which Mid. Eng. *tumblere* is a frequentative form, appears also in Du. *tuimelen*, Ger. *taumeln*, to stagger, tumble about; Fr. *tomber*, to fall, is Teutonic in origin. As applied to a person, "tumbler" is another word for an acrobat; one who shows his agility by turning somersaults, standing on his head, walking or dancing on his hands, &c. It is interesting to note that Herodias' daughter Salome is described as a *tumbestere* in Harl. MS., 1701, f. 8, quoted by Halliwell (*Dict. of Archaic Words*), and in the margin of Wycliffe's Bible (Matt. xiv. 6) *tumblide* is given as a variant of daunside (danced). Similarly, in early pictures of her dancing before Herod, she is represented sometimes as standing on her head. The common drinking-glass known as a "tumbler," which now is the name given to a plain cylindrical glass without a stem or foot, was originally a glass with a rounded or pointed base, which could only stand on being emptied and inverted (see Drinking Vessels, Plate I., fig. 3).

TUMBLE-WEED, a botanical term for a plant which breaks loose when dry, and is blown about, scattering its seeds by the way.

TUMKUR, or Toomkoor, a town and district of southern India, in the west of Mysore state. The town has a station on the Madras & Southern Mahratta railway, 43 m. N.W. from Bangalore. The area of the district is 4158 sq. m. It consists chiefly of elevated land intersected by river valleys. A range of hills rising to nearly 4000 feet crosses it from north to south, forming the waterparting between the systems of the Krishna and the Cauvery. The principal streams are the Jayamangala and the Shimsha. The mineral wealth of Tumkur is considerable; iron is obtained in large quantities from the hill-sides; and excellent building-stone is quarried. The slopes of the Devaray-durga hills, a tract of 18 sq. m., are clothed with forests, in which large game abounds, including tigers, leopards, bears and wild hog. The climate of Tumkur is equable and healthy; the annual rainfall averages 39 in.

The population in 1901 was 679,162, showing an increase of 17% in the decade. The cultivated products consist chiefly of millets, rice, pulses and oil seeds. The chief industries are the making of coarse cotton cloths, woollen blankets and ropes.

TUMMEL, a river of Perthshire, Scotland. Discharging from Loch Rannoch, it flows eastward to a point near the Falls of Tummel, where it bends to the S.E., a direction which it maintains until it falls into the Tay, just below Logierait, after a course of 58 m. from its source in Stob Ghabbar (3565 ft.). Its only considerable affluent is the Garry, 24 m. long, an impetuous river which issues from Loch Garry (2½ m. long, ¼ m. wide, and 1334 ft. above the sea). About midway in its course the Tummel expands into Loch Tummel (2¾ m. long, ½ m. wide, 128 ft. deep, and 500 ft. above the sea), between which and the confluence with the Garry occur the Pass and Falls of the Tummel, which are rather in the nature of rapids, the descent altogether amounting to 15 ft. The scenery throughout this reach is most picturesque, culminating at the point above the eastern extremity of the loch, known as Queen Victoria's View. The chief places of interest on the river are Kinloch Rannoch; Dunalastair, a rocky hill in well-wooded grounds, the embellishment of which was largely due to Alexander Robertson of Struan (1670–1749), the Jacobite and poet, from whom the spot takes its name ("the stronghold of Alexander"); Foss; Faskally House (beautifully situated on the left bank); Pitlochry; and Ballinluig.

TUMOUR (Lat. *tumor*, a swelling), a term applied, from the earliest period of medical literature, to any swelling of which the nature and origin were unknown. Thus used in its most literal sense, the word is of purely clinical derivation and has no pathological significance of any kind. Consequently a very heterogeneous collection of swellings have been described as tumours, including such diverse conditions as an abscess, a tubercular gland, the enlarged spleen of malaria or a cancer. With the progress of bacteriology and the improved technique of histology it has been found possible, however, to separate these various "swellings" into certain groups: (1) *Inflammatory or Infective Tumours*; (2) *Tumours due to Hypertrophy*; (3) *Cysts*; (4) *Spontaneous Tumours, or Tumours proper*. The tendency of modern convention is to restrict the use of the term "tumour" to the last group, but for the sake of completeness it is necessary to touch briefly on the distinguishing features of the first three groups.

1. *Inflammatory or Infective Tumours.*—These have certain characteristics which separate them sharply from other classes of tumour. In the first place all of them are due to the irritative action of some micro-organism (see Pathology). Inflammation due to microbial action always follows a typical course. First, a number of wandering cells derived from the blood, the lymph or the connective tissues make their way to the site of irritation, and thus produce the red, painful swelling with which every one is familiar. A struggle now ensues between these cells and the invading bacteria; if the victory rests with the former, the inflammation gradually subsides, and the swelling disappears in course of time. But if the bacteria gain the upper hand a number of the cells are killed, undergo liquefaction and are converted into pus, so that an abscess results. Thus an inflammatory swelling may be solid or fluid according to the severity of the irritant. The common inflammatory bacteria—staphylococcus and streptococcus—cause suppuration in the majority of cases, but there are a few organisms such as streptothrix, spirochaeta pallida, and in many instances the tubercle bacillus, which set up an inflammation of an extremely chronic type, rarely progressing to the formation of pus, but leading rather to the development of a hard, solid mass of very slow growth, that may persist for months or even years.

To the naked eye these solid inflammatory swellings may closely simulate the spontaneous tumours with which they have been often confused, but a microscopical examination will correct the mistake in nearly every case. For the minute structure of the infective tumours, whatever their situation, is almost identical; they consist merely of an irregular collection of inflammatory cells; and this of itself is sufficient to mark them off quite distinctly from the group of tumours proper, which, as will presently be seen, vary widely in structure according to the tissue from which they spring, and show a resemblance to the parent type at once characteristic and peculiar. To this statement there is one exception, for a form of malignant tumour, known as a sarcoma, may bear a very deceptive likeness to an inflammatory swelling.

2. *Hypertrophic Tumours.*—A tissue or organ is said to be hypertrophied when it is increased in size but remains normal in structure. The most familiar example is the hypertrophy of the skeletal muscles that follows increased use, or the hypertrophy of the heart muscle which helps to compensate the faulty action of the valves. But neither of these constitutes a hypertrophic tumour. For an instance of this we must turn to the enlargement of the spleen that occurs in malaria and certain forms of anaemia, of the thyroid gland in goitre, and of the lymphatic glands in Hodgkin's disease. In each of these conditions there is merely an increase of apparently normal tissue, and from a microscopical examination of the hypertrophied organ it would be impossible to say that it was other than healthy.

The enlargement of the spleen and of the thyroid in these cases are overshadowed by certain changes in the blood and in the nervous system which constitute a distinct disease; but in Hodgkin's disease there are no specific symptoms apart from the swelling of the glands, and it has been suggested that this may be due either to the action of some micro-organism which has hitherto escaped detection, or to a widely diffused growth of a sarcomatous type. If the former supposition be correct these glandular swellings must be classed with the infective tumours; if the latter they should be regarded as spontaneous tumours. There is, at present, no agreement on this point, and they have, therefore, been described here as hypertrophic tumours.

3. *Cysts.*—A cyst may be defined as a collection of fluid surrounded by a wall or capsule. The nature of the fluid varies according to the site and origin of the cyst; the cyst-wall is usually composed of a tough layer of fibrous tissue. Cysts arise by the dilatation of a pre-existing space with fluid; and when, as often happens, the cyst-wall is tensely stretched by the pressure of the fluid within, they may easily be mistaken for solid tumours.

The number and variety of cysts are very great, and they are only mentioned here on account of the errors in diagnosis for which they are often responsible. For further details the reader should consult the special textbooks.

4. *Spontaneous Tumours, or Tumours Proper* (*synonyms: Neoplasm, New Growth*).—The following definition of a spontaneous tumour suggested by Ziegler is perhaps the most satisfactory: "A neoplasm or tumour is a new formation of tissue, which is atypical in structure, serves no useful purpose to the whole economy, and the growth of which has no typical termination." In this definition the words "new formation of tissue" exclude the cystic swellings; the attribute "atypical in structure" excludes hypertrophies; and the final clause "the growth of which has no typical termination" excludes all swellings of an inflammatory nature which progress, however slowly, towards either suppuration or resolution and recovery.

These tumours arise by the exaggerated and abnormal proliferation of a single cell, or a group of cells. They increase in size solely by the multiplication of their own cells, and the only contribution which the surrounding tissues make to the progress is the formation of a "stroma," or supporting framework of fibrous tissue; and even that is wanting in many cases. Inasmuch as the newly-formed cells of the tumour take on the likeness of the parent from which they are sprung, it follows that the minute structure of such a tumour, whatever its situation, will be a more or less exact copy of that of the tissue whence it originated. A tumour growing from the skin will therefore imitate the cell-structure of the normal skin; the resemblance of a breast tumour to the healthy breast is often so close as to make it a hard task to distinguish the one from the other; whilst the similarity of bony and cartilaginous tumours to true bone and cartilage is evident to all.

This imitation of the parent type by the spontaneous tumours is one of their most remarkable characteristics, and provides a reliable criterion by which they may be separated from the inflammatory new growths, which are all built up on the same general plan. Consequently it is almost always possible to determine the origin of a tumour from an examination of its histological appearances; and conversely we know that an epithelial tumour will never spring from a connective tissue nor a connective tissue tumour from an epithelium.

Another outstanding feature of the neoplastic tumours is that they lead an entirely independent existence subject to none of the restraints to which the normal cell must needs submit. These normal cells are, indeed, possessed of certain limited powers of multiplication, by which they are enabled to replace the slight loss of tissue which the wear and tear of life perpetually entails; or, again, they can on occasion make good a greater loss of substance, as in the healing of an ulcer, or the regeneration of a skin wound. But these powers are confined within certain well-marked bounds, which may not be transgressed. Contrast with this the tumour cell, emancipated from all control and owning to no restraint. It is true that the simple tumours often remain stationary after attaining a certain size, but the general tendency of all tumours is towards persistent and unlimited growth, and the cancer cell continues its career unchecked by everything save death.

The spontaneous tumours are seen in every tissue and organ of the body, though in some they are relatively infrequent. Nor are they confined to man, for they have been found throughout the vertebrate kingdom. It is often stated that a higher state of civilization has inflicted on European races a greater susceptibility to tumour formation. As to this, reliable evidence is hard to obtain, but such a statement would seem to be only partially true, and the apparent immunity of certain native races is to some extent due to lack of sufficient observations.

It is usual to separate these tumours into two groups: the *Non-malignant, Innocent or Benign*, and the *Malignant or Cancerous*. Of these two groups the latter are the more familiar and have attracted much more attention and study than the former, on account of the danger to life which they involve, but in point of numbers they are greatly outweighed by the first group. Two or more non-malignant tumours, of the same or different varieties, are often found in the same individual; but with the cancers this is a rare occurrence, and such growths are usually single.

The non-malignant tumours are usually rounded in shape. In size they vary enormously; a fibroid tumour may be as small as a pea; a fatty tumour may weigh forty pounds. Often they cease growing after attaining a certain size, but there are very many exceptions to this, and it is seldom possible to predict the subsequent course of one of these growths. They possess, however, four constant characteristics by which they may be distinguished from the malignant variety.

1. A non-malignant tumour, whatever its size, remains localized to the part from which it originates. It is not an "infiltrating" growth, that is to say it does not eat its way into the surrounding tissues, but rather pushes them aside, and so may be called "expansive." Moreover, it is separated from them by a thin but usually well-marked layer of fibrous tissue known as the "capsule" of the tumour, which seems to be formed as the result of a slight inflammation that the presence of the tumour always causes among the healthy tissues surrounding it, and may be regarded as a protest on their part against the invasion of the tumour.

2. Non-malignant tumours are not of themselves dangerous to life. They may, however, cause a great deal of pain and even death, when situated in some sensitive or delicate organ. For instance, a small tumour may cause intense pain by pressing on a nerve, or dropsical swelling of a limb by obstructing a vein, or death from suffocation by blocking the larynx. Nevertheless it remains true that any evil effects are due not to the nature of the tumour, but to its situation, whereas a cancer causes death whatever its position.

3. These tumours never reproduce themselves in distant parts of the body. More than one may be present in the same individual, but each arises independently, and the widespread dissemination so typical of a cancerous growth is never seen.

4. An innocent growth never recurs after operation. The boundaries of the growth are so well defined that complete removal is usually easy, and the operation is a simple and satisfactory proceeding.

Malignant Tumours, or Cancers.—There are two varieties of malignant tumour: the *Sarcomata*, arising from the connective tissues; the *Carcinomata*, arising from epithelial tissues. It is customary to describe them both as cancers. The main features of these tumours are as follows:—

1. *The Infiltrating Nature of a Malignant Tumour.*—A cancer follows a course very different from that of an innocent tumour. Its growth has no appointed termination, but continues with unabated vigour until death; moreover, it is more rapid than that of the innocent tumours, and so does not permit of the formation of a capsule by the neighbouring tissues. In consequence such a tumour shows no well-defined boundary, but from its margin fine tendrils of cancer cells make their way in all directions into the surrounding parts, which gradually become more and more involved in the process. Thus a cancer of the breast will attack both the skin covering it and the underlying muscle and bone; a cancer of the intestine will eat its way into the liver, spleen and kidney, until these organs become to a great extent replaced by cancer cells, and can no longer perform their proper functions.

2. *Formation of Secondary Growths, or Metastases.*—In addition to this spread of growth by direct extension, another characteristic of malignant tumours is a tendency to dissemination, that is, to reproduce themselves in various parts of the body far removed from the original site; so that it is not unusual to find after death that a cancer of the breast has given rise to secondary, or metastatic, deposits in the lymphatic glands, the lungs, the ribs and other bones, the brain and the abdominal organs. These secondary deposits are due to the tumour cells making their way through the walls of the small lymph and blood vessels and becoming detached by the force of the circulation, by which they are carried to some distant part of the body, there to continue their career of uncontrolled growth.

The sarcomata and carcinomata differ somewhat as regards the path of dissemination. The former are vascular tumours, well supplied with blood-vessels; consequently dissemination usually occurs by way of the blood-stream rather than by the lymphatic circulation, and the commonest site for the secondary deposits of sarcoma is the lung. The carcinomata are less vascular, and the tendency of the growth is to invade the small lymph channels, so that the first signs of metastases are to be looked for in the lymphatic glands; at a later date these deposits may be spread throughout the body, particularly in the liver and other abdominal organs, the lungs and the bones.

The formation of metastases is of the utmost importance from a clinical point of view, as the success of an operation depends on the removal of all the secondary deposits as well as of the original growth. For instance, a few months after the first appearance of a cancer of the breast the axillary lymph glands will be found to be hard and enlarged. This means that some of the cells of the primary growth have been carried in the lymph stream to these glands, and have begun to grow there; consequently any operation for the removal of the cancer of the breast must include the removal of these glands. If the breast tumour only be taken away the growth will continue unchecked in the glands. It is a matter of great difficulty to determine by the naked eye or the touch whether a gland is infected or not. In many cases where there is no evident enlargement the microscope will show the presence of cancer cells; and a certain opinion can only be given after a microscopical examination.

In operations for cancer of the breast or tongue the modern practice is to regard the lymphatic glands of the axilla or neck respectively as infected in every case, however early it be, and to remove them accordingly. In other parts of the body where the glands are inaccessible, the only solution of the difficulty is to urge the removal of the tumour at the earliest possible moment, before lymphatic infection has had time to occur.

The frequency and rapidity of metastasis formation varies greatly. As a general rule cancer of the breast is more liable than other forms of growth to be followed by widespread secondary deposits. On the other hand, in cases of cancer of the skin secondary infection is usually confined to the neighbouring lymphatic glands, and seldom occurs in any of the internal organs.

3. *Termination of Malignant Tumours.*—In one or two well authenticated cases a malignant tumour has disappeared of its

own accord without any treatment, and a natural cure may be said to have occurred. But these form such an infinitesimal proportion of the whole that they do not affect the general truth of the statement that the universal tendency of a malignant tumour is to cause death.

Although the separation of the new growths into two groups is supported by certain fairly definite characteristics, both clinical and histological, yet it seems likely that the difference between them is one of degree rather than of kind. There is every reason to believe that the same perverted impulse may give rise either to an innocent or a cancerous growth, the issue depending in part on the intensity of the impulse, and in part on the resisting powers of the tissues in which the incipient tumour cells lie. Such a hypothesis is supported by the analogy of the microbial infections, where the final outcome of life or death depends no less on the defensive mechanism of the individual than on the virulence of the infecting organism. Again, it is beyond doubt that occasionally a tumour, which for years has been void of the least taint of malignancy, may become converted into an active cancer. Moreover, certain tumours seem to lie on the border line, for example, rodent ulcers and cancers of the parotid gland. These are malignant in that they are undoubtedly infiltrating tumours, they are innocent in that they never form metastatic deposits. Therefore it seems that malignancy or the reverse is not to be regarded as an absolute and constant attribute of any particular tumour or class of tumours, but rather as an expression of the balance struck in the conflict between the opposing forces of the tumour and its host.

Histology of Tumours.—On examining a microscopical preparation of an epithelial tumour it is found to be built up of two distinct elements. There are the epithelial cells, which form the essential part of the tumour; there is a network of fibrous connective-tissue cells, which acts as a supporting framework to the epithelial elements, and is known as the stroma of the tumour. This twofold structure is seen in all the epithelial tumours, both non-malignant and malignant, and in the case of the latter it is a general rule that the greater the proportion of epithelial to connective-tissue elements the faster will the tumour grow. On the other hand in the connective-tissue tumours (with the exception of the sarcomata) this compound structure is absent and there is only one type of cell present; thus a fatty tumour consists merely of fat cells; a bony tumour of bone cells, and so on.

To understand clearly the differences and likenesses that obtain between the malignant and the non-malignant new growths it is necessary to compare the histology of the two groups.

Figs. 1*a*, 1*b* represent an innocent tumour (adenoma) of the breast. Figs. 2*a*, 2*b* a cancer (spheroidal-celled carcinoma) of the breast. Fig. 3 an innocent tumour (papilloma) of the skin. Fig. 4 a cancer of the skin.

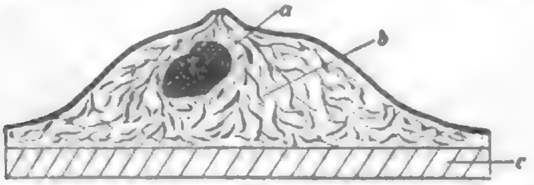

FIG. 1*a*.—Diagram to show the relations of an innocent tumour (adenoma) of the breast.

a, Tumour; *b*, normal breast tissue; *c*, underlying muscular tissue.

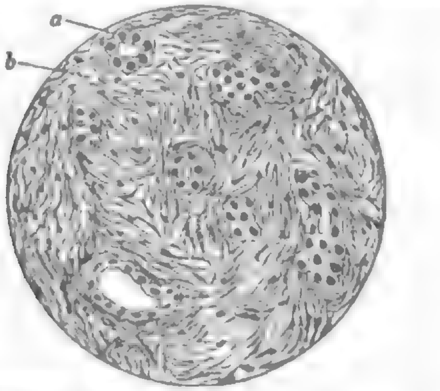

FIG. 1*b*.—Microscopical appearances of an adenoma of the breast. (Drawn from an actual specimen.)

a, Tumour cells; *b*, fibrous connective tissue.

In the adenoma the individual cells bear the closest resemblance to the glandular cells of the normal breast from which they are derived. In addition they tend to follow the normal very closely in their arrangement, so that at times it is difficult or impossible to decide which is tumour and which is healthy breast substance. Finally the growth is surrounded by a well defined capsule of fibrous tissue.

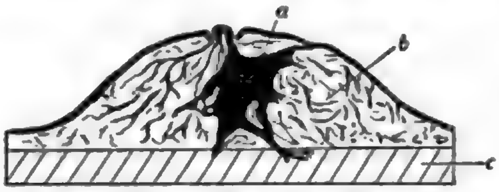

FIG. 2*a*.—Diagram to show the relations of a malignant tumour (spheroidal cell carcinoma) of the breast. Note the indrawing of the nipple by the growth and the infiltration of the underlying muscle.

a, Tumour; *b*, normal breast tissue; *c*, muscle.

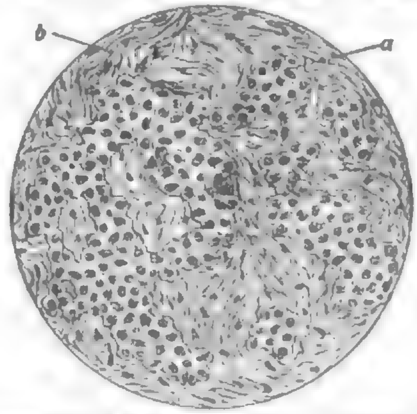

FIG. 2*b*.—Microscopical appearances of a carcinoma of the breast. (Drawn from an actual specimen.)

a, Tumour cells; *b*, stroma.

In the carcinoma, the individual resemblance is present, though less conspicuous, as many of the cells are irregular in size and shape. But the similarity of the arrangement is very hard to make out or even absent. The cells are arranged in disorderly masses; they are not enclosed by any semblance of a capsule, but tend to transgress their proper boundaries and invade the underlying muscles. Figs. 3 and 4 show analogous changes in an innocent and in a malignant tumour of the skin.

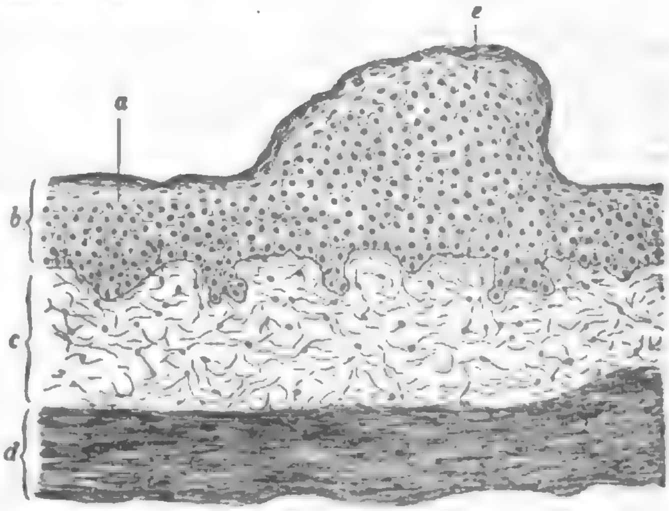

FIG. 3.—Non-malignant tumour (papilloma) of the skin. The tumour is formed by an outward proliferation of the cells of the epidermis, but these cells show no tendency to invade the underlying connective tissue or muscle. (Semidiagrammatic.)

a, Normal skin.
b, Epithelium or epidermis.
c, Connective tissue.
d, Muscular tissue.
e, Papilloma.

Speaking generally it may be said that the cells of an adenoma are fully differentiated and typical of the normal, whereas the cells of a carcinoma show less perfect differentiation, are in some degree atypical and resemble rather the actively growing cells found at an early stage of embryonic life. But it is in the cells of a sarcoma that the widest departure from type is seen. A sarcoma is a malignant growth arising from connective tissue, but the resemblance to adult connective tissue is almost non-existent and the cells are essentially of an embryonic type. These differences between the innocent and the malignant cell bear out the well-established physiological rule that the less the functional development of a cell or tissue the greater its power of growth. The primitive impulse is growth, which gives place at a later stage to the development of function.

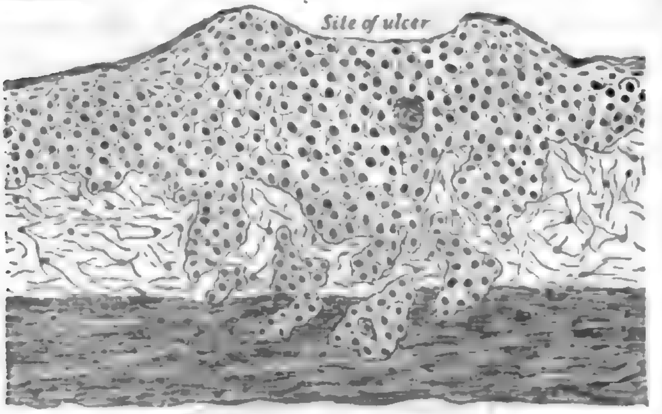

Fig. 4.—Malignant tumour (epithelioma, squamous-celled carcinoma) of the skin. The cells of the epidermis have proliferated both outwardly and inwardly and have invaded and replaced the underlying tissues. An ulcer has been formed on the surface by the necrosis of the superficial cells. (Semidiagrammatic.)

In theory it is always possible to distinguish with certainty between an innocent tumour and a cancer by means of the microscope. In practice this is, unfortunately, not the case. There are some tumours whose histological appearances seem to be on the borderline between the two conditions, and often these are the very cases in which the clinical features give no direct clue to their nature. In such circumstances it is only by taking into consideration every detail, both clinical and pathological, that an opinion can be formulated, and even then it remains to some extent a matter of guesswork.

The Causation of Tumours.—An enormous number of suggestions as to the causation of tumours have been put forward from time to time. Many of these were at the outset quite untenable, and reference can only be made here to the more important.

First in point of time came *Virchow's hypothesis* that tumours arise as the direct result of irritation or injury. Many examples of such a sequence of events are familiar to everybody. A cancer of the lip or tongue will often follow the irritation of a clay pipe or a jagged tooth; a tumour of the breast is often attributed to a blow. But, on the other hand, there must be innumerable instances in which such a cause of irritation has not been followed by a tumour; and it is necessary to discount the natural anxiety of mankind to seek a cause for every unexplained occurrence, so that a slight injury which under ordinary circumstances would be forgotten is branded as the undoubted cause of any tumour that may subsequently make its appearance. As a complete explanation Virchow's hypothesis is insufficient, but it is quite probable that irritation may have an accessory or predisposing influence in tumour formation, and that it may be enough finally to upset the balance of a group of cells, which for some other reason were already hovering on the brink of abnormal growth.

There is one peculiar form or irritation that demands special attention, that is exposure to the X rays. It is beyond doubt that exposure to these rays will cause cancerous ulceration of the skin; though what is the constituent of the rays that produces this effect is not known. Fortunately the danger can be obviated by the use of rubber gloves.

Cohnheim's Hypothesis of Embryonic Remnants.—According to Cohnheim more cells are produced in embryonic life than are required for the development of the body, and a remnant is left unappropriated. Owing to their embryonic nature, these cells possess an exaggerated power of proliferation, and if at a later period of life this should be roused into activity by some mechanical or other form of stimulus, their rate of growth will outstrip that of the adult cells and a tumour will develop. As with Virchow's so with Cohnheim's hypothesis. It is at best only a partial explanation which may be applicable to a small proportion of tumours; and it could never account for X-ray cancer, or the inoculability of mouse cancer.

The *Parasitic hypothesis* is still a matter of keen debate. In some degree cancer with its localized primary growth and widespread secondary deposits resembles certain infective diseases of microbial origin, such as pyaemia, where from a small primary site of infection the bacteria become disseminated throughout the body. From this analogy it was argued that tumour formation was due to the activity of some parasite. But if the mode of dissemination of a cancer and of a micro-organism be carefully examined this analogy is found to be false. When a micro-organism lodges in a gland or other part of the body, by its irritative action it stimulates the cells of that gland to increased activity, and any swelling that occurs is produced by the proliferation of those cells. But when a group of cancer-cells is deposited in a gland the subsequent growth arises entirely from the multiplication of those cancer-cells, and the gland cells take no part whatever in its formation.

A very large number of organisms both animal and vegetable have been described as occurring in tumours; and some of these have been cultivated on artificial media outside the body; but to none of them can any direct causal relationship with cancer be attributed. One of the best authenticated, a small coccus, known as *Micrococcus neoformans* can certainly be cultivated from many tumours malignant and innocent, and it has been suggested that it may be responsible for the slight inflammatory changes that occur in the neighbourhood of most new growths. The final and critical test of the connexion of an organism with some diseased condition is the production of a similar condition in animals by inoculation of that organism, and this experiment has signally failed with all the suggested cancer parasites. Another very cogent argument against the infective hypothesis is the fact that although tumours of identical structure are found throughout the vertebrate kingdom, it has never yet been found possible artificially to transmit these tumours from one species to another. If they were of an infective nature it is almost inconceivable that the gap between two allied species should be such an insuperable bar to transmission.

Quite recently Borrel of the Pasteur Institute has stated that certain animal parasites from the skin are often to be found buried in the cell masses of cancers of the skin and breast, and he thinks that these parasites may be the carriers of some as yet unknown cancer virus, just as the mosquito is the carrier of malaria.

Ribbert has suggested that tumour formation may be due to "alteration of tissue tension." In his opinion the various cells of the body are normally held in a state of equilibrium by some condition of mutual interdependence amongst themselves. Should this equilibrium be disturbed some of these cells may escape from the controlling influence usually exercised upon them by their neighbours, and become endowed with greatly enhanced powers of growth.

Adami considers that every cell possesses two distinct properties, a property of function and a property of growth, and he regards these as incompatible, that is to say, a cell cannot at the same time be carrying out a specific function and also undergoing active growth. He believes that on occasion some of these cells may abandon their "habit of work" and assume a "habit of growth," and this will lead to the development of a tumour.

Neither of the two latter explanations brings us very much nearer the solution of the question—they merely place the unknown factor one step farther back; but they serve to emphasize the biological aspect of the problem. At the present time the general weight of evidence seems to favour the idea that tumour formation is due to some intrinsic cause, whereby the normal processes of growth are disturbed, rather than to any extrinsic cause such as microbial infection. Therefore it is from a careful study of the laws of growth, and from research directed along broad biological lines that the best results are to be looked for in the future.

Classification of Spontaneous Tumours.—So little is known as to the nature of these tumours that a satisfactory classification on a scientific basis is not yet within reach. The following is merely suggested as convenient:—

I.—*Connective-tissue Tumours.*

Innocent.	*Malignant.*
Lipoma (fatty tumour).	
Fibroma (fibrous tumour).	Sarcoma.
Myoma (muscular tumour).	Endothelioma.
Osteoma (bony tumour).	
Chondroma (cartilaginous tumour).	
Odontoma (tumour in connexion with teeth).	
Myxoma (mucoid tumour).	
Neuroma (tumour in connexion with nerves).	
Glioma (neuroglial tumour).	
Endothelioma (endothelial tumour).	
Angioma (tumour composed of blood vessels).	

II.—*Epithelial Tumours.*

Innocent.	*Malignant.*
Papilloma.	Carcinoma.
Adenoma.	Rodent Ulcer.

I. *Connective-tissue Tumours.*[1]—*Lipoma* (fig. 5).—Of the connective-tissue group the fatty tumours are the most common. They often arise from the layer of fat beneath the skin, and a usual site for these subcutaneous lipomata is the back of the trunk, though at times they are found on the limbs and elsewhere. They are soft, painless swellings, sometimes of great size; though usually single, as many as a dozen may be present in the same individual. Lipomata are also found in the abdominal cavity, growing from the subperitoneal layer of fat.

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[1] Figs. 5, 6, 7, 8, 9, 14, 15 and 17 have been redrawn from Bland Sutton's *Tumours*, by permission; figs. 10, 11, 12 and 13 are from Rose & Carless, *Surgery*, by permission.

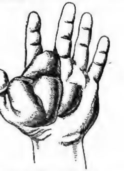


FIG. 5.—Lipoma of the palm.

What is known as a *diffuse lipoma* (fig. 6) consists of a generalized overgrowth of the subcutaneous fat of the neck, and this may be so extensive as to obliterate the outline of the jaw.

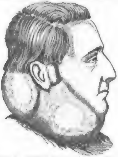


FIG. 6.—Diffuse lipoma of the neck.

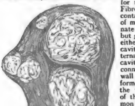


FIG. 7.—Uterus in sagittal section showing interstitial and submucous fibroids.

Fibroma (fig. 7).—Of tumours containing fibrous tissue, by far the most important are the fibroids of the uterus. A better name for these tumours would be Fibromyomata, as they always contain a varying proportion of muscle fibres. They originate in the wall of the uterus, but generally come to project either internally into the cavity of the uterus, or externally into the peritoneal cavity; and often their sole connexion with the uterine wall is a stalk or pedicle formed from the capsule of the tumour. Fibromyomata of the uterus are most common from 35 to 45 years of age; in girls under 20 they are almost unknown. They may attain a great size and are often multiple. They seem to be equally common in married and unmarried women. Not every fibroid is a source of danger or discomfort, for in the majority of cases they are discovered by chance or not until after death. On the other hand they may give rise to severe symptoms, and that in many different ways. First, they may cause haemorrhage prolonged over years so that the health is entirely ruined. Secondly, they may become inflamed and septic, and lead to severe blood-poisoning. Next, for some unknown reason, a fibroid tends to prevent conception, whilst, should pregnancy occur, labour is greatly impeded. Finally, it seems to be established that a fibroid may occasionally become converted into a sarcoma.

Examples of *pure* fibrous tissue tumours are the small multiple growths of the subcutaneous tissue, known as *Painful subcutaneous nodule*, and the irregular outgrowth from the gum known as *Epulis*.

A *Myoma* is composed of unstriped muscle fibres. It is a rare tumour sometimes found in the oesophagus, stomach and bladder.

Osteoma (fig. 8).—Bony tumours not infrequently arise from the bones of the head or face. They grow very slowly, and are so hard that surgical removal may be very difficult. They also occur as irregular outgrowths from the bones of the limbs, and are then known as *Exostoses* (fig. 9). A common site for these is the inner and lower end of the femur, at the point of attachment of the adductor muscle, and such a tumour seems to originate from an ossification of the tendon of this muscle.

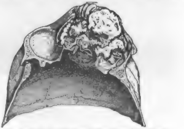


FIG. 8.—Osteoma of the left frontal sinus (seen from below).

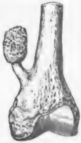


FIG. 9.—Exostosis of the femur produced by the ossification of the tendon of the adductor magnus.

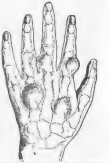


FIG. 10.—Multiple chondromata of the fingers.

Chondroma (fig. 10).—Cartilaginous tumours are often found in children and young people growing from the bones of the limbs in the neighbourhood of the joints. They are frequently multiple, especially in the hands and feet. These tumours grow slowly and are quite painless. Should removal be necessary, it is usually an easy matter.

Odontoma.—Several varieties of this tumour have been described arising in connexion with the teeth and due to delayed or faulty development. They may cause great deformity of the jaw.

A *Myxoma* is composed of loose, gelatinous connective tissue similar to that found in the umbilical cord. Some nasal polypi seem to be of this nature, but true myxomatous tumours are rare. It is, however, not uncommon for a fibroma or a sarcoma to be converted by degeneration into myxomatous-like tissue.

Neuroma.—A pure neuroma is very uncommon, but a tumour known as a *Pseudo-neuroma* (fig. 11) is often found in the course of a nerve. This is formed by a localized overgrowth of the fibrous tissue of the nerve sheath.

Glioma.—This variety of tumour arises from the neuroglia, the supporting tissue of the brain and spinal cord. Consequently gliomata are only found in these two structures.

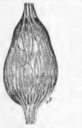


FIG. 11.—Pseudo-neuroma: fibrous tumour growing from nerve sheath, and causing the fibres to be stretched over it.

Endothelioma.—Of late years a small class of tumour has been described as originating apparently from the endothelium lining the lesser blood and lymph channels. Many of the recorded examples have been connected with the mouth, the tongue, the palate or the parotid gland. Some of these tumours are quite innocent, others are typically malignant.

An *Angeioma* consists of a meshwork of blood-vessels bound together by a small amount of fat and fibrous tissue. Two varieties are described: (*a*) The *simple naevus*, or *port-wine stain*, scarcely deserves to be called a tumour. It appears as a reddish-blue discolouration of the skin due to over growth and dilatation of the underlying blood-vessels. This condition is most commonly found on the face or scalp, and may be of congenital origin. (*b*) In the *cavernous naevus* the vascular hypertrophy is on a larger scale, and may produce a definite pulsating tumour. Here, again, the head is the usual situation.

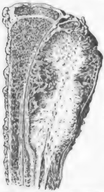


FIG. 12.—Ossifying periosteal sarcoma of fibula.

Sarcoma.—This is the malignant type of the connective-tissue tumour. The general arrangement of a sarcoma shows a mass of atypical cells loosely bound together by a small amount of connective tissue. The cells vary greatly in size and shape in different tumours, and in accordance with the prevailing type the following varieties of sarcoma have been described: (i.) *round-cell sarcoma*, (ii.) *spindle-cell sarcoma*, (iii.) *melanotic sarcoma*, (iv.) *myeloid sarcoma*. The first two groups contain the great majority of all sarcomata, and may occur in almost any part of the body, but they are especially liable to attack the bones (fig. 12). A sarcoma of bone may be either *periosteal* when it grows from the periosteum covering the outer surface of the bone, or *endosteal* when it lies in the medullary cavity. A peculiar form of sarcoma is found in the parotid and other salivary glands. The cells are usually spindle-shaped, and among them lie scattered masses of cartilage and fibrous tissue. These tumours are seldom very malignant, and dissemination is rare (fig. 13). The *melanotic sarcoma* is of a brown or black colour owing to the presence of granules of pigment (melanin) in and among the tumour cells. A melanotic sarcoma may arise from a pigmented wart or mole, or from the pigmented layers of the retina. The primary growth is usually small, but dissemination occurs with great rapidity throughout the body. The *myeloid sarcoma*, or *myeloma* (fig. 14), is composed of very large cells like those of bone-marrow from which it is probably derived. It is only found in the interior of bones, chiefly in those of the arm and leg. The degree of malignancy is low, dissemination never occurs, and recurrence after operation is rare.

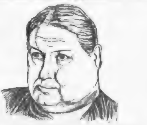


FIG. 13.—Malignant tumour of the parotid gland.

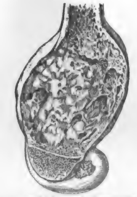


FIG. 14.—Lower end of a femur in longitudinal section, showing a myeloma.

II.—*Epithelial Tumours.*

Papilloma.—The familiar example of a papilloma is the simple wart, which is formed by a proliferation of the squamous epithelium of the skin (fig. 3). It seems probable that some warts are of an infective nature, for instances of direct contagion are not uncommon. Occasionally warts are pigmented, and are then liable to be the seat of a melanotic sarcoma. Papillomata are also found in the bladder (fig. 15), as long delicate filaments growing from the bladder wall. These consist of a connective-tissue core covered by a thin layer of epithelium.

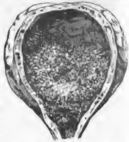


FIG. 15.—Villous papilloma of the bladder.

Adenoma.—(Figs. 1*a* and 1*b*). The glandular tumours are of very common occurrence in the breast, the ovary and the intestinal canal. The structure of an adenoma of the breast has already been described (*vide supra*), and the structure of other adenomata is on the same general plan. The main features of an innocent glandular tumour are: (*a*) the presence of a rounded, painless swelling with a well-defined margin; (*b*) the swelling is freely movable in the surrounding tissues, and if it lies close beneath the skin it is not attached thereto; (*c*) there is no enlargement of the neighbouring lymphatic glands.

Carcinoma.—The following varieties of carcinoma are described:—

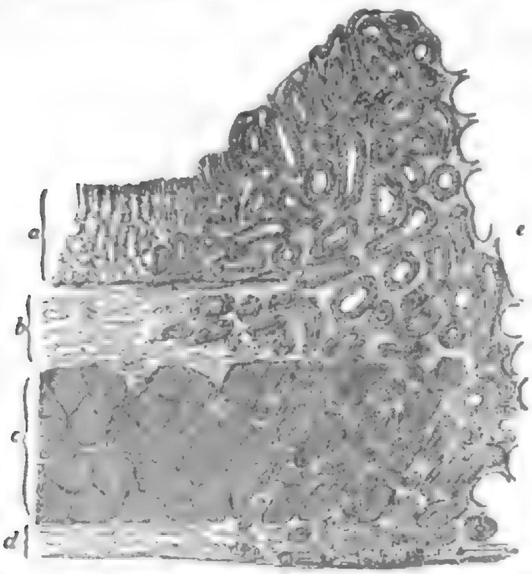
i. *Squamous-cell carcinoma* (fig. 4), arising from those parts of the body covered by squamous epithelium, namely the skin, the mouth, the pharynx, the upper part of the oesophagus and the bladder.

ii. *Spheroidal-cell carcinoma* (figs. 2*a* and 2*b*), arising from spheroidal epithelium, as in the breast, the pylorus, the pancreas, the kidney and the prostrate.

iii *Columnar-cell carcinoma* (figs. 16 and 17), arising from columnar epithelium, as in the intestine.

The general histology of these tumours corresponds to that of a spheroidal-cell carcinoma already described (*vide supra*), the only variation between the three groups being in the shape of the cells. The clinical characteristics of a carcinoma, whatever its situation, are: (*a*) the presence of a swelling which has no well defined margin, but fades away into the surrounding tissues to which it is fixed; (*b*) when the tumour lies near the skin (*e.g.* a carcinoma of the breast) it becomes fixed to this at an early date; (*c*) the tumour is painful and tender, the degree of pain varies widely, and in the early stages there may be none; (*d*) the neighbouring lymphatic glands soon become enlarged and tender, showing that they are the seat of metastatic deposits; (*e*) in squamous carcinoma of the skin, ulceration speedily occurs.

Rodent Ulcer.—This shows itself as a slowly progressing ulceration of the skin, and is especially common on the face near the eye or ear. The condition is one of purely local malignancy, and dissemination does not occur. It is believed to be a carcinoma of the sebaceous glands of the skin. (L. C.*)



(Redrawn from Ziegler's *Pathological Anatomy*, by permission of Macmillan & Co.)

FIG. 16.—Section through advancing margin of columnar; cancer of stomach.

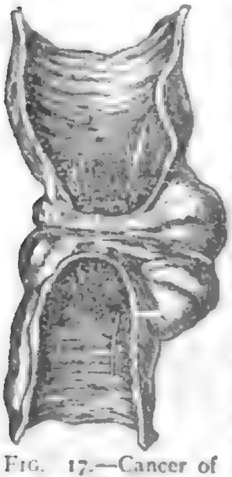


FIG. 17.—Cancer of the sigmoid flexure of the colon.

TUMULUS, a Latin word meaning a heap or mound, also used in classical writings in the secondary sense of a grave. In Roman epitaphs we meet with the formula *tumulum faciendum curavit*, meaning the grave and its monument; and on the inscribed monumental stones placed over the early Christian graves of Gaul and Britain the phrase *in hoc tumulo jacet* expresses the same idea. But among archaeologists the word is usually restricted in its technical modern application to a sepulchral mound of greater or less magnitude. The mound may be of earth, or of stones with a covering of earth, or may be entirely composed of stones. In the latter case, if the tumulus of stones covers a megalithic cist or a sepulchral chamber with a passage leading into it from the outside, it is often called a dolmen. (See STONE MONUMENTS, BARROW and CAIRN.) The custom of constructing sepulchral tumuli was widely prevalent throughout the prehistoric ages and is referred to in the early literature of various races as a fitting commemoration of the illustrious dead. Prehistoric tumuli are found abundantly in almost all parts of Europe and Asia from Britain to Japan. They occur with frequency also in northern Africa, and in many parts of North and South America the aboriginal populations have practised similar customs. Sepulchral tumuli, however, vary so much in shape and size that the external appearance is no criterion of age or origin. In North America, especially in the Wisconsin region, there are numerous mounds made in shapes resembling the figures of animals, birds or even human forms. These have not been often found to be sepulchral, but they are associated with sepulchral mounds of the ordinary form some of which are as much as 300 ft. in diameter and 90 ft. in height. Perhaps the largest tumulus on record is the tomb of Alyattes, king of Lydia, situated near Sardis, constructed in his own lifetime, before 560 B.C. It is a huge mound, 1180 ft. in diameter and 200 ft. high. In south-eastern Europe, and especially in southern Russia, the sepulchral tumuli are very numerous and often of great size, reaching occasionally to 400 ft. in circumference and over 100 ft. in height. These are mostly of the period of the Greek colonies of the Tauric Chersonese, dating from about the 5th century B.C. to about the 2nd century A.D., and their contents bear striking testimony to the wealth and culture of the people who reared them.

AUTHORITIES.—Duncan McPherson, M.D., *Antiquities of Kertch and Researches in the Cimmerian Bosphorus* (London, 1857); Cyrus Thomas, "Burial Mounds of the Northern Sections of the United States," *Fifth Annual Report of the Bureau of Ethnology to the Smithsonian Institution* (Washington, 1887); Kondakoff, Tolstoi and Reinach, *Antiquités de la Russie méridionale* (Paris, 1891). (J. AN.)

TUN, a town in the province of Khorasan, Persia, situated about 150 m. S. of Nishapur in 34° N., 58° 7′ E., at an elevation of 1200 ft. The town, which has a population of 7000, is surrounded by a wall, 20 ft. in height, raised on a high rampart of mud. It has three gates, handsome bazaars, good caravanserais and numerous large gardens and fields producing opium, tobacco and cotton. Some silk is also grown.

TUNBRIDGE WELLS, a municipal borough and inland watering-place of England, chiefly in the Tonbridge parliamentary division of Kent, but extending into the eastern division of Sussex, 34½ m. S.E. by S. of London by the South Eastern & Chatham railway, served also by a branch of the London Brighton & South Coast line. Pop. (1891), 29,296; (1901), 33,373. It owes its popularity to its chalybeate spring and its beautiful situation in a hilly wooded district. The wells are situated by the Parade (or Pantiles), a walk associated with fashion since the time of their discovery. It was paved with pantiles in the reign of Queen Anne. Reading and assembly rooms adjoin the pump-room. The town is built in a picturesquely irregular manner, and a large part of it consists of districts called "parks" occupied by villas and mansions. On Rusthall Common about a mile from the town is the curiously shaped mass of sandstone known as the Toad Rock, and a mile and a half south-west is the striking group called the High Rocks. The Tunbridge Wells sanatorium is situated in grounds sixty acres in extent. Five miles south-east of Tunbridge Wells is Bayham Abbey, founded in 1200, where ruins of a church, a gateway, and dependent buildings adjoin the modern Tudor mansion. Three miles south, in Sussex, the village of Frant stands on a hill which is perhaps the finest of the many view-points in this district, commanding a wide prospect over some of the richest woodland scenery in England. The vicinity of Tunbridge Wells is largely residential. To the north lies the urban district of SOUTHBOROUGH (pop. 6977). There is a large trade in Tunbridge ware, which includes work-tables, boxes, toys, &c., made of hard woods, such as beech, sycamore, holly, and cherry, and inlaid with mosaic. Tunbridge Wells was incorporated in 1889, and is governed by a mayor, 8 aldermen and 24 councillors. Area, 3991 acres.

The town owes its rise to the discovery of the medicinal springs by Dudley, Lord North, in 1606. Henrietta Maria, wife of Charles I., retired to drink the waters at Tunbridge Wells after the birth of her eldest son Charles. Soon after the Restoration it was visited by Charles II. and Catherine of Braganza. It was a favourite residence of the princess Anne previous to her accession to the throne, and from that time became one of the chief resorts of London fashionable society. In this respect it reached its height in the second half of the 18th century, and is specially associated with Colley Cibber, Samuel Johnson, Cumberland the dramatist, David Garrick, Samuel Richardson, Sir Joshua Reynolds, Beau Nash, Miss Chudleigh and Mrs Thrale. The Tunbridge Wells of that period is sketched with much graphic humour in Thackeray's *Virginians*.

TUNDRA (a Russian word, signifying a marshy plain), in physical geography, the name applied to the treeless and often marshy plains which border the arctic coasts of Europe, Asia and North America. The Russian tundra, apart from the arctic conditions of climate and flora, may be compared with the steppes farther south.

TUNGABHADRA, a river of southern India, the chief tributary of the Kistna. It is formed by the junction of two streams, the Tunga and the Bhadra, which both rise in Mysore in the Western Ghats. The united river for nearly all its course forms the boundary between Madras and the dominions of the nizam of Hyderabad. On its right bank stood the capital of the ancient Hindu dynasty of Vijayanagar, now a wilderness of ruins. From of old its waters have been utilized for irrigation. Near its confluence with the Kistna it supplies the Kurnool-Cuddapah Canal. A project has been recently under consideration to dam the river higher up, and there construct an artificial lake that would have an area of 160 sq. m., the cost of this scheme being roughly estimated at nearly £6,000,000.

T'UNG-CHOW, a sub-prefectural city in Chih-li, the metropolitan province of China, on the banks of the Peiho in 39° 54′ N. 116° 41′ E., 12 m. E. of Peking. Its population is estimated at about 50,000.

T'ung-Chow marks the highest point at which the Peiho is navigable, and here merchandise for Peking is transferred to a canal. The city, which is faced on its eastern side by the river, and on its other three sides is surrounded by populous suburbs, is upwards of 3 m. in circumference. The walls are about 45 ft. in height and about 24 ft. wide at the top. They are being allowed to fall into decay. Two main thoroughfares connect the north and south gates and the east and west gates. The place derives its importance from the fact that it is the port of Peking. Like most Chinese cities, T'ung-Chow has appeared in history under various names. By the founder of the Han dynasty (206 B.C.) it was called Lu-Hien; with the rise of the T'ang dynasty (618 A.D.) its name was changed to Hüan-Chow; and at the beginning of the 12th century, with the advent of the Kin dynasty to power, Hüan-Chow became T'ung-Chow. It was at T'ung-Chow that Sir Harry Parkes, Sir Henry Loch and their escort were treacherously taken prisoners by the Chinese when they were sent forward by Lord Elgin to negotiate terms of peace after the troubles of 1860. During the Boxer outbreak in 1900 T'ung-Chow was occupied by the allied armies, and a light railway connecting the city with Peking was constructed by German military engineers.

TUNGSTEN [symbol W, atomic weight 184·0 (O=16)], a metallic chemical element found in the minerals wolfram, an iron and manganese tungstate, scheelite, a calcium tungstate, stolzite, a lead tungstate, and in some rarer minerals. Its presence in scheelite was detected by Scheele and Bergman in 1781, and in 1783 Juan, José and d'Elhuyar showed the same substance occurred in wolfram; they also obtained the metal. Tungsten may be prepared from wolfram by heating the powdered ore with sodium carbonate, extracting the sodium carbonate with water, filtering and adding an acid to precipitate tungstic acid, H_2WO_4. This is washed and dried and the oxide so obtained reduced to the metal by heating with carbon to a high temperature (Hadfield, *Journ. Iron and Steel Inst.*, 1903, ii. 38). On a small scale it is obtained by reducing the trioxide in a current of hydrogen, or the chloride by sodium vapour, or the oxide with carbon in the electric furnace; in the last case the product is porous and can be welded like iron. In the form of a powder, it is obtained by reducing the oxide with zinc and extracting with soda, or by dissolving out the manganese from its alloys with tungsten. The metal may be used uncombined, but large quantities of ferrotungsten are made in the electric furnace; other alloys are prepared by acting on a mixture of the oxides with aluminium. Tungsten has been applied in the manufacture of filament electric lamps. The metal has a crystalline structure, and melts at about 2800°. The powdered metal burns at a red heat to form the trioxide; it is very slowly attacked by moist air. It combines with fluorine with incandescence at ordinary temperatures, and with chlorine at 250–300°; carbon, silicon, and boron, when heated with it in the electric furnace, give crystals harder than the ruby. It is soluble in a mixture of nitric and hydrofluoric acids, and the powdered metal, in aqua regia, but slowly attacked by sulphuric, hydrochloric and hydrofluoric acids separately; it is also soluble in boiling potash solution, giving a tunstate and hydrogen.

Tungsten dioxide, WO_2, formed on reducing the trioxide by hydrogen at a red heat or a mixture of the trioxide and hydrochloric acid with zinc, or by decomposing the tetrachloride with water, is a brown strongly pyrophoric powder, which must be cooled in hydrogen before being brought into contact with air. It is slightly soluble in hydrochloric and sulphuric acids, giving purple solutions. It dissolves in potash, giving potassium tungstate and hydrogen, and is readily oxidized to the trioxide.

Tungsten trioxide, WO_3, occurs in nature as wolframine, a yellow mineral found in Cumberland, Limoges, Connecticut and in North Carolina. It is prepared as shown above, or by other methods. It is a canary-yellow powder, which becomes a dark orange on heating; the original colour is regained on cooling. On exposure to light it assumes a greenish tinge. A crystalline form was obtained by Debray as olive-green prisms by igniting a mixture of sodium tungstate and carbonate in a current of hydrochloric acid gas, and by Nordenskjold by heating hydrated tungstic acid with borax. Partial reduction of tungsten trioxide gives blue or purple-red products which are intermediate in composition between the dioxide and trioxide. Tungsten trioxide forms two acids, tungstic acid, H_2WO_4, and metatungstic acid, $H_2W_4O_{13}$; it also gives origin to several series of salts, to which the acids corresponding are unknown. Thus we have salts of the following types $M_2O(WO_3)_n$, where $n=1, 2, 3, 4, 5, 6, 7, 8$, and also $(M_2O)_m(WO_3)_n$, where $m, n=2, 5; 3, 7; 4, 3; 5, 12$; M standing for a monovalent metal. The $(M_2O)_5(WO_3)_{12}$ or $M_{10}W_{12}O_{41}$ salts are called paratungstates. *Tungstic acid*, H_2WO_4, is obtained as $H_2WO_4{\cdot}H_2O$ by precipitating a tungstate with cold acid; this substance has a bitter taste and its aqueous solution reddens litmus. By using hot acid the yellow anhydrous tungstic acid is precipitated, which is insoluble in water and in all acids except hydrofluoric. It may be obtained in a flocculent form by exposing the hexachloride to moist air. *Metatungstic acid*, $H_2W_4O_{13}{\cdot}7H_2O$, is obtained by decomposing the barium salt with sulphuric acid or the lead salt with hydrochloric acid. It forms yellow octahedra, which become anhydrous at 100°, and are converted into the trioxide on ignition. It is readily soluble in water, and on boiling the aqueous solution a white hydrate is first deposited which after a time is converted into the trioxide. Graham obtained a colloidal tungstic acid by dialysing a dilute solution of sodium tungstate and its equivalent of hydrochloric acid; on concentrating in a vacuum a gummy product is obtained, which still remains soluble after heating to 200°, but it is converted into the trioxide on heating to redness. When moistened it becomes adhesive. The solution has a bitter taste and does not gelatinize, even under the influence of boiling acids.

Of the salts, the normal tungstates are insoluble in water with the exception of the alkaline tungstates; they are usually amorphous, but some can be obtained in the crystalline form. The metatungstates of the alkalis are obtained by boiling normal tungstates with tungstic acid until the addition of hydrochloric acid to the filtrate gives no precipitate. The most important tungstate is the so-called tungstate of soda, which is sodium paratungstate, $Na_{10}W_{12}O_{41}{\cdot}28H_2O$. This salt is obtained by roasting wolfram with sodium carbonate, lixiviating, neutralizing the boiling filtrate with hydrochloric acid and crystallizing at ordinary temperatures. The salt forms large monoclinic prisms; molecules containing 25 and 21 H_2O separate from solutions crystallized at higher temperatures. The salt is used as a mordant in dyeing and calico printing, and also for making textiles non-inflammable. Several other sodium tungstates are known, as well as potassium and ammonium tungstates. Many salts also occur in the mineral kingdom: for example, scheelite is $CaWO_4$, stolzite is $PbWO_4$, farberite is $FeWO_4$, wolfram is $(Fe,Mn)WO_4$, whilst hübnerite is $MnWO_4$.

By partial reduction of the tungstates under certain conditions products are obtained which are insoluble in acids and alkalis and present a bronze-like appearance which earned for them the name of tungsten bronzes. The sodium compound was first obtained by Wöhler on reducing sodium tungstate with hydrogen; coal-gas, zinc, iron or tin also effect the reduction. It forms golden cubes which are unattacked by alkalis or by any acid except hydrofluoric. It appears to be a mixture of which the components vary with the materials and methods used in its production (Philipp, *Ber.*, 1882, 15, p. 499). A blue bronze, $Na_2W_5O_{15}$, forming dark blue cubes with a red reflex, is obtained by electrolysing fused sodium paratungstate; a purple-red variety, $Na_2W_4O_{12}$, and a reddish yellow form result when sodium carbonate and sodium tungstate are heated respectively with tungsten trioxide and tinfoil. Similar potassium tungsten bronzes are known.

Tungstic acid closely resembles molybdic acid in combining with phosphoric, arsenious, arsenic, boric, vanadic and silicic acids to form highly complex acids of which a great many salts exist. Of the phosphotungstic acids the most important is phosphoduodecitungstic acid, $H_3PW_{12}O_{40}{\cdot}nH_2O$, obtained in quadratic pyramids by crystallizing mixed solutions of orthophosphoric and metatungstic acids. Two sodium salts, viz. $Na_8HPW_{11}O_{40}\cdot nH_2O$ and $Na_3PW_{12}O_{40}\cdot nH_2O$, are obtained by heating sodium hydrogen phosphate with a tungstate. The most important silicotungstic acids are silicodecitungstic acid $H_8W_{10}SiO_{36}\cdot 3H_2O$, tungstosilicic acid, $H_8W_{12}SiO_{42}\cdot 20H_2O$, and silicoduodecitungstic or silicotungstic acid, $H_8W_{12}SiO_{42}\cdot 29H_2O$. On boiling gelatinous silica with ammonium polytungstate and evaporating with the occasional addition of ammonia, ammonium silicodecitungstate is obtained as short rhombic prisms. On adding silver nitrate and decomposing the precipitated silver salt with hydrochloric acid, a solution is obtained which on evaporation in a vacuum gives the free acid as a glassy mass. If this be dissolved in water and the solution concentrated, some silicic acid separates and the filtrate deposits triclinic prisms of tungstosilicic acid. Silicotungstic acid is obtained as quadratic pyramids from its mercurous salt which is prepared from mercurous nitrate and the salt formed on boiling gelatinous silicic acid with a polytungstate of an alkali metal.

Pertungstic Acid, HWO_4.—The sodium salt, $NaWO_4\cdot H_2O$, is obtained by evaporating in a vacuum the product of boiling a solution of sodium paratungstate with hydrogen peroxide. Its solution liberates chlorine from hydrochloric acid and iodine from potassium iodide.

Halogen Compounds.—Although the trioxide is soluble in hydrofluoric acid, evaporation of the solution leads to the recovery of the oxide unchanged. A double salt of the oxyfluoride, viz. $2KF\cdot WO_2F_2\cdot H_2O$, is obtained as crystalline scales by dissolving normal potassium tungstate in hydrofluoric acid and adding potassium hydroxide till a permanent precipitate is just formed. Other oxyfluorides are known. The hexafluoride, WF_6, is a very active gaseous compound, which attacks glass and metals, obtained from tungsten hexachloride and hydrofluoric acid (Ruff and Eisner, *Ber.*, 1905, 38, p. 742). Oxyfluorides of the formulae WOF_4 and WO_2F_2 are also known. Tungsten forms four chlorides, viz. WCl_2, WCl_4, WCl_5, WCl_6. The dichloride, WCl_2, is an amorphous grey powder obtained by reducing the hexachloride at a high temperature in hydrogen, or, better, by heating the tetrachloride in a current of carbon dioxide. It changes on exposure to air and dissolves slightly in water to give a brown solution, the insoluble portion gradually being converted into an oxide with evolution of hydrogen. The tetrachloride, WCl_4, is obtained by partial reduction of the higher chlorides with hydrogen; a mixture of the penta- and hexa-chloride is distilled in a stream of hydrogen or carbon dioxide, and the pentachloride which volatilizes returned to the flask several times. This gives the tetrachloride as a greyish-brown crystalline powder. It is very hygroscopic and with cold water gives the oxide and hydrochloric acid. On heating it gives the di- and penta-chlorides. At a high temperature hydrogen reduces it to the metal partly in the form of a black pyrophoric powder. The pentachloride, WCl_5, is obtained as a product in the preparation of the tetrachloride. It forms black lustrous crystals, or when quickly condensed, a dark green crystalline powder. It melts at 248° and boils at 275·6°; the vapour density corresponds to the above formula. It is more hygroscopic than the tetrachloride; and when treated with much water the bulk is at once decomposed into the blue oxide and hydrochloric acid, but an olive-green solution is also produced. The hexachloride, WCl_6, is obtained by heating the metal in a current of dry chlorine in the absence of oxygen or moisture, otherwise some oxychloride is formed; a sublimate of dark violet crystals appear at first, but as the hexachloride increases in quantity it collects as a very dark red liquid. When perfectly pure, the hexachloride is stable even in moist air, but the presence of an oxychloride brings about energetic decomposition; similarly water has no action on the pure compound, but a trace of the oxychloride occasions sudden decomposition into a greenish oxide and hydrochloric acid. It melts at 275° and boils at 346·7° (759·5 mm.). Vapour density determinations indicate that dissociation occurs when the vapour is heated above the boiling point.

Several oxychlorides are known. The monoxychloride, $WOCl_4$, is obtained as red acicular crystals by heating the oxide or dioxychloride in a current of the vapour of the hexachloride, or from the trioxide and phosphorus pentachloride. It melts at 210·4° and boils at 227·5° forming a red vapour. Moist air brings about the immediate formation of a yellowish crust of tungstic acid. The dioxychloride, WO_2Cl_2, is obtained as a light lemon-yellow sublimate on passing chlorine over the brown oxide. It is unaffected by moist air or cold water, and even when boiled with water the decomposition is incomplete. Tungsten combines directly with bromine to give, when the bromine is in excess, the penta- and not a hexabromide. This substance forms crystals resembling iodine, which melt at 276° and boil at 333°. It slowly evolves bromine on standing, and is at once decomposed by water into the blue oxide and hydrobromic acid. The dibromide, WBr_2, is a non-volatile bluish-black powder obtained by reducing the pentabromide with hydrogen. By passing bromine vapour over red-hot tungsten dioxide a mixture of WO_2Br_2 and $WOBr_4$ is obtained, from which the latter can be removed by gently heating when it volatilizes. The dioxybromide forms light red crystals or a yellow powder; it volatilizes at a red heat, and is not acted upon by water. The monoxybromide forms brownish-black needles, which melt at 277° and boil at 327·5; it is decomposed by water. The di-iodide is obtained as green metallic scales on passing iodine over red-hot tungsten.

Tungsten disulphide, WS_2, is obtained as soft black acicular crystals by the action of sulphur, sulphuretted hydrogen or carbon bisulphide on tungsten. The trisulphide, WS_3, is obtained by dissolving the trioxide in ammonium sulphide or by passing sulphuretted hydrogen into a solution of a tungstate and precipitating by an acid in both cases. When dry it is a black mass which yields a liver-coloured powder. It is sparingly soluble in cold water, but is easily dissolved by potassium carbonate or ammonia. By dissolving it in a hydrosulphide a sulphotungstate is produced; these salts can also be obtained by passing sulphuretted hydrogen into a solution of a tungstate.

A *nitride*, W_2N_3, is obtained as a black powder by acting with ammonia on the oxytetrachloride or hexachloride; it is insoluble in sodium hydroxide, nitric and dilute sulphuric acids; strong sulphuric acid, however, gives ammonia and tungstic acids. Ammonia does not react with tungsten or the dioxide, but with trioxide at a red heat a substance of the formula $W_3H_4N_2O_3$ is obtained, which is insoluble in acids and alkalis and on ignition decomposes, evolving nitrogen, hydrogen and ammonia. Phosphorus combines directly with the metal to form W_3P_4; another phosphide, W_3P, results on igniting a mixture of phosphorus pentoxide and tungsten trioxide.

The atomic weight has been determined by many investigators; the chief methods employed being the analysis and synthesis of the trioxide and the analysis of the hexachloride. The former was employed by Pennington and Smith and Desi (*Zeit. anorg. Chem.*, 1895, 8, pp. 198, 205) who obtained the value 183·42.

TUNGUSES, a widespread Asiatic people, forming a main branch of the Mongol division of the Mongol-Tatar family. They are the *Tung-hu* of the Chinese, probably a corrupt form of *tonki* or *donki*, that is, "men" or "people." The Russian form *Tungus*, wrongly supposed to mean "lake people," appears to occur first in the Dutch writer Massa (1612); but the race has been known to the Russians ever since they reached the Yenisei. The Tungus domain, covering many hundred thousand square miles in central and east Siberia and in the Amur basin, stretches from the Yenisei eastwards to the Pacific, where it occupies most of the seaboard between Korea and Kamchatka. It also reaches the Arctic Ocean at two points, in the Nisovaya tundra, west of the Khatanga River, and in a comparatively small enclosure in the Yana basin over against the Lyakhov (New Siberia) Archipelago. But the Tunguses proper are chiefly centred in the region watered by the three large eastern tributaries of the Yenisei, which from them take their names of the Upper, Middle or Stony, and Lower Tunguska. Here the Tunguses are known to the Samoyedes by the name of *Aya* or "younger brothers," implying a comparatively recent immigration (confirmed by other indications) from the Amur basin, which appears to be the original home both of the Tunguses and of the closely allied Manchus. The Amur is still mainly a Tungus river almost from its source to its mouth: the Oroches (Orochus), Daurians, Birars, Golds, Manegrs, Sanagirs, Ngatkons, Nigidals, and some other aboriginal tribes scattered along the main stream and its affluents—the Shilka, Sungari and Usuri—are all of Tungus stock and speech. On the Pacific the chief subdivisions of the race are the Lamuts, or "sea people," grouped in small isolated hunting communities round the west coast of the Sea of Okhotsk, and farther south the Tazi between the Amur delta and Korea. The whole race, exclusive of Manchus, numbers probably little more than 50,000, of whom some 10,000 are in the Amur basin, the rest in Siberia.

The Tungus type is essentially Mongolic, being characterized by broad flat features, small nose, wide mouth, thin lips, small black and somewhat oblique eyes, black lank hair, dark olive or bronze complexion, low stature, averaging not more than 5 ft. 4 in.; they are distinguished from other Mongolic peoples by the square shape of the skull and the slim, wiry, well-proportioned figure. This description applies more especially to the Tunguska tribes, who may be regarded as typical Tunguses, and who, unlike most other Mongols, betray no tendency to obesity. They are classed by the Russians, according to their various pursuits, as Reindeer, Horse, Cattle, Dog, Steppe and Forest Tunguses. A few have become settled agriculturists; but the great bulk of the race are still essentially forest hunters, using the reindeer both as mounts and as pack animals. Nearly all lead nomad lives in pursuit of fur-bearing animals, whose skins they supply to Russian and Yakut traders in exchange for provisions, clothing and other necessaries of life. The picturesque and even elegant national costume shows in its ornamentation and general style decided Japanese influence, due no doubt to long-continued intercourse with that nation at some period previous to the spread of the race from the Amur valley to Siberia. Many of the Tungus tribes have been baptized, and are, therefore, reckoned as "Greek Christians"; but Russian orthodoxy has not penetrated far below the surface, and most of them are still at heart Shamanists and nature-worshippers, secretly keeping the teeth and claws of wild animals as idols or amulets, and observing Christian rites only under compulsion. But, whether Christians or pagans, all alike are distinguished above other Asiatics, perhaps above all other peoples, for their truly noble moral qualities. All observers describe them as "cheerful under the most depressing circumstances, persevering, open-hearted, trustworthy, modest yet self-reliant, a fearless race of hunters, born amidst the gloom of their dense pine forests, exposed from the cradle to every danger from wild beasts, cold and hunger. Want and hardships of every kind they endure with surprising fortitude, and nothing can induce them to take service under the Russians or quit their solitary woodlands" (Keane's *Asia*, p. 479). Their numbers are steadily decreasing owing to the ravages of small-pox, scarlet fever, and especially famine, their most dreaded enemy. Their domain is also being continually encroached upon by the aggressive Yakuts from the north and east, and from the south by the Slavs, now settled in compact bodies in the province of Irkutsk about the upper course of the Yenisei. It is remarkable that, while the Russians often show a tendency to become assimilated to the Yakuts, the most vigorous and expansive of all the Siberian peoples, the Tunguses everywhere yield before the advance of their more civilized neighbours or become absorbed in the surrounding Slav communities. In the Amur valley the same fate is overtaking the kindred tribes, who are disappearing before the great waves of Chinese migration from the south and Russian encroachments both from the east and west.

See L. Adam, *Grammaire de la langue toungouse* (Paris, 1874); C. Hickisch, *Die Tungusen* (St Petersburg, 1879); L. Schrenck, *Reisen und Forschungen im Amurlande* (St Petersburg, 1881–1891); Mainov, *Niekotorya dannyia* (Irkutsk, 1898).

TUNIC (O. Eng. *tunice, tunical*, taken, before the Norman conquest, directly from Lat. *tunica*, of which the origin is unknown), properly the name given in Latin to the principal undergarment of men and women, answering to the chiton (*χιτών*) of the Greeks, and covered by the outer garment, the *palla* (Gr. *ἱμάτιον*), in the case of women, and by the peculiar Roman garment, the *toga*, in the case of men. The male *tunica* differed from the *χιτών* in usually having short sleeves (see further COSTUME: § *Ancient Greek and Roman*). The term, more often in the form "tunicle" (Lat. dim. *tunicula*), is applied, in ecclesiastical usage, to a vestment worn over the alb by the sub-deacon in the celebration of the Mass. In general current usage it is used of any loose short garment, girt at the waist and reaching from the neck to some distance above the knee. It is thus the name of the fatigue coat of a soldier of the British army. There are numerous uses of "tunic" or "tunica" in anatomy, zoology and botany in the sense of a covering or integument.

TUNICATA. This group of marine animals was formerly regarded as constituting, along with the Polyzoa and the Brachiopoda, the invertebrate class Molluscoidea. It is now known to be a degenerate branch of the Chordata, and to be more nearly related to the Vertebrata than to any group of the Invertebrata. The Tunicata are found in all seas, from the littoral zone down to abyssal depths. They occur either fixed or free, solitary, aggregated or in colonies. The fixed forms are the "simple" and "compound" Ascidians. The colonies are produced by budding and the members are conveniently known as Ascidiozooids. Some Tunicata undergo alternation of generations, and most of them show a retrograde metamorphosis in their life-history.

HISTORY[1]

More than two thousand years ago Aristotle gave a short account of a simple Ascidian under the name of *Tethyum*. Schlosser and Ellis, in a paper on *Botryllus*, published in the *Philosophical Transactions* of the Royal Society for 1756, first brought the compound Ascidians into notice; but it was not until the commencement of the 19th century, as a result of the careful anatomical investigations of G. Cuvier (1) upon the simple Ascidians and of J. C. Savigny (2) upon the compound, that the close relationship between these two groups of the Tunicata was conclusively demonstrated. Lamarck (3) in 1816 instituted the class Tunicata, which he placed between the Radiara and the Vermes in his system of classification. The Tunicata included at that time, besides the simple and the compound Ascidians, the pelagic forms *Pyrosoma*, which had been first made known by F. Péron in 1804, and *Salpa*, described by P. Forskål in 1775.

A. v. Chamisso, in 1819, made the important discovery that *Salpa* in its life-history passes through the series of changes which were afterwards more fully described by J. J. S. Steenstrup in 1842 as "alternation of generations"; and a few years later Kuhl and Van Hasselt's investigations upon the same animal resulted in the discovery of the alternation in the directions in which the wave of contraction passes along the heart and in which the blood circulates through the body. It has since been found that this observation holds good for all groups of the Tunicata. In 1826 H. Milne-Edwards and Audouin made a series of observations on living compound Ascidians, and amongst other discoveries they found the free-swimming tailed larva, and traced its development into the young Ascidian.

In 1845 Carl Schmidt (6) first announced the presence in the test of some Ascidians of "tunicine," a substance very similar to cellulose, and in the following year Löwig and A. v. Kölliker (7) confirmed the discovery and made some additional observations upon this substance and upon the structure of the test in general. T. H. Huxley (8), in an important series of papers published in the *Transactions* of the Royal and Linnean Societies of London from 1851 onwards, discussed the structure, embryology and affinities of the pelagic Tunicates *Pyrosoma*, *Salpa*, *Doliolum* and *Appendicularia*. These important forms were also investigated about the same time by C. Gegenbaur, C. Vogt, H. Müller, A. Krohn and F. S. Leuckart. The most important epoch in the history of the Tunicata is the date of the publication of A. Kowalevsky's celebrated memoir upon the development of a simple Ascidian (9). The tailed larva had been previously investigated; but its minute structure had not been sufficiently examined, and the meaning of what was known of it had not been understood. It was reserved for Kowalevsky in 1866 to demonstrate the striking similarity in structure and in development between the larval Ascidian and the vertebrate embryo. He showed that the relations between the nervous system, the notochord and the alimentary canal are the same in the two forms, and have been brought about by a very similar course of embryonic development. This discovery clearly indicated that the Tunicata are closely allied to *Amphioxus* and the Vertebrata, and that the tailed larva represents the primitive or ancestral form from which the adult Ascidian has been evolved by degeneration, and this led naturally to the view usually accepted at the present day, that the group is a degenerate side-branch from the lower end of the phylum Chordata, which includes the Tunicata (Urochorda), *Balanoglossus*, &c. (Hemichorda), *Amphioxus* (Cephalochorda) and the Vertebrata. Kowalevsky's great discovery has since been confirmed and extended to all other groups of the Tunicata by C. v. Kupffer (12), A. Giard (13 and 15), and others.

In 1872 H. Fol (14) added largely to the knowledge of the Appendiculariidae, and Giard (15) to that of the compound Ascidians. The most important additions which have been made to the latter since have been those described by Von Drasche (16) from the Adriatic and those discovered by the "Challenger" and other expeditions (17). The structure and the systematic arrangement of the simple Ascidians have been mainly discussed of recent years by J. Alder and A. Hancock (18), C. Heller (19), H. de Lacaze-Duthiers (20), M. Traustedt (21), L. Roule, R. Hartmeyer, C. P. Sluiter, W. Michaelsen and W. A. Herdman (17, 22). In 1874 Ussoff (23) investigated the minute structure of the nervous system and of the underlying gland (first discovered by Hancock), and showed that the duct communicates with the front of the branchial sac or pharynx by an aperture in the dorsal (or "olfactory") tubercle. In 1880 C. Julin (24) drew attention to the similarity in structure and relations between this gland and the *hypophysis cerebri* of the vertebrate brain, and insisted upon their homology. M. M. Metcalf has since added to our knowledge of these structures. The Thaliacea have of late years been the subject of several very important memoirs. The researches of F. Todaro, W. K. Brooks (25), W. Salensky (26), O. Seeliger, Korotneff and others have elucidated the embryology, the gemmation and the life-history of the Salpidae; and K. Grobben, Barrois (27), and more especially Uljanin (28), have elaborately worked out the structure and the details of the complicated life-history of the Doliolidae. Finally, we owe to the successive memoirs of J. Hjort, O. Seeliger, W. E. Ritter, E. van Beneden, C. Julin, C. P. Sluiter, R. Hartmeyer and others the description of many new forms and much information as to the development and life-history of the group.

The new forms described from Puget Sound and Alaska have drawn renewed attention to the similarity of the fauna in that region of the North Pacific and the fauna of north-west Europe. There is probably a common circumpolar Tunicate fauna which sends extensions downwards in both Atlantic and Pacific. As the result of the careful quantitative work of the German Plankton expedition, A. Borgert thinks that the temperature of the water has more to do with both the horizontal and the vertical distribution of pelagic

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[1] Only the more important works can be mentioned here. For a more detailed account of the history of the group and a full bibliography see (17) and (35) in the list of works at the end of this article.

Tunicata in the sea than any other factor. It is probable that the occasional phenomenal swarms of *Doliolum* which have been met with in summer in the North Atlantic are a result of the curious life-history which, in favourable circumstances, allows a small number of budding forms to produce from the numerous minute buds an enormous number of the next generation. The great increase in the number of species known from nearly all seas during the last twelve or fifteen years of the 19th century enables us now to form a truer estimate of the geographical distribution of the group than was possible when the "Challenger" collections were described, and shows that the Tunicata at least give no support to the "bi-polar theory" of the distribution of animals.

ANATOMY

As a type of the Tunicata, *Ascidia mentula*, one of the larger species of the simple Ascidians, may be taken. This species is found in most of the European seas, in shallow water. **External Characters.** It has an irregularly ovate form, of a dull grey colour, and is attached to some foreign object by one end (fig. 1). The opposite end of the body has a terminal opening surrounded by eight rounded lobes. This is the mouth or branchial aperture, and it indicates the anterior end of the animal. About half-way back from the anterior end is the atrial or cloacal aperture, surrounded by six lobes and placed upon the dorsal edge. When the Ascidian is living and undisturbed, water is being constantly drawn in through the branchial aperture and passed out through the atrial. If coloured particles be placed in the water near the apertures, they are seen to be sucked into the body through the branchial aperture, and after a short time some of them are ejected with considerable force through the atrial aperture. The current of water passing in is for respiratory purposes, and it also conveys food into the animal. The atrial current is mainly the water which has been used in respiration, but it also contains all excretions from the body, and at times the ova and spermatozoa or the embryos.

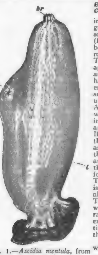
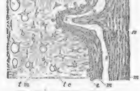


FIG. 1.—*Ascidia mentula*, from the right side.

at, Atrial aperture; *br*, branchial aperture; *l*, test.

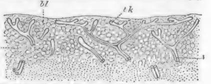
The Test. The outer grey part of the body, which is attached at or near its posterior end and penetrated by the two apertures, is the "test." This is a firm gelatinous cuticular secretion upon the outer surface of the ectoderm, which is a layer of flat cells. Although at first produced as a cuticle, the test soon becomes organized by the migration into it of cells derived from the mesoderm. A. Kowalevsky has shown that cells of the mesenchyme of the larva make their way through the ectoderm to the exterior during the metamorphosis, and become the first cells of the young test. Some of the cells in the adult test may, however, be ectodermal in origin (see fig. 2). These test cells may remain as rounded or fusiform or stellate cells embedded in the gelatinous matrix, to which they are constantly adding by secretions on their surfaces; or they may develop vacuoles which become larger and fuse so that each cell has an ovate clear cavity (a bladder cell), surrounded by a delicate film of protoplasm with the nucleus still visible at one point; or they may form pigment granules in the protoplasm; or, lastly, they may deposit carbonate of lime, so that one or several of them together produce a calcareous spicule in the test. Only the unmodified test cells and the bladder cells are found in *Ascidia mentula* (fig. 3).



(From Herdman, "*Challenger*" *Report*.)

FIG. 2.—Diagrammatic section of part of Mantle and Test of an Ascidian, showing the formation of a vessel and the structure of the test.

m,	Mantle.	*blc*,	Bladder cell.	*mc*,	Mantle cells.
e,	Ectoderm.	*s, s'*,	Blood sinus in mantle being drawn out into test.	*y*,	Septum of vessel.
tc,	Test cell.				
tm,	Matrix.				



(From *The Cambridge Natural History*, vol. viii., "Fishes, &c." By permission of Macmillan & Co., Ltd.)

FIG. 3.—Section through the surface layer of Test of *Ascidia mentula*.

bl, Bladder cells; *tc*, test cell; *tk*, terminal knobs of vessels; *v*, vessels of test.

Calcareous spicules are found chiefly in the Didemnidae amongst compound Ascidians; but pigmented cells may occur in the test of almost all groups of Tunicata. The matrix in which these structures are embedded is usually clear and apparently homogeneous; but in some cases it becomes finely fibrillated, especially in the family Cynthiidae. It is this matrix which contains tunicine. At one point on the left side near the posterior end a tube enters the test, and then splits up into a number of branches, which extend in all directions and finally terminate in rounded enlargements or bulbs, situated chiefly in the outer layer of the test. These tubes are known as the "vessels" of the test, and they contain blood. Each vessel is bounded by a layer of ectoderm cells lined by connective tissue (fig. 4, B), and is divided into two tubes by a septum of connective tissue. The septum does not extend into the terminal bulb, and consequently the two tubes communicate at their ends (fig. 4, A). The vessels are formed by an outgrowth of a blood sinus (derived originally from the blastocoele of the embryo) from the body wall (mantle) into the test, the wall of the sinus being formed by connective tissue and pushing out a covering of ectoderm in front of it (fig. 2, *s'*). The test is turned inwards at the branchial and atrial apertures to line two funnel-like tubes—the branchial siphon leading to the branchial sac, and the atrial siphon leading to the atrial or peribranchial cavity.

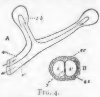


FIG. 4.

A, A vessel from the test.
B, Diagrammatic transverse section of a vessel.
ec, Ectoderm.
c t, Connective tissue.
s, s', The two tubes.
y, Septum.
t k, Terminal bulb.

The body wall, inside the test and the ectoderm, is formed of a layer (the somatic layer of mesoderm) of connective tissue, enclosing muscle fibres, blood sinuses, and nerves. This layer (the mantle) has very much the shape of the test outside it, but at the two apertures it is drawn out to form the branchial and atrial siphons (fig. 5). **Mantle, Body Wall and Body Cavities.** In the walls of these siphons the muscle fibres form powerful circular bands, the sphincter muscles. Throughout the rest of the mantle the bands of muscle fibres form a rude irregular network. They are numerous on the right side of the body, and almost totally absent on the left. The muscles are all formed of very long fusiform non-striped fibres. The connective tissue of the mantle is chiefly a clear gelatinous matrix, containing cells of various shapes; it is frequently pigmented, giving brilliant red or yellow colours to the body, and is penetrated by numerous lacunae, in which the blood flows. Inside the mantle, in all parts of the body, except along the ventral edge, there is a cavity—the atrial or peribranchial cavity—which opens to the exterior by the atrial aperture. This cavity is lined by a layer of cells derived originally from the ectoderm[1] and directly continuous with that layer through the atrial aperture (fig. 6); consequently the mantle is covered both externally and internally by ectodermal cells.

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[1] According to E. van Beneden and Julin (30) only the outer wall of the atrium is lined with epiblast, the inner wall being derived from the hypoblast of the primitive branchial sac.

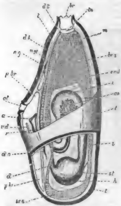

FIG. 5.—Diagrammatic dissection of *A. mentula* to show the anatomy.

at,	Atrial aperture.
br,	Branchial aperture.
a,	Anus.
brs,	Branchial sac.
dl,	Dorsal lamina.
dt,	Dorsal tubercle.
end,	Endostyle.
h,	Heart.
i,	Intestine.
m,	Mantle.
ng,	Nerve ganglion.
œ,	Oesophagus.
œa,	Oesophageal aperture.
ov,	Ovary.
pbr,	Peribranchial cavity.
r,	Rectum.
st,	Stomach.
t,	Test.
tn,	Tentacles.
vd,	Vas deferens.
ngl,	Subneural gland.

There is no true body cavity or coelom in the mesoderm; and yet the Tunicata are Coelomata in their structure and affinities, although it is very doubtful whether the enterocoele which has been described in the development is really found. In any case the coelom if formed is afterwards suppressed, and in the adult is only represented by the pericardium and its derivatives and the small cavities of the renal and reproductive organs.

Branchial Sac and Neighbouring Organs.

The branchial aperture (mouth) leads into the branchial siphon (buccal cavity or stomodaeum), and this opens into the anterior end of a very large cavity (the branchial sac) which extends nearly to the posterior end of the body (see figs. 5 and 6). This branchial sac is an enlarged and modified pharynx, and is therefore properly a part of the alimentary canal. The oesophagus opens from it far back on the dorsal edge (see below). The wall of the branchial sac is pierced by a large number of vertical slits—the stigmata—placed in numerous transverse rows (secondary or subdivided gill-slits). These slits place the branchial sac in communication with the peribranchial or atrial cavity, which lies outside it (fig. 6). Between the stigmata the wall of the branchial sac is traversed by blood-vessels, which are arranged in three regular series (fig. 7)—(1) the transverse vessels, which run horizontally round the wall and open at their dorsal and ventral ends into large longitudinal vessels, the dorsal and ventral sinuses; (2) the fine longitudinal vessels, which run vertically between adjacent transverse vessels and open into them, and which bound the stigmata; and (3) the internal longitudinal bars, which run vertically in a plane internal to that of the transverse and fine longitudinal vessels. These bars communicate with the transverse vessels by short side branches where they cross, and at these points are prolonged into the lumen of the sac in the form of hollow papillae. The edges of the stigmata are richly set with cilia, which drive the water from the branchial sac into the peribranchial cavity, and so cause the currents that flow in through the branchial aperture and out through the atrial.

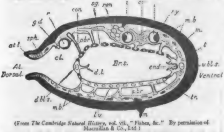

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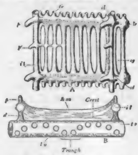
FIG. 6.—Semi-diagrammatic transverse section of *Ascidia*, passing through the atrial aperture, seen from anterior surface, left side uppermost.

At,	Atrial aperture.	*mb*,	Muscle-bundles.
atl,	Atrial lobe.	*ov*,	Ovary.
Brs,	Branchial sac.	*pbr*,	Peribranchial cavity.
cl,	Cloaca.	*r*,	Rectum.
con,	Connective.	*ren*,	Renal vesicles.
dbls,	Dorsal blood-sinus.	*sg*,	Stigmata.
dl,	Dorsal lamina.	*sph*,	Atrial sphincter.
end,	Endostyle.	*t*,	Test.
gd,	Genital ducts.	*tr*,	Transverse vessel.
si',	Intestine.	*ty*,	Typhlosole.
lv,	Interstigmatic vessel.	*vbls*,	Ventral blood-sinus.
m,	Mantle.		



(From Herdman, "*Challenger*" *Report.*)

FIG. 7.—A, Part of branchial sac of *Ascidia* from inside. B, Transverse section of same.

tr,	Transverse vessel.	*lv*,	Fine longitudinal vessels.
cd,	Connecting duct.	*p.p'*,	Papillae.
hm,	Horizontal membrane.	*sg*,	Stigmata.
il,	Internal longitudinal bar.		

(A and B are drawn to different scales.)

Endostyle.

Along its ventral edge the wall of the branchial sac is continuous externally with the mantle (fig. 6), while internally it is thickened to form two parallel longitudinal folds bounding a groove, the "endostyle" or ventral furrow (figs. 5, 6, 8, *end.*) corresponding to the hypopharyngeal groove of *Amphioxus* and the median part of the thyroid gland of Vertebrata. The endoderm cells which line the endostyle are greatly enlarged at the bottom, where they bear very long cilia, and on parts of the sides of the furrow so as to form projecting glandular pads (fig. 8, *gl.*).

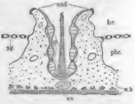


FIG. 8.—Transverse section of the endostyle of an Ascidian.

br., Branchial sac; *end.*, lips of endostyle; *gl.*, glandular tracts; *m.b.*, muscle bands; *pbr.*, peribranchial cavity; *sg.*, stigma; *v.v*, ventral vessel.

It is generally supposed that this organ is a gland for the production of the mucous secretion which is spread round the edges of the branchial sac and catches the food particles in the passing current of water. It has, however, been pointed out that there are comparatively few gland cells in the epithelium of the endostyle, and that it is possible that this furrow is merely a ciliated path along which the mucous secretion (produced in part by the subneural gland) is conveyed posteriorly along the ventral edge of the branchial sac. There are sensory bipolar cells in the lateral walls of the endostyle. At its anterior end the edges of the endostyle become continuous with the right and left halves of the posterior of two circular ciliated ridges—the peripharyngeal bands—which run parallel to one another round the front of the branchial sac. The dorsal ends of the posterior peripharyngeal band bend posteriorly (enclosing the epibranchial groove), and then join to form the anterior end of a fold which runs along the dorsal edge of the branchial sac as far as the oesophageal aperture. This fold is the dorsal lamina (figs. 5, 6, *dl*).

Peripharyngeal Bands.

Dorsal Lamina.

It probably serves to direct the stream of food particles entangled in a string of mucus from the anterior part of the dorsal lamina to the oesophagus. **Dorsal Languets.** In many Ascidians this organ, instead of being a continuous membranous fold as in *A. mentula*, is represented by a series of elongated triangular processes—the dorsal languets—one attached in the dorsal median line opposite to each transverse vessel of the branchial sac. The anterior peripharyngeal band is a complete circular ridge, having no connexion with either the endostyle or the dorsal lamina. In front of it lies the prebranchial zone, which separates the branchial sac behind from the branchial siphon in front. The prebranchial zone is bounded anteriorly by a muscular band—the posterior edge of the sphincter muscle—which bears a circle of long delicate processes, the tentacles (figs. 5, 9, 10, *tn*). **Tentacles.** These project inwards at right angles so as to form a network across the entrance to the branchial sac. Each tentacle consists of connective tissue covered with epithelium (endoderm), and contains two or more cavities which are continuous with blood sinuses in the mantle. **Subneural Gland.** In the dorsal median line near the anterior end of the body, and embedded in the mantle on the ventral surface of the nerve ganglion, there lies a small glandular mass—the subneural gland—which, as Julin has shown (24), there is reason to regard as the homologue of the *hypophysis cerebri* of the vertebrate brain. Julin and E. van Beneden have suggested that the function of this organ may possibly be renal. The subneural gland, which was first noticed by Hancock, communicates anteriorly, as Ussoff (23) pointed out, by means of a narrow duct with the front of the branchial sac (pharynx). The opening of the duct is enlarged to form a funnel-shaped cavity, which may be folded upon itself, convoluted, or even broken up into a number of smaller openings, so as to form a complicated projection, called the dorsal tubercle, situated in the dorsal part of the prebranchial zone. (fig. 9). **Dorsal Tubercle.** The dorsal tubercle in *A mentula* is somewhat horseshoe-shaped (fig. 10); it varies in form in most Ascidians according to the genus and species, and in some cases in the individual also. The function of the neural gland must still be regarded as doubtful. The secretion is formed by the degeneration and disintegration of cells proliferated from the walls of the duct or its branches, and no concretions are found. The ciliated funnel of the dorsal tubercle is a sense-organ, innervated by a large nerve from the ganglion; it may be a sense-organ for testing the quality of the water entering the branchial sac.

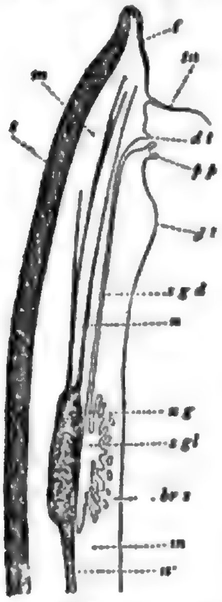


FIG. 9.—Diagrammatic section through anterior dorsal part of *A. mentula*, showing the relations of the nerve ganglion, subneural gland, &c.

n, Nerve.
n', Myelon.
pp, Peripharyngeal band.
sgl, Subneural gland.
sgd, Its duct.
t, Test lining branchial siphon.

Nervous System. The single elongated ganglion in the median dorsal line of the mantle between the branchial and atrial siphons is the only nerve-centre in *A. mentula* and most other Tunicata. It is the degenerate remains of the anterior part of the cerebro-spinal nervous system of the tailed larval Ascidian (see below). The posterior or spinal part has entirely disappeared in most Tunicata. It persists, however, in the Appendiculariidae and traces of it are found in some Ascidians (*e.g. Clavelina*). The ganglion gives off distributory nerves at both ends, which run through the mantle to the neighbourhood of the apertures, where they divide and subdivide. **Sense-Organs.** The only sense-organs are the pigment spots between the branchial and atrial lobes, the tentacles at the base of the branchial siphon, the dorsal tubercle, and possibly the languets or dorsal lamina. These are all in a lowly developed condition. Nerve-endings have also been found in the endostyle, the peripharyngeal bands and other parts of the wall of the pharynx. The larval Ascidians, on the other hand, have well-developed intracerebral optic and otic sense-organs; and in some of the pelagic Tunicata otocysts and pigment spots or eyes are found in connexion with the ganglion. Atrial tentacles (which may also be sensory) have now been found in a number of the gregarious Cynthiidae and Polystyelidae.

Alimentary Canal. The mouth and the pharynx (branchial sac) have already been described. The remainder of the alimentary canal is a bent tube which in *A. mentula* and most other Ascidians lies embedded in the mantle on the left side of the body, and projects into the peribranchial cavity. The oesophagus leaves the branchial sac in the dorsal middle line near the posterior end of the dorsal lamina (see fig. 5, *oe*). It is a short curved tube which leads ventrally to the large fusiform thick-walled stomach. The intestine emerges from the ventral end of the stomach, and soon turns anteriorly, then dorsally, and then posteriorly so as to form a curve—the intestinal loop—open posteriorly. The intestine now curves anteriorly again, and from this point runs nearly straight forward as the rectum, thus completing a second curve—the rectal loop—open anteriorly (see fig. 5). The wall of the intestine is thickened internally to form the typhlosole, a pad which runs along its entire length. The anus opens into the dorsal part of the peribranchial cavity near to the atrial aperture. The walls of the stomach are glandular; and a system of delicate tubules with dilated ends, which ramifies over the outer wall of the intestine and communicates with the cavity of the stomach by means of a duct, is probably a digestive gland.

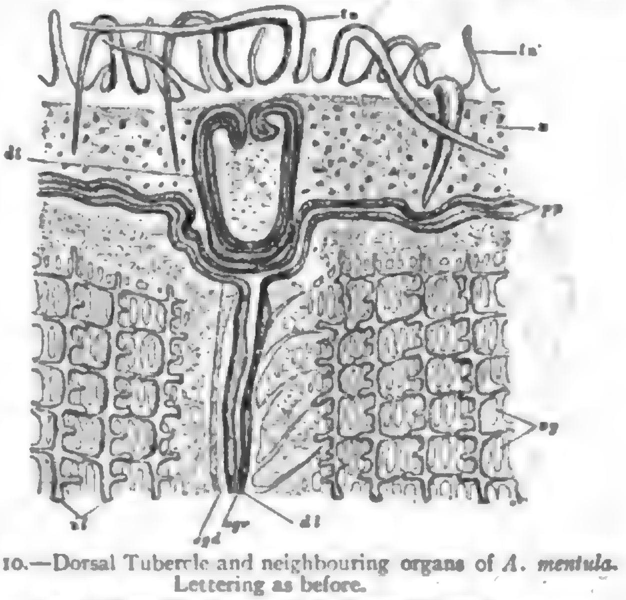


FIG. 10.—Dorsal Tubercle and neighbouring organs of *A. mentula*. Lettering as before.

egr, Epibranchial groove; *s*, prebranchial zone.

Excretory Organs. A mass of large clear vesicles which occupies the rectal loop, and may extend over the adjacent walls of the intestine, is a renal organ without a duct. Each vesicle is the modified remains of a part of the primitive coelom or body cavity, and is formed of cells which eliminate nitrogenous waste matters from the blood circulating in the neighbouring blood lacunae and deposit them in the cavity of the vesicle, where they form a concentrically laminated concretion of a yellowish or brown colour. These concretions contain uric acid, and in a large Ascidian are very numerous. The nitrogenous waste products are thus deposited and stored up in the renal vesicles in place of being excreted from the body. In other Ascidians the renal organ may differ from the above in its position and structure; but in no case has it an excretory duct, unless the subneural gland is to be regarded as an additional renal organ.

Blood Vascular System and Coelom. The heart is an elongated fusiform tube placed on the ventral and posterior edge of the stomach, in a space (the pericardium) which is part of the original coelom or body cavity, the rest of which exists merely in the form of lacunae and of the cavities of the reproductive organs and renal vesicles in the adult Ascidian. The wall of the heart is formed of a layer of epithelio-muscular cells, the inner ends of which are cross-striated; and waves of contraction pass along it from end to end, first for a certain number of beats in one direction and then in the other, so as to reverse the course of circulation periodically. At each end the heart is continued into a vessel (see fig. 11), which is merely a large sinus or lacuna lined with a delicate endothelial layer. The sinus leaving the ventral end of the heart is called the branchio-cardiac vessel,[1] and the heart itself is merely the differentiated posterior part of this sinus and is therefore a ventral vessel. The branchio-cardiac vessel, after giving off a branch which, along with a corresponding branch from the cardio-visceral vessel, goes to the test, runs along the ventral edge of the branchial sac externally to the endostyle, and communicates laterally with the ventral ends of all the transverse vessels of the branchial sac. The sinus leaving the dorsal end of the heart is called the cardio-visceral vessel, and this, after giving off to the test the branch above mentioned, breaks up into a number of sinuses, which ramify over the alimentary canal and the other viscera. These visceral lacunae finally communicate with a third great sinus, the viscero-branchial vessel, which runs forward along the dorsal edge of the branchial sac externally to the dorsal lamina and joins the dorsal ends of all the transverse vessels of the branchial sac. Besides these three chief systems, there are numerous lacunae in all parts of the body, by means of which anastomoses are established between the different currents of blood. All these blood spaces and lacunae are to be regarded as derived from the blastocoele of the embryo, and not, as has been usually supposed, from the coelom (30).

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[1] On account of the periodic reversal of the circulation none of the vessels can be called arteries or veins.

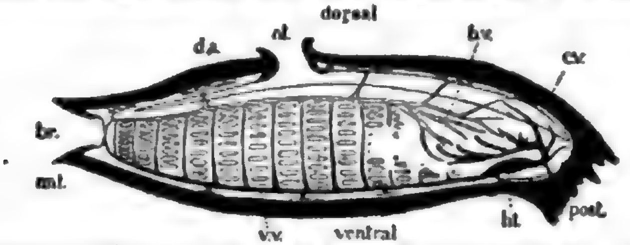


FIG. 11.—Diagram of the Blood Circulation in an Ascidian. The test is solid black.

at, Atrial aperture.
br, Branchial aperture.
bv, Branchio-visceral vessel.
cv, Cardio-visceral system.
da, Dorsal aorta.
ht, Heart.
vv, Ventral or branchio-cardiac vessel.

Course of Circulation.

When the heart contracts ventro-dorsally the course of the circulation is as follows: the blood which is flowing through the vessels of the branchial sac is collected in an oxygenated condition in the branchio-cardiac vessel, and, after receiving a stream of blood from the test, enters the heart (*ht*). It is then propelled from the dorsal end of the heart into the cardio-visceral vessels, and so reaches the test and digestive and other organs; then, after circulating in the visceral lacunae, it passes into the branchio-visceral vessel in an impure condition, and is distributed to the branchial vessels (fig. 11, *da*) to be purified again. When the heart on the other hand contracts dorso-ventrally, this course of the circulation is reversed. As the test receives a branch from each end of the heart, it follows that it has afferent and efferent vessels whichever way the blood is flowing. In some Ascidians the vessels in the test become very numerous and their end branches terminate in swollen bulbs close under the outer surface of the test. In this way an accessory respiratory organ is probably formed in the superficial layer of the test. The blood corpuscles are chiefly colourless and amoeboid; but in most if not all Ascidians there are also some pigmented corpuscles in the blood. These are generally of an orange or reddish brown tint, but may be opaque white, dark indigo-blue, or even of other colours. Precisely similarly pigmented cells are found throughout the connective tissue of the mantle and other parts of the body.

Reproductive Organs.

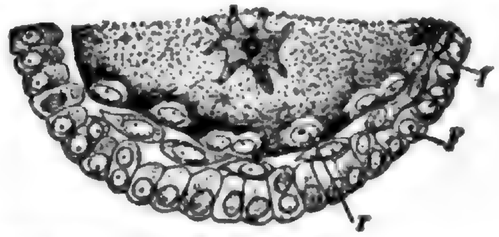
A. mentula is hermaphrodite, and the reproductive organs lie, with the alimentary canal, on the left side of the body. The ovary is a ramified gland which occupies the greater part of the intestinal loop (see fig. 5). It contains a cavity which, along with the cavities of the testis, is derived from a part of the original coelom, and the ova are formed from its walls and fall when mature into the cavity. The oviduct is continuous with the cavity of the ovary and leads forwards alongside the rectum, finally opening near the anus into the peribranchial cavity. The testis is composed of a great number of delicate branched tubules, which ramify over the ovary and the adjacent parts of the intestinal wall. Those tubules terminate in ovate swellings. Near the commencement of the rectum the larger tubules unite to form the vas deferens, a tube of considerable size, which runs forwards alongside the rectum, and, like the oviduct, terminates by opening into the peribranchial cavity close to the anus. The lumen of the tubules of the testis, like the cavity of the ovary, is a part of the original coelom, and the spermatozoa are formed from the cells lining the wall. In some Ascidians reproductive organs are present on both sides of the body, and in others (*Polycarpa*) there are many complete sets of both male and female systems, attached to the inner surface of the mantle on both sides of the body and projecting into the peribranchial cavity.[1]

EMBRYOLOGY[2] AND LIFE-HISTORY

We owe to W. E. Castle (1896) the most complete account which has yet been given of the early stages of development in an Ascidian. His careful study of the cell lineage in *Ciona* has made it clear that some of the conflicting statements of his predecessors arose from incorrect orientation of the embryos. One of the most important of his conclusions is that the mesoderm of Ascidians, and probably that of the archaic Vertebrates, is derived from both primary layers, ectoderm and endoderm. Further, he finds that *Ciona* produces both ova and spermatozoa at the same time, but self-fertilization very rarely occurs. The eggs are laid just before dawn, and the larva is hatched during the following night. The test cells adhering to the young homogeneous test have, it is now well known, no connexion with the cells found later in the adult test. The larvae are free-swimming for from one to several days. They avoid the light. The spermatozoon enters at the ventral hemisphere, and that point determines the median plane and the posterior end of the embryo. The ventral is the animal pole. The cleavage is from the beginning bilateral. The first cleavage plane is vertical, and separates the right and left halves of the embryo. The four smaller dorsal cells with yolk give rise to the endodermal hemisphere; the four larger, more protoplasmic, cells form the ventral ectodermal hemisphere. The cells of the latter hemisphere divide more rapidly, and form the future aboral surface. When the dorsal hemisphere has twenty-two cells the ventral has fifty-four. The gastrulation is a combination of epiboly and invagination. The ventral ectoderm grows over, so as to envelop the dorsal hemisphere, while the latter sinks down and becomes saucer-shaped. In the centre of the dorsal surface ten cells form the future endoderm. Round these comes a ring of cells, the chordamesenchyme ring, from which the notochord and mesenchyme arise. Outside this ring is a row of cells, the neuro-muscular ring. The more anterior of these cells form the medullary plate, the more posterior the longitudinal musculature of the larva. The remainder of the cells (in the 112-cell stage) form ectoderm. By growth at the anterior end the blastopore gets pushed posteriorly, and the anterior chorda cells are covered up, and come to lie in the dorsal wall of the archenteron, sixteen cells in two rows, one over the other. The blastopore closes in the posterior part of the dorsal surface. In front of it is the medullary plate, with a continuation backwards at the sides of the blastopore. This region forms the trunk of the larva, the part posterior to it being drawn out to form the tail. The chorda cells pass back into the tail, while the mesenchyme cells shift forwards into the trunk. The muscle cells, derived from the neuro-muscular ring, lie behind the blastopore, and form the muscles of the tail. The closure of the medullary canal takes place from the blastopore forwards, and then the nerve cord is grown over by ectoderm. After closure of the blastopore the mesenchyme cells lie as lateral masses in the trunk; later they become the blood corpuscles and the mantle cells, &c.

Castle also discusses some important theoretical questions. He points out that, in *Ciona* at least, the chorda-mesenchyme ring takes part along with endoderm in the primary invagination, and so belongs to the primary endoderm; while the rest of the mesoderm, the muscle cells of the neuro muscular ring, are carried in by a secondary invagination, and belong to the outer layer of the young gastrula, or primary ectoderm. He considers that the chorda must be regarded as a mesodermal organ. He agrees with former observers in seeing no trace of enterocoele formation, and he doubts whether any Chordata are Enterocoela. He does not believe in distinguishing those Metazoa with a mesoderm from those with a "mesenchyme." He considers that embryology gives no support to the Annelid hypothesis as to the origin of Chordates.

A long-continued discussion as to the origin, nature and fate of certain cells, the "testa-zellen," which make their appearance between the young embryo and its follicle (fig. 12), has ended in practical agreement that these small cells are derived from the follicle-cells, and have nothing to do with the test. In *Salpa*, however, certain follicle-cells enter the embryo, and perform important functions in guiding the development for a time.



(After Pizon.)

FIG. 12.—Portion of Mature Ovum of Ascidian, showing F, follicle, and *f*, *r*, "test-cells."

Embryology.

In most Ascidians the eggs are fertilized in the peribranchial cavity, and undergo most of their development before leaving the parent; in some cases, however, the eggs are laid, and fertilization takes place in the surrounding water. The segmentation is complete and regular (fig. 13, A) and results in the formation of a spherical blastula, which then undergoes invagination (fig. 13, B). The embryo elongates, and the blastopore or invagination opening comes to be placed on the dorsal edge near the posterior end (fig. 13, C). The hypoblast cells lining the archenteron are columnar in form, while the epiblast cells are more cubical (fig. 13, B, C, D). The dorsal surface of the embryo now becomes flattened and then depressed to form a longitudinal groove, extending forwards from the blastopore to near the front of the body. This "medullary groove" now becomes converted into a closed

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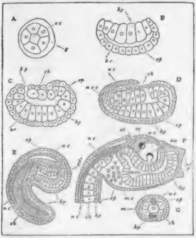
[1] For structure of other forms, see below.

[2] For reproduction by gemmation see under "Classification" below.

canal by its side walls growing up, arching over, and coalescing in the median dorsal line (fig. 13, D). This union of the *laminae dorsales* to form the neural canal commences at the posterior end behind the blastopore and gradually extends forwards. Consequently the blastopore comes to open into the posterior end of the neural canal (fig. 13, D), while the anterior end of that cavity remains open to the exterior. In this way the archenteron communicates indirectly with the exterior. The short canal leading from the neural canal to the archenteron is known as the neurenteric canal (fig. 13, D, *nec*). Previous to this stage some of the hypoblast cells at the front edge of the blastopore and forming part of the dorsal wall of the archenteron (fig. 13, C, *ch*) have become separated off, and then arranged to form an elongated band, two cells wide, underlying the posterior half of the neural canal (fig. 13, D, E, *ch*). This is the origin of the notochord. Outgrowths from the sides of the archenteron give rise to laterally placed masses of cells, which are the origin of the mesoblast. These masses show no trace of metameric segmentation. The cavities (reproductive and renal vesicles) which are formed later in the mesoblast represent the coelom. Consequently the body cavity of the Tunicata is a modified form of enterocoele. The anterior part of the embryo, in front of the notochord, now becomes enlarged to form the trunk, while the posterior part elongates to form the tail (fig. 13, E). In the trunk the anterior part of the archenteron dilates to form the mesenteron, the greater part of which becomes the branchial sac; at the same time the anterior part of the neural canal enlarges to form the cerebral vesicle, and the opening to the exterior at the front end of the canal now closes. In the tail part of the embryo the neural canal remains as a narrow tube, while the remains of the wall of the archenteron—the dorsal part of which becomes the notochord—are converted into lateral muscle bands (fig. 13, G) and a ventral cord of cells, which eventually breaks up to form blood corpuscles. As the tail grows longer, it becomes bent round the trunk of the embryo inside the egg-membrane. About this period the epiblast cells begin to form the test as a cuticular deposit upon their outer surface. The test is at first devoid of cells and forms a delicate gelatinous investment, but it shortly afterwards becomes cellular by the migration into it of test cells formed by proliferation from the epiblast.[1]



(After Kowalevsky.)

FIG. 13.—Stages in the Embryology of a Simple Ascidian.

A to F, Longitudinal vertical sections of embryos, all placed with the dorsal surface uppermost and the anterior end at the right.

A, Early blastula stage, during segmentation.

B, Early gastrula stage.

C, Stage after gastrula, showing commencement of notochord.

D, Later stage, showing formation of notochord and of neural canal.

E, Embryo showing body and tail and completely formed neural canal.

F, Larva just hatched; end of tail cut off.

G, Transverse section of tail of larva.

adp,	Adhering papillae of larva.	*nec*,	Neurenteric canal.
at,	Epiblastic (atrial) involution.	*oc*,	Ocular organ of larva.
au,	Auditory organ of larva.	*g*,	Gelatinous investment of embryo.
ar,	Archenteron.		
bc,	Blastocoele.	*m*,	Muscle cells of tail.
bp,	Blastopore.	*mes*,	Mesenteron.
ch,	Notochord.	*mc*,	Mesoderm cells.
ep,	Epiblast.	*nv*,	Cerebral vesicle at anterior end of neural canal.
hy,	Hypoblast.		
nc,	Neural canal.		

Larval Stage.

The embryo is hatched about two or three days after fertilization, in the form of a tadpole-like larva, which swims actively through the sea by vibrating its long tail. The anterior end of the body is provided with three adhering papillae (fig. 13, F, *adp*.) in the form of epiblastic thickenings. In the free-swimming tailed larva the nervous system, formed from the walls of the neural canal, becomes considerably differentiated. The anterior part of the cerebral vesicle remains thin-walled (fig. 13, F), and two unpaired sense-organs develop from its wall and project into the cavity. These are a dorsally and posteriorly placed optic organ, provided with retina, pigment layer, lens and cornea, and a ventrally placed auditory organ, consisting of a large spherical partially pigmented otolith, attached by delicate hair-like processes to the summit of a hollow *crista acoustica* (fig. 13, F, *au*). The posterior part of the cerebral vesicle thickens to form a solid ganglionic mass traversed by a narrow central canal: this becomes the ganglion of the adult Ascidian. The wall of the neural canal behind the cerebral vesicle becomes differentiated into an anterior thicker region, placed in the posterior part of the trunk and having a superficial layer of nerve fibres, and a posterior narrower part which traverses the tail, lying on the dorsal surface of the notochord, and gives off several pairs of nerves to the muscles of the tail. Just in front of the anterior end of the nervous system a dorsal involution of the epiblast breaks through into the upturned anterior end of the mesenteron and thus forms the mouth opening. Along the ventral edge of the mesenteron, which becomes the branchial sac, the endostyle is formed as a narrow groove with thickened side walls. It probably corresponds to the median portion of the thyroid body of Vertebrata. A curved outgrowth from the posterior end of the mesenteron forms the alimentary canal (oesophagus, stomach and intestine), which at first ends blindly. An anus is formed later by the intestine opening into the left of two lateral epiblastic involutions (the atria), which rapidly become larger and fuse dorsally to form the peribranchial cavity. Outgrowths from the wall of the branchial sac meet these epiblastic involutions and fuse with them to give rise to the first formed pair of stigmata, which thus come to open into the peribranchial cavity; and these alone correspond to the gill clefts of *Amphioxus* and the Vertebrata.

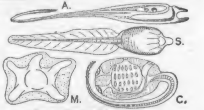


FIG. 14.—Sketches of Ascidian Larvae.
A, *Ascidia*; S, *Styela*; M, *Anurella*; C, Compound Ascidian.

Fig. 14 shows a few characteristic forms of Ascidian "tadpoles," or free-swimming larvae. A and S are typical simple Ascidians; M is the aberrant tailless form found in some *Molgulidae*; and C is the larva of a typical compound Ascidian.

Metamorphosis to Adult Form.

After a short free-swimming existence the fully developed tailed larva fixes itself by its anterior adhering papillae to some foreign object, and then undergoes a remarkable series of retrogressive changes, which convert it into the adult Ascidian. The tail atrophies, until nothing is left but some fatty cells in the posterior part of the trunk. The adhering papillae disappear and are replaced functionally by a growth of the test over neighbouring objects. The nervous system with its sense organs atrophies until it is reduced to the single small ganglion, placed on the dorsal edge of the pharynx, and a slight nerve cord running for some distance posteriorly (van Beneden and Julin). Changes in the shape of the body and a further growth and differentiation of the branchial sac, peribranchial cavity and other organs now produce gradually the structure found in the adult Ascidian.

The most important points in connexion with this process of development and metamorphosis are the following: (1) In the

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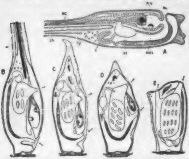
[1] Some of the first test cells are also probably derived from the epithelium of the egg follicle.

Ascidian embryo all the more important organs (*e.g.* notochord, neural canal, archenteron) are formed in essentially the same manner as they are in *Amphioxus* and other Chordata. (2) The free-swimming tailed larva possesses the essential characters of the Chordata, inasmuch as it has a longitudinal skeletal axis (the notochord) separating a dorsally placed nervous system (the neural canal) from a ventral alimentary canal (the archenteron); and therefore during this period of its life-history the animal belongs to the Chordata. (3) The Chordate larva is more highly organized than the adult Ascidian, and therefore the changes by which the latter is produced from the former may be regarded as a process of degeneration (3:). The important conclusion drawn from all this is that the Tunicata are the degenerate descendants of a group of primitive Chordata (see below).

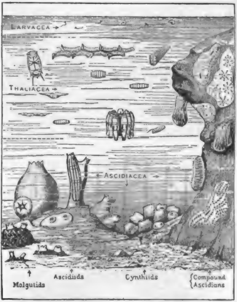


(From *The Cambridge Natural History*, vol. vii., "Fishes, &c." By permission of Macmillan & Co., Ltd.)

Fɪɢ. 15.—Metamorphosis of an Ascidian (modified from Kowalevsky and others).

A, Free-swimming tailed larva. B, The metamorphosis—larva attached. C, Tail and nervous system of larva degenerating. D, Further degeneration and metamorphosis of larva into E, the young fixed Ascidian.

at, Atrial invagination.
ch, Notochord.
hy, Hypoblast cells.
i, Intestine.
m, Mouth.
mes, Mesenteron.
nc, Neural canal.
nv, Neural vesicle with sense-organs.



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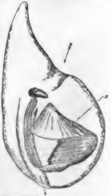
Fɪɢ. 16.—Sketch of the chief kinds of Tunicata found in the sea.

Classification and Characters of Groups

Order 1.—Larvacea

Characters of Larvacea. Free-swimming pelagic forms provided with a large locomotory appendage (the tail), in which there is a skeletal axis (the urochord). A relatively large test (the "house") is formed with great rapidity as a secretion from the ectoderm; it is merely a temporary structure, which is cast off and replaced by another. The branchial sac is simply an enlarged pharynx with two ventral ciliated openings (stigmata) leadin to the exterior. There is no separate peribranchial cavity. The nervous system consists of a large dorsally placed ganglion and a long nerve cord, which stretches backwards over the alimentary canal to reach the tail, along which it runs on the left side of the urochord. The anus opens ventrally on the surface of the body in front of the stigmata. No reproduction by gemmation or metamorphosis is known in the life-history.



(After Fol.)

Fɪɢ. 17.—*Oikopleura cophocerca* in "House," seen from right side, magnified. The arrows indicate the course of the water.

z, Lateral reticulated parts of "House."

Structure of Appendicularia. This is one of the most interesting groups (fig. 16) of the Tunicata, as it shows more completely than any of the rest the characters of the original ancestral forms. It has undergone little or no degeneration, and consequently corresponds more nearly to the tailed-larval condition than to the adult forms of the other groups. The order includes a single family, the Appendiculariidae, all the members of which are minute and free-swimming. They occur on the surface of the sea in most parts of the world. They possess the power to form with great rapidity an enormously large investing gelatinous layer (fig. 11), which corresponds to the test of other groups. This was first described by von Mertens and by him named "Haus." It is only loosely attached to the body and is frequently thrown off soon after its formation and again reformed. H. Lohmann has made a careful study of the mode of formation of this "house" from certain large ectoderm cells, the "oikoplasts," and he considers that it probably fulfils the following functions: Its complicated apparatus of passages with partial septa form a finely perforated network, through which a relatively large volume of water is strained so as to entrap microscopic food particles; it helps in locomotion by its hydrostatic effect, and it is also a protection to the animal, which may escape from enemies by throwing off the house, which is many times its own size. The tail in the Appendiculariidae is attached to the ventral surface of the body (fig. 18), and usually points more or less anteriorly. The supposed traces of vertebration in the muscle bands and the nerve cord are probably artifacts, and do not indicate true metameric segmentation. Near the base of the tail there is a distinct elongated ganglion (fig. 18, *ng*′). The anterior (cerebral) ganglion has connected with it an otocyst, a pigment spot, and a tubular process opening into the branchial sac and representing the dorsal tubercle and associated parts of an ordinary Ascidian. The branchial aperture or mouth leads into the branchial sac or pharynx. There are no tentacles. The endostyle is short. There is no dorsal lamina, and the peripharyngeal bands run dorsally and posteriorly. The wall of the branchial sac has only two ciliated apertures (fig. 19). They are homologous with the primary stigmata of the typical Ascidians and the gill clefts of vertebrates. They are placed far back on the ventral surface, one on each side of the middle line, and lead into short funnel-shaped tubes which open on the surface of the body behind the anus (fig. 18, *at*). These tubes correspond to the right and left atrial involutions which, in an ordinary Ascidian, fuse to form the peribranchial cavity. The heart, according to Lankester, is formed of two cells, which are placed at the opposite ends and connected by delicate contractile protoplasmic fibrils. The large ovary and testis are placed at the posterior end of the body. The remainder of the structural details can be made out from figs. 18 and 19.

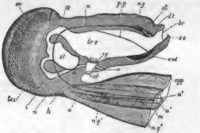


Fig. 18.—Semi-diagrammatic view of *Appendicularia* from the right.

a,	Anus.	*ov*,	Ovary.
at,	One of the atrial apertures.	*pp*,	Peripharyngeal band.
app,	Tail.	*ng*,	Cerebral ganglion.
br,	Branchial aperture.	*ng'*,	Caudal ganglion.
brs,	Branchial sac.	*ng''*,	Enlargement of nerve cord in tail.
dt,	Dorsal tubercle.	*so*,	Sense-organ (tactile) on lower lip.
end,	Endostyle.	*sg*,	Ciliated aperture in pharynx.
h,	Heart.	*st*,	Stomach.
i,	Intestine.	*tes*,	Testis.
m,	Muscle band of tail.	*u*,	Urochord.
n,	Nerve cord in body.	*u'*,	Its cut end.
n',	Nerve cord in the tail.		
oe,	Oesophagus.		
ot,	Otocyst.		

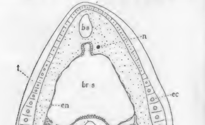


Fig. 19.—Transverse Section of *Oikopleura*; anterior part of body and tail.

At,	Atrial passage.	*n*,	Nerve.
b.s,	Blood sinus.	*n.ch*,	Notochord.
br.s,	Branchial sac (pharynx).	*R*,	Rectum.
ec,	Ectoderm.	*sg*,	Stigma.
en,	Endoderm	*t*,	Test.

The family Appendiculariidae comprises amongst others the following genera: *Oikopleura* (Mertens), and *Appendicularia* (Cham.), in both of which the body is short and compact and the tail relatively long, while the endostyle is straight; *Megalocercus* (Chun) containing *M. abyssorum*, a huge deep-sea form from the Mediterranean (30 mm. long); *Fritillaria* (Quoy and Gaimard), in which the body is long and composed of anterior and posterior regions, the tail relatively short, the endostyle recurved, and an ectodermal hood is formed over the front of the body; and *Kowalevskia* (Fol), a remarkable form described by Fol (14), in which the heart and endostyle are said to be absent, while the branchial sac is provided with four rows of ciliated tooth-like processes.

ORDER II.—THALIACEA

Thaliacea.

Free-swimming pelagic forms which may be either simple or compound, and the adult of which is never provided with a tail or a notochord. The test is permanent and may be either well developed or very slight. The musculature of the mantle is in the form of more or less complete circular bands, by the contraction of which locomotion is effected. The branchial sac has either two large or many small apertures, leading to a single peribranchial cavity, into which the anus opens. Blastogenesis takes place from a ventral endostylar stolon. Alternation of generations occurs in the life-history, and may be complicated by polymorphism. The Thaliacea comprises two groups Cyclomyaria and Hemimyaria.

Sub-order 1.—Cyclomyaria.

Characters of Cyclomyaria.

Free-swimming pelagic forms which exhibit alternation of generations in their life-history but never form permanent colonies. The body is cask-shaped, with the branchial and atrial apertures at the opposite ends. The test is more or less well developed. The mantle has its musculature in the form of circular bands surrounding the body. The branchial sac is fairly large, occupying the anterior half or more of the body. Stigmata are usually present in its posterior part only. The peribranchial cavity is mainly posterior to the branchial sac. The alimentary canal is placed ventrally close to the posterior end of the branchial sac. Hermaphrodite reproductive organs are placed ventrally near the intestine.

This group forms one family, the Doliolidae, including three genera, *Doliolum* (Quoy and Gaimard), *Dolchinia* (Korotneff) and *Anchinia* (C. Vogt).

Structure of Doliolum.

Doliolum, of which about a dozen species are known from various seas, has a cask-shaped body, usually from 1 to 2 cm. in length. The terminal branchial and atrial apertures (fig. 20) are lobed and the lobes are provided with sense organs. The test is very slightly developed and contains no cells. The mantle has eight or nine circular muscle bands surrounding the body. The most anterior and posterior of these form the branchial and atrial sphincters. The wide branchial and atrial apertures lead into large branchial and peribranchial cavities, separated by the posterior wall of the branchial sac, which is pierced by stigmata; consequently there is a free passage for the water through the body along its long axis, and the animal swims by contracting its ring-like muscle bands, so as to force out the contained water posteriorly. Stigmata may also be found on the lateral walls of the branchial sac, and in that case there are corresponding anteriorly directed diverticula of the peribranchial cavity. There is a distinct endostyle on the ventral edge of the branchial sac and a peripharyngeal band surrounding its anterior end, but there is no representative of the dorsal lamina on its dorsal edge. The oesophagus commences rather on the ventral edge of the posterior end of the branchial sac, and runs backwards to open into the stomach, which is followed

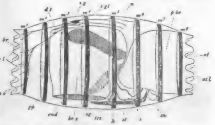


Fig. 20.—*Doliolum denticulatum*, sexual generation, from the left side. Lettering as for fig. 18.

m^1—m^8,	Muscle bands.	*pbr*,	Peribranchial cavity
ng,	Nerve ganglion.	*atl*,	Atrial lobes.
sg,	Stigmata.	*so*,	Sense organs.
sgl,	Subneural gland.	*brl*,	Branchial lobes.

by a curved intestine opening into the peribranchial cavity. The alimentary canal as a whole is to the right of the middle line. The hermaphrodite reproductive organs are to the left of the middle line alongside the alimentary canal. They open into the peribranchial cavity. The ovary is nearly spherical, while the testis is elongated, and may be continued anteriorily for a long distance. The heart is placed in the middle line ventrally, between the posterior end of the endostyle and the oesophageal aperture. The nerve ganglion lies about the middle of the dorsal edge of the body, and gives off many nerves. Under it is placed the subneural gland, the duct of which runs forward and opens into the anterior end of the branchial sac by a simple aperture, surrounded by the spirally twisted dorsal end of the peripharyngeal band (fig. 20., *dl*).

Development of Doliolum.

The ova of the sexual generation produce tailed larvae; these develop into forms known as "nurses," which are asexual, and are characterized by the possession of nine muscle bands, an auditory sac on the left side of the body, a ventrally-placed stolon near the heart, upon which buds are produced and a dorsal outgrowth near the posterior end of the body. The nurse after producing the buds becomes a degenerate form with very wide muscle bands. The buds give rise eventually to the sexual generation, which is polymorphic, having three distinct forms, in two of which the reproductive organs remain undeveloped. The buds while still very young migrate from their place of origin on the stolon, divide by fission, and become attached to the dorsal outgrowth of the body of the nurse, where they develop. The three forms produced are as follows. (1) Nutritive forms (trophozooids), which remain permanently attached to the nurse and serve to provide it with food; they have the body elongated dorso-ventrally, and the musculature is very slightly developed. (2) Foster forms (phorozooids), which, like the preceding, do not become sexually mature, but, unlike them, are set free as cask-shaped bodies with eight muscle bands and a ventral outgrowth, which is formed of the stalk by which the body was formerly united to the nurse. On this outgrowth the (3) forms (gonozooids) which become sexually mature are attached while still young buds, and after the foster forms are set free these reproductive forms gradually attain their complete development and are eventually set free and lose all trace of their connexion with the foster forms. They resemble the foster forms in having a cask-shaped body with eight muscle bands, but differ in having no outgrowth or process, and in having the reproductive organs fully developed.[1]

Anchinia.

Anchinia, of which only one species is known, *A. rubra*, from the Mediterranean, has the sexual forms permanently attached to portions of the dorsal outgrowth from the body of the unknown nurse. The body is elongated dorso-ventrally. The test is well developed and contains branched cells. The musculature is not so well developed as in *Doliolum*. There are two circular bands at the anterior end and two at the posterior, and two on the middle of the body. The stigmata are confined to the obliquely placed posterior end of the branchial sac. The alimentary canal forms a U-shaped curve. The reproductive organs are placed on the right side of the body. The life-history is still imperfectly known. As in the case of *Doliolum* the sexual generation is polymorphic, and has three forms, two of which remain in a rudimentary condition so far as the reproductive organs are concerned. In *Anchinia*, however, the three forms do not occur together on one stolon or outgrowth, but are produced successively, the reproductive forms of the sexual generation being independent of the "foster forms" (see Barrois, 27).

Sub-order 2.—Hemimyaria.

Characters of Hemimyaria.

Free-swimming pelagic forms which exhibit alternation of generations in their life-history and in the sexual condition form colonies. The body is more or less fusiform, with the long axis antero-posterior, and the branchial and atrial apertures nearly terminal. The test is well developed. The musculature of the mantle is in the form of a series of transversely-running bands, which do not form complete independent rings as in the Cyclomyaria. These transverse muscles are probably to be regarded as branchial and atrial sphincters which have spread over the body. The branchial and peribranchial cavities form a continuous space in the interior of the body, opening externally by the branchial and atrial apertures, and traversed obliquely from the dorsal and anterior end to the ventral and posterior by a long narrow vascular band, which represents the dorsal lamina, the dorsal blood-vessel, and the neighbouring part of the dorsal edge of the branchial sac of an ordinary Ascidian. The alimentary canal is placed ventrally. It may either be stretched out (ortho-enteric) so as to extend for some distance anteriorly, or—as is more usual—be concentrated (caryo-enteric) to form along with the reproductive organs a rounded opaque mass near the posterior end of the body known as the visceral mass or "nucleus." The embryonic development is direct, no tailed larva being formed.

Salpidae.

This sub-order contains one family, the Salpidae, including the single genus *Salpa* (Forskål), which, however, may be divided into two well-marked groups of species—(1) those, such as *S. pinnata*, in which the alimentary canal is stretched out along the ventral surface of the body, and (2) those, such as *S. fusiformis* (fig. 21, A), in which the alimentary canal forms a compact globular mass, the "nucleus," near the posterior end of the body. About fifteen species altogether are known; they are all pelagic forms and are found in nearly all seas. Each species occurs in two forms—the solitary asexual (*proles solitaria*) and the aggregated sexual (*proles gregaria*)—which are usually quite unlike one another. The solitary form (fig. 21, B) gives rise by internal gemmation to a complex tubular stolon, which contains processes from all the more important organs of the parent body and which becomes segmented into a series of buds or embryos. As the stolon elongates, the embryos near the free end which have become advanced in their development are set free in groups, which remain attached together by processes of the test, each enclosing a diverticulum from the mantle so as to form "chains" (fig. 22). Each member of the chain is a *Salpa* of the sexual or aggregated form, and when mature may—either still attached to its neighbours or separated from them (fig. 21, A)—produce one or several embryos, which develop into the solitary *Salpa*. Thus the two forms alternate regularly.

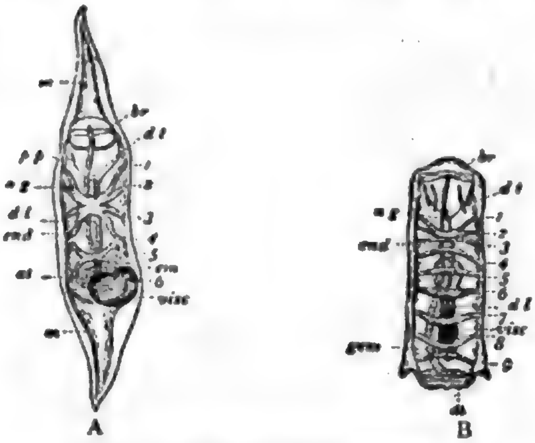


FIG. 21.—*Salpa runcinata-fusiformis.*

A, Aggregated form: *em*, Embryo; *gem*, Gemmiparous stolon; *m*, Mantle; *visc*, Visceral mass (nucleus). B, Solitary form: 1–9, Muscle bands. Lettering as before.

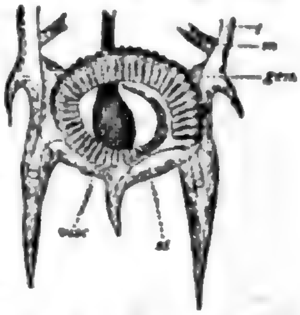


FIG. 22.—Posterior part of solitary form of *Salpa democratica-mucronata*, showing a chain of embryos nearly ready to be set free.

gem, Young aggregated *Salpae* forming the chain.
st, Stolon.
m, Muscle band of the mantle.

Structure of Salpa.

The more important points in the structure of a typical *Salpa* are shown in fig. 23. The branchial and atrial apertures are at opposite ends of the body, and each leads into a large cavity, the branchial and peribranchial sacs, which are in free communication at the sides of the obliquely-running dorsal lamina or "gill." The test is well developed and adheres closely to the surface of the mantle. The muscle bands of the mantle do not completely encircle the body. They are present dorsally and laterally, but the majority do not reach the ventral surface. In many cases neighbouring bands join in the median dorsal line (fig. 21). The anterior end of the dorsal lamina is prolonged to form a prominent tentacular organ, the languet, projecting into the branchial sac. The nerve ganglion (which represents the ganglion of the Ascidian along with the subneural gland), dorsal lamina, peripharyngeal bands and endostyle, are placed in their

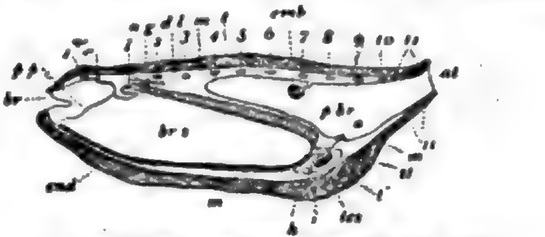


FIG. 23.—Semi-diagrammatic representation of *Salpa* from left side. Lettering as before.

emb, Embryo.
m, Mantle.
l, Languet.
t', Thickening of test over nucleus.
dl, Gill or branchia.
1–11, Muscle bands of mantle.

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[1] For further details see Uljanin (28) and Neumann, *Doliolum*, in *Deutsch. Tief-See Exped.* (Jena, 1905).

usual positions; but in place of any distinct subneural gland there are two lateral neural glandular masses first described by Metcalf. These have no connexion with the ciliated funnel, but open by lateral ducts into the branchial cavity. Median and lateral eyes are also found in connexion with the ganglion. The large spaces at the sides of the dorsal lamina (often called the gill or branchia of *Salpa*), by means of which the cavity of the branchial sac is placed in free communication with the peribranchial cavity, are to be regarded as gigantic *stigmata* formed by the suppression of the lateral walls of the branchial sac. Fig. 23 represents an aggregated or sexual *Salpa* which was once a member of a chain, since it shows a testis and a developing embryo. The ova (always few in number, usually only one) appear at a very early period in the developing chain *Salpa*, while it is still a part of the gemmiparous stolon in the body of the solitary *Salpa*. This gave rise to the view put forward by Brooks (25), that the ovary really belongs to the solitary *Salpa*, which is therefore a female producing a series of males by asexual gemmation, and depositing in each of these an ovum, which will afterwards, when fertilized, develop in the body of the male into a solitary or female *Salpa*. This idea would of course entirely destroy the view that *Salpa* is an example of alternation of generations. The sexual or chain *Salpa*, although really hermaphrodite, is always protogynous; *i.e.* the female elements or ova are produced at an earlier period than the male organ or testis. This prevents self-fertilization. The ovum is fertilized by the spermatozoa of an older *Salpa* belonging to another chain, and the embryo is far advanced in its development before the testis is formed. Follicular cells, known as kalymmocytes, migrate into the ovum and for a time play an important part in moulding the development and nourishing the blastomeres. At an early period in its development a part of the embryo becomes separated off, along with a part of the wall of the cavity in which it lies, to form the "placenta," in which the embryonic and the maternal blood streams circulate in close proximity (or actually coalesce during one period) and so allow of the passage of nutriment to the developing embryo. At a somewhat later stage a number of cells placed at the posterior end of the body alongside the future nucleus become filled up with oil-globules to form a mass of nutrient material—the elaeoblast—which is used up later on in the development. Many suggestions have been made as to the homology of the elaeoblast. The most probable is that it is the disappearing rudiment of the tail found in the larval condition of most Ascidians.

Development of Salpa.

Addendum.

The family Octacnemidae includes the single remarkable genus *Octacnemus*, found during the "Challenger" expedition, and first described by Moseley (29). It is now known in both a solitary and an aggregated form, and was regarded by Herdman as a deep-sea representative of the pelagic Salpidae, possibly fixed; or, better, as related to the primitive fixed forms from which Salpidae have been derived. Metcalf, however, has shown that the aggregated form of *O. patagoniensis*, which he has described, is more nearly related to the Clavelinidae amongst Ascidiacea. The body is somewhat discoid, with its margin prolonged to form eight tapering processes (fig. 24), on to which the muscle bands of the mantle are continued. The alimentary canal forms a compact nucleus (fig. 24, A); the endostyle is very short; and the dorsal lamina is also reduced. The reproduction and life-history are entirely unknown. *Octacnemus bythius* was found by the "Challenger" expedition in the South Pacific at depths of 1070 and 2160 fathoms, and Metcalf has since described a new species, *O. patagoniensis* from 1050 fathoms off the Patagonian coast, in which there is an aggregated form (fig. 24, B) consisting of individuals united by a stolon composed of test and body-walls.

Octacnemidae.

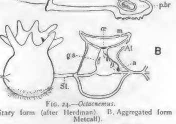


FIG. 24.—*Octacnemus.*

A, Solitary form (after Herdman). B, Aggregated form (after Metcalf).

a,	Anus.	*m*,	Mouth.
At,	Atrial aperture.	*œ*,	Oesophagus.
br.s,	Branchial sac.	*p.br*,	Peribranchial cavity.
g.s,	Gill slit.	*st*,	Stolon.

ORDER III.—ASCIDIACEA

Fixed or free-swimming simple or compound Ascidians which in the adult are never provided with a tail and have no trace of a notochord. The free-swimming forms are colonies, the simple Ascidians being always fixed. The test is permanent and well developed; as a rule it increases with the age of the individual. The branchial sac is large and well developed. Its walls are perforated by numerous slits (stigmata) opening into the peribranchial cavity, which communicates with the exterior by the atrial aperture. Many of the forms reproduce by gemination, and in most of them the sexually-produced embryo develops into a tailed larva.

Ascidiacea.

The Ascidiacea includes three groups—the simple Ascidians, the compound Ascidians and the free-swimming colonial *Pyrosoma*.

Sub-Order 1.—Ascidiae simplices.

Fixed Ascidians which are solitary and very rarely reproduce by gemmation; if colonies are formed, the members are not buried in a common investing mass, but each has a distinct test of its own. No strict line of demarcation can be drawn between the simple and the compound Ascidians, and one of the families of the former group, the Clavelinidae (the social Ascidians), forms a transition from the typical simple forms, which never reproduce by gemmation, to the compound forms, which always do. The Ascidiae Simplices may be divided into the following families:—

Simple Ascidians.

Family I., Clavelinidae.—Simple Ascidians which reproduce by gemmation to form small colonies in which each ascidiozooid has a distinct test, but all are connected by a common blood system, and by prolongations of "epicardiac tubes" from the branchial sacs. Buds formed on stolons which are vascular outgrowths from the posterior end of the body, containing prolongations from the ectoderm, mesoderm and endoderm of the ascidiozooid. Branchial sac not folded; internal longitudinal bars usually absent; stigmata straight; tentacles simple. This family contains, amongst others, the following three genera: *Ecteinascidia* (Herdman), with internal longitudinal bars in branchial sac; *Clavelina* (Savigny), with intestine extending behind branchial sac; and *Perophora* (Wiegmann), with intestine alongside branchial sac.

Family II., Ascidiidae.—Solitary fixed Ascidians with gelatinous test; branchial aperture usually eight-lobed, atrial aperture usually six-lobed. Branchial sac not folded; internal longitudinal bars usually present; stigmata straight or curved; tentacles simple. This family is divided into three sections:—

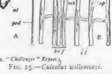
Sub-family 1, Hypobythinae.—Branchial sac with no internal longitudinal bars. One genus, *Hypobythius* (Moseley).

Sub-family 2, Ascidinae.—Stigmata straight. Many genera, of which the following are the more important: *Ciona* (Fleming), dorsal languets present; *Ascidia* (Linnaeus, = *Phallusia*, Savigny), dorsal lamina present (see figs. 1 to 10); *Rhodosoma* (Ehrenberg), anterior part of test modified to form operculum; *Abyssascidia* (Herdman), intestine on right side of branchial sac.

Sub-family 3, Corellinae.—Stigmata curved. Three chief genera: *Corella* (Alder and Hancock), test gelatinous, body sessile; *Corynascidia* (Herdman), test gelatinous, body pedunculated; *Chelyosoma* (Brod. and Sow.), test modified into horny plates.

Family III., Cynthiidae.—Solitary fixed Ascidians, usually with leathery test; branchial and atrial apertures both four-lobed. Branchial sac longitudinally folded (fig. 26); stigmata straight; tentacles simple or compound. This family is divided into three sections:—

Sub-family 1, Styelinae.—Not more than four folds on each side of branchial sac (fig. 26, S) tentacles simple. The more important genera are: *Styela* (Macleay), stigmata normal, and *Bathyoncus* (Herdman), stigmata absent or modified.



(After Herdman, "*Challenger*" *Report.*)

FIG. 25.—*Culeolus willemoesi.*

A, Entire body, natural size.		B, Part of branchial sac magnified.	
		br f,	Slight fold of branchial sac.
at,	Atrial aperture.	*i l*,	Internal longitudinal bar.
br,	Branchial aperture.	*mh*,	Mesh.
ped,	Peduncle.	*sp*,	Calcareous spicules in vessels.
		tr,	Transverse vessels.

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Sub-family 2, Cynthinae.—More than eight folds in branchial sac (fig. 26, C); tentacles compound; body sessile. The chief genus is *Cynthia* (Savigny), with a large number of species.

Sub-family 3, Bolteninae.—More than eight folds in branchial sac; tentacles compound; body pedunculated (fig. 25, A). The chief genera are: *Boltenia* (Savigny), branchial aperture four-lobed, stigmata normal; and *Culeolus* (Herdman), branchial aperture with less than four lobes, stigmata absent or modified (fig. 25, B). This last is a deep-sea genus discovered by the "Challenger" expedition (see 17).

Family IV., Molgulidae.—Solitary Ascidians, sometimes not fixed; branchial aperture six-lobed, atrial four-lobed. Test usually incrusted with sand. Branchial sac longitudinally folded; stigmata more or less curved, usually arranged in spirals; tentacles compound. The chief genera are: *Molgula* (Forbes), with distinct folds in the branchial sac, and *Eugyra* (Ald. and Hanc.), with no distinct folds, but merely broad internal longitudinal bars in the branchial sac. In some of the Molgulidae (genus *Anurella*, Lacaze-Duthiers, 20) the embryo (fig. 14, M) does not become converted into a tailed larva, the development being direct, without metamorphosis. The embryo when hatched assumes gradually the adult structure, and never shows the features characteristic of larval Ascidians, such as the urochord and the median sense-organs. Bourne has described an aberrant Molgulid, *Oligotrema*, from the Loyalty Islands, with a reduced branchial sac and enlarged pinnate muscular branchial lobes, apparently used for catching food!

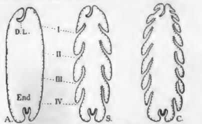


FIG. 26.—Diagrams showing Transverse Sections of Typical Branchial Sacs.

A, Unfolded type. S, *Styela*, with four folds on each side.
C, *Cynthia*, with eight folds on one side and seven on the other.
D.L., Dorsal lamina; End, endostyle; I, II, &c., folds.

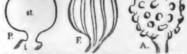


FIG 27.—Types of Stomach amongst Compound Ascidians.
P, Plain. F, Folded. A, Areolated.
i, Intestine; *œ*, oesophagus; *st*, stomach.

Figs. 26 and 27 illustrate some details of structure of branchial sac and of stomach in various simple and compound Ascidians, which are made use of in classification, and in the definitions of genera and larger groups.

Sub-Order 2.—Ascidiae Compositae.

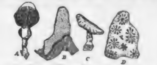
Compound Ascidians.

Fixed Ascidians which reproduce by gemmation, so as to form colonies in which the ascidiozooids are buried in a common investing mass and have no separate tests. This is probably a somewhat artificial assemblage formed of two or three groups of Ascidians which produce colonies in which the ascidiozooids are so intimately united that they possess a common test or investing mass. This is the only character which distinguishes them from the Clavelinidae, but the property of reproducing by gemmation separates them from the rest of the Ascidiae Simplices. The Ascidiae Compositae may be divided into seven families, which fall into two well-marked groups: (1) the Chalarosomata, including the first five families, with extended body, divided into two or three regions, and more nearly related to the Clavelinidae; and (2) the Pectosomata, including the Botryllidae and Polystyelidae, with a compact body, not divided into regions, and evidently related to the Cynthiidae amongst simple Ascidians.

Family I., Distomidae.—Ascidiozooids divided into two regions, thorax and abdomen: testes numerous; vas deferens not spirally coiled. The chief genera are: *Distoma* (Gaertner); *Distaplia* (Della Valle); *Colella* (Herdman), forming a pedunculated colony (see fig. 28, A) in which the ascidiozooids develop incubatory pouches, connected with the peribranchial cavity, in which the embryos undergo their development (17); and *Chondrostachys* (Macdonald).

Family II., Coelocormidae.—Colony not fixed, having a large axial cavity with a terminal aperture. Branchial apertures five-lobed. This includes one species, *Coelocormus huxleyi* (Herdman), which is, in some respects, a transition form between the ordinary compound Ascidians (*e.g.* Distomidae) and the Ascidiae Luciae (*Pyrosoma*).

Family III., Didemnidae.—Colony usually thin and incrusting test containing stellate calcareous spicules. Testis single, large; vas deferens spirally coiled. The chief genera are—*Didemnum* (Savigny), in which the colony is thick and fleshy and there are only three rows of stigmata on each side of the branchial sac; and *Leptoclinum* (Milne-Edwards), in which the colony is thin and incrusting (fig. 28, B) and there are four rows of stigmata on each side of the branchial sac.



(After Herdman, "*Challenger*" *Report*)

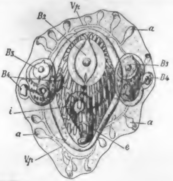
FIG. 28.—Colonies of Ascidiae Compositae. (Natural size.)

A, *Colella quoyi*.
B, *Leptoclinum neglectum*.
C, *Pharyngodictyon mirabile*.
D, *Botryllus*, showing arrangement of ascidiozooids in circular systems, each of which has a central common cloaca.

Family IV., Diplosomidae.—Test reduced in amount, rarely containing spicules. Vas deferens not spirally coiled. In *Diplosoma* (Macdonald), the most important genus, the larva is gemmiparous.

Family V., Polyclinidae.—Ascidiozooids divided into three regions—thorax, abdomen and post-abdomen. Testes numerous; vas deferens not spirally coiled. The chief genera are: *Pharyngodictyon* (Herdman), with stigmata absent or modified, containing one species, *Ph. mirabile* (fig. 28, C), the only compound Ascidian known from a depth of 1000 fathoms; *Polyclinum* (Savigny), with a smooth-walled stomach; *Aplidium* (Savigny), with the stomach wall longitudinally folded (fig. 27); and *Amaroucium* (Milne-Edwards), in which the ascidiozooid has a long post-abdomen and a large atrial languet.

Family VI., Botryllidae.—Ascidiozooids having the intestine and reproductive organs alongside the branchial sac. Dorsal lamina present; internal longitudinal bars present in branchial sac. The chief genera are: *Botryllus* (Gaertn. and Pall.), with simple stellate systems (fig. 28, D), and *Botrylloides* (Milne-Edwards), with elongated or ramified systems. It is well known that in the family Botryllidae, amongst compound Ascidians, the ectodermal vessels containing



(After Pizon)

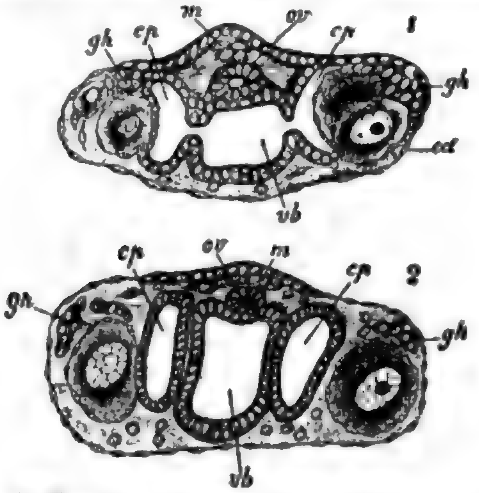
FIG. 29.—Young Colony of *Botryllus*, showing Buds and Ampullae
a, Ampullae; *B2 B3*, *B4*, Successive generations of buds;
e, Stomach; *i*, Intestine; *vp*, Vessels of the test.

blood, which ramify through the common test and serve to connect the vascular systems of the various members of the colony, have numerous large ovate dilatations, the ampullae, upon their terminal twigs (fig. 29). Various functions have been assigned to these ampullae in the past, and Bancroft has shown that in addition to acting as storage reservoirs for blood, organs for the secretion of test matrix, and accessory organs of respiration, they are also organs for blood propulsion. The ampullae execute co-ordinated pulsations, the co-ordination being due to variations in the blood-pressure. It was actually found that the ampullae could keep up the circulation for some time in a portion of a colony independently of the hearts of the ascidiozooids. All the hearts in a colony of *Botryllus* contract simultaneously and in the same direction. The reversal of the circulation may be regarded as due to the engorgement of the ampullae in the superficial parts of the colony. These when distended overcome the resistance of the heart's action, and cause it to stop and then reverse.

Family VII., Polystyelidae.—Ascidiozooids not grouped in systems. Branchial and atrial apertures four-lobed. Branchial sac may be folded; internal longitudinal bars present. The chief genera are: *Thylacium* (Carus), with ascidiozooids projecting above general surface of colony; *Goodsiria* (Cunningham), with ascidiozooids completely imbedded in investing mass; and *Chorizocormus* (Herdman), with ascidiozooids united in little groups which are connected by stolons. Several of the species show transitions between the other Polystyelidae and the Styelinae amongst simple Ascidians.

Gemmation and Growth of Colonies.—A number of new observations have been made in recent years upon the budding of compound Ascidians, some of which are very puzzling and contradictory in their results. Metschnikoff, Kowalevsky, Giard, Hjort, Pizon, Seeliger, Ritter, van Beneden and Julin have all in turn added to our knowledge of the details of development and life-history, of the various processes of gemmation and of the formation of colonies. It is impossible as yet to reconcile all the conflicting accounts, but the following points at least seem pretty clear.

Gemmation may be very different in its details in closely related compound Ascidians. There are, however, two main types of budding, to one or other of which most of the described methods may be referred. There is first the "stolonial" or "epicardiac" type, seen in the Chalarosomata, typically in Distomidae and Polyclinidae, and comparable with the gemmation in Clavelinidae, Pyrosomidae and Thaliacea outside this group. Secondly, there is the "parietal" or "peribranchial" type, seen in the Pectosomata, typically in the Botryllidae. The remarkable process of gemmation seen in the families Didemnidae and Diplosomidae may probably be regarded as a modification of the stolonial type. The double embryo in the Diplosomidae is probably to be interpreted as precocious budding (rather than as embryonic fission), due to acceleration in development (tachygenesis). The type of budding, and even details such as the length of the stolon, have much to do with differences in the nature and appearance of the colonies produced. The stolon, which has a wall continuous with the body-wall of the parent, contains an endodermal element in the form of the so-called "epicardium," and also a prolongation of the ovary, or at least a string of migrating germ-cells, so that the reproductive elements are also handed on. Still, it is clear from recent researches that the development of the bud (blastozooid) and that of the embryo (oozooid) do not proceed along parallel lines. It is impossible to harmonize the facts of gemmation with the germ-layer theory, and attempts to explain budding in Ascidians as a process of regeneration, by which the organs of the parent or their germ-layers give rise to the corresponding organs in the bud, have signally failed.



(After Pizon.)

FIG. 30.—Young buds of *Botryllus* sectioned to show the separation of the branchial (*vb*) from the peribranchial (*cp*) cavities.

ov, Dorsal tube.
m, Mesoderm cells.
gh, Germ cells.
ect, Ectoderm.

Reproduction by Gemmation and the Formation of Colonies.

Figs. 29 and 30 show the buds in the Botryllidae, after Pizon, who has followed day by day the changes of growth in young colonies of Botryllidae, tracing the rise of successive generations of buds and the degeneration of their parents. The buds are parietal, arising from the walls of the peribranchial cavities (fig. 29), and at an early period they acquire the structure shown in fig. 30, where there are two vesicles undergoing further subdivision and differentiation, but investigators still differ as to whether the inner, which gives rise to the branchial sac and alimentary canal, is not produced along with the outer from the ectoderm of the parent.

A remarkable case of polymorphism has been found by M. Caullery in the buds of the compound Ascidian *Colella*. Some of the buds have an abundant store of reserve materials in their outer layer of cells, while others are without this supply. The former are placed deeply in the stalk, develop slowly, and probably serve to regenerate the colony when the head portion has been removed or has died down. In these cases where the ectoderm has taken on the function of storing the reserve material, it is found that all the organs of the bud are formed from the cells of the endodermic vesicle. The first ascidiozooid of the colony produced by the tailed larva does not form sexual reproductive organs, but reproduces by gemmation so as to make a colony. Thus there is alternation of generations in the life-history. In the most completely formed colonies (*e.g. Botryllus*) the ascidiozooids are arranged in groups (systems or coenobii), and in each system are placed with their atrial apertures towards one another, and all communicating with a common cloacal cavity which opens to the exterior in the centre of the system (fig. 28, D).

Sub-Order 3.—Ascidiae Luciae.

Ascidiae Luciae.

Free-swimming pelagic colonies having the form of a hollow cylinder closed at one end. The ascidiozooids forming the colony are embedded in the common test in such a manner that the branchial apertures open on the outer surface and the atrial apertures on the inner surface next to the central cavity of the colony. The ascidiozooids are produced by gemmation from a rudimentary larva (the cyathozooid) developed sexually.

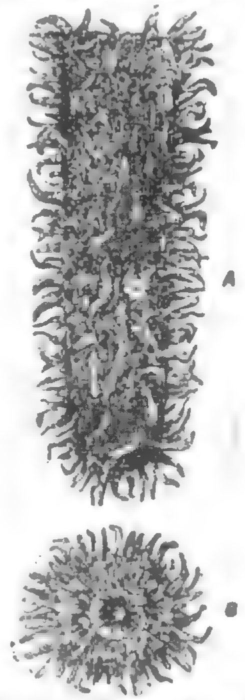
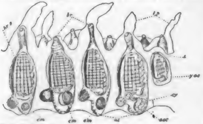


FIG. 31.—*Pyrosoma elegans.*

A, Side view of entire colony.
B, End view of open extremity.

Structure of Pyrosoma.

This sub-order includes a single family, the Pyrosomidae, containing one well-marked genus, *Pyrosoma* (Péron), with half a dozen species. They are found swimming near the surface of the sea, chiefly in tropical latitudes, and are brilliantly phosphorescent. A fully developed *Pyrosoma* colony may be from an inch or two to upwards of twelve feet in length. The shape of the colony is seen in fig. 31. It tapers slightly towards the closed end, which is rounded. The opening at the opposite end is reduced in size by the presence of a membranous prolongation of the common test (fig. 31, B). The branchial apertures of the ascidiozooids are placed upon short papillae projecting from the general surface, and most of the ascidiozooids have long conical processes of the test projecting outwards beyond their branchial apertures (figs. 31, 32 and 33). There is only a single layer of ascidiozooids in the *Pyrosoma* colony, as all the fully developed ascidiozooids are placed with their antero-posterior axes at right angles to the surface and communicate by their atrial apertures with the central cavity of the colony (fig. 32). Their dorsal surfaces are turned towards the open end of the colony. The more important points in the structure of the ascidiozooid of *Pyrosoma* are shown in fig. 33. A circle of tentacles, of which one, placed ventrally (fig. 33, *tn*), is larger than the rest, is found just inside the branchial aperture. From this point a wide cavity, with a few circularly placed muscle bands running round its walls, leads back to the large branchial sac, which occupies the greater part of the body. The stigmata are elongated transversely and crossed by internal longitudinal bars. The dorsal lamina is represented by a series of eight languets (*l*). The nerve ganglion (on which is placed a small pigmented sense organ), the subneural gland, the dorsal tubercle, the peripharyngeal bands, and the endostyle are placed in the usual positions. On each side of the anterior end of the branchial sac, close to the peripharyngeal bands, is a mass of rounded gland cells which are the source of the phosphorescence. The alimentary canal is placed posteriorly to the branchial sac, and the anus opens into a large peribranchial (or atrial) cavity, of which only the median posterior part is shown (*p.br.*) in fig. 33. The reproductive organs are developed in a diverticulum of the peribranchial cavity, and consist of a lobed testis and a single ovum at a time. The development takes place in a part of the peribranchial cavity (fig. 32, *em*). The segmentation is meroblastic, and an elongated embryo is formed on the surface of a mass of yolk. The embryo, after the formation of an alimentary cavity, a tubular nervous system, and a pair of laterally placed atrial tubes, divides into an anterior and a posterior part. The anterior part then segments into four pieces, which afterwards develop into the first ascidiozooids of the colony, while the posterior part remains in a rudimentary condition, as the "cyathozooid"; it eventually atrophies. As the four ascidiozooids increase in size, they grow round the cyathozooid and soon encircle it (fig. 32, *asc* and *cy*). The cyathozooid absorbs the nourishing yolk upon which it lies, and distributes it to the ascidiozooids by means of a heart and system of vessels which have been meanwhile formed. When the cyathozooid atrophies and is absorbed, its original atrial aperture remains and deepens to become the central cavity of the young colony, which now consists of four ascidiozooids placed in a ring, around where the cyathozooid was, and enveloped in a common test. The colony gradually increases by the formation of buds from these four original ascidiozooids.

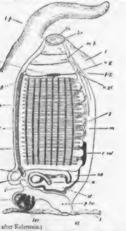


(Partly after Savigny.)

FIG. 32.—Part of a Longitudinal Section through wall of *Pyrosoma*, showing arrangement of ascidiozooids, magnified.

at, Atrial apertures.
br, Branchial apertures.
asc, Young ascidiozooid of a future colony produced by budding from *cy*, cyathozooid.
em, Embryos in various stages.
t, Test.
t.p, Processes of test.
br.s, Branchial sac.
y.as, Young ascidiozooid.

Development of Pyrosoma.



(Partly after Kelerstein.)

FIG. 33.—Mature Ascidiozooid of *Pyrosoma*, from left side. Lettering as before.

c.m, Cellular mass, the seat of phosphorescence.
c.m', Posterior cellular mass.
g.s, Gemmiparous stolon.
m.b, Muscle band.
n.gl, Sulmeural gland.
pig, Pigment spot on ganglion.
t.p, Process of test.

PHYLOGENY

Phylogeny

The accompanying diagram (fig. 34) shows graphically the probable origin and course of evolution of the various groups of Tunicata, and therefore exhibits their relations to one another much more correctly than any system of linear classification can do. The ancestral Proto-Tunicata are here regarded[1] as an offshoot from the Proto-Chordata—the common ancestors of the Tunicata (Urochorda), *Amphioxus* (Cephalochorda) and the Vertebrata. The ancestral Tunicata were probably free-swimming forms, not very unlike the existing Appendiculariidae, and are represented in the life-history of nearly all sections of the Tunicata by the tailed larval stage. The Larvacea are the first offshoot from the ancestral forms which gave rise to the two lines of descendants, the Proto-Thaliacea and the Proto-Ascidiacea. The Proto-Thaliacea then split into the ancestors of the existing Cyclomyaria and Hemimyaria. The Proto-Ascidiacea gave up their pelagic mode of life and became fixed. This ancestral process is repeated at the present day when the free-swimming larva of the simple and compound Ascidians becomes attached. The Proto-Ascidiacea, after the change, are probably most nearly represented by the existing genus *Clavelina*. They have given rise directly or indirectly to the various groups of simple and compound Ascidians and the Pyrosomidae. These groups form two lines, which appear to have diverged close to the position of the family Clavelinidae. The one line leads to the more typical compound Ascidians, and includes the Polyclinidae, Distomidae, Didemnidae, Diplosomidae, Coelocormidae, and finally the Ascidiae Luciae or Salpiformes. The second line gave rise to the simple Ascidians, and to the Botryllidae and Polystyelidae, which are, therefore, not closely allied to the other compound Ascidians. The later Proto-Ascidiacea were probably colonial forms, and gemmation was retained by the Clavelinidae and by the typical compound Ascidians (Distomidae, &c.) derived from them. The power of forming colonies by budding was lost, however, by the primitive simple Ascidians, and must, therefore, have been regained independently by the ancestral forms of the Botryllidae and the Polystyelidae. If this is a correct interpretation of the course of evolution of the Tunicata, we arrive at the following important conclusions. (1) The Tunicata, as a whole, form a degenerate branch of the Proto-Chordata; (2) the Ascidiae Luciae (*Pyrosoma*) are much more closely related to the typical compound Ascidians than to the other pelagic Tunicata, viz. the Larvacea and the Thaliacea; and (3) the Ascidiae Compositae form a polyphyletic group, the sections of which have arisen at several distinct points from the ancestral simple Ascidians.

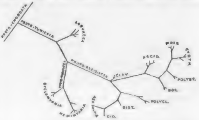


FIG. 34.

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[1] By Dohrn and others their point of origin is placed considerably farther up on the stem of the Chordata, thus causing the Tunicata to be regarded as very degenerate Vertebrata (see 31).

Müller's *Archiv* (1852); (12) Kupffer, *Arch. f. mikr. Anat.* (1869, 1872); (13) Giard, "Étude d. trav. embryolog. d. *Tun.*, &c.," in *Arch. zool. expér* (1872), vol. i.; (14) Fol, "Études sur les appendiculaires du détroit de Messine," in *Mém. soc. phys. hist. nat. Genève*, vol. xxi.; (15) Giard, "Recherches s. l. Asc. Comp.," in *Arch. zool. expér.* (1872), vol. i.; (16) Von Drasche, *Die Synascidien der Bucht von Rovigno* (Vienna, 1883); (17) Herdman, "Report upon the *Tunicata* of the 'Challenger' Expedition," pt. i. in *Zool. "Chall." Exp.* (1882), vol. vi.; pt. ii. in *Zool. "Chall." Exp.* (1886), vol. xiv.; pt. iii. in *Zool. "Chall." Exp.* (1889), vol. xxvii.; (18) Alder and Hancock, in *Ann. Mag. Nat. Hist.* (1863, 1870); (19) Heller, "Untersuch. u. d. Tunic. d. Adriat. Meeres," in *Denkschr. d. k. Akad. Wiss.* (1875–1877); (20) Lacaze-Duthiers, "Asc. simp. d. côtes d. l. Manche," in *Arch. zool. expér.* (1874, 1877); (21) Traustedt, in *Vidensk. medd. naturh. For.* (Copenhagen, 1881–1884); (22) Herdman, "Notes on British *Tunicata*, &c.," in *Journ. Linn. Soc. Zool.* (1880), vol. xv.; (23) Ussoff, in *Proc. imp. soc. nat. hist.* (Moscow, 1876), vol. xviii.; (24) Julin, "Rech. s. l'org. d. asc. simp.," in *Arch. d. biol.* (1881), vol. ii.; (25) Brooks, "Development of *Salpa*," in *Bull. Mus. Comp. Zool.* iii. 291 (Harvard); (26) Salensky, *Ztschr. f. wiss. Zool.* (1877); (27) Barrois, *Journ. d. l'anat. et phys.* (1885), vol. xxi.; (28) Uljanin, *Fauna, &c., d. Golfes von Neapel* (1884), vol. x.; (29) Moseley, "On Deep-sea Ascid," in *Trans. Linn. Soc.* (1876), 2nd series, vol. i.; (30) E. van Beneden and Julin, "Morph. d. Tuniciers," in *Arch. d. Biol.* (1886), vol. vi.; (31) Dohrn, "Studien zur Urgesch. der Wirbelth." in *Mitth zool. Stat. Neapel*; (32) Herdman, "Revised Classification," *Journ. Linn. Soc* (1891), vol xxiii.; (33) Herdman, *Descriptive Catalogue of Australian Tunicata* (1899); (34) Brooks, *The Genus Salpa* (1893); (35) Seeliger, *Bronn's Thier-Reich Tunicata*.

(W. A. He.)

TUNICLE (Lat. *tunicella*), a liturgical vestment of the Christian church, proper to subdeacons. It is practically the same vestment as the dalmatic (*q.v.*).

TUNING FORK, a small bar of cast steel with tolerably defined edges, bent into a fork with two prongs, with a handle of the same metal extending from the bend of the fork and serving as a sound-post to transmit the vibrations to any resonance board or body convenient for reinforcing the sound. The fork is set in vibration by striking one of the prongs against a hard substance, or pressing the prongs together if they are light ones, or if heavy drawing a bow across. The tuning fork was invented by John Shore, royal trumpeter in 1711, sergeant trumpeter at the entry of George I. in 1714, and lutanist to the Chapel Royal in 1715. It is used for determining musical pitch (see Pitch), and also in certain physical experiments (see Sound).

TUNIS, capital of Tunisia, the largest city in North Africa outside Egypt, in 36° 48′ N., 10° 12′ E. Tunis is situated on an isthmus between two salt lakes, the marshy Sebkha-el-Sejumi to the south-west, and the shallow el-Bahira (little sea), or Lake of Tunis, to the north-east. An artificially deepened channel through the Bahira into the Gulf of Tunis has converted the city into a seaport (see below). North-west and south-west the city is commanded by hills, on which are forts, that on Sidi bel Hassan to the south dating from the middle ages. The city, which was formerly strongly fortified, is built in the shape of an amphitheatre, with the kasbah, or citadel, at its highest point. The old town (Medina), the walls of which have in great part disappeared, lies between two suburbs, the Ribat-el-Sowika on the north and the Ribat Bab-el-Jezira on the south. These suburbs were also surrounded by a wall, now pulled down, leaving the gates of the city isolated. An outer wall, however, encloses the Medina and its suburbs. Beyond the Bab-el-Bahar (sea-gate), now called Porte de France, on the level ground by the Bahira, is the marine town, or Quartier Franc, built since the French occupation in 1881. No attempt has been made by the French to modernize the ancient city.

The European Quarter.—From the landing stage a short street leads into the broad Avenue Jules Ferry or de la Marine running east to west and ending in the Place de la Résidence, on the north side of which is the Roman Catholic cathedral and on the south side the palace of the French resident-general, with a large garden. The main thoroughfare is continued westwards by the Avenue de France, which leads to the Porte de France. Beyond the gate is the small Place de la Bourse, in which is the British consulate. From the Porte electric trams run to the harbour and also in a circle round the native city. From the Place de la Résidence cross-roads run north and south. The northern road, the Rue de Rome, led to the Gare du Nord, the station for Carthage, Goletta and La Marsa. This line was replaced in 1908 by an electric tramway built along the northern bank of the canal connecting Tunis and Goletta. The southern road, the Rue-es-Sadikia, leads to the Gare du Sud, the station for Susa, Kairawan, &c., and also for Algiers. The Avenue Jules Ferry is intersected by a north-to south street running in a straight line over two miles. The northern section is called the Avenue de Paris; the southern Avenue de Carthage. By these avenues, served by electric trams, access is gained to the suburbs of the city. In the Avenue de France or Avenue Jules Ferry are the chief hotels and cafés, the casino-theatre, the principal banks and the finest shops. In the Rue d'Italie, running south from the Avenue de France, are the post office, market buildings, and French Protestant church. There is an English church in the Rue d'Espagne. Behind the cathedral is a disused cemetery with a chapel, where the Christian slaves are supposed to have worshipped. The coffins in the vaults have been removed to the Chapel of St Louis at Carthage. Among them was that of M. de Lesseps, French consul-general (d. 1832), father of the maker of the Suez Canal. Next to the cemetery is the old Greek church. North of the Avenue de France is a district, inhabited chiefly by Maltese, which has obtained the name of Malta-es-Segheira (Little Malta).

The Native Town.—To the visitor from Europe the attraction of Tunis lies in the native city, where, in the Rue al Jezira, along which runs electric trams, he can see hundreds of camels in the morning bearing charcoal to market; where he may witness the motley life of the bazaars, or, by the Bab-Jedid, watch the snake-charmers and listen to the Moorish story-tellers. Christians are forbidden to enter the mosques. From various points the traveller can look over the city, with its great citadel, its many minarets and its flat-topped houses. Many of the dwellings of the richer residents are adorned with arcades, the marble columns of which were taken from the ruins of Carthage. The Porte de France is the threshold of the ancient city. Two narrow streets climb the hill towards the citadel. That to the right, the Rue de la Kasbah, opens into a small square (Suk-el-Islam or Place de la Kasbah), on the left of which is the Dar-el-Bey (palace of the bey), while beyond it rise the walls of the citadel. That to the left leads to the chief mosque of the city, the Jamaa-al-Zeituna (mosque of the Olive Tree), founded in A.D. 698. It has many domes and a spacious cloister, and its central court can be seen from the neighbouring streets. Attached to the mosque is a college attended by several hundreds of Moslem youths. The Dar-el-Bey contains numerous rooms beautifully decorated in the Moorish style of the 18th century; and the judgment hall has a domed roof adorned with the delicate arabesque plaster-work known as *Nuksh hadida*. The kasbah, which forms the western side of the Suk-el-Islam, includes within the circuit of its walls a mosque built about A.D. 1232 by Abu Zakariya the Hafsite. Of the ancient kasbah nothing but the walls remain, the old buildings having been demolished to make way for barracks for the French troops. Besides being a fortress the kasbah formerly contained a palace of the beys, barracks for janissaries and bagnios for the Christian slaves. When in July 1535 the Spaniards under Charles V. attacked Tunis, the Christians in the kasbah, said to number 10,000, rose against their keepers and helped to secure the victory of the emperor. The Spaniards during their occupancy of Tunis strengthened the kasbah and built an aqueduct to supply it with water. Immediately north of the kasbah are the buildings of the Sadiki College, and north of the college is the Palais de Justice, a building completed in 1901. It stands between the line of the ancient wall and the enceinte. Its walls are decorated with faience taken from an ancient Tunisian palace. North-east of the Palais de Justice, which like the Sadiki College is built in the Moorish style, rises the great dome, surrounded by smaller cupolas, of the largest mosque in the city, that named after Sidi Mahrez, a renowned saint of the 5th century of the Mahommedan era, whose tomb makes it a sanctuary for debtors. East of the mosque, which dates from the 17th century, and just without the inner city walls, here demolished, is the Protestant cemetery of St George, used during the 17th, 18th and the greater part of the 19th centuries. Here are buried several British consuls. Here also was the grave of John Howard Payne, author of "Home, Sweet Home" and consul for the United States, who died at Tunis in 1852. In 1883 the body was disinterred and removed to America, but a monument has been placed on the spot similar to that erected over the new tomb at Washington.

The Bazaars.—The native city to the north of the Rue de la Kasbah includes the Jewish quarter and the synagogue. The Jews of Tunis adopt a special costume, the women wearing gaily coloured vests and close-fitting white trousers. Beyond the Jewish quarter, in the Ribat-el-Soweika, is the Place el Halfa-Ouine, a favourite rendezvous of the poorer Moslem population, wherein are many native cafés. South of the Rue de la Kasbah is the bazaar quarter. Here the streets are very narrow and tortuous, some being vaulted and many covered in with planking. They are known as suks (markets), and each suk is devoted to one particular trade. Beyond paving the streets the French have made no alteration in the suks, which retain their original character unimpaired. The shops consist of small cubes, open in the front, in which the trader squats cross-legged amidst his wares. The principal suks are el-Attarin (market of the perfumers), el-Farashin (carpets and cloths), el-Serajin (saddlery) and el-Birka (jewelry). The suk el-Birka was formerly the slave market. Near by are the green-tiled domes and walls enriched with rose-coloured marbles of the mausoleum of the beys.

Public Institutions, &c.—Tunis is furnished with well-equipped hospitals and a large asylum for aged people kept by the Little Sisters of the Poor. The principal educational establishments, besides that of the mosque of the Olive Tree, are the Sadiki College, founded in 1875, for free instruction in Arabic and European subjects, the Lycée Carnot in the Avenue de Paris, formerly the College of St Charles (founded by Cardinal Lavigerie), open to Christians and Moslems alike, and the normal school, founded in 1884 by the reigning bey, for the training of teachers in the French language and European ideas. The Dames de Sion have a large establishment for the teaching of small children of both sexes, and there is a secondary school for girls. All the schools are well attended. About a mile and a half north of the centre of the European quarter, on the slopes of a hill rising 270 ft., is the Parc du Belvedère covering some 240 acres and commanding extensive views. Water is supplied to the city, with its numerous fountains, from Jebel Zaghwan (*vide infra*) by the Roman aqueduct repaired, at a cost of half a million sterling, by the bey Mahommed al-Sadik (d. 1882).

The Port.—The canal which traverses the shallow Bahira, and connects Tunis with the Mediterranean, is nearly seven miles long. By means of breakwaters it is continued beyond the coast-line and is at its mouth 328 ft. wide. It has a uniform depth of 21⅓ ft., but its width within the lake is reduced to 98 ft. In the centre, however, the canal is widened to 147 ft. to allow vessels to pass. There is a harbour at the entrance (see GOLETTA). That at the Tunis end of the canal is 1312 ft. long by 984 ft. broad, and is of the same depth as the canal. The canal was begun in 1885 and was opened to navigation in June 1893. An additional basin, south-east of the main harbour, was opened in 1905 and is used for the exportation of phosphates. Of the ships using the harbour more than half are French, and one-third Italian, British vessels coming next. British goods, however, are largely carried in French bottoms, and next to France the United Kingdom and Malta take most of the trade of the port. The exports are chiefly phosphates and other minerals, cereals, olive oil, cattle, hides, sponges and wax. The imports are cotton goods, flour, hardware, coal, sugar, tea, coffee, &c. The figures of trade and shipping are included in those of the trade of the regency (see TUNISIA), of which Tunis and Goletta take about a third.

Population.—The population of the city at the census of 1906 was returned at 227,519. The "natives"—Arabs, Berbers, "Moors," Turks and negroes—were estimated at 100,000, Tunisian Jews at 50,000, French 18,000, Italians 52,000, Maltese 6000, Greeks 500 and Levantines 1000. The French language is predominant in the European quarter.

Environs: The Bardo Palace, Zaghwan, &c.—The environs of Tunis are picturesque and afford many beautiful views, the finest being from the hill on the south-east, crowned by a French fort, and from the Belvedère already mentioned. About a mile and a quarter from the Bab Bu Saadun, the north-west gate of the city, is the ancient palace called the Bardo, remarkable for the "lion court," a terrace to which access is gained by a flight of steps guarded by marble lions, and for some apartments in the Moorish style. The finest of these apartments, containing beautiful arabesque plaster work, formed the old Harem, and are now part of the Musée Alaoui, which occupies a considerable portion of the Bardo. In this museum M. Paul Gauckler, the director of the department of art and antiquities in the Tunisian government, has formed a magnificent collection of Carthaginian and Roman antiquities, especially Roman mosaics. In the Musée Arabe, which occupies an adjacent small palace built about 1830, are treasures illustrative of the Arab-Berber or Saracenic art of Tunisia.

South-east of the city, along the valley of the Wadi Melain, are hundreds of large stone arches, magnificent remains of the Roman aqueduct from Zaghwan to Carthage. At Zaghwan (38 m. by rail from Tunis), over the spot whence the spring which supplies the aqueduct issues from the hill, are the ruins of a beautiful Temple of the Waters. The spring is now diverted direct into the aqueduct and is not visible at the surface. Between Zaghwan and Tunis, and accessible by the same railway, is Wadna, the Roman Uthina, where, besides numerous other ruins, are the fairly preserved arches of a large amphitheatre. The ruins of Carthage (*q.v.*) lie a few miles north of Goletta.

History.—Tunis is probably of greater antiquity than Carthage, of which city however it became a dependency, being repeatedly mentioned in the history of the Punic Wars. Strabo speaks of its hot baths and quarries. The importance of Tunis dates from the Arab conquest, when, as Carthage sank, Tunis took its place commercially and politically. It became the usual port for those going from the sacred city of Kairawan to Spain, and was one of the residences of the Aghlabite dynasty (800–909). In the 10th century it suffered severely, being repeatedly pillaged in the wars of the Fatimite caliphs Al-Qaim and Abu Tahir Isma'il el Mansur with the Sunnite leader Abu Yazid and the Zenata Berbers.

For its later fortunes, see TUNISIA, of which regency, since the accession of the Hafsites, Tunis has been the capital.

TUNISIA (Regency of Tunis), a country of North Africa, under the protection of France, bounded N. by the Mediterranean, W. by Algeria, E. by Tripoli and S. by the Sahara. Tunisia reaches farther north than any other part of Africa, Ras-al-Abiadh (Cape Blanc)[1] being in 37° 20′ N. On the south the boundary of the Tunisian Sahara is undetermined, but it may be roughly placed at 31° N. This would give, therefore, a greatest length of something like 440 m. The country lies between 11° 40′ E. and 7° 35′ E. The average length is about 300 m., and the average breadth 150 m.; consequently the area may be estimated at 50,000 sq. m. (For map, see ALGERIA.)

Physical Features.—Geographically speaking, Tunisia is merely the eastern prolongation of the Mauretanian projection of northern Africa, of that strip of mountainous, fertile and fairly well-watered country north of the Sahara desert, which in its flora and its fauna, and to some extent in its human race, belongs rather to Europe than to Africa. Tunisia is divided into the following four fairly distinct regions:—

1. On the north and north-west the Aures mountains of Algeria are prolonged into Tunisia, and constitute the mountainous region of the north, which lies between the Majerda river and the sea, and also includes the vicinity of the city of Tunis and the peninsula of the Dakhelat el Mawin, which terminates in Ras Addar (Cape Bon). This first division is called by the French "the Majerda Mountains." It includes within its limits the once famous district of the "Kroumirs,"[2] a tribe whose occasional thefts of cattle across the frontier gave the French an excuse to invade Tunisia in 1881. The highest point which the mountains attain in this division of Tunisia is about 4125 ft., near Ain Draham in Kroumiria. The country, however, about Bizerta is very mountainous, though the summits do not attain a greater altitude than about 3000 ft. The district between Bizerta and the Gulf of Tunis is a most attractive country, resembling greatly the mountainous regions of South Wales. It is well watered by streams more or less perennial. The principal river, the Majerda, is formed by the junction of the Wad Malleg and the Wad Kkallad. It and its

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[1] It is possible that Ras-ben-Sekka, a little to the west of Cape Blanc, may be actually the most northerly point.

[2] The French seem systematically unable to master certain sounds foreign to their own language, or sounds which they suppose to be foreign. Thus the "w," though constantly represented in French by "ou," is continually changed by them into "v" when they transcribe foreign languages, just as the Greek χ and the German and Scottish "ch" is almost invariably rendered by the French in Algeria and Tunis as "kr." Add to this the insertion of vowel sounds where they are lacking in the Arabic and you derive from the real word *Khmir* the modern French term of Kroumir. In like manner *sebkha*, a salt lake, is constantly written by the French as *sebkra*.

tributaries rise in the Majerda and Aures mountains. Flowing north-east the Majerda forms an extensive plain in its lower course, reaching the sea near the ruins of Utica. Vegetation is abundant, and recalls that of the more fertile districts of southern Spain and of Italy. On the higher mountains the flora has a very English character, though the actual species of plants may not be the same.

2. The central plateau region, stretching between the Majerda valley and the mountains of Gafsa. The average elevation of this country is about 2000 ft. The climate, therefore, in parts is exceedingly cold and bleak in winter, and as it is very wind-swept and parched in summer by the terrible *qibli* or "sirocco" it is much less attractive in appearance than the favoured region on the northern littoral. Although it is almost always covered with some kind of vegetation, trees are relatively rare. A few of the higher mountains have the Aleppo pine and the juniper; elsewhere only an infrequent wild terebinth is to be seen. In these two regions the date palm is never met with growing naturally wild. Its presence is always due to its having been planted by man at some time or another, and therefore it is never seen far from human habitations. These central uplands of Tunisia in an uncultivated state are covered with alfa or esparto grass; but they also grow considerable amounts of cereals—wheat in the north, barley in the south. The range of the Saharan Atlas of Algeria divides (roughly speaking) into two at the Tunisian frontier. One branch extends northwards up this frontier and north-eastwards across the central Tunisian table-land, and the other continues south-eastwards between Gafsa and the salt lakes of the Jerid. The greatest altitudes of the whole of Tunisia are attained on this central table-land, where Mt Sidi Ali bu Musin ascends to about 5700 ft. About 30 m. south of the city of Tunis is the picturesque mountain of Zaghwan, approximately 4000 ft. in altitude, and from whose perennial springs comes the water-supply of Tunis to-day as it did in the time of the Carthaginians and Romans. North-east of Zaghwan, and nearer Tunis, is the Jebel Resās, or Mountain of Lead, the height of which is just under 4000 ft.

3. The Sahel. This well-known Arab term for coast-belt (which in the plural form reappears as the familiar "Swahili" of Zanzibar) is applied to a third division of Tunisia, viz. the littoral region stretching from the Gulf of Hammamet to the south of Sfax. It is a region varying from 30 to 60 m. in breadth, fairly well watered and fertile. In a less marked way this fertile coast region is continued southwards in an ever-narrowing belt to the Tripolitan frontier. This region is relatively flat, in some districts slightly marshy, but the water oozing from the soil is often brackish, and in places large shallow salt lakes are formed. Quite close to the sea, all along the coast from Hammamet to Sfax, there are great fertility and much cultivation; but a little distance inland the country has a rather wild and desolate aspect, though it is nowhere a desert until the latitude of Sfax has been passed.

4. The Tunisian Sahara. This occupies the whole of the southern division of Tunisia, but although desert predominates, it is by no means all desert. At the south-eastern extremity of Tunisia there is a clump of mountainous country, the wind-and-water-worn fragments of an ancient plateau, which for convenience may be styled the Matmata table-land. Here altitudes of over 3000 ft. are reached in places, and in all the upper parts of this table-land there is fairly abundant vegetation, grass and herbage with low junipers, but with no pine trees. Fairly high mountains (in places verging on 4000 ft.) are found between Gafsa and the salt lakes of the Jerid.

The Shats.

These salt lakes are a very curious feature. They stretch with only two short breaks in a line from the Mediterranean at the Gulf of Gabes to the Algerian frontier, which they penetrate for a considerable distance. They are called by the French (with their usual inaccuracy of pronunciation and spelling) "chotts"; the word should really be the Arabic *shat*, an Arab term for a broad canal, an estuary or lake. These shats however are, strictly speaking, not lakes at all at the present day. They are smooth depressed areas (in the case of the largest, the Shat el Jerid, lying a few feet below the level of the Mediterranean), which for more than half the year are expanses of dried mud covered with a thick incrustation of white or grey salt. This salt covering gives them at a distance the appearance of big sheets of water. During the winter, however, when the effect of the rare winter rains is felt, there may actually be 3 or 4 ft. of water in these shats, which by liquefying the mud makes them perfectly impassable. Otherwise, for about seven months of the year they can be crossed on foot or on horseback. It would seem probable that at one time these shats (at any rate the Shat el Jerid) were an inlet of the Mediterranean, which by the elevation of a narrow strip of land on the Gulf of Gabes has been cut off from them. It is, however, a region of past volcanic activity, and these salt depressions may be due to that cause. Man is probably the principal agent at the present day in causing these shats to be without water. All round these salt lakes there are numerous springs, gushing from the sandy hillocks. Almost all these springs are at a very hot temperature, often at boiling point. Some of them are charged with salt, others are perfectly fresh and sweet, though boiling hot. So abundant is their volume that in several places they form actual ever-flowing rivers. Only for the intervention of man these rivers would at all times find their way into the adjoining depressions, which they would maintain as lakes of water. But for a long period past the freshwater streams (which predominate) have been used for irrigation to such a degree that very little of the precious water is allowed to run to waste into the lake basins; so that these latter receive only a few salt streams, which deposit on their surface the salt they contain and then evaporate. This abundant supply of fresh warm water maintains oases of extraordinary luxuriance in a country where rain falls very rarely. Perennial streams of the description referred to are found between the Algerian frontier and Gabes on the coast. The town at Gabes itself is on the fringe of a splendid oasis, which is maintained by the water of an ever-running stream emptying itself into the sea at Gabes after a course of not more than 20 m.

The Jerid.

All this region round the shats has been called the "Jerid" from the time of the Arab occupation. "Jerid" means in Arabic a "palm frond" and inferentially "a palm grove." The fame of this Belad-el-Jerid, or "Country of the Date Palms," was so exaggerated during the 17th and 18th centuries that the European geographers extended the designation from this small area in the south of Tunisia to cover much of inner Africa. With this country of Jerid may be included the island of Jerba, which lies close to the coast of Tunisia in the Gulf of Gabes. The present writer believes that the date palm was really indigenous to this district of the Jerid, as it is to countries of similar description in southern Morocco, southern Algeria, parts of the Tripolitaine, Egypt, Mesopotamia, southern Persia and north-western India; but that north of the latitude of the Jerid the date did not grow naturally in Mauretania, just as it was foreign to all parts of Europe, in which, as in true North Africa, its presence is due to the hand of man. To some extent it may be said that true North Africa lies to the north of the Jerid country, which, besides its Saharan, Arabian and Persian affinities, has a touch about it of real Africa, some such touch as may be observed in the valley of the Jordan. In the oases of the Jerid are found several species of tropical African mammals and two or three of Senegalese birds, and the vegetation seems to have as much affinity with tropical Africa as with Europe. In fact, the country between the Matmata highlands and the strait separating Jerba from the mainland is singularly African in the character and aspect of its flora. To the south of the Jerid the country is mainly desert—vast unexplored tracts of shifting sand, with rare oases. Nevertheless, all this southern district of Tunisia bears evidence of once having been subject to a heavy rainfall, which scooped out deep valleys in the original table-land, and has justified the present existence of immense watercourses—watercourses which are still, near their origin, favoured with a little water.

Mineral Springs.

Hot and mineral springs may be almost said to constitute one of the specialities of Tunisia. They offered a singular attraction to the Romans, and their presence in remote parts of the country no doubt was often the principal cause of Roman settlement. Even at the present day their value is much appreciated by the natives, who continue to bathe in the ruined Roman baths. The principal mineral springs of medicinal value are those of Korbus and Hammam Lif (of remarkable efficacy in rheumatic and syphilitic affections and certain skin diseases), of the Jerid and Gafsa, of El Hamma, near Gabes, and of various sites in the Kroumir country.

Climate.—The rainfall in the first geographical division is pretty constant, and may reach a yearly average of about 22 in. Over the second and third divisions the rainfall is less constant, and its yearly average may not exceed 17 in. The mean annual temperature at Sūsa is 75° F., the mean of the winter or rainy season 60° and of the hot season 97°. At Tunis the temperature rarely exceeds 90°, except with a wind from the Sahara. The prevailing winds from May to September are east and north-east and during the rest of the year north-west and east. A rainy season of about two months usually begins in January; the spring season of verdure is over in May; summer ends in October with the first rains. Violent winds are common at both equinoxes. In the Tunisian Sahara rain is most uncertain. Occasionally two or three years may pass without any rainfall; then may come floods after a heavy downfall of a few weeks. Perhaps if an average could be struck it would amount to 9 or 10 in. per annum.

[*Geology.*—The greater part of Tunisia is composed of sandstones, marls and loosely stratified deposits belonging to the Pliocene and Quaternary periods. The oldest strata, consisting of gypsiferous marls, are referred to the Muschelkalk and show an alternation of lagoon with marine conditions. The Lias and Oolite formations are well represented, but the Sequanian and Kimmeridgian subdivisions are absent. Lower Cretaceous rocks, consisting of thick limestones, shales and marls, occur in Central Tunisia. The fossils show many notable affinities with those in the Lower Cretaceous of the Pyrenees. Limestones and marls represent the stages Cenomanian to Upper Senonian. The fossils of the Cenomanian have affinities with those in the Cenomanian of Spain, Egypt, Madagascar, Mozambique and India. The Senonian consists of a central facies with *Micraster peini*; a meridional facies with *Ostrea*; and a northern facies developed round Tunisia with large forms of *Inoceramus* and echinoids. Phosphatic deposits are well developed among the Lower Eocene rocks. The Middle Eocene is characterized by the presence of *Ostrea bogharensis* and the Upper Eocene by highly fossiliferous sandstones and marls. The Oligocene and Miocene formations are present, but the Upper Miocene is confined to the coast. Quaternary deposits cover much of the desert regions.[1]]

Minerals.—Coal has been discovered in the Khmir (" Kroumir ") country, but the principal mines at present worked in Tunisia are those of copper, lead and zinc. Zinc is chiefly found in the form of calamine. Iron is worked in the Kef district. Valuable deposits of phosphates are present, chiefly in the south-west of Tunisia, in the district of Gafsa. Marble is found in the valley of the Majerda (at Shemtu), at Jebel Ust (about 35 m. south of Tunis), and at Jebel Dissa, near Gabes. The marbles of Shemtu are the finest pink Numidian marbles, which were much esteemed by the Carthaginians and Romans. It has been sought to work again the ancient quarries of Shemtu, but it was found that the marble had been spoilt by ferruginous and calcareous veins.

Flora.—The flora of Tunisia is very nearly identical with that of Algeria, though it offers a few species either peculiar to itself or not found in the last-named country. On the whole its character is less Saharan than that of parts of Algeria, for the influences of the desert do not penetrate so far north in Tunisia as they do in Algeria. There are very few patches of real forest outside the Khmir country, though it is probable that in the time of the Romans the land was a good deal more covered with trees than at the present day. Some authorities, however, dispute this, in a measure, by saying that it was not naturally forested, and that the trees growing represented orchards of olives or other fruit trees planted by the Romans or romanized Berbers. But in the Majerda Mountains there are dense primeval forests lingering to the present day, and consisting chiefly of the cork oak (*Quercus ruber*), and two other species of oak (*Quercus mirbeckii* and *Q. kermes*), the pistachio or terebinth tree, the sumach (*Rhus pentaphila*), and other species of *Rhus* which are widely spread. In the mountains of Khmiria and the central plateau there are also the alder, the poplar, the Aleppo pine, the caroub, the tamarisk, the maple, the nettle-tree, several willows and junipers. The jujube-tree (*Zisyphus*) is found at various places along the eastern littoral. The retama shrub is met with in sandy districts, especially in the Sahara, but also right up to the north of Tunisia. The wild olive, the wild cherry, two species of wild plums, the myrtle, the ivy, arbutus, and two species of holly are found in the mountains of Khmiria, at various sites at high elevation near Tunis and Bizerta, and along the mountainous belt of the south-west which forms the frontier region between Tunisia and Algeria. The present writer, riding up to these frontier mountains from the thoroughly Saharan country round Gafsa, found himself surrounded by a flora very reminiscent of Switzerland or England. On the other hand, the flora of the shat region, of the south-eastern littoral, and of the Kerkena islands opposite Sfax, is thoroughly Saharan, with a dash, as it were, in places of an African element. The date palm grows wild, as has been already related, in Jerba. The only other species of palm found wild in Tunisia is the *Chamaerops humilis*, or dwarf palm, which is found on the mountains of the north at no very great altitude. The wild flowers of the north of Tunisia are so extremely beautiful during the months of February, March and April as to constitute a distinct attraction in themselves.[2]

Fauna.—The fauna of Tunisia at the present day is much impoverished as regards mammals, birds and reptiles. In 1880 the present writer saw lions killed in the north-west of Tunisia, but by 1902 the lion was regarded as practically extinct in the regency, though occasional rumours of his appearance come from the Khmir Mountains and near Feriana. Leopards of large size are still found in the north-west of central Tunisia. The cheetah lingers in the extreme south of the Jerid; so also does the caracal lynx. The pardine lynx is found fairly abundantly in the west of Tunisia in the mountains and forest. The striped hyena is scattered over the country sparsely. The genet and the common jackal are fairly abundant. The common ichneumon is rare. The zorilla, another purely African species, is found in the south of Tunisia. The Barbary otter is present in the Majerda and in some of the salt lakes. The Tunisian hedgehog is peculiar to that country and to Algeria. There is a second species (*Erinaceus deserti*) which is common to all North Africa. In the south of Tunisia, especially about the shats, the elephant-shrew (*Macroscelides*) is found, an animal of purely African affinities. Tunisia does not appear to possess the Barbary ape, which is found in Algeria and Morocco. Natives of Morocco and of the Sahara oases occasionally bring with them young baboons which they assert are obtained in various Sahara countries to the south and south-west of Tunisia. These baboons appear to belong to the Nubian species, but they cannot be considered indigenous to any part of Tunisia. The porcupine and a large Octodont rodent (*Ctenodactylus*), the jerboa (two species), the hare, and various other rodents are met with in Tunisia. The wild boar inhabits the country, in spite of much persecution at the hands of "chasseurs." The forested regions shelter the handsome Barbary red deer, which is peculiar to this region and the adjoining districts of Algeria. In the extreme south, in the Sahara desert, the addax antelope is still found. The hartebeest appears now to be quite extinct; so also is the leucoryx, though formerly these two antelopes were found right up to the centre of Tunisia, as was also the ostrich, now entirely absent from the country. In the marshy lake near Mater (north Tunisia), round the mountain island of Jebel Ashkel, is a herd of over 50 buffaloes; these are said to resemble the domestic (Indian) buffalo of the Levant and Italy, and to have their origin in a gift of domestic buffaloes from a former king of Naples to a bey or dey of Tunis. Others again assert the buffaloes to have been there from time immemorial; in which case it is very desirable that a specimen should be submitted for examination. [An allied form with gigantic horns is found fossil in Algeria.] They are the private property of the bey, who very properly preserves them. Far down in the Sahara, to the south of Tunisia, the Arabs report the existence of a wild ass, apparently identical with that of Nubia. Roman mosaics show representations not only of this ass, but of the oryx, hartebeest, and perhaps of the addax. The dorcas gazelle is still common in the south of Tunisia; but perhaps the most interesting ruminant is the magnificent udad, or Barbary sheep, which is found in the sterile mountainous regions of south Tunisia. The birds have been ably illustrated by Mr Whitaker in the *Ibis* magazine of the British Ornithological Union. They are, as a rule, common to the south Mediterranean region. A beautiful little bird almost peculiar to the south of Tunisia and the adjoining regions of Algeria, is a species of bunting (*Fringilla*), called by the Arabs *bu-habibi*.[3] This little bird, which is about the size of the linnet, has the head and back silvery blue, and the rest of the plumage chocolate red-brown. It is of the most engaging tameness, being fortunately protected by popular sentiment from injury. It inhabits the Jerid, and extends thence across the Algerian frontier. Among reptiles the Egyptian cobra seems to be indigenous in the south, where also is found the dreaded horned viper. Some nine or ten other species of snakes are present, together with an abundance of lizards, including the *Varanus*, and most species of Mediterranean tortoises are represented. The coasts are very rich in fish, and the tunny fisheries of the north are one of the principal sources from which the world's supply of tunny is derived.

Inhabitants.—The natives of Tunisia at the present day belong mainly to two stocks, which may be roughly classified as the Berber (*q.v.*) and the Arab (*q.v.*), about two-thirds being of Berber and the remaining third of Arab descent. But the Berbers of to-day are little more than an incomplete fusion of some four earlier and once independent stocks. These four divisions taken in the order of their assumed priority of invasion or habitation are: (1) the " Neanderthal " type, which is found in the districts of the shats and the adjoining Matmata table-land in the south, and in the " Kroumir " country of the north-west;[1] (2) ordinary Berbers, dolichocephalous, and of brown complexion, found over the greater part of Tunisia, especially in the east and south centre; (3) the short-headed Berbers, found in part of the Matmata country, part of the Sahara, the island of Jerba, the Cape Bon Peninsula, and the vicinity of Susa, Kairwan, and Sfax; (4) Berbers of a blond type, that is to say, with a tendency to brown or yellow moustaches, brown beard and head hair, and grey eyes. These are met with in the west and north-west of Tunisia, and in one patch on the coast of the Cape Bon Peninsula, near Nabeul.

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[1] See L. Pervinquière, *L'Étude géologique de la Tunisie centrale* (Paris, 1903); G. Rolland, " Carte geologique du littoral nord de la Tunisie," *Bull. soc. géol. de la France* (1888), vol. xvii.; H. H. Johnston, "A Journey through the Tunisian Sahara," *Geog. Journ.* (1898), vol. xi.; *Carte géologique de la régence de Tunis*, 1:800,000 with notes (Tunis, 1892).

[2] List of Plants commonly met with in northern Tunisia:—

Adonis microcarpa, DC.
Nigella damascena, L.
Fumaria spicata, L.
Cistus halimifolius, L.
Silene rubella, L.
Oxalis cernua, Thunb.
Geranium tuberosum, L.
Malva sylvestris, L.
Tetragonolobus purpureus, Moench.
Retama retam, Webb.
Fedia cornucopiae, Gaertn.
Helichrysum Stoechas, DC.
Centaurea (*Seridia*), sp.
Urospermum Dalechampi, Desf.
Scorzonera alexandrina, Boiss.
Stachys hirta, L.
Stachys, sp. not identified.
Anagallis collina, Schousb.
Convolvulus tricolor, L.
Solenanthus lanatus, DC.
Lycium europaeum, L.
Solanum sodomaeum, L.
Celsia cretica, L.
Linaria, sp. allied to *L. reflexa*, Desf.
Linaria triphylla, L. var.
Orobanche, sp.
Trixago apula, Stev.
Cynomorium coccineum.
Plantago albicans, L.
Euphorbia serrata, L.
Ophrys fusca, Link.
Orchis papilionacea, L.
Romulea bulbocodium, Sebast. and Mauri.
Gladiolus byzantinus, Mill.
Ornithogalum umbellatum, L.
Allium roseum, L.
Asphodelus fistulosus, L.
Muscari comosum, Mill.
Echium sericeum, Vahl.
Echium maritimum, Willd.
Anchusa italica, Retz.
Arum italicum, Mill.
Lagurus ovatus, L.

To this list should also be added the common wild tulip, the Italian cyclamen, the common scarlet poppy, the fennel, wild carrot and many varieties of thistle, some of gorgeous colouring.

[3] " Father of my friend."

The Arabs of more or less unmixed descent are purely nomads. They are met with in a long strip of country south of the Majerda, between the Algerian frontier and the sea-coast north of Susa; also inland, to the south-west of Susa, and near Kef; also in another long strip between the vicinity of Sfax on the north and the Jerid on the south. They are descended from the second Arab invasion which began in the 11th century (see *History*). The extreme south of Tunis is ranged over by Berber Tawareq[2] or Tamasheq. Berber dialects are still spoken in Tunisia in the island of Jerba, in the Matmata country, and in the Tunisian Sahara. Elsewhere to a remarkable degree the Arabic language has extinguished the Berber tongue, though no doubt in vulgar Tunisian a good many Berber words remain. Short vocabularies of the Berber spoken in the Tunisian Sahara have been published by Sir H. H. Johnston in the *Geog. Journ.* (1898), vol. xi., and by Mr G. B. Michell in the *Journ. African Soc.* (1903). The Berbers are organized in tribes with purely democratic government and laws of their own, which are not those of the Koran.

On the north-eastern littoral of Tunisia the population is very mixed. The inhabitants of the Cape Bon Peninsula show evident signs of Greek blood arising from Greek invasions, which began in prehistoric times and finished with the downfall of the Byzantine Empire in North Africa. The presence of the Romans, and the constant introduction of the Italians, first as slaves, and quite recently as colonists, has also added an Italian element to the north Tunisian population. But from the fact that the bulk of the Tunisian population belongs to the Iberian section of the Berbers, and to this being no doubt the fundamental stock of most Italian peoples, the intermixture of the Italianized Berber with his African brother has not much affected the physique of the people, though it may have slightly tinged their mental characteristics.

The Phoenicians have left no marked trace of their presence; but inasmuch as they were probably of nearly the same race as the Arabs, it would not be easy to distinguish the two types. Arab and Berber have mingled to some extent, though no considerable fusion of the two elements has taken place. In fact, it is thought by some French students of the country that the Arab element will probably be eliminated from Tunisia, as it is the most unsettled. It is considered that these nomads will be gently pushed back towards the Sahara, leaving cultivable Tunisia to the settled Berber stock, a stock fundamentally one with the peoples of Mediterranean Europe.

The inhabitants of the coast towns belong, in large part, to the class generally known as "Moors." The pure Turks and the Kuluglis (sons of Turkish fathers by Moorish women or slave girls) are no longer numerous. Among the "Moors" the descendants of the Andalusian refugees form an exclusive and aristocratic class.

The present population of Tunisia numbers approximately 2,000,000, and consists of:—

Berbers, more or less of pure race, say	620,000
Arabs, " " " "	500,000
Mixed Arab and Berber peoples, say	520,000
"Moors" (chiefly the population of the principal cities, of mixed Roman, Berber, Spanish, Moor and Christian races), say	110,000
Sudanese negroes and natives of Morocco, Tripoli and Turkey, say	40,000
Jews (mostly natives of Tunis, indeed, some descended from families settled at Carthage before the destruction of Jerusalem)	68,000
Europeans (Christians)[3]	163,000

Towns.—Besides the capital, Tunis, the chief towns of Tunisia are Sfax, Susa and Kairwan. These places are noticed separately, as are also Goletta (formerly the port of Tunis), Bizerta (a naval port and arsenal), Kef, Porto Farina, and the ruins at Carthage and Sbeitla (Sufetula). Other towns of Tunisia are, on the east coast, Nabeul, pop. about 5000, the ancient Neapolis, noted for the mildness of its climate and its pottery manufactures; Hammamet with 3700 inhabitants; Monastir (the Ruspina of the Romans), a walled town with 5600 inhabitants and a trade in cereals and oils; Mahdiya or Mahdia (*q.v.*; in ancient chronicles called the city of Africa and sometimes the capital of the country) with 8500 inhabitants, the fallen city of the Fatimites, which since the French occupation has risen from its ruins, and has a new harbour (the ancient *Cothon* or harbour, of Phoenician origin, cut out of the rock is nearly dry but in excellent preservation); and Gabes (Tacape of the Romans, Qabis of the Arabs) on the Syrtis, a group of small villages, with an aggregate population of 16,000, the port of the Shat country and a dépôt of the esparto trade. The chief town of the Majerda basin is Beja (pop. 5000), the ancient Vaga, an important corn market. The principal mosque at Beja was originally a Christian basilica, and is still dedicated to Sidna Aissa (our Lord Jesus). Gafsa, in the south of Tunisia, is a most interesting old Roman town, with hot springs. It is in railway communication with Sfax. West of Gafsa are immense beds of phosphates. Almost all the towns of Tunisia were originally Roman or romanized Berber settlements; consequently the remains of Roman buildings form a large part of the material of which their existing structures are composed.

Antiquities and Art.—The principal Roman and other ruins in the regency are the aqueducts near the capital (Tunis) and the temple at Zaghwan, described under Tunis city; the great reservoir near Carthage (*q.v.*); the amphitheatre at El Jem (see SUSA); the temples and other ruins of Sbeitla (*q.v.*); the ruins of Dugga, near Tebursuk, in the north-west of the regency (the amphitheatre of Dugga, the ancient Thugga, is a magnificent spectacle); the baths, amphitheatre and temples of Feriana (the ancient Thelepte); the whole route between Feriana (which is in the south of Tunisia, 33 m. north-west of Gafsa) and Tebessa in Algeria is strewn on both sides with Roman ruins; the old houses and other ruins at and near Thala; the baths and other ruins of Gafsa; the baths at Tuzer, El Hamma and Gabes. There is an interesting Phoenician burial-ground near Mahdia. There are Roman ruins, scarcely known, in the vicinity of Beja and the country of the Mogods (the district behind Cape Serrat). In short, Tunisia is as much strewn with Roman remains as is Italy itself.

Saracenic art has perhaps not attained here the high degree it reached in western Algeria, Spain and Egypt; still it presents much that is beautiful to see and worthy to be studied. One of the most ancient, as it is one of the loveliest fragments, strange to say, is found at Tuzer, in the Jerid, the *mahrab* of a ruined mosque.[4] There are some very beautiful doorways to mosques and other specimens of Moorish art at Gabes. Examples of this art found at Tunis and Kairwan have been noticed under those headings. But the visible remains of Saracenic art in Tunis and its vicinity are of relatively recent date, the few mosques which might offer earlier examples not being open to inspection by Christians. It may be noted, however, as a general condition that the native towns and villages of Tunisia, where they have not been spoiled by the shocking tastelessness of Mediterranean Europe, are exceedingly picturesque, and offer exceptional attractions to the painter.

Industries.—Agriculture is the principal industry. Oats, wheat and barley are the chief crops in the north. In the central region the olive is largely cultivated, in the south the date-palm. Viticulture is also of importance; almonds, oranges, lemons, &c., are also grown for export. The alfa and cork industries employ large numbers of persons, as do also the sardine, anchovy and tunny fisheries. The fisheries are in the hands of Italians, Maltese and Greeks. There are large herds of cattle and flocks of sheep and goats. About 60,000 acres are cultivated by French immigrants and about 15,000 acres by Italians.

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[1] In this Matmata country are the celebrated Troglodytes, people living in caves and underground dwellings now, much as they did in the days when the early Greek geographers alluded to them. See "A Journey in the Tunisian Sahara," by Sir H. H. Johnston, in the *Geog. Journ.* (June 1898).

[2] Tawareq (Tuareg) is the Arab designation of the Libyan or Desert Berbers. It is the plural form of *Targi*, "a raider." The Tawareq call themselves by some variant of the root *Masheq*—*Tamasheq, Imoshagh*, &c.

[3] Of recent introduction for the most part, consisting (census of 1906) of 81,156 Italians, 34,610 French, 10,330 Maltese, about 1000 Greeks and the remainder British, German, Austrian, &c. The French army of occupation (20,360 men) is not included in these figures.

[4] Since this was written the *mahrab* in question has been removed to Paris.

Among native industries may be mentioned the spinning and weaving of wool for clothing, carpet-weaving, the manufacture of pottery, slippers and matting, saddle-making and leather embroidery. Silk-weaving, formerly important, is declining.

In 1907 the number of mines working was 32. The export of phosphates rose from 445,000 tons in 1904 to 1,267,000 tons in 1908. The export of coal in that year was 74,000 tons, and copper ore 937 tons (*vide supra*, § *Minerals*).

Commerce.—The commerce of Tunisia has thriven under the French protectorate, having risen from an annual total of about £1,700,000 in 1881 to £8,687,000 in 1908. British trade with Tunisia has nearly tripled since the establishment of the French protectorate. It stood at over £600,000 in annual value during the year 1898. In 1908 the total trade with Great Britain and Malta amounted to £914,000. In the same year the imports from France exceeded £2,750,000 and the exports to France £1,685,000. From Algeria the imports were £656,000; to Algeria the exports were £185,000. The principal exports are olive oil, wheat, esparto grass, barley, sponges, dates, fish (especially tunny), hides, horses, wool, phosphates, copper, zinc and lead. The imports consist mainly of European manufactured goods (especially British cotton), machinery, flour, alcohol, sugar, timber, coal and petroleum. About half the shipping trade is in the hands of the French; in 1908, of the total tonnage of ships entered, 4,155,000, French vessels represented 1,905,000 tons, Italian vessels 1,422,000 tons and British vessels 299,000 tons.

Communications.—The French have made since 1882 about 2000 m. of good roads. The first railway built (1871–1872) was that between Goletta and Tunis. This line, with the extensions to La Marsa and Bardo, is 21½ m. in length. It was constructed by an English company, which in 1880 sold it to an Italian company, despite the keen competition of French rivals (see *History*, below). The conversion of Tunis into a seaport (1893) destroyed the importance of this line, which was then sold to the French Bone-Guelma Company (Bone-Guelma et Prolongements), which owns the majority of the railways in Tunisia.

The second railway connects the capital with the frontier of Algeria, where, at Suk Ahras, it joins the main line to Constantine, Algiers, &c. This line was built by the Bone-Guelma Company. The concession was obtained in 1877, and the line, 191 m. long, was finished in 1880. A branch line (8 m.) connected Beja with this railway, and another (11 m.) ran from Tunis to Hamman-el-Enf, a favourite seaside resort of the Tunisians.

For the next twelve years there was a pause in railway construction followed by the opening, in 1892, of the line between Susa and Moknine (30 m.). Then came the continuation of the line from Hamman-el-Enf to Hammamet and along the Sahel to Susa (93 m.), and the building of a line from Susa to Kairwan, 31 m. (the last-named line superseded a horse-tramway built by the French army during the campaign of 1881). A branch line to Bizerta (43½ m.) from Jedeida on the main Algeria-Tunis line was also built as well as one from Tunis to Zaghwan (44 m.). A short line, branching from the Tunis-Zaghwan line, was carried south-west to Pont du Fahs. These with a few short branch lines were built between 1892 and 1900 by the Bone-Guelma Company. In 1906 was opened a continuation of the line from Pont du Fahs to Kef and thence south-west to Kalaat-es-Senam, a place midway between Kef and Tebessa, the centre of the Algerian phosphate region. A branch from the Kef line runs to the phosphate mines of Kalaa-Jerda.

Another railway (completed by 1900) runs from Sfax, along the coast to Mahres, thence inland to Gafsa and the phosphate mines of Metalwi. This line, 151 m. long, was for some years isolated from the general Tunisian system. The total mileage of the Tunisian railways was computed to be 1060 m. by the finishing of the Susa-Sfax, Gabes-Tebessa lines in 1909. Extensions of the railway system are contemplated to Gabes and, beyond, to the Tripolitan frontier. In the south communication is maintained chiefly by camel caravans.

Posts and Telegraphs.—The whole of Tunisia is covered with a network of telegraph lines (2500 m.), and there are telephones working in most of the large towns. The telegraph system penetrates to the farthest French post in the Sahara, is connected with the Turkish system on the Tripolitan frontier and with Algeria, and by cable with Sicily, Malta, Sardinia and Marseilles. There is an efficient post office service, with about 400 post offices.

Finance.—The principal bank is the Banque de Tunisie. The coinage formerly was the caroub and piastre (the latter worth about 6d.), but in 1891 the French reformed the coinage, substituting the franc as a unit, and having the money minted at Paris. The values of the coinage are pieces of 5 and 10 centimes in bronze, of 50 centimes, 1 franc and 2 francs in silver, of 10 francs and 20 francs in gold. The inscriptions are in French and Arabic. The public debt was consolidated in 1884 into a total of £5,702,000, guaranteed by France, and bearing 4% interest. In 1888 it was converted into a loan paying 3½% interest, and in 1892 another conversion reduced the rate of interest to 3%. In 1902 a new loan of £1,800,000 was issued at 3%. At the beginning of 1907 the total Tunisian debt was £9,287,260; in that year the government was authorized to contract another loan of £5,000,000 at 3% (£3,000,000 being guaranteed by France) for railways, roads and colonization. The weights and measures are those of France. The revenue for the year 1900 was £1,456,640, and the expenditure was £1,452,597. In 1910 receipts and expenditure balanced at about £1,888,000 each. The principal sources of revenue are direct taxation, stamp and death duties, customs, port and lighthouse dues, octroi and tithes, tobacco, salt and gunpowder monopolies, postal and telegraph receipts, and revenue from the state domains (lands, fisheries, forests, mines). The civil list paid to the Bey of Tunis amounts to £36,000 per annum, and the endowment of the princes and princesses of the beylical family to £31,200 a year more.

Administration.—From a native's point of view Tunisia still appears to be governed by the Bey of Tunis, his Arab ministers and his Arab officials, the French only exercising an indirect—though a very real—control over the indigenous population (Mahommedans and Jews). But all Christians and foreigners are directly governed by the French, and the native administration is supervised by a staff of thirteen French *contrôleurs* and their French and Tunisian subordinates. Seven of the departments of state have Frenchmen at their head, the other two, Tunisians: thus the larger proportion of the Bey's ministers are French. France is directly represented in Tunisia by a minister resident-general, and by an assistant resident. The French resident-general is the virtual viceroy of Tunisia, and is minister for foreign affairs. Besides Mussulman (native) schools there were in the regency, in 1906, 158 public schools, 5 lycées and colleges and 21 private schools. At these schools were 22,000 pupils (13,000 boys), all save 3500 Mussulmans being Europeans or Jews.

History.—The history of Tunisia begins for us with the establishment of the Phoenician colonies (see PHOENICIA and CARTHAGE). The Punic settlers semitized the coast, but left the Berbers of the interior almost untouched. The Romans entered into the heritage of the Carthaginians and the vassal kings of Numidia, and Punic speech and civilization gave way to Latin, a change which from the time of Caesar was helped on by Italian colonization; to this region the Romans gave the name of "Africa," apparently a latinizing of the Berber term "Ifriqa," "Ifrigia" (in modern Arabic, *Ifriqiyah*).

The Province of "Africa."

Rich in corn, in herds, and in later times also in oil, and possessing valuable fisheries, mines and quarries, the province of Africa, of which Tunisia was the most important part, attained under the empire a prosperity to which Roman remains in all parts of the country still bear witness. Carthage was the second city of the Latin part of the empire, "after Rome the busiest and perhaps the most corrupt city of the West, and the chief centre of Latin culture and letters." In the early history of Latin Christianity Africa holds a more important place than Italy. It was here that Christian Latin literature took its rise, and to this province belong the names of Tertullian and Cyprian, of Arnobius and Lactantius, above all of Augustine. Lost to Rome by the invasion of the Vandals, who took Carthage in 439, the province was recovered by Belisarius a century later (533–34), and remained Roman till the Arab invasions of 648–69. The conqueror, 'Oqba-bin-Nafa, founded the city of Kairwan (673) which was the residence of the governors of "Ifriqiyah" under the Omayyads and thereafter the capital of the Aghlabite princes, the conquerors of Sicily, who ruled in merely nominal dependence on the Abbasids.

The Latin element in Africa and the Christian faith almost disappeared in a single generation;[1] the Berbers of the

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[[1] The North African Church was not utterly swept away by the Moslem conquest, though its numbers at that time were very greatly diminished, and thereafter fell gradually to vanishing point, partly by emigration to Europe. Its episcopate in the 10th century still numbered thirty members, but in 1076 the Church could not provide three bishops to consecrate a new member of the episcopate, and for that purpose Gregory VII. named two bishops to act with the archbishop of Carthage. In the 13th century the native episcopate had disappeared. Abd ul-Mumin, the Almohade conqueror of Tunisia, compelled many of the native Christians to embrace Islam, but when Tunis was captured by Charles V. in 1535, there were still found in the city native Christians, the last remnants of the

Arab Conquest and Berber Dynasties.

mountains, who had never been latinized and never really christianized, accepted Islam without difficulty, but showed their stubborn nationality, not only in the character of their Mahommedanism, which has always been mixed up with the worship of living as well as dead saints (marabouts) and other peculiarities, but also in political movements. The empire of the Fâtimites (*q.v.*) rested on Berber support, and from that time forth till the advent of the Turks the dynasties of North Africa were really native, even when they claimed descent from some illustrious Arab stock. When the seat of the Fâtimite Empire was removed to Egypt, the Zîrites, a house of the Sanhaja Berbers, ruled as their lieutenants at Mahdia, and about 1050 Mo'izz the Zîrite, in connexion with a religious movement against the Shi'ites, transferred his very nominal allegiance to the Abbasid caliphs. The Fâtimites in revenge let loose upon Africa about A.D. 1045 a vast horde of Beduins from Upper Egypt (Beni Hilâl and Solaim), the ancestors of the modern nomads of Barbary. All North Africa was ravaged by the invaders, who, though unable to found an empire or overthrow the settled government in the towns, forced the agricultural Berbers into the mountains, and, retaining from generation to generation their lawless and predatory habits, made order and prosperity almost impossible in the open parts of the country until its effective occupations by the French. The Zîrite dynasty was finally extinguished by Roger I. of Sicily, who took Mahdia in 1148 and established his authority over all the Tunisian coast. Even Moslem historians speak favourably of the Norman rule in Africa; but it was brought to an early end by the Almohade caliph Abd ul-Mumin, who took Mahdia in 1160.

The Hafsites.

The Almohade Empire soon began to decay, and in 1336 Abû Zakarîyâ, prince of Tunis, was able to proclaim himself independent and found a dynasty, which subsisted till the advent of the Turks. The Hafsites (so called from Abû Ḥafṣ, the ancestor of Abû Zakarîyâ, a Berber chieftain who had been one of the intimate disciples of the Almohade mahdi) assumed the title of Prince of the Faithful, a dignity which was acknowledged even at Mecca, when in the days of Mostanṣir, the second Hafsite, the fall of Bagdad left Islam without a titular head. In its best days the empire of the Hafsites extended from Tlemçen to Tripoli, and they received homage from the Merinids of Fez; they held their own against repeated Frankish invasions, of which the most notable were that which cost St Louis of France his life (1270), and that of the duke of Bourbon (1390), when English troops took part in the unsuccessful siege of Mahdia. They adorned Tunis with mosques, schools and other institutions, favoured letters, and in general appear to have risen above the usual level of Moslem sovereigns. But their rule was troubled by continual wars and insurrections; the support of the Beduin Arabs was imperfectly secured by pensions, which formed a heavy burden on the finances of the state;[1] and in later times the dynasty was weakened by family dissensions. Leo Africanus, writing early in the 16th century, gives a favourable picture of the "great city" of Tunis, which had a flourishing manufacture of fine cloth, a prosperous colony of Christian traders, and, including the suburbs, nine or ten thousand hearths; but he speaks also of the decay of once flourishing provincial towns, and especially of agriculture, the greater part of the open country lying waste for fear of the Arab marauders. Taxation was heavy, and the revenue very considerable. Don Juan of Austria, in a report to Philip II., states that the land revenue alone under the last Hafsite was 375,935 ducats, but of this a great part went in tribute to the Arabs.

Turkish Conquest.

Rise of the Beys.

The conquest of Algiers by the Turks gave a dangerous neighbour to Tunisia, and after the death of Mohammed the Hafsite in 1525 a disputed succession supplied Khair-ad-Dîn Barbarossa with a pretext for occupying the city in the name of the sultan of Constantinople. Al-Ḥasan, the son of Mahommed, sought help from the emperor, and was restored in 1535 as a Spanish vassal, by a force which Charles V. commanded in person, while Andrea Doria was admiral of the fleet. But the conquest was far from complete, and was never consolidated. The Spaniards remained at Goletta and made it a strong fortress, they also occupied the island of Jerba and some points on the south-east coast; but the interior was a prey to anarchy and civil war, until in 1570 'Alî-Pasha of Algiers utterly defeated Ḥâmid, the son and successor of Ḥasan, and occupied Tunis. In 1573 the Turks again retreated on the approach of Don Juan, who had dreams of making himself king of Tunis; but this success was not followed up, and in the next year Sultan Selim II. sent a strong expedition which drove the Spaniards from Tunis and Goletta, and reduced the country to a Turkish province. Nevertheless the Spanish occupation left a deep impression on the coast of Tunis, and not a few Spanish words passed into Tunisian Arabic. After the Turkish conquest, the civil administration was placed under a pasha; but in a few years a military revolution transferred the supreme power to a Dey elected by the janissaries, who formed the army of occupation. The government of the Deys lasted till 1705, but was soon narrowed or overshadowed by the authority of the Beys, whose proper function was to manage the tribes and collect tribute. From 1631 to 1702 the office of Bey was hereditary in the descendants of Murâd, a Corsican renegade, and their rivalry with the Deys and internal dissensions kept the country in constant disorder. Ibrahîm, the last of the Deys (1702–1705), destroyed the house of Murâd, and absorbed the beyship in his own office; but, when he fell in battle with the Algerians, Ḥussein b. 'Alî, the son of a Cretan renegade, was proclaimed sovereign by the troops under the title of "Bey," and, being a prince of energy and ability, was able to establish the hereditary sovereignty, which has lasted without change of dynasty to the present time.[2]

Frequent wars with Algiers form the chief incidents in the internal history of Tunisia under the Beys. Under Deys and Beys alike Tunisia was essentially a pirate state. Occasionally acts of chastisement, of which the bombardment of Porto Farina by Blake in 1655 was the most notable, and repeated treaties, extorted by European powers, checked from time to time, but did not put an end to, the habitual piracies, on which indeed the public revenue of Tunis was mainly dependent. The powers were generally less concerned for the captives than for the acquisition of trading privileges, and the Beys took advantage of the commercial rivalry of England and France to play off the one power against the other. The release of all Christian slaves was not effected till after the bombardment of Algiers; and the definite abandonment of piracy may be dated from the presentation to the Bey in 1819 of a collective note of the powers assembled at Aix-la-Chapelle. The government had not elasticity enough to adapt itself to so profound a change in its ancient traditions; the finances became more and more hopelessly embarrassed, in spite of ruinous taxation; and attempts at European innovations in the court and army made matters only worse, so long as no attempt was made to improve

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once powerful Church. Traces of Christianity remained among the Kabyles till after the conquest of Granada (1492), when the influx of Andalusian Moors from Spain completed the conversion of those tribes. It may be added that down to the early years of the 19th century it was alleged that some of the Tuareg tribes in the Sahara professed Christianity (see *e.g.* Hornemann's *Travels*). For the North African Church after the Moslem conquest, see Migne, *Pat. lat.*; and Mas Latrie, *Afrique septentrionale.* Their information is summarized in the introduction to vol. ii. of Azurara's *Discovery and Conquest of Guinea*, Hakluyt Society's edition (1899).—ED.]

[1] In the 13th and 14th centuries the Hafsites also paid tribute to Sicily for the freedom of the sea and the right to import Sicilian corn—a clear proof of the decline of Tunisian agriculture.

[2] Muhammad VI. es Sadok, the reigning Bey at the time of the French occupation, died in October 1882, and was succeeded by his brother 'Alî IV. This prince reigned until 1902, the throne then passing to his son Muhammad VII. el Hadi, who died in 1906, when his cousin Muhammad VIII. en Nasr (b. 1855) became Bey.

the internal condition of the country. In the third quarter of the 19th century not more than a tenth part of the fertile land was under cultivation, and the yearly charge on the public debt exceeded the whole annual revenue. In these circumstances only the rivalry of the European powers that had interests in Tunisia protracted from year to year the inevitable revolution. The French began to regard the dominions of the Bey as a natural adjunct to Algeria, but after the Crimean War Turkish rights over the regency of Tunis were revived. After the Franco-German War the embarrassed Bey turned towards Great Britain for advice, and a British protectorate—suggested by the proximity of Malta—was not an impossibility under the remarkable influence of the celebrated Sir Richard Wood, British diplomatic agent at the court of Tunis from 1855 to 1879. The railways, lighthouses, gas and waterworks and other concessions and industries were placed in British hands. But in 1878, at the Congress of Berlin, Lord Salisbury agreed to allow France a "free hand" in Tunisia in return for French acquiescence in the British lease of Cyprus.

Occupation by the French.

After 1862, however, the kingdom of Italy began to take a deep interest in the future of Tunisia. When the country went bankrupt in 1869, a triple control was established over Tunisian finances, with British, French and Italian "controllers." In 1880 the Italians bought the British railway from Tunis to Goletta. This and other actions excited the French to act on the secret understanding effected with the British foreign minister at the Berlin Congress. In 1881 a French force crossed the Algerian frontier under pretext of chastising the independent Khmir or Kroumir tribes on the north-east of the regency, and, quickly dropping the mask, advanced on the capital and compelled the Bey to accept the French protectorate. The actual conquest of the country was not effected without a serious struggle with Moslem fanaticism, especially at Sfax; but all Tunisia was brought completely under French jurisdiction and administration, supported by military posts at every important point. In 1883 the new situation under the French protectorate was recognized by the British government withdrawing its consular jurisdiction in favour of the French courts, and in 1885 it ceased to be represented by a diplomatic official. The other powers followed suit, except Italy, which did not recognize the full consequences of the French protectorate until 1896. In 1884 a thorough reform of the government and administration of the country was begun under the direction of a succession of eminent French residents-general. In 1897 Great Britain surrendered her commercial treaty with Tunisia and agreed (subject to a special temporary privilege regarding cotton goods) to allow her commerce and all other relations with Tunisia to be subjected to the same conditions as those affecting all such relations between Britain and France.

Relations with Turkey.

The French protectorate over Tunisia, based on the treaty signed by the Bey at Bardo on the 12th of May 1881 and confirmed by the treaty of La Marsa (June 8, 1883), was not recognized by Turkey, which claimed the regency as part of the Ottoman dominions. The protests of the Porte were ignored by the French, and in 1892 Turkey so far recognized the actual situation as to determine the Tunisia-Tripoli frontier as far south as Ghadames. South of that point the Saharan frontiers of Algeria, Tunisia and Tripoli remained undefined. Working eastward from Tunisia and Algeria the French occupied several points to which Turkey laid claim. Thus the oasis of Janet, S.S.W. of Rhat, was occupied in 1906. The action of France led to counter-action by Turkey and to various frontier incidents. Janet was reoccupied by Ottoman troops in the summer of 1910, but in deference to French protests the troops were withdrawn pending the delimitation of the frontier. At the same time Turkey maintained the claim that Tunisians were Ottoman subjects.

Frontier troubles had however little effect on the remainder of the protectorate. In 1904–1905 there were famines and some native discontent in the south of Tunisia; but in general the country has prospered amazingly under the French protectorate. The native dynasty has been strengthened rather than weakened, and Tunisia may be pointed out as the best and wisest example of French administration over an alien land and race. Though on a smaller scale it is worthy to be set as a pendant to the British work in Egypt.

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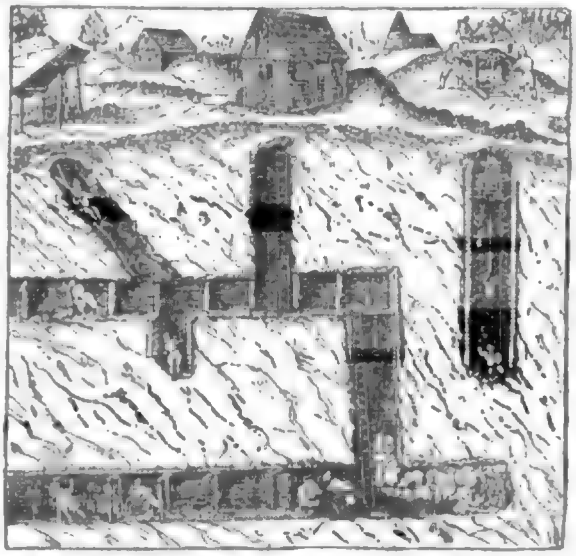
TUNNEL (Fr. *tonnel*, later *tonneau*, a diminutive from Low Lat. *tonna, tunna*, a tun, cask), a more or less horizontal underground passage made without removing the top soil. In former times any long tube-like passage, however constructed, was called a tunnel. At the present day the word is sometimes popularly applied to an underground passage constructed by trenching down from the surface to build the arching and then refilling with the top soil; but a passage so constructed, although indistinguishable from a tunnel when completed, is more correctly termed a "covered way," and the operations "cutting" and "covering," instead of tunnelling. Making a small tunnel, afterwards to be converted into a larger one, is called "driving a heading," and in mining operations small tunnels are termed "galleries," "driftways" and "adits." If the underground passage is vertical it is a shaft; if the shaft is begun at the surface the operations are known as "sinking"; and it is called a "rising" if worked upwards from a previously constructed heading or gallery.

Tunnelling has been effected by natural forces to a far greater extent than by man. In limestone districts innumerable swallow-holes, or shafts, have been sunk by the rain water following joints and dissolving the rock, and from the bottom of these shafts tunnels have been excavated to the sides of hills in a manner strictly analogous to the ordinary method of executing a tunnel by sinking shafts at intervals and driving headings therefrom. Many rivers find thus a course underground. In Asia Minor one of the rivers on the route of the Mersina railway extension pierces a hill by means of a natural tunnel, whilst a little south at Seleucia another river flows through a tunnel, 20 ft. wide and 23 ft. high, cut 1600 years ago through rock so hard that the chisel marks are still discernible. The Mammoth Cave of Kentucky and the Peak caves of Derbyshire are examples of natural tunnelling. Mineral springs bring up vast quantities of matter in solution. It has been estimated that the Old Well Spring at Bath has discharged since the beginning of the 19th century solids equivalent to the excavation of a 6 ft. by 3 ft. heading 9 m. long; and yet the water is perfectly clear and the daily flow is only the 150th part of that pumped out of the great railway tunnel under the Severn. Tunnelling is also carried on to an enormous extent by the action of the sea. Where the Atlantic rollers break on the west coast of Ireland, or on the seaboard of the western Highlands of Scotland, numberless caves and tunnels have been formed in the cliffs, beside which artificial tunnelling operations appear insignificant. The most gigantic subaqueous demolition hitherto carried out by man was the blowing up in 1885 of Flood Rock, a mass about 9 acres in extent, near Long Island Sound, New York. To effect this gigantic work by a single instantaneous blast a shaft was sunk 64 ft. below sea-level, from the bottom of which 4 m. of tunnels or galleries were driven so as to completely honeycomb the rock. The roof rock ranged from 10 ft. to 24 ft. in thickness, and was supported by 467 pillars 15 ft. square; 13,286 holes, averaging 9 ft. in length and 3 ins. in diameter, were drilled in the pillars and roof. About 80,000 cub. yds. of rock were excavated in the galleries and 275,000 remained to be blasted away. The holes were charged with 110 tons of "rackarock," a more powerful explosive than gunpowder, which was fired by electricity, when the sea was lifted 100 ft. over the whole area of the rock. Where natural forces effect analogous results, the holes are bored and the headings driven by the chemical and mechanical action of the rain and sea, and the explosive force is obtained by the expansive action of air locked up in the fissures of the rock and compressed to many tons per square foot by impact from the waves. Artificial breakwaters have often been thus tunnelled into by the sea, the compressed air blowing out the blocks and the waves carrying away the débris.

With so many examples of natural caves and tunnels in existence it is not to be wondered at that tunnelling was one of the earliest works undertaken by man, first for dwellings and tombs, then for quarrying and mining, and finally for water-supply, drainage, and other requirements of civilization. A Theban king on ascending the throne began at once to drive the tunnel which was to form his final resting-place, and persevered with the work until death. The tomb of Mineptah at Thebes was driven at a slope for a distance of 350 ft. into the hill, when a shaft was sunk and the tunnel projected a farther length of about 300 ft., and enlarged into a chamber for the sarcophagus. Tunnelling on a large scale was also carried on at the rock temples of Nubia and of India, and the architectural features of the entrances to some of these temples might be studied with advantage by the designers of modern tunnel fronts. Flinders Petrie has traced the method of underground quarrying followed by the Egyptians opposite the Pyramids. Parallel galleries about 20 ft. square were driven into the rock and cross galleries cut, so that a hall 300 to 400 ft. wide was formed, with a roof supported by rows of pillars 20 ft. square and 20 ft. apart. Blocks of stone were removed by the workmen cutting grooves all round them, and, where the stone was not required for use, but merely had to be removed to form a gallery, the grooves were wide enough for a man to stand up in. Where granite, diorite and other hard stone had to be cut the work was done by tube drills and by saws supplied with corundum, or other hard gritty material, and water—the drills leaving a core of rock exactly like that of the modern diamond drill. As instances of ancient tunnels through soft ground and requiring masonry arching, reference may be made to the vaulted drain under the south-east palace of Nimrod and to the brick arched tunnel, 12 ft. high and 15 ft. wide, under the Euphrates. In Algeria, Switzerland, and wherever the Romans went, remains of tunnels for roads, drains and water-supply are found. Pliny refers to the tunnel constructed for the drainage of Lake Fucino as the greatest public work of the time. It was by far the longest tunnel in the world, being more than 3½ m. in length, and was driven under Monte Salviano, which necessitated shafts no less than 400 ft. in depth. Forty shafts and a number of "cuniculi," or inclined galleries, were sunk, and the excavated material was drawn up in copper pails, of about ten gallons capacity, by windlasses. The tunnel was designed to be 10 ft. high by 6 ft. wide, but its actual cross-section varied. It is stated that 30,000 labourers were occupied eleven years in its construction. With modern appliances such a tunnel could be driven from the two ends without intermediate shafts in eleven months.

No practical advance was made on the tunnelling methods of the Romans until gunpowder came into use. Old engravings of mining operations early in the 17th century show that excavation was still accomplished by pickaxes or hammer and chisel, and that wood fires were lighted at the ends of the headings to split and soften the rock in advance (see fig. 1).



(From Agricola's *De re metallica*, Basel, 1621.)

FIG. 1 —Method of mining, 1621.

Crude methods of ventilation by shaking cloths in the headings and by placing inclined boards at the top of the shafts are also on record. In 1766 a tunnel 9 ft. wide, 12 ft. high and 2880 yds. long was begun on the Grand Trunk Canal, England, and completed eleven years later; and this was followed by many others. On the introduction of railways tunnelling became one of the ordinary incidents of a contractor's work; probably upwards of 4000 railway tunnels have been executed.

Tunnelling under Rivers and Harbours.—In 1825 Marc Isambard Brunel began, and in 1843 completed, the Thames tunnel between Rotherhithe and Wapping now used by the East London railway. He employed a peculiar "shield," made of timber, in several independent sections. Part of the ground penetrated was almost liquid mud, and the cost of the tunnel was about £1300 per lineal yard. In 1818 he took out a patent for a tunnelling process, which included a shield, and which mentioned cast iron as a surrounding wall. His shield foreshadowed the modern shield, which is substituted for the ordinary timber work of the tunnel, holds up the earth of excavation, affords space within its shelter for building the permanent walls, overlaps these walls in telescope fashion, and is moved forward by pushing against their front ends. The advantages of cast-iron walls are that they have great strength in small space as soon as the segments are bolted together, and they can be caulked water-tight.

In 1830 Lord Cochrane (afterwards 10th earl of Dundonald) patented the use of compressed air for shaft-sinking and tunnelling in water-bearing strata. Water under any pressure can be kept out of a subaqueous chamber or tunnel by sufficient air of a greater pressure, and men can breathe and work therein—for a time—up to a pressure exceeding four atmospheres. The shield and cast-iron lining invented by Brunel, and the compressed air of Cochrane, have with the aid of later inventors largely removed the difficulties of subaqueous tunnelling. Cochrane's process was used for the foundation of bridge piers, &c., comparatively early, but neither of these devices was employed for tunnelling until half a century after their invention. Two important subaqueous tunnels in the construction of which neither of these valuable aids was adopted are the Severn and the Mersey tunnels.

The Severn tunnel (fig. 16), 4⅓ m. in length for a double line of railway, begun in 1873 and finished in 1886, Hawkshaw, Son, Hayter & Richardson being the engineers and T. A. Walker the contractor, is made almost wholly in the Trias and Coal Measure formations, but for a short distance at its eastern end passes through gravel. At the lowest part the depth is 60 ft. at low water and 100 ft. at high water, and the thickness of sandstone over the brickwork is 45 ft. Under a depression in the bed of the river on the English side there is a cover of only 30 ft. of marl. Much water was met with throughout. In 1879 the works were flooded for months by a land spring on the Welsh side of the river, and on another occasion from a hole in the river bed at the Salmon Pool. This hole was subsequently filled with clay and the works completed beneath. Two preliminary headings were driven across the river to test the ground. "Break-ups" were made at intervals of two to five chains and the arching was carried on at each of these points. All parts of the excavation were timbered, and the greatest amount excavated in any one week was 6000 cub. yds. The total amount of water raised at all the pumping stations is about 27,000,000 gallons in twenty-four hours.

The length of the Mersey tunnel (fig. 15) between Liverpool and Birkenhead between the pumping shafts on each side of the river is one mile. From each a drainage heading was driven through the sandstone with a rising gradient towards the centre of the river. This heading was partly bored out by a Beaumont machine to a diameter of 7 ft. 4 in. and at a rate attaining occasionally 65 lineal yds. per week. All of the tunnel excavation, amounting to 320,000 cub. yds., was got out by hand labour, since heavy blasting would have shaken the rock. The minimum cover between the top of the arch and the bed of the river is 30 ft. Pumping machinery is provided for 27,000,000 gallons per day, which is more than double the usual quantity of water. Messrs Brunlees & Fox were the engineers, and Messrs Waddell the contractors for the works, which were opened in 1886, about six years after the beginning of operations.

In 1869 P. W. Barlow and J. H. Greathead built the Tower foot-way under the Thames, using for the first time a cast-iron lining and a shield which embodied the main features of Brunel's design. Barlow had patented a shield in 1864, and A. E. Beach one in 1868. The latter was used in a short masonry tunnel under Broadway, New York City, at that time. In 1874 Greathead designed and built a shield, to be used in connexion with compressed air, for a proposed Woolwich tunnel under the Thames, but it was never used. Compressed air was first used in tunnel work by Hersent, at Antwerp, in 1879, in a small drift with a cast-iron lining.

In the same year compressed air was used for the first time in any important tunnel by D. C. Haskin in the famous first Hudson River tunnel, New York City. This was to be of two tubes, each having internal dimensions of about 16 ft. wide by 18 ft. high. The excavation as fast as made was lined with thin steel plates, and inside of these with brick. In June 1880 the northerly tube had reached 360 ft. from the Hoboken shaft, but a portion near the latter, not of full size, was being enlarged. Just after a change of shifts the compressed air blew a hole through the soft silt in the roof at this spot, and the water entering drowned the twenty men who were working therein. From time to time money was raised and the work advanced. Between 1888 and 1891 the northerly tunnel was extended 2000 ft. to about three-fourths of the way across, with British capital and largely under the direction of British engineers—Sir Benjamin Baker and E. W. Moir. Compressed air and a shield were used, and the tunnel walls were made of bolted segments of cast iron. The money being exhausted, the tunnel was allowed to fill with water, and it so remained for ten years. Both tubes were completed in 1908.

The use of compressed air in the Hudson tunnel, and of annular shields and cast-iron lined tunnel in constructing the City & South London railway (1886 to 1890) by Greathead, became widely known and greatly influenced subaqueous and soft-ground tunnelling thereafter. The pair of tunnels for this railway from near the Monument to Stockwell, from 10 ft. 2 in. to 10 ft. 6 in. interior diameter, were constructed mostly in clay and without the use of compressed air, except for a comparatively short distance through water-bearing gravel. In this gravel a timber heading was made, through which the shield was pushed. The reported total cost was £840,000. Among the tunnels constructed after the City & South London work was well advanced, lined with cast-iron segments, and constructed by means of annular shields and the use of compressed air, were the St Clair (Joseph Hobson, engineer) from Sarnia to Port Huron, 1889–1890, through clay, and for a short distance through water-bearing gravel, 6000 ft., 18 ft. internal diameter; and the notable Blackwall tunnel under the Thames (Sir Alexander Binnie, engineer, and S. Pearson & Sons, contractors), through clay and 400 ft. of water-saturated gravel, 1892–1897, about 3116 ft. long, 24 ft. 3 in. in internal diameter. The shield, 19 ft. 6 in. long, contained a bulkhead with movable shutters, as foreshadowed in Baker's proposed shield (fig. 2). Numerous tunnels of small diameter have been similarly constructed under the Thames and Clyde for electric and cable ways, several for sewers in Melbourne, and two under the Seine at Paris for sewer siphons.

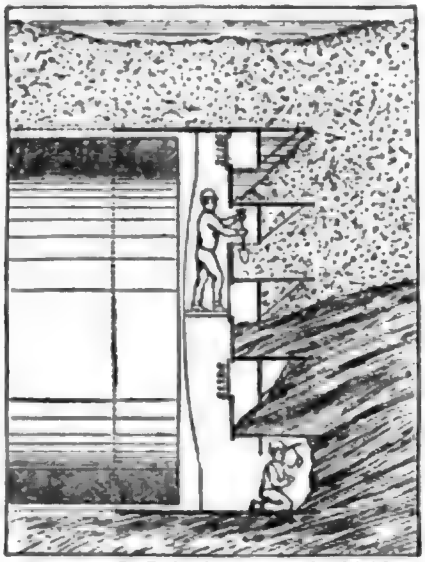
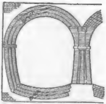


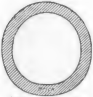
FIG. 2.—B. Baker's pneumatic shield.

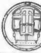
The Rotherhithe tunnel, under the Thames, for a roadway, with a length of 4863 ft. between portals, of which about 1400 ft. are directly under the river, has the largest cross-section of any subaqueous tube of this type in the world (see fig. 3). It was begun in 1904 and finished in 1908, Maurice Fitzmaurice being the engineer of design and construction, and Price & Reeves the contractors. It penetrates sandy and shelly clay overlying a seam of limestone, beneath which are pebbles and loamy sand. A preliminary tunnel for exploration, 12 ft. in diameter, was driven across the river, the top being within 2 ft. of the following main tunnel. The top of the main tunnel excavation in the middle of the river was only 7 ft. from the bed of the Thames, and a temporary blanket of filled earth, usually allowed in similar cases, was prohibited owing to the close proximity of the docks. The maximum progress in one day was 12·5 ft., and the average in six days 10·4 ft. The air compressors were together capable of supplying 1,000,000 cub. ft. of air per hour.

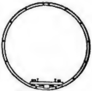
Some tunnels of marked importance of this type—to be operated solely with electric cars—have been built under the East and Hudson rivers at New York. Two tubes of 15 ft. interior diameter and 4150 ft. long penetrate gneiss and gravel directly under the East River between the Battery and Brooklyn. They were begun in 1902, with Wm. B. Parsons and George S. Rice as engineers, and were finished in December 1907, under the direction of D. L. Hough of the

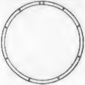

The Thames Tunnel (Brunel), 1825-1842.

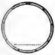
Tower Subway, Thames, 1869. 1 tube.

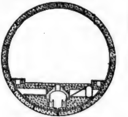

Hudson River (Haskin), 1879.

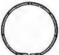

City & South London Railway, Thames. 2 tubes.

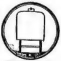

St Clair River. 1 tube.

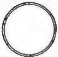

Hudson River, Morton St. 2 tubes.

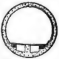

Glasgow Cable Subway, Clyde. 2 tubes.

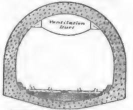

Blackwall Tunnel, Thames. 1 tube.


Waterloo & City Railway, Thames. 2 tubes.

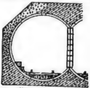

River Spree, Berlin. 1 tube.

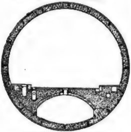

Baker St. & Waterloo Railway, Thames. 2 tubes.

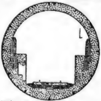

Greenwich Footway Tunnel. 1 tube.

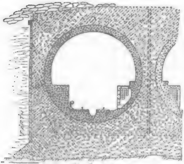


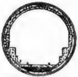
East Boston Tunnel under Harbour. 1 tube.

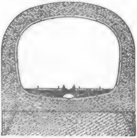

Harlem River. 2 tubes.


Rotherhithe, Thames. 1 tube


Hudson and East Rivers. Pennsylvania Railroad. 2 and 4 tubes.


Detroit River Tunnel. 2 tubes.


Battery to Brooklyn, East River. 2 tubes.


River Seine, Paris. 1 tub

Scale of Feet

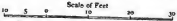


FIG. 3.—Cross Sections of Tunnels under Rivers and Harbours.

New York Tunnel Company. They carry subway trains. In one of the blow-outs of compressed air a workman was blown through the gravel roof into the river above. He lived until the next day. Two other tubes of the same size built also through gneiss and gravel between 1905 and 1907 by the Degnon Contracting Company, with R. A. Shailer as the contractors' engineer, go from 42nd Street to Long Island City.

Four much larger tubes (see fig. 3) built in 1904 to 1909, for the Pennsylvania railroad, with Alfred Noble as chief engineer, S. Pearson & Son as contractors, and E. W. Moir as general manager, cross from 32nd and 33rd Streets to Long Island. The maximum average progress per day (one heading) for the best month's work was: rock, 4·1 ft.; rock and earth, 3·8 ft.; earth, with full sand face, 12·8 ft. The best methods of preventing blow-outs were found to consist of employing clay blankets (sometimes 25 ft. thick) on the river bed, which could be carried up to 20 ft. depth of water, and of filling the pores of the sand and gravel with blue lias lime or cement grout. The maximum air pressure was 38 ℔ per sq. in. In the case of sand face with poor leaky cover the usual practice was to make the air pressure equal to that of water from the surface down to about a quarter the distance below the top of the shield. The average amount of free air supplied per man per hour was approximately 2300 cub. ft. On the Hudson river side two tubes of the same size as those in the East River are for the Pennsylvania trains to New Jersey. Two tubes from Morton Street to New Jersey, begun by Haskin, already referred to, are for subway trains, and so are the most southerly of all on the Hudson side, viz. the two from Cortlandt Street to under the Pennsylvania station in Jersey City.

The two tubes from Morton Street were completed under the direction of Charles M. Jacobs, who was also chief engineer of the four other Hudson River tubes. The contractors for the Hudson tubes for the Pennsylvania road were the O'Rourke Contracting Company. Skilful treatment was required to overcome the difficulties on the New York side of the Hudson in all the tubes where the face excavation was partly in rock and partly in soft earth. Most of their length, however, was through silt, and in this the tunnelling was the easiest and most rapid that has ever been carried out in subaqueous work, 50 lineal ft. per day being sometimes accomplished. A large proportion of the silt which under ordinary processes would be taken into the tunnel through the shield, carried to the shore and got rid of by expensive methods, was by the latter process merely displaced as the shield with nearly or quite closed diaphragm was pushed ahead.

The East Boston tunnel, the first important example of a shield-built monolithic concrete arch, from the Boston Subway to East Boston, is 1·4 m. long, 3400 ft. being under the harbour. One mile was excavated by tunnelling with roof shields about 29 ft. wide, through clay containing pockets of sand and gravel. The engineer was H. A. Carson, and the contractors the Boston Tunnel Construction Company and Patrick McGovern.

Some 25 m. of waterworks brick-lined tunnels have been built since 1864, mostly in clay, under the Great Lakes, without the use of shields, though in the later ones compressed air was utilized. A large portion of the latest Cleveland tunnel, 9 ft. interior diameter, was built at the rate of 17 ft. per day at a cost of about $18 per ft. During this work three explosions of inflammable gases occurred, in which nineteen men were killed and others were injured. Later a fire at the shaft in the lake caused the death of ten men. Work was thereafter completed under the engineering direction of G. H. Benzenberg. Less serious accidents, principally explosions of marsh gas, occurred in many of the other tunnels. In one case (at Milwaukee under Benzenberg) drift material was penetrated, with large boulders and coarse and fine gravel, and without any sand or clay filling, apparently in direct communication with the lake bottom. At times the necessary air pressure was 42 ℔ per sq. in.

Subaqueous Tunnels made by sinking Tubes, Caissons, &c.—In 1845 De la Haye, in England, doubtless having in mind the tedious and difficult work of the Thames tunnel, proposed to make tunnels under water by sinking large tubes on a previously prepared bed and connecting them together. Since then many inventors have proposed similar schemes. In 1866 Belgrand sank twin plate-iron pipes, 1 metre diameter and 156 metres long, under the Seine at Paris for a sewer siphon, and there have since been numerous examples of sunk cast-iron subaqueous water-pipes. It is believed that the first tunnel of this class, large enough for men to move upright in, was by H. A. Carson, assisted by W. Blanchard and F. D. Smith, in 1893–1894, in the outer portion of Boston harbour, for the metropolitan sewer outlet. The later tubes were about 9 ft. exterior diameter, in sections each 52 ft. long, weighing about 210,000 ℔, made of brick and concrete, with a skin of wood and water-tight bulkheads at each end. A trench was dredged in the harbour bed and saddles were accurately placed to support the tubes. The latter, made in cradles above water alongside a wharf, were lowered by long vertical screws moved by steam power, and were towed ¼ to ¾ m. to their final positions. After sufficient water had been admitted they were lowered to their saddles by travelling shears on temporary piles. The temporary joints between consecutive sections were made by rubber gaskets between flanges which were bolted together by divers. The later operations were backfilling the trench over the pipes, and in each section pumping out the water, removing its bulkheads, and making good the masonry between consecutive bulkheads, this masonry being inside the flanges. This work, about 1500 ft. in length, was done without contractors, by labourers and foremen under the immediate control of the engineers, and was found perfectly tight, straight and sound.

The double-track railroad tunnel at Detroit, made in 1906–1909, under the direction of an advisory board consisting of W. J. Wilgus (chairman), H. A. Carson and W. S. Kinnear (the last-named being chief engineer), is 1½ m. long, with a portion directly under the river of ½ m. The method used under the river (proposed by Wilgus) is an important variation on the Boston scheme. A trench was dredged with a depth equal to the thickness of the tunnel below the river bed and about 70 ft. below the river surface, and grillages were accurately placed in it to support the ends of thin steel tube-forms, inside of which concrete was to be moulded and outside of which deposited. These tubes, each about 23 ft. in diameter and 262·5 ft. long, were in pairs (one tube for each track), and were connected sidewise and surrounded by thin steel diaphragms 12 ft. apart. Planking, to limit the concrete, was secured outside the diaphragms (see fig. 3). The forms were made tight, bulkheaded at their ends, floated into place, sunk by admitting water, set on the grillages, and the ends of successive pairs connected together by bolts through rubber gaskets and flanges. The succeeding pair of tubes was not lowered until concrete had been deposited through the river around the tubes of the preceding pair. The following steps were to remove the water from one pair of tubes, mould inside a lining of concrete 20 in. thick, remove the contiguous bulkheads, and repeat again and again the processes described until the subaqueous tunnel was complete.

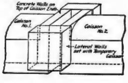
The New York Rapid Transit tunnel under Harlem river, built 1904–1905, has two tubes, each about 15 ft. diameter and 400 ft. long, with a surrounding shell of cast iron itself surrounded by concrete. The outside width of concrete is about 33 ft. Its top is 28 ft. below high water and about 3 ft. below the bed of the river. D. D. McBean, the sub-contractor, dredged a trench in the river to within 7 or 8 ft. of the required depth. He then enclosed a space of the width of the tunnel from shore to mid-stream with 12-in. sheet piling, which was evenly cut off some 2 ft. above the determined outside top of the tunnel. On top of this piling he sank and tightly fitted a flat temporary roof of timber 5 ft. thick in sections, and covered this with about 5 ft. of dredged mud. Water was expelled from this subaqueous chamber by compressed air, after which the remaining earth was easily taken out, and the iron and concrete tunnel walls were then built in the chamber. For the remaining part of the river the foregoing process was varied by cutting off the sheet piling at mid-height of the tunnel and making the upper half of the tunnel, which was built above and lowered in sections through the water, serve as the roof of the chamber in which the lower half of the tunnel was built.

The tunnels of the Métropolitain railway of Paris (F. Bienvenüe, engineer-in-chief) under the two arms of the Seine, between Place Chatelêt and Place Saint Michel, were made by means of compressed-air caissons sunk beneath the river bed, were next made by the aid of temporary small caissons sunk through about 26 ft. of earth under the river. The tops of the side walls were made even with the end walls. A steel rectangular coffer-dam (figs. 5 and 6) was sunk to rest with rubber or clay joint on these surrounding walls. The coffer-dam had shafts reaching above the surface of the water, so that the earth core was easily taken out (after removing the water) in free air. The adjacent chambers under the caissons were then connected together. Three caissons, of a total length of 396 ft., were used under the larger arm, and two, of an aggregate length

Mountain Tunnels for Railways.

Tunnel.	Location.	Length. (miles)	Internal Width and Height.	Material penetrated.	Average progress per day = 24 hrs. (lin. yds.).	Approximate cost per lin. yd.
Mont Cenis (1 tunnel) .	Modane, France and Bardonecchia, Italy.	7·98	26 ft. 3 in. × 24 ft. 7 in. (horseshoe).	Granitic	2·57	£ 226
St Gotthard (1 tunnel)	Göschenen and Airolo in Switzerland.	9·3	26 ft. 3 in. × 24 ft. 7 in. (horseshoe).	Granitic	6·01	143
Arlberg (1 tunnel) . .	Innsbruck and Bludenz in Tirol.	6·36	25 ft. 3 in. wide	—	9·07	108
Simplon (2 tunnels) .	Brigue, Switzerland and Iselle, Italy.	12·3	16 ft. 5 in. × 19 ft. 6 in. each (min.).	Gneiss, mica schist, limestone and disintegrated mica schist rock.	11·63	148

L. Chagnaud being the contractor. They were built of plates of sheet steel and masonry, with temporary steel diaphragms in the ends, filled with concrete, making a cross wall with a level top about even with the outside top of the tunnel and about 2 ft. below the bottom of the Seine. The caissons were sunk on the line of the tunnel so that adjacent ends (and the walls just described) were nearly 5 ft. apart with—at that stage—a core of earth between them. Side walls joining the end walls and thus enclosing the earth core on four sides (fig. 4)


Concrete Walls on Top of Caisson Ends
Caisson No. 1.
Caisson No. 2.
Lateral Walls set with Temporary Caisson

(From *Engineering News*, New York.)

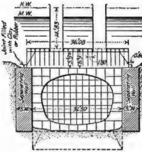
FIG. 4.—Perspective showing manner of enclosing space between tunnel caissons for the Métropolitain under the Seine at Paris.

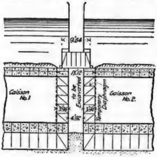
of 132 ft., under the smaller arm of the Seine. The cost of the tunnel was 7000 francs per lineal metre.

William Sooy Smith published in Chicago, in 1877, a description of a scheme for building a tunnel under the Detroit river by sinking caissons end to end, each caisson to be secured to the adjoining one by tongued and grooved guides, and a nearly water-tight connexion between the two to be made by means of an annular inflated hose.

Tunnelling through Mountains.—Where a great thickness of rock overlies a tunnel through a mountain, it may be necessary to do the work wholly from the two ends without intermediate shafts. The problem largely resolves itself into devising the most expeditious way of excavating and removing the rock. Experience has led to great advances in speed and economy, as may be seen from examples in the above table.

In 1857 the first blast was fired in connexion with the Mont Cenis works; in 1861 machine drilling was introduced; and in 1871 the tunnel was opened for traffic. With the exception of about 300 yds. the tunnel is lined throughout with brick or stone. During the first four years of hand labour the average progress was not more than 9 in. per day on each side of the Alps; but with compressed air rock-drills the rate towards the end was five times greater.





(From *Engineering News*, New York.)

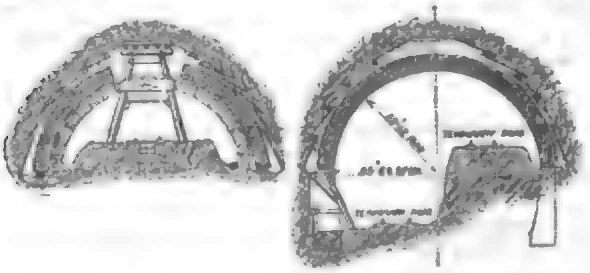
FIG. 5.—Transverse Section.

FIG. 6.—Longitudinal Section.

Coffer-dam superimposed over joints between caissons in tunnels for the Métropolitain under the Seine at Paris.

In 1872 the St Gotthard tunnel was begun, and in 1881 the first locomotive ran through it. Mechanical drills were used from the beginning. Tunnelling was carried on by driving in advance a top heading about 8 ft. square, then enlarging this sideways, and finally sinking the excavation to invert level (see figs. 7 and 8). Air for working the rock-drills was compressed to seven atmospheres by turbines of about 2000 horse-power.

The driving of the Arlberg tunnel was begun in 1880 and the work was completed in little more than three years. The main heading was driven along the bottom of the tunnel and shafts were opened up 25 to 70 yds. apart, from which smaller headings were driven right and left. The tunnel was enlarged to its full section at different points simultaneously in lengths of 8 yds., the excavation of each occupying about twenty days, and the masonry fourteen days. Ferroux percussion air-drills and Brandt rotary hydraulic drills were used, the performance of the latter being especially satisfactory. After each blast a fine spray of water was injected, which assisted the ventilation materially. In the St Gotthard tunnel the discharge of the air-drills was relied on for ventilation. In the Arlberg tunnel over 8000 cub. ft. of air per minute were thrown in by ventilators. To keep pace with the miners, 900 tons of excavated material had to be removed, and 350 tons of masonry introduced, daily at each end of the tunnel, which necessitated the transit of 450 wagons. The cost per lineal yard varied according to the thickness of masonry lining and the distance from the mouth of the tunnel. For the first thousand yards from the entrance the prices per lineal yard were £11 8s. for the lower heading; £7 12s. for the upper one; £30 10s. for the unlined tunnel; £45 for the tunnel with a thin lining of masonry; and £124 5s. with a lining 3 ft. thick at the arch, 4 ft. at the sides, and 2 ft. 8 in. at the invert.



FIGS. 7 and 8.—Method of excavation in St Gotthard Tunnel.

The Simplon tunnel was begun in 1898 and completed in 1905. It is over 30 % longer than the St Gotthard, and the greatest depth below the surface is 7005 ft. A novel method was introduced in the shape of two parallel bores (56 ft. apart, connected at intervals of 660 ft. by oblique galleries), which greatly facilitated ventilation, and resulted in increased economy and rapidity of construction, while ensuring the health of the men. One of these galleries was made large enough for a single-track railroad, and the second is to be enlarged and similarly used. The death-rate in the Simplon tunnel was decreased as compared with the St Gotthard from 800 in eight years to 60 in seven years. Had one wide tunnel been made instead of two narrow ones, it would have been difficult to maintain its integrity; even with the narrow cross-section employed the floor was forced up at points in the solid rock from the great weight above, and had to be secured by building heavy inverts of masonry. Temperatures were reduced to 89° F. by spraying devices, although the rock temperatures ranged from 129° to 130° F. At one point 4374 yds. from the portal of Iselle the "Great Spring" of cold water was struck; it yielded 10,564 gallons per minute at 600 lb pressure per sq. in., and reduced the temperature to 55·4° F., the lowest point recorded. A spring of hot water was met on the Italian side which discharged into the tunnel 1600 gallons per minute with a temperature of 113° F. The maximum flow of cold water was 17,081 gallons per minute, and of hot water 4330 gallons per minute. These springs often necessitated a temporary abandonment of the work. Water power from the Rhone at the Swiss and from the Diveria at the Italian end provided the power for operating all plant during the construction of most of the work. Among the able engineers connected with this work must be mentioned Alfred Brandt, a man of remarkable energy and ability, whose drills were used with much success. He died early in the work, of injuries received from falling rock.

A group of tunnels—the Tauern, Bärengraben, Wocheiner and Bosrück—was undertaken by the Austrian government in connexion with new Alpine railroads to increase the commercial territory tributary to the seaport of Trieste, which at one time was greater than Hamburg. The principal tunnel of this group is under the main body of the Tauern mountain. The bottom drifts met on the 21st of July 1907. The difficulties resulted mostly from mountain débris and springs. There are four minor tunnels between Schwarzach, St Veit, and the north portal of the Tauern, and nineteen between the south portal and the south slope at Möllbrücken.

The electric railway from the Eiger glacier to near the summit of the Jungfrau includes a tunnel 1½ m. long, 3·6 metres wide and 3·8 metres high, with a midway station, from which a large part of northern Switzerland can be seen. From the Jungfrau terminus, at an elevation of 13,428 ft., the summit, 242 ft. higher, will be reached by an elevator.

The Hoosac tunnel was the first prominent tunnel in America. It was begun in 1855 and finished in 1876, after many interruptions. It was memorable for the original use in America of air-drills and nitroglycerin. The Pennsylvania railroad tunnels crossing New York City under 32nd and 33rd Streets are of unusual size. Owing to the close proximity of large buildings and other structures special methods were adopted for mining the rock to lessen the vibrations by explosions. At 33rd Street and 4th Avenue the tunnels pass directly under two of the Rapid Transit system, above which there is another belonging to the Metropolitan Traction Company, so that there are three tunnels at different levels under the street.

Among other rock tunnels may be mentioned the Albula, through a granite ridge of the Rhaetian Alps, for a single-track narrow-gauge railroad, 3·6 m. long; tunnels on the Midland railway, near Totley in Derbyshire, over 3·5 m. long, largely in shale, and at Cowburn, over 2 m. long, in shale and harder rock, each 27 ft. wide and 20·5 ft. high inside; the Suram, on the Trans-Caucasus railway, for double track, 2·47 m. long, through soft rock; the tail-race tunnel for the Niagara Falls Water Power Company, 1·3 m. long, 19 ft. wide and 21 ft. high, through argillaceous shale and limestone, costing about $1,250,000; the Tequixquiac outlet to the drainage system for the city of Mexico, costing $6,760,000; the Cascade, Washington, part of the Great Northern railroad system, saving 9 m. in distance; and the Gunnison, irrigating 147,000 acres in Colorado.

Tunnelling in Towns.—Where tunnels have to be carried through soft soil in proximity to valuable buildings special precautions have to be taken to avoid settlement. A successful example of such work is the tunnel driven in 1886 for the Great Northern Railway Company under the Metropolitan Cattle

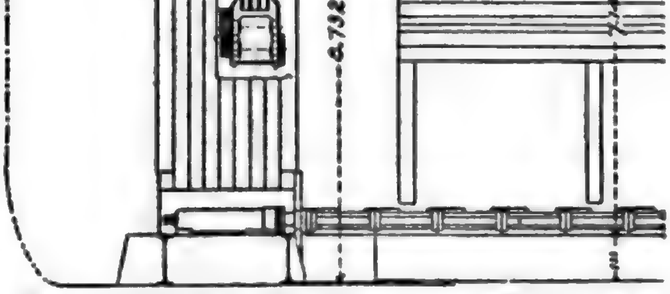


FIG. 9.—Paris Métropolitain Tunnel, longitudinal horizontal section.

Market, London. This was done by the crown-bar method, the bars being built in with solid brickwork. The subsidence in the ground was from 1 to about 3½ in. Several buildings were tunnelled under without any structural damage.

London has now some 90 m. of tunnels for railways, mostly operated by electric traction. Most of those which have been constructed since 1890 have been tunnelled by the use of cylindrical shields and walls of cast iron. Shields about 23 ft. in diameter were used in constructing the stations on the Central London railway, and one 32 ft. 4 in. in diameter and only 9 ft. 3 in. long was used for a short distance on the Clapham extension of the City and South London railway.

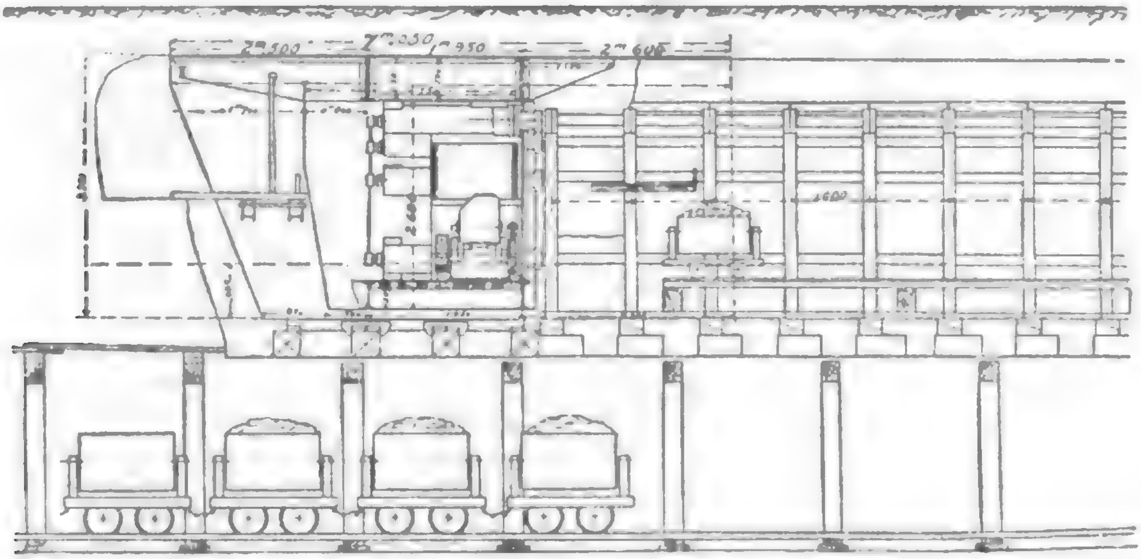


Fig. 10.—Paris Métropolitain Tunnel, longitudinal vertical section.

Paris has an elaborate plan for underground railways some 50 m. in length, a considerable number of which have been constructed since 1898 under the engineering direction of F. Bienvenüe. Instead of using completely cylindrical shields and cast-iron walls, as in London, roof-shields (*boucliers de voûte*) were employed for the construction of the upper half of the tunnel, and masonry walls were adopted throughout. In general, the upper half of the tunnel was executed first (figs. 9 and 10) and the lower part completed by underpinning.

Figs. 11, 12 and 13 illustrate a case of tunnelling near important buildings in Boston in 1896, with a roof-shield 29 ft. 4 in. in external diameter. The vertical sidewalls were first made in small drifts, the roof-shield running on top of these, and the core was taken out later and the invert or floor of the tunnel put in last. Each hydraulic press of the shield reacted against a small continuous cast-iron rod imbedded in the brick arch. In some large sewerage tunnels in Chicago the shields were pushed from a wall of oak planks, 8 in. thick, surrounding the brick walls of the sewer.

Ventilation of Tunnels.—The simplest method for ventilating a railway tunnel is to have numerous wide openings to daylight at frequent intervals. If these are the full width of the tunnel, at least 20 ft. in length, and not farther apart than 200 yds., it can be naturally ventilated. Such arrangements are, however, frequently impracticable, and then recourse must be had to mechanical means.

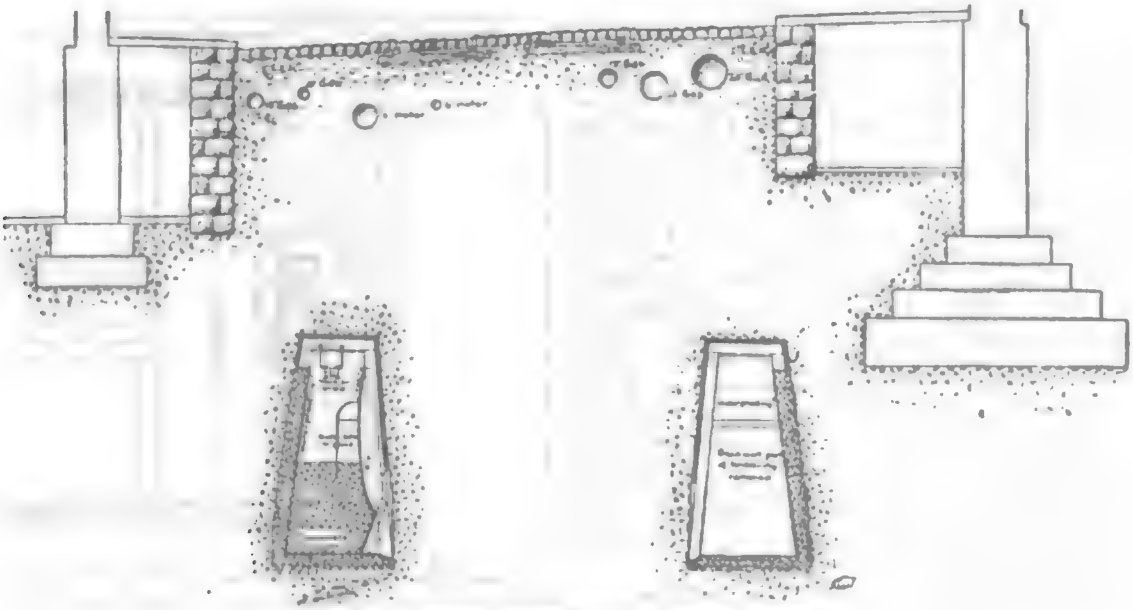


Fig. 11.—Boston Subway, first and second phases.

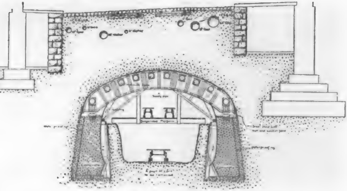


FIG. 12.—Boston Subway, third phase.

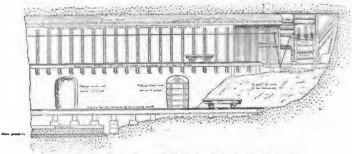
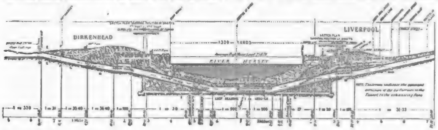


FIG. 13.—Boston Subway, longitudinal vertical section through shield.

The first application of mechanical or fan ventilation to railway tunnels was made in the Lime Street tunnel of the London and North-Western railway at Liverpool, which has since been replaced by an open cutting. At a later date fans were applied to the Severn and Mersey tunnels.

The principle ordinarily acted upon, where mechanical ventilation has been adopted, is to exhaust the vitiated air at a point midway between the portals of a tunnel, by means of a shaft with which is connected a ventilating fan of suitable power and dimensions. In the case of the tunnel under the river Mersey (fig. 14) such a shaft could not be provided, owing to the river being overhead, but a ventilating heading was driven from the middle of the river (at which point entry into the tunnel was effected) to each shore, where a fan 40 ft. in diameter was placed. In this way the vitiated air is drawn from the lowest point of the railway, while fresh air flows in at the stations on each side to replenish the partial vacuum, as indicated by arrows in the accompanying longitudinal section of the tunnel. The principle was that fresh air should enter at each station and "split" each way into the tunnel, and that thus the atmosphere on the station platforms should be maintained in a condition of purity.

The fans in the Mersey tunnel are somewhat similar to the well-known Guibal fans, with the exception of an important alteration in the shutter. With the Guibal shutter, the top of the opening



(From a diagram in *Proc. Inst. Civ. Eng.*)

FIG. 14.—Longitudinal Section of the Mersey Tunnel, showing Method of Ventilation.

into the chimney from the fan has a line parallel to that of the fan-shaft and of the fan-blades, and, as a consequence, as each blade passes this shutter, the stoppage of the discharge of the air is instantaneous, and the sudden change of the pressure of the air on the face of the blade whilst discharging and the reversal of the pressure, due to the vacuum inside the fan-casing, cause the vibration hitherto inseparable from this type of ventilator. As an illustration of the effect of the pulsatory action of the Guibal shutters the following figures may be given: a fan having ten arms and running, say, sixty revolutions per minute, and working twenty-four hours per day, gives (10 × 60 × 60 × 24 =) 864,000 blows per day transmitted from the tip of the fan-vanes to the fan-shaft; the shaft is thus in a constant state of tremor, and sooner or later reaches its elastic limit, and the consequent injury to the general structure of the fan is obvious. This difficulty is avoided by cutting a Λ-shaped opening in the shutter, thus gradually decreasing the aperture and allowing the air to pass into the chimney in a continuous stream instead of intermittently. The action of this regulating shutter increases the durability and efficiency of the fans in an important degree. In towns like Liverpool and Birkenhead any pulsatory action would be readily felt by the inhabitants, but with the above arrangement it is difficult to detect any sound whatever, even when standing close to the buildings containing the fans. The admission of the air on both sides is found in practice to conduce to smooth running and to the reduction of the side-thrust which occurs when the air is admitted on one side only. The fans are five in number: two are 40 ft. in diameter by 12 ft. wide, and two 30 ft. in diameter by 10 ft. wide, one of each size being erected at Liverpool and at Birkenhead respectively. In addition, there is a high-speed fan 16 ft. in diameter in Liverpool which throws 300,000 cub. ft.

The following table gives the result of experiments made with the ventilating fans of the Mersey railway:—

Fan at	Diameter of Fan in feet.	Width of Blade in feet.	Number of Revolutions per minute.	Area of Drift-way in square feet.	Water-gauge in inches.	Velocity of Air in feet per minute.	Volume of Air in cubic feet per minute.
Hamilton Street, Birkenhead .	30	10	47	113	1·30	1895	214,135
Shore Road, Birkenhead .	40	12	45	41	2·50	3288[1]	134,685
James Street, Liverpool . .	40	12	45	72	2·45	2465	178,880
James Street, Liverpool . .	30	10	60	60	2·30	2062	123,720
Bold Street, Liverpool . .	16[2]	—	—	—	—	—	300,000
						Total	951,420

The central point of the Severn tunnel (fig. 15) lies toward the Monmouthshire bank of the river, and ventilation is effected from that point by means of one fan placed on the surface at Sudbrooke, Monmouth, at the top of a shaft which is connected with a horizontal heading leading to the centre. This fan, which is 40 ft. in diameter by 12 ft. in width, removes from the tunnel some 400,000 cub. ft. per minute, and draws in an equivalent volume of fresh air from the two ends.

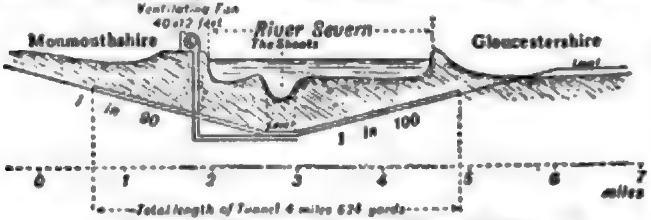
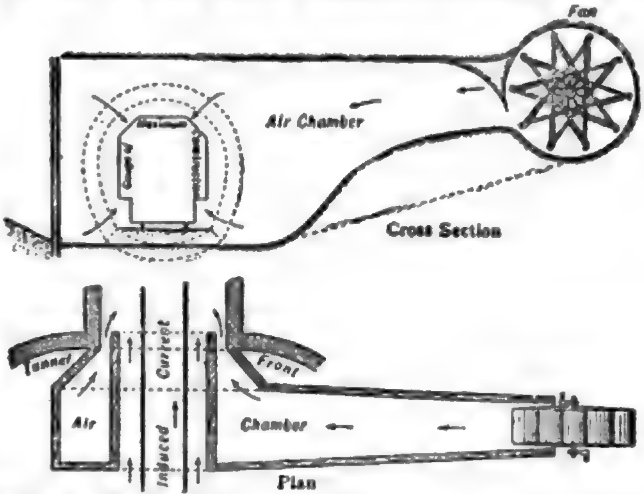


FIG. 15.—Section of Severn Tunnel (Fox).

About 1896 an excellent system was introduced by Signor Saccardo, the well-known Italian engineer, which to a great extent has minimized the difficulty of ventilating long tunnels under mountain-ranges where shafts are not available. This system, which is not applicable to tunnels in which underground stations exist, is illustrated in fig. 16, which represents its application to the single-line tunnel through the Apennines at Pracchia. This tunnel is one of fifty-two single-line tunnels, with a gradient of 1 in 40, on the main line between Florence and Bologna, built by Thomas Brassey. There is a great deal of traffic which has to be worked by heavy locomotives. Before the installation of a ventilating system under any condition of wind the state of this tunnel, about 3000 yds. in length, was bad; but when the wind was blowing in at the lower end at the same time that a heavy goods or passenger train was ascending the gradient the condition of affairs became almost insupportable. The engines, working with the regulators full open, often emitted large quantities of both smoke and steam, which travelled concurrently with the train. The goods trains had two engines, one in front and another at the rear, and when, from the humidity in the tunnel, due to the steam, the wheels slipped and possibly the train stopped, the state of the air was indescribable. A heavy train with two engines, conveying a royal party and their suite, arrived on one occasion at the upper exit of the tunnel with both enginemen and both firemen insensible; and on another occasion, when a heavy passenger train came to a stop in the tunnel, all the occupants were seriously affected.



(From the *Proc. Inst. Civ. Eng.*)

FIG. 16.—Diagram illustrating the Saccardo System for Ventilating Tunnels.

In applying the Saccardo system, the tunnel was extended for 15 or 20 ft. by a structure either of timber or brickwork, the inside line of which represented the line of maximum construction, and this was allowed to project for about 3 ft. into the tunnel. The space between this line and the exterior constituted the chamber into which air was blown by means of a fan. Considering the length of tunnel it might at first be thought there would be some tendency for the air to return through the open mouth, but nothing of the kind happened. The whole of the air blown by the fan, 164,000 cub. ft. per minute, was augmented by the induced current yielding 46,000 cub. ft. per minute, making a total of 210,000 cub. ft.; and this volume was blown down the gradient against the ascending train, so as to free the driver and men in charge of the train from the products of combustion at the earliest possible moment. Prior to the installation of this system the drivers and firemen had to be clothed in thick woollen garments, pulled on over their ordinary clothes, and wrapped round and round the neck and over the head; but in spite of all these precautions they sometimes arrived at the upper end of the tunnel in a state of insensibility. The fan, however, immensely improved the condition of the air, which is now pure and fresh.

In the case of the St Gotthard tunnel, which is 9¼ m. in length and 26 ft. wide with a sectional area of 603 sq. ft., the Saccardo system was installed in 1899 with most beneficial results. The railway is double-tracked and worked by steam locomotives, the cars being lighted by gas. The ventilating plant is situated at Göschenen at the north end of the tunnel and consists of two large fans operated by water power. The quantity of air passed into the narrow mouth of the tunnel is 413,000 cub. ft. per minute at a velocity of 686 ft., this velocity being much reduced as the full section of the tunnel is reached. A sample of the air taken from a carriage contained 10·19 parts of carbonic acid gas per 10,000 volumes.

In the Simplon tunnel, where electricity is the motive power, mechanical ventilation is installed. A steel sliding door is arranged at each entrance to be raised and lowered by electric power. After the entrance of a train the door is lowered and fresh air forced into the tunnel at considerable pressure from the same end by fans.

The introduction of electric traction has simplified the problem of ventilating intra-urban railways laid in tunnels at a greater or less distance below the surface, since the absence of smoke and products of combustion from coal and coke renders necessary only such a quantity of air as is required by the passengers and staff. For supplying air to the shallow tunnels which form the underground portions of the Metropolitan and District railways in London, open staircases, blow-holes and sections of uncovered track are relied on. When the lines were worked by steam locomotives they afforded notorious examples of bad ventilation, the proportion of carbonic acid amounting to from 15 or 20 to 60, 70 and even 89 parts in 10,000. But since the adoption of electricity as the motive power the atmosphere of the tunnels has much improved, and two samples taken from the cars in 1905 gave 11·27 and 14·07 parts of carbonic acid in 10,000.

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[1] In the case of this circular drift-way a velocity of 4000 ft. per minute was subsequently attained.

[2] Quick-running fan.

When deep level "tube" railways were first constructed in London, it was supposed that adequate ventilation would be obtained through the lift-shafts and staircases at the stations, with the aid of the scouring action of the trains which, being of nearly the same cross-section as the tunnel, would, it was supposed, drive the air in front of them out by the openings at the stations they were approaching, while drawing fresh air in behind them at the stations they had left. This expectation, however, was disappointed, and it was found necessary to employ mechanical means. On the Central London railway, which runs from the Bank of England to Shepherd's Bush, a distance of 6 m., the ventilating plant installed in 1902 consists of a 300 h.p. electrically driven fan, which is placed at Shepherd's Bush and draws in fresh air from the Bank end of the line and at other intermediate points. The fan is 5 ft. wide and 20 ft. in diameter, and makes 145 revolutions a minute, its capacity being 100,000 cub. ft. a minute. It is operated from 1 to 4 a.m., and the openings at all the intermediate stations being closed it draws fresh air in at the Bank station. The tunnel is thus cleared out about 2¾ times each night and the air is left in the same condition as it is outside. The fan is also worked during the day from 11 a.m. to 5 p.m., the intermediate doors being open; in this way the atmosphere is improved for about half the length of the line and the cars are cleared out as they arrive at Shepherd's Bush. Samples of the air in the tunnel taken when the fan was not running contained 7·07 parts of carbonic acid in 10,000, while the air of a full car contained 10·7 parts. The outside air at the same time contained 4·4 parts. A series of tests made for the London County Council in 1902 showed that the air of the cars contained a minimum of 9·60 parts and a maximum of 14·7 parts. In some of the later tube railways in London—such as the Baker Street and Waterloo, and the Charing Cross and Hampstead lines—electrically driven exhaust fans are provided at about half-mile intervals; these each extract 18,500 cub. ft. of air per minute from the tunnels, and discharge it from the tops of the station roofs, fresh air being conveyed to the points of suction in the tunnels.

The Boston system of electrically operated subways and tunnels is ventilated by electric fans capable of completely changing the air in each section about every fifteen minutes. Air admitted at portals and stations is withdrawn midway between stations. In the case of the East Boston tunnel, the air leaving the tunnel under the middle of the harbour is carried to the shore through longitudinal ducts (fig. 3) and is there expelled through fan-chambers.

In the southerly 5 m. of the New York Rapid Transit railway, which runs in a four-track tunnel of rectangular section, having an area of 650 sq. ft., and built as close as possible to the surface of the streets, ventilation by natural means through the open staircases at the stations is mainly relied upon, with satisfactory results as regards the proportions of carbonic acid found in the air. But when intensely hot weather prevails in New York the tunnel air is sometimes 5° hotter still, due to the conversion of electrical energy into heat. This condition is aggravated by the fine diffusion through the air of oil from the motors, dust from the ballast and particles of metal ground off by the brake shoes, &c.

Volume of Air Required for Ventilation.—The consumption of coal by a locomotive during the passage through a tunnel having been ascertained, and 29 cub. ft. of poisonous gas being allowed for each pound of coal consumed, the volume of fresh air required to maintain the atmosphere of the tunnel at a standard of purity of 20 parts of carbon dioxide in 10,000 parts of air is ascertained as follows: The number of pounds of fuel consumed per mile, multiplied by 29, multiplied by 500, and divided by the interval in minutes between the trains, will give the volume of air in cubic feet which must be introduced into the tunnel per minute. As an illustration, assume that the tunnel is a mile in length, that the consumption of fuel is 32 lb per mile, and that one train passes through the tunnel every five minutes in each direction; then the volume of air required per minute will be

$$\frac{32 \text{ lb} \times 29 \text{ cub. ft.} \times 500}{2\frac{1}{2} \text{ minutes}} = 185{,}600 \text{ cub. ft},$$

Corrosion of Rails in Tunnels.—Careful tests made in the Box and Severn tunnels of the Great Western railway, to ascertain if possible the loss that takes place in the weight of rails owing to the presence of corrosive gases, gave the following results:—

BOX TUNNEL (1 m. 66 chains in length).

Percentage of Wear per annum.

	lb per yard % per annum.
Down line, gradient falling 1 in 100—	
At east mouth	0·439 = 0·377
28 chains from east mouth	1·800 = 1·540
48 chains from east mouth	2·110 = 1·810
1 m. 8 chains from east mouth	2·880 = 2·480
At west mouth	0·640 = 0·553
Up line, gradient rising 1 in 100—	
At east mouth	0·620 = 0·575
1 m. 8 chains from east mouth	1·500 = 1·380
1 m. 28 chains from east mouth	1·520 = 1·310
At west mouth	0·680 = 0·587

SEVERN TUNNEL (4 m. 28½ chains in length).

Percentage of Wear per annum.

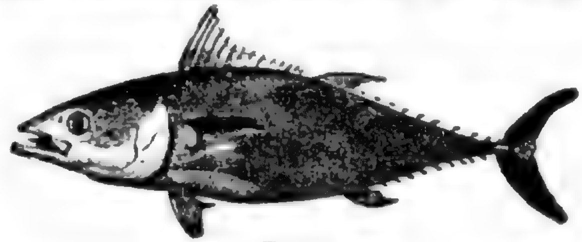
	lb per yard % per annum.
Down line, outside and quite clear of tunnel, Bristol end, gradient falling 1 in 100	0·280 = 0·240
Up line, outside and quite clear of tunnel, Newport end, gradient falling 1 in 90	0·440 = 0·390
At Bristol mouth, gradient falling 1 in 100	1·200 = 1·020
33 chains from Bristol mouth, gradient falling 1 in 100	2·160 = 1·860
3 m. 75½ chains from Bristol mouth, gradient rising 1 in 90	1·900 = 1·630
At Newport mouth	0·310 = 0·270
Down and up line under main-shaft level	3·200 = 2·750

It will be seen that the maximum wear and corrosion together reached the extraordinary weight of 2¾ lb per yard of rail per year—a very serious amount that involved great expenditure. The wear occurred over the whole of the rail, but the top, over which the engine and train passed, wore at a greater rate, presumably on account of the surface being kept bright and the gases being able to act on it. The Great Western Company tried the experiment in the Severn tunnel of boxing up the rails, so that the ballast approached their surface within 1 in. or 1½ in. It was found, however, that—in the case, at any rate, of the limestone ballast—the cure was almost worse than the disease, the result being a maximum wear of 2¾ lb and an average wear of just under 2 lb per yard of rail per year. The average on the open line would be about 0·25 lb in the same time.

See *Proc. Inst. Civ. Eng.*; also works on tunnelling by Drinker, Simms, Stauffer and Prelini, and on tunnel shields, &c., by Copperthwaite. (H. A. C.)

TUNNEL VAULT, the term in architecture given to the semicircular or elliptical vault over underground passages, in contradistinction to the wagon or barrel vault of edifices above ground.

TUNNY (*Thunnus thynnus*), one of the largest fishes of the family of mackerels, belongs to the genus of which the bonito (*Th. pelamys*) and the albacores (*Th. albacora, Th. alalonga*, &c.) are equally well-known members. From the latter the tunny is distinguished by its much shorter pectoral fins, which reach backwards only to, or nearly to, the end of the first dorsal fin. It possesses nine short finlets behind the dorsal, and eight behind the anal fin. Its colour is dark bluish above, and greyish, tinged and spotted with silvery, below. The tunny is a pelagic fish, but periodically approaches the shore, wandering in large shoals, within well-ascertained areas along the coast. It not infrequently appears in small companies or singly in the English Channel and in the German Ocean, probably in pursuit of the shoals of pilchards and herrings on which it feeds. The regularity of its appearance on certain parts of the coasts of the Mediterranean has led to the establishment of a systematic fishery, which has been carried on from the time of the Phoenicians to the present day. Immense numbers of tunnies were caught on the Spanish coast and in the Sea of Marmora, where, however, this industry has much declined. The Sardinian tunnies were considered to be of superior excellence. The greatest number is now caught on the north coast of Sicily, the fisheries of this island supplying most of the preserved tunny which is exported to other parts of the world. In ancient times the fish were preserved in salt, and that coming from Sardinia, which was specially esteemed by the Romans, was known as



Tunny.

Salsamentum sardicum. At present preference is given to tunny preserved in oil. Many of the fishes, especially the smaller ones, are consumed fresh. The tunny occurs also in the Pacific and is much sought for by anglers on the coast of southern California, where tuna-fishing has become a fashionable sport; but several other species seem to take its place in the Indo-Pacific ocean. It is one of the largest fishes, attaining to a length of ten ft. and to a weight of more than a thousand pounds.

In connexion with the extremely active life of these fishes allusion should be made to the fact, first ascertained in 1839 by John (brother of Sir Humphry) Davy, that the temperature of the blood of a tunny may be considerably higher than that of the surrounding water, a discovery which disposed of the time-honoured division of vertebrate animals into warm-blooded and cold-blooded.

The variations and movements of the tunny and albacores were studied with special care by King Carlos of Portugal, who published in 1899 a large illustrated memoir entitled *A Pesca do atum no Algarve in 1898* (Lisbon). This memoir is accompanied by excellent figures of the different species of *Thunnus* and charts of their distribution in the Atlantic.

TUNSTALL (or TONSTALL), **CUTHBERT** (1474–1559), English prelate, was an illegitimate son of Thomas Tunstall of Thurland Castle, Lancashire, his legitimate half-brother, Brian Tunstall, being killed at Flodden in 1513. Cuthbert seems to have studied at Oxford, at Cambridge and at Padua, and he became a distinguished scholar, winning favourable comment from Erasmus. Having held several livings in quick succession, he became chancellor to William Warham, archbishop of Canterbury, in 1511, and he was soon employed on diplomatic business by Henry VIII. and Wolsey, being sent to Brussels in 1515 and to Cologne in 1519, while he was at Worms during the famous Diet of 1521. In 1516 he had been made master of the rolls; in 1521 he became dean of Salisbury, in 1522 bishop of London, and in 1523 keeper of the privy seal. For Henry VIII. he negotiated with Charles V. after his victory at Pavia in 1525 and he helped to arrange the Peace of Cambrai in 1529. In 1530 he succeeded Wolsey as bishop of Durham. Tunstall's religious views now gave some anxiety. He adhered firmly to the traditional teaching of the Church, but after some slight hesitation he accepted Henry as its head and publicly defended this position. In 1537 the bishop was appointed president of the new council of the north, but although he was often engaged in treating with the Scots he found time to take part in other public business and to attend parliament, where in 1539 he participated in the discussion on the bill of six articles. Although he disliked the religious policy pursued by the advisers of Edward VI. and voted against the first act of uniformity in 1549, he continued to discharge his public duties without molestation until after the fall of the protector Somerset; then in May 1551, he was placed in custody. A bill charging him with treason was introduced, but the House of Commons refused to pass it; he was, however, deprived of his bishopric in October 1552. On the accession of Mary in 1553 he was released and was again bishop of Durham, but during this reign he showed no animus against the Protestants. When Elizabeth came to the throne he refused to take the oath of supremacy, and he would not help to consecrate Matthew Parker as archbishop of Canterbury. He was arrested, and was still a prisoner at Lambeth when he died on the 18th of November 1559.

Among Tunstall's writings are *De veritate corporis et sanguinis domini nostri Jesu Christi in eucharistia* (1554); and *De arte supputandi libri quattuor* (1522). The bishop's correspondence as president of the council of the north is in the British Museum.

TUNSTALL, a market town of Staffordshire, England, on the northern outskirts of the Potteries district, included in the parliamentary borough of Newcastle-under-Lyme, 4 m. N.W. from Stoke-upon-Trent by the North Staffordshire railway. Pop. of urban district (1901), 19,492. The town is of modern growth. The Victoria Institute (1889) includes a library and schools of art and science. The neighbourhood is full of collieries, ironworks and potteries. Kidsgrove, Chatterley and Talk-o'-th'-hill are large neighbouring villages; the mines at the last-named were the scene of a terrible explosion in 1866, by which nearly a hundred lives were lost. There are brick and tile works in Tunstall. The town is included in the large parish of Wolstanton, and in the borough of Stoke-on-Trent (*q.v.*) under the "Potteries Federation" scheme (1908).

TUPIS (Comrades), a tribe and stock of South American Indians of Brazil. They call all other peoples *Tapuyas* (foreigners). Their original home is believed to have been on the Amazon, and from its mouth they spread far southwards along the Brazilian coast. When hard pressed by the Portuguese they retreated to the Andes. Martius gives the Tupi nation a wide range, from the Atlantic to the Andes, and from Paraguay to the Amazon. Of this stock are the Omaguas, Cocomas and other Peruvian tribes. Latham makes the Tupis members of the Guarani stock. The "Lingoa Geral" or trade language between Portuguese and Amazon Indians is a corruption of the Tupi tongue.

TUPPER, SIR CHARLES, BART. (1821–), British colonial statesman, son of the Rev. Charles Tupper, D.D., was born at Amherst, Nova Scotia, on the 2nd of July 1821, and was educated at Horton Academy. He afterwards studied for the medical profession at Edinburgh University, where he received the diplomas of M.D. and L.R.C.S. In 1855 he was returned to the Nova Scotia Assembly for Cumberland county. In 1862 he was appointed, by act of parliament, governor of Dalhousie College, Halifax; and from 1867 till 1870 he was president of the Canadian Medical Association. Mr Tupper was a member of the executive council and provincial secretary of Nova Scotia from 1857 to 1860, and from 1863 to 1867. He became prime minister of Nova Scotia in 1864, and held that office until the Union Act came into force on the 1st of July 1867, when his government retired. He was a delegate to Great Britain on public business from the Nova Scotia government in 1858 and 1865, and from the Dominion government in March 1868. Mr Tupper was leader of the delegation from Nova Scotia to the Union conference at Charlottetown in 1864, and to that of Quebec during the same year; and to the final colonial conference in London, which assembled to complete the terms of union, in 1866–1867. On that occasion he received a patent of rank and precedence from Queen Victoria as an executive councillor of Nova Scotia. He was sworn a member of the privy council of Canada, June 1870, and was president of that body from that date until the 1st of July 1872, when he was appointed minister of inland revenue. This office he held until February 1873, when he became minister of customs under Sir John Macdonald, resigning with the ministry at the close of 1873. On Sir John's return to power in 1878, Mr Tupper became minister of public works, and in the following year minister of railways and canals. At this time he was made K.C.M.G. Mr Tupper was the author of the Public Schools Act of Nova Scotia, and had been largely instrumental in moulding the Dominion Confederation Bill and other important measures. Sir Charles represented the county of Cumberland, Nova Scotia, for thirty-two years in succession—first in the Nova Scotia Assembly, and subsequently in the Dominion parliament until 1884, when he resigned his seat on being appointed high commissioner for Canada in London. Shortly before the Canadian Federal elections of February 1887, Sir Charles re-entered the Conservative cabinet as finance minister. By his efforts the Canadian Pacific railway was enabled to float a loan of $30,000,000, on the strength of which the line was finished several years before the expiration of the contract time. He resigned the office of finance minister in May 1888, when he was reappointed high commissioner for the Dominion of Canada in London. Sir Charles was designated one of the British plenipotentiaries to the Fisheries Convention at Washington in 1887, the result of which conference was the signing of a treaty in February 1888 (rejected by the U.S. Senate) for the settlement of the matters in dispute between Canada and the United States in connexion with the Atlantic fisheries. He was created a baronet in September 1888. When the Dominion cabinet, under Sir Mackenzie Bowell, was reconstituted in January 1896 Sir Charles Tupper accepted office, and in the following April he succeeded Bowell in the premiership. On both patriotic and commercial grounds he urged the adoption of a preferential tariff with Great Britain and the sister colonies. At the general election in the ensuing June the Conservatives were severely defeated, and Sir Charles Tupper and his colleagues resigned, Sir Wilfrid Laurier becoming premier. The Conservative party now gradually became more and more disorganized, and at the next general election, in November 1900, they were again defeated. Sir Charles Tupper, who had long been the Conservative leader, sustained in his own constituency of Cape Breton his first defeat in forty years.

TUPPER, MARTIN FARQUHAR (1810–1889), English writer, the author of *Proverbial Philosophy*, was born in London on the 17th of July 1810. He was the son of Martin Tupper, a doctor, who came of an old Huguenot family. He was educated at Charterhouse and at Christ Church, Oxford, where he gained a prize for a theological essay, Gladstone being second to him. He was called to the bar at Lincoln's Inn, but never practised. He began a long career of authorship in 1832 with *Sacra Poesis*, and in 1838 he published *Geraldine, and other Poems*, and for fifty years was fertile in producing both verse and prose; but his name is indissolubly connected with his long series of didactic moralisings in blank verse, the *Proverbial Philosophy* (1838–1867), which for about twenty-five years enjoyed an extraordinary popularity that has ever since been the cause of persistent satire. The first part was, however, a comparative failure, and N. P. Willis, the American author, took it to be a forgotten work of the 17th century. The commonplace character of Tupper's reflections is indubitable, and his blank verse is only prose cut up into suitable lengths; but the *Proverbial Philosophy* was full of a perfectly genuine moral and religious feeling, and contained many apt and striking expressions. By these qualities it appealed to a large and uncritical section of the public. A genial, warm-hearted man, Tupper's humane instincts prompted him to espouse many reforming movements; he was an early supporter of the Volunteer movement, and did much to promote good relations with America. He was also a mechanical inventor in a small way. In 1886 he published *My Life as an Author*; and on the 29th of November 1889 he died at Albury, Surrey.

TURBAN, the name of a particular form of head-dress worn by men of Mahommedan races. The earlier forms of the word in English are *turbant*, *turband*, and *tolibant* or *tulipant*, the latter showing that variant of the original which survives in the name of the flower, the tulip. All these forms represent the French adaptation of the Turkish *tulbend*, a vulgarism for *dulbend*, from Persian *dulband*, a sash or scarf wound round the head. The Moslem turban is essentially a scarf of silk, fine linen, cotton or other material folded round the head, sometimes, as in Egypt, round the tarbush or close-fitting felt cap; sometimes, as in Afghanistan, round a conical cap; or, as among certain races in India, round the skull-cap or *kullah*. Races, professions, degrees of rank, and the like vary in the style of turban worn; distinctions being made in size, methods of folding, and colour and the like (see India: *Costume*). At the end of the 18th and beginning of the 19th century, a species of head-dress somewhat resembling the true turban in outward form was worn by ladies of western nations, chiefly for use indoors.

TURBERVILLE (or Turbervile), **GEORGE** (1540?–1610?), English poet, second son of Nicholas Turberville of Whitchurch, Dorset, belonged to an old Dorsetshire family, the D'Urbervilles of Mr Thomas Hardy's novel, *Tess*. He became a scholar of Winchester College in 1554, and in 1561 was made a fellow of New College, Oxford. In 1562 he began to study law in London, and gained a reputation, according to Anthony à Wood, as a poet and man of affairs. He accompanied Thomas Randolph in a special mission to Moscow to the court of Ivan the Terrible in 1568. Of his *Poems describing the Places and Manners of the Country and People of Russia* (1568) mentioned by Wood, only three metrical letters describing his adventures survive, and these were reprinted in Hakluyt's *Voyages* (1589). His *Epitaphs, Epigrams, Songs and Sonets* appeared "newly corrected with additions" in 1567. In the same year he published translations of the *Heroycall Epistles* of Ovid, and of the *Eglogs* of Mantuan (Gianbattista Spagnuoli, called Mantuanus), and in 1568 *A Plaine Path to Perfect Vertue* from Dominicus Mancinus. The *Book of Falconry or Hawking* and the *Noble Art of Venerie* (printed together in 1575) may both be assigned to Turberville. The title page of his *Tragical Tales* (1587), which are translations from Boccaccio and Bandello, says that the book was written at the time of the author's troubles. What these were is unknown, but Wood says he was living and in high esteem in 1594. He probably died before 1611. He is a disciple of Wyat and Surrey, whose matter he sometimes appropriated. Much of his verse is sing-song enough, but he disarms criticism by his humble estimate of his own powers.

His *Epitaphs* &c. were reprinted in Alexander Chalmers's *English Poets* (1810), and by J. P. Collier in 1867.

TURBET I HAIDARI, a district of the province of Khorasan in Persia, bounded N. by Meshed, E. by Bakharz, S. by Khaf and W. by Turshiz. It has a population of about 30,000, composed chiefly of members of the Turki Karai tribe and Beluchis. The Karais were settled here by Timur in the 14th century and now provide a battalion of infantry and 150 cavalrymen to the army. The district contains about 150 villages and hamlets, most of them situated in its more fertile eastern part, and pays a yearly revenue of £14,000. Much silk was formerly produced, now very little, but there are large crops of grain.

Turbet i Haidari, the capital of the district, is 76 m. nearly S. of Meshed, in 35° 17′ N., 59° 11′ E., at an elevation of 4100 ft. The town is picturesquely situated on the bank of a deep and wide ravine in the midst of lofty hills, and surrounded by clusters of villages. Its population amounts to 8000 souls. There is a well-stocked bazaar and a number of Russian traders have established themselves here since 1903, when the place was connected with Meshed on one side and with Seistan on the other side by a telegraph line which, nominally Persian, is worked and maintained by a Russian staff. A British consul has resided here since 1905, and there is also a post office.

The place was formerly known as Zavah and derives its present name from the turbet or tomb of a holy man named Kutb ed din Haidar, the founder of the ascetic sect of dervishes known as the Haidaris. He died *c.* 1230 and is buried in a large domed building a short distance outside the town.

TURBINE (Lat. *turbo*, a whirlwind, a whirling motion or object, a top), in engineering, a machine which applies the energy of a jet of water or steam to produce the rotation of a shaft. It consists essentially of a wheel or chamber provided with a number of blades or vanes upon which the fluid jet impinges; the impelled fluid causes the blades to rotate and also the shaft to which they are attached. Water turbines are treated under Hydraulics, and steam turbines under Steam Engine.

TURBOT[1] (*Rhombus maximus* or *Psetta maxima*), one of the largest and most valuable of the flat-fishes or *Pleuronectidae*. The turbot, which rarely exceeds a length of two feet, has great width of body, and is scaleless, but is covered with conical bony tubercles. The eyes are on the left side of the body, the lower being slightly in advance of the upper; the mouth is large and armed with teeth of uniformly minute size. The turbot is found all round the coasts of Europe (except in the extreme north), preferring a flat sandy bottom with from 10 to 50 fathoms of water. The broad banks off the Dutch coast are a favourite resort. It is a voracious fish, and feeds on other fish, crustaceans and molluscs. It seems to constantly change its abode, wandering northward during the summer, and going into deeper water in the cold season. The eggs of the turbot, like those of the majority of flat-fishes, are pelagic and buoyant. They are small and very numerous, varying from five to ten millions in fish of 18 to 21 lb weight. The young fish are symmetrical and swim vertically like the young of other Pleuronectids, but they reach a much larger size before metamorphosis than species of other genera, specimens from ¾ in. to 1 in. in length being frequently taken swimming at the surface of the water and not completely converted into the adult condition. Specimens one year old are from 3 to 4½ in. long, some perhaps larger. About 1860 it was estimated that the Dutch supplied turbot to the London market to the value of £80,000 a year. In 1900 the total weight of turbot landed on English and Welsh coasts for the year was according to the Board of Trade returns 60,715 cwt. valued at £252,680. The turbot is also common, though not abundant, in the Mediterranean, and is replaced in the Black Sea by an allied species with much larger bony tubercles (*Rh. maeoticus*). Both species grow to a large size, being usually sold at from 5 to 10 lb; but the common turbot is stated to attain to a weight of 30 lb.

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[1] The word "turbot" is of great antiquity, perhaps of Celtic origin; it is preserved in French in the same form as in English, and is composed of two words, of which the second is identical with the "but" in halibut and with the German "Butte," which signifies flat-fish. The German name for the turbot is "Steinbutte."

TUREEN, a deep dish or bowl, round or oval in shape, and with a cover, made to serve soup at table. The word is a corruption of the more correct "terrine," an earthenware vessel (Med. Lat. *terrineus*, made of earth, *terra*). The corruption is due to mis-spelling in early cookery-books, and an absurd story that the name arose from Marshal Turenne once drinking his soup from his helmet was invented to account for it.

TURENNE, HENRI DE LA TOUR D'AUVERGNE, VICOMTE DE (1611–1675), marshal of France, second son of Henri, duke of Bouillon and sovereign prince of Sedan, by his second wife Elizabeth, daughter of William the Silent, prince of Orange, was born at Sedan on the 11th of September 1611. He was educated in the doctrines of the Reformed religion and received the usual training of a young noble of the time, but physical infirmity, and particularly an impediment of speech (which he never lost), hampered his progress, though he showed a marked partiality for history and geography, and especial admiration of the exploits of Alexander the Great and Caesar. After his father's death in 1623, he devoted himself to bodily exercises and in a great measure overcame his natural weakness. At the age of fourteen he went to learn war in the camp of his uncle, Maurice of Nassau, and began his military career (as a private soldier in that prince's bodyguard) in the Dutch War of Independence. Frederick Henry of Nassau, who succeeded his brother Maurice in 1625, gave Turenne a captaincy in 1626. The young officer took his part in the siege warfare of the period, and won special commendation from his uncle, who was one of the foremost commanders of the time, for his skill and courage at the celebrated siege of Hertogenbosch (Bois-le-Duc) in 1629. In 1630 Turenne left Holland and entered the service of France. This step was dictated not only by the prospect of military advancement but also by his mother's desire to show the loyalty of the Bouillon dominions to the French crown. Cardinal Richelieu at once made him colonel of an infantry regiment. He still continued to serve at frequent intervals with the prince of Orange, who was the ally of France, and his first serious service under the French flag was at the siege of La Motte in Lorraine by Marshal de la Force (1634), where his brilliant courage at the assault won him immediate promotion to the rank of *maréchal de camp* (equivalent to the modern grade of major-general). In 1635 Turenne served under Cardinal de la Valette in Lorraine and on the Rhine. The siege of Mainz was raised but the French army had to fall back on Metz from want of provisions. In the retreat Turenne measured swords with the famous imperialist General Gallas, and distinguished himself greatly by his courage and skill. The reorganized army took the field again in 1636 and captured Saverne (Zabern), at the storming of which place Turenne was seriously wounded. In 1637 he took part in the campaign of Flanders and was present at the capture of Landrecies (July 26) and in the latter part of 1638, under Duke Bernhard of Saxe-Weimar (1608–1639), he directed the assault of Breisach (reputed the strongest fortress on the upper Rhine), which surrendered on the 17th of December. He had now gained a reputation as one of the foremost of the younger generals of France, and Richelieu next employed him in the Italian campaign of 1639–40 under "Cadet la Perle," Henri de Lorraine, count of Harcourt (1601–1666). On the 19th of November 1639 he fought in the famous rearguard action called the battle of the "Route de Quiers," and during the winter revictualled the citadel of Turin, held by the French against the forces of Prince Thomas of Savoy. In 1640 Harcourt saved Casale and besieged Prince Thomas's forces in Turin, which were besieging in their turn another French force in the citadel. The latter held out, while Prince Thomas was forced to surrender on the 17th of September 1640, a fourth army which was investing Harcourt's lines being at the same time forced to retire. The favourable result of these complicated operations was largely due to Turenne, who had by now become a lieutenant-general. He himself commanded during the campaign of 1641 and took Coni (Cuneo), Ceva and Mondovi. In 1642 he was second in command of the French troops which conquered Roussillon. At this time the conspiracy of Cinq Mars (see FRANCE: *History*) in which Turenne's elder brother, the duke of Bouillon, was implicated, was discovered.

The earlier career of Turenne was markedly influenced by the relations of the principality of Sedan to the French crown, sometimes it was necessary to advance the soldier to conciliate the ducal family, at others the machinations of the latter against Richelieu or Mazarin prevented the king's advisers from giving their full confidence to their general in the field. Moreover his steady adherence to the Protestant religion was a further element of difficulty in Turenne's relations with the ministers. Cardinal Richelieu nevertheless entrusted him with the command in Italy in 1643 under Prince Thomas (who had changed sides in the quarrel). Turenne took Trino in a few weeks, but was recalled to France towards the end of the year. He was made a marshal of France (December 19) and was soon sent to Alsace to reorganize the "Army of Weimar"—the remnant of Duke Bernhard of Saxe-Weimar's troops—which had just been severely defeated at Tüttlingen (November 24–25, 1643). He was at this time thirty-two years of age and had served under four famous commanders. The methodical prince of Orange, the fiery Bernhard, the soldierly Cardinal de la Valette and the stubborn and astute Harcourt had each contributed much to the completeness of Turenne's training, and he took the field in 1644 prepared by genius and education for the responsibilities of high command.

The work of reorganization over, Marshal Turenne began the campaign in June by crossing the Rhine at Breisach, but was almost instantly joined by an army under the duc d'Enghien (afterwards the great Condé), who, as a prince of the royal house, took the chief command of the united armies of "France" and "Weimar." The four famous campaigns which followed brought to an end the Thirty Years' War (*q.v.*). The chief event of the first of these was the desperately-fought battle of Freiburg against Count Mercy's Bavarians (August 3, 5 and 9, 1644), after which Philipsburg was successfully besieged. Before the capitulation Enghien withdrew and left Turenne in command. The marshal opened the campaign of 1645 with a strong forward movement, but was surprised and defeated by Mercy at Mergentheim (Marienthal) on the 2nd of May. Enghien was again sent to the front with the army of France and Turenne's army was greatly increased by the arrival of a Swedish force and a contingent from Hesse-Cassel. The Swedes soon departed, but Enghien was at the head of 20,000 men when he met the Bavarians in a battle even more stubbornly contested than Freiburg. Mercy was killed and his army decisively beaten at Allerheim near Nördlingen (August 3, 1645).

Ill-health forced Enghien to retire soon afterwards, and Turenne was for the third time left in command of the French army. He was again unfortunate against the larger forces of the imperialists, but the campaign ended with a gleam of success in his capture of Trier (Trèves). In the following year (1646) he obtained more decided successes, and, by separating the Austrians from the Bavarians, compelled the

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elector of Bavaria to make peace (signed March 14, 1647). In 1647 he proposed to attack the thus weakened army of the emperor, but was ordered into Flanders instead. Not only was the opportunity thus lost but a serious mutiny broke out amongst the Weimar troops, whose pay was many months in arrear. The marshal's tact and firmness were never more severely tried nor more conspicuously displayed than in his treatment of the disaffected regiments, among whom in the end he succeeded in restoring order with little bloodshed. He then marched into Luxemburg, but was soon recalled to the Rhine, for in 1648 Bavaria had returned to her Austrian alliance and was again in arms. Turenne and his Swedish allies made a brilliant campaign, which was decided by the action of Zusmarshausen (May 17), Bavaria being subsequently wasted with fire and sword until a second and more secure pacification was obtained. This devastation, for which many modern writers have blamed Turenne, was not a more harsh measure than was permitted by the spirit of the times and the circumstances of the case.

The peace of Westphalia (1648) was no peace for France, which was soon involved in the civil war of the Fronde (see France: *History*). Few of Turenne's actions have been more sharply criticized than his adhesion to the party of revolt. The army of Weimar refused to follow its leader and he had to flee into the Spanish Netherlands, where he remained until the treaty of Rueil put an end to the first war of the Fronde. The second war began with the arrest of Condé and others (January 1650), amongst whom Turenne was to have been included; but he escaped in time and with the duchesse de Longueville held Stenay for the cause of the "Princes"—Condé, his brother Conti, and his brother-in-law the duc de Longueville. Love for the duchess seems to have ruled Turenne's action, both in the first war, and, now, in seeking Spanish aid for the princes. In this war Turenne sustained one of his few reverses at Rethel (December 15, 1650); but the second conflict ended in the early months of the following year with the collapse of the court party and the release of the princes.

Turenne became reconciled and returned to Paris in May, but the trouble soon revived and before long Condé again raised the standard of revolt in the south of France. In this, the third war of the Fronde, Turenne and Condé were opposed to each other, the marshal commanding the royal armies, the prince that of the Frondeurs and their Spanish allies. Turenne displayed the personal bravery of a young soldier at Jargeau (March 28, 1652), the skill and wariness of a veteran general at Gien (April 7), and he practically crushed the civil war in the battle of the Faubourg St Denis (July 2) and the reoccupation of Paris (October 21). Condé and the Spaniards, however, still remained to be dealt with, and the long drawn out campaigns of the "Spanish Fronde" gave ample scope for the display of scientific generalship on the part of both the famous captains. In 1653 the advantage was with Turenne, who captured Rethel, St Menehould and Muzon, while Condé's sole prize was Rocroy. The short campaign of 1654 was again to the advantage of the French; on the 25th of July the Spanish were defeated at Arras. In 1655 more ground was gained, but in 1656 Turenne was defeated at Valenciennes in the same way as he had beaten Condé at Arras. The war was eventually concluded in 1657 by Turenne's victory at the Dunes near Dunkirk, in which a corps of English veterans sent by Cromwell played a notable part (June 3–14); a victory which, followed by another successful campaign in 1658, led to the peace of the Pyrenees in 1659.

On the death of Cardinal Mazarin in 1661 Louis XIV. took the reins of government into his own hands and one of his first acts was to appoint Turenne "marshal-general of the camps and armies of the king." He had offered to revive the office of constable of France (suppressed in 1627) in Turenne's favour if the marshal would become a Roman Catholic. Turenne declined. Born of Calvinist parents and educated a Protestant, he had refused to marry one of Richelieu's nieces in 1639 and subsequently rejected a similar proposal of Mazarin. He had later married a daughter of the Protestant Marshal de la Force, to whom he was deeply attached. But he sincerely deplored the division of the Christian church into two hostile camps. He had always distrusted the influence of many dissident and uncontrolled sects; the history of Independency in the English army and people made a deep impression on his mind, and the same fear of indiscipline which drove the English Presbyterians into royalism drew Turenne more and more towards the Roman Catholic Church. How closely both he and his wife studied such evidence as was available is shown by their correspondence, and, in the end, two years after her death, he was prevailed upon by the eloquence of Bossuet and the persuasions of his nephew, the abbé de Bouillon, to give in his adhesion to the Orthodox faith (October 1668). In 1667 he had returned to the more congenial air of the "Camps and Armies of the King," directing, nominally under Louis XIV., the famous "Promenade militaire" in which the French overran the Spanish Netherlands. Soon afterwards Condé, now reconciled with the king, rivalled Turenne's success by the rapid conquest of Franche Comté, which brought to an end the War of Devolution in February 1668.

In Louis XIV.'s Dutch War of 1672 (see Dutch Wars) Turenne was with the army commanded by the king which overran Holland up to the gates of Amsterdam. The terms offered by Louis to the prince of Orange were such as to arouse a more bitter resistance. The dikes were opened and the country round Amsterdam flooded. This heroic measure completely checked Turenne, whom the king had left in command. Europe was aroused to action by the news of this event, and the war spread to Germany. Turenne fought a successful war of manœuvre on the middle Rhine while Condé covered Alsace. In January 1673 Turenne assumed the offensive, penetrated far into Germany, and forced the Great Elector of Brandenburg to make peace; later in the year, however, he was completely outmanœuvred by the famous imperial general Montecucculi, who evaded his opponent, joined the Dutch and took the important place of Bonn. In June 1674, however, Turenne won the battle of Sinzheim, which made him master of the Palatinate. Under orders from Paris the French wasted the country far and wide, and this devastation has usually been considered the gravest blot on Turenne's fame, though it is difficult to say that it was more unjustifiable than other similar incidents in medieval and even in modern war. In the autumn the allies again advanced, and though Turenne was again outmanœuvred, his failure on this occasion was due to the action of the neutral city of Strassburg in permitting the enemy to cross the Rhine by the bridge at that place. The battle of Enzheim followed; this was a tactical victory, but hardly affected the situation, and, at the beginning of December, the allies were still in Alsace. The old marshal now made the most daring campaign of his career. A swift and secret march in mid-winter from one end of the Vosges to the other took the allies by surprise. Sharply following up his first successes, Turenne drove the enemy to Turkheim, and there inflicted upon them a heavy defeat (January 5, 1675). In a few weeks he had completely recovered Alsace. In the summer campaign he was once more opposed to Montecucculi, and after the highest display of "strategic chess-moves" by both commanders, Turenne finally compelled his opponent to offer battle at a disadvantage at Sassbach. Here, on the 27th of July 1675, he was killed by almost the first shot fired. The news of his death was received with universal sorrow. Turenne's most eloquent countrymen wrote his *éloges*, and Montecucculi himself exclaimed: "Il est mort aujourd'hui un homme qui faisait honneur à l'homme." His body was taken to St Denis and buried with the kings of France. Even the extreme revolutionists of 1793 respected it, and, when the bones of the sovereigns were thrown to the winds, the remains of Turenne were preserved at the Jardin des Plantes until the 22nd of September 1800, when they were removed by order of Napoleon to the church of the Invalides at Paris, where they still rest.

Turenne was one of the great captains whose campaigns Napoleon recommended all soldiers to "read and re-read." His fame as a general was the highest in Europe at a period when war was studied more critically than ever before, for his military character epitomized the art of war of his time (Prince de Ligne). Strategic caution and logistic accuracy, combined with brilliant dash in small combats and constancy under all circumstances of success or failure may perhaps be considered the salient points of Turenne's genius for war. Great battles he avoided. "Few sieges and many combats" was his own maxim. And, unlike his great rival Condé, who was as brilliant in his first battle as in his last, Turenne improved day by day. Napoleon said of him that his genius grew bolder as it grew older, and a modern author, the duc d'Aumâle (*Histoire des princes de la maison de Condé*), takes the same view when he says: "Pour le connaître il faut le suivre jusqu'à Sulzbach. Chez lui chaque jour marque un progrès." In his personal character Turenne was little more than a simple and honourable soldier, endowed with much tact, but in the world of politics and intellect almost helpless in the hands of a skilful intriguer or casuist. His morals, if not beyond reproach, were at least more austere than those prevalent in the age in which he lived. He was essentially a commander of regular armies. His life was spent with the troops; he knew how to win their affection; he tempered a severe discipline with rare generosity, and his men loved him as a comrade no less than they admired him as a commander. Thus, though Condé's genius was far more versatile, it is Turenne whose career best represents the art of war in the 17th century. For the small, costly, and highly trained regular armies, and the dynastic warfare of the age of Louis XIV., Turenne was the ideal army leader.

The most notable of the numerous portraits of Turenne are those of P. de Champagne at Versailles, and of Senin (dated 1670) in the Jones collection at South Kensington, London. Of the older memoirs of Turenne the most important are those of "Du Buisson," *La Vie du vicomte de Turenne*—the author is apparently Gatien de Sandraz de Courtilz (Paris, the Hague, and Cologne, 1688–1695); Abbé Raguenet, *Histoire du vicomte de Turenne* (Paris, 1741) and especially Ramsay, *Histoire d'Henry de la Tour d'Auvergne, vicomte de Turenne* (Paris, 1735), the second volume of which contains the marshal's memoirs of 1643–1658. These memoirs, of which the Prince de Ligne wrote that "ce ne sont pas de conseils, ce sont des ordres . . . 'faites' . . . 'allez,' &c."—were written in 1665, but were first published (*Mémoires sur la guerre, tirés des originaux*, &c.) in 1738, reprinted in Michaud, *Mémoires sur l'histoire de France*, 3rd series, vol. iii., and Liskenne and Sauvan's *Bibliothèque historique et militaire*, vol. iv. (Paris, 1846). A manuscript *Maximes de M. de Turenne* (1644) exists in the Staff Archives at Vienna, and of other documentary collections may be mentioned Grimoard, *Collections de lettres et mémoires trouvés dans la portefeuille de M. de Turenne* (Paris, 1782); *Recueil de lettres écrites au vicomte de Turenne par Louis XIV. et ses ministres*, &c. (Paris, 1779); *Correspondance inédite de Turenne avec Le Tellier et Louvois*, ed. Barthélemy (Paris, 1874). See also the *Observations on the Wars of Marshal Turenne*, dictated by Napoleon at St Helena (1823); Puységur, *La Guerre par principes et règles* (Paris, 1748); Précis in *Bibliothèque internationale d'hist. milit.* (Brussels, 1883); Duruy, *Histoire de Turenne* (Paris, 1880); Roy, *Turenne, sa vie et les institutions militaires de son temps* (Paris, 1884); Hardÿ de Périni, *Turenne et Condé* (Paris, 1907); Neuber, *Turenne als Kriegstheoretiker und Feldherr* (Vienna, 1869); Sir E. Cust, *Lives of the Warriors of the 17th Century* (London, 1867); T. O. Cockayne, *Life of M. de Turenne* (founded on Ramsay's work; London, 1853); G. B. Malleson, *Turenne*. *Marshal Turenne*, by "the author of the Life of Sir Kenelm Digby" (London, 1907), is a valuable work by a civilian, and is based in the main on Ramsay's work, the memoirs of Cardinal de Retz, James, duke of York, &c., and on Napoleon's commentaries. A remarkable parallel between Turenne and Condé, in Saint-Evremont's *éloge* of the latter, will be found in Carrion-Nisas, *Essai sur l'histoire général de l'art militaire*, ii. 83 (Paris, 1824). (C. F. A.)

TURF, the top or surface of earth when covered with grass, forming a coherent mass of mould or soil in which the roots of grasses and other plants are embedded. This is capable of being cut out in solid mat-like blocks, known by the same name. Similarly "peat" (*q.v.*) when cut in pieces for fuel or other purposes is also styled "turf." The term is applied widely to any stretch or sward of trimmed grass-land, and thus by metonymy, to horse-racing and all connected with it, from the owning and running of race-horses to betting. The word "turf" is common to Teutonic languages, cf. Du. *turf*, Ger. *Torf*, Dan. *törv*, &c. It has been connected with Skt. *darbha*, grass, so called from being matted or twisted together, *darbh*, to wind. The Teutonic word was adapted in Med. Lat., as *turba* (cf. Fr. *tourbe*, Ital. *torba*), whence was formed *turbaria*, turbary, the right of digging and cutting turf in common with the owner of the land. (See COMMONS.)

TURGAI, a province of Russian Central Asia, formerly a part of the Kirghiz steppe, and now included in the governor-generalship of the Steppes, bounded by the province of Uralsk and the governments of Orenburg and Tobolsk on the W. and N., by Akmolinsk on the E., and by Syr-darya and the Sea of Aral on the S. This territory, which has an area of 176,219 sq. m.—nearly as large as that of Caucasia and Transcaucasia taken together—belongs to the Aral-Caspian depression. It has, however, the Mugojar Hills on its western border and includes a part of the southern Urals; and from Akmolinsk it is separated by a range of hills which run between the two largest rivers of the Kirghiz steppe—the Turgai and the Sary-su. In the north it includes the low belt of undulating land which stretches north-east from the Mugojar Hills and separates the rivers belonging to the Aral basin from those which flow towards the Arctic Ocean, and beyond this range it embraces the upper Tobol. The remainder is steppe land, sloping gently towards the Sea of Aral.

The Mugojar Hills consist of an undulating plateau nearly 1000 ft. in altitude, built up of Permian and Cretaceous deposits and deeply trenched by rivers. They are not the independent chain which our maps represent them to be:[1] they merely continue the Urals towards the south, and are connected with the Ust-Urt plateau by a range of hills which was formerly an island of the Aral-Caspian Sea. Their northern extremity joins the undulating plateau (400 to 600 ft.), built up of sandstones and marls, which separates the tributaries of the Tobol from those of the river Ural, and falls by a range of steep crags—probably an old shore-line of the Aral basin—towards the steppes. The steppe land of Turgai is only some 300 ft. above the sea-level, and is dotted with lakes, of which the Chalkar-teniz, which receives the Turgai and its tributary the Irgiz, is the largest. The Turgai was, at a recent epoch, a large river flowing into the Sea of Aral and receiving an extensive system of tributaries, which are now lost in the sands before joining it. Remains of aquatic plants buried in the soil of the steppe, and shells of *Mytilus* and *Cardium*, both still found in the Sea of Aral, show that during the Glacial period this region was overflowed by the waters of the Aral-Caspian Sea.

The climate of Turgai is exceedingly dry and continental. Orsk, a town of Orenburg, on its north-western border, has a January as cold as that of the west coast of Novaya Zemlya (-4° F.), while in July it is as hot as July in Morocco (73°); the corresponding figures for Irgiz, in the centre of the province, are 7° and 77°. At Irgiz and Orsk the annual rainfall is somewhat under 10 in. and 12 in. respectively (3 in. in summer). The west winds are parched before they reach the Turgai steppes, and the north-east winds, which in winter bring cold, dry snows from Siberia, raise in summer formidable clouds of sand. A climate so dry is of course incompatible with a vigorous forest growth. There is some timber on the southern Urals, the Mugojar Hills and the water-parting of the Tobol; elsewhere trees are rare. Shrubs only, such as the wild cherry (*Cerasus chamaecerasus*) and the dwarf almond (*Amygdalus nana*) grow on the hilly slopes, while the rich black-earth soil of the steppe is chiefly clothed with feather grass (*Stipa pennata*), the well-known ornament of the south Russian steppes. In spring the grass vegetation is luxuriant, and geese and cranes are attracted in vast numbers from the heart of the steppe by the fields of the Kirghiz. The jerboa (*Dipus jaculus*) and the marmot (*Spermophilus rufescens*) are characteristic of the fauna; another species of marmot (*Arctomys bobac*) and the steppe fox (*Canis corsac*) are common; and the saiga antelope of Central Asia is occasionally met with. Farther south the black earth disappears and with it the feather grass, its place being taken by its congener, *Stipa capillata*. Trees disappear, and among the bushes along the banks of the rivers willows and the pseudo-acacia or Siberian pea tree (*Caragana microphyla*) are most prevalent. In the middle parts of the province the clayey soil is completely clothed with wormwood (*Artemisia fragrans* and *A. monogyna*), with a few grassy plants on the banks of the rivers and lakes (*Lasiagrostis splendens, Alhagi camelorum* and *A. kirghizorum, Obione portulacoides, Halimodendrum argenteum*); while large areas consist of shifting sands, saline clays clothed with various *Salsolaceae*, and the desiccated beds of old lakes. Such lakes as still exist, notwithstanding the rapid desiccation now goigg on, are surrounded by thickets of reeds—the retreat of wild boars. Turgai is thus the borderland between the flora of Europe and that of Central Asia.

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[1] See P. S. Nazarov, in "Recherches zoologiques dans les steppes des Kirghizes," in *Bull. soc. des natur. de Moscow* (1886), No. 4.

The population was estimated in 1906 at 511,800, composed mainly of Kirghiz, though Russians have immigrated in large numbers. The province is divided into four districts, the chief towns of which are Turgai, the capital; Ak-tyubinsk in the district of Iletsk; Irgiz and Kustanaisk in the Nikolayevsk district, a prairie town which has grown with great rapidity. Agriculture is mainly carried on by the Russian settlers in the Nikolayevsk district, where the crops do not suffer so much from droughts as they do elsewhere. But the Kirghiz have also begun to cultivate the soil. and in 1900 there were in all 612,200 acres under cereals.

The principal crops are rye, wheat, oats, barley and potatoes. Livestock breeding is the leading occupation of the Kirghiz. Camels are bred and kept by the nomads both for their own personal use and for the transport of goods between Bokhara, Khiva and Russian Turkestan. Considerable quantities of cattle and various animal products are exported to Orenburg, Orsk and Troitsk, and to Ust-Uisk and Zverinogolovsk, where large fairs are held. The Kirghiz of the southern parts migrate in winter to the better sheltered parts of the province of Syr-darya, while in the summer some 30,000 *kibitkas* (felt tents) of nomads come from the neighbouring provinces to graze their cattle on the grassy steppes of Turgai. Salt is obtained from the lakes. There are a few oil-works, tanneries and flour-mills, and the Kirghiz are active in the making of carpets and felt goods. Education is a little more advanced than in the other steppe provinces; the system of "migratory schools" has been introduced for the Kirghiz.

See Y. Talferov, *The Turgai Province* (1896), in Russian.

(P. A. K.; J. T. Be.)

TURGOT, ANNE ROBERT JACQUES, Baron de Laune (1727–1781), French statesman and economist, was born in Paris on the 10th of May 1727. He was the youngest son of Michel Étienne Turgot, "provost of the merchants" of Paris, and Madeleine Françoise Martineau, and came of an old Norman family. He was educated for the Church, and at the Sorbonne, to which he was admitted in 1749 (being then styled abbé de Brucourt), he delivered two remarkable Latin dissertations, *On the Benefits which the Christian Religion has conferred on Mankind*, and *On the Historical Progress of the Human Mind*. The first sign we have of his interest in economics is a letter (1749) on paper money, written to his fellow student the abbé de Cicé, refuting the abbé Terrasson's defence of Law's system. He was fond of verse-making, and tried to introduce into French verse the rules of Latin prosody, his translation of the fourth book of the *Aeneid* into classical hexameters being greeted by Voltaire as "the only *prose* translation in which he had found any enthusiasm." In 1750 he decided not to take holy orders, giving as his reason, according to Dupont de Nemours, "that he could not bear to wear a mask all his life." In 1752 he became *substitut*, and later *conseiller* in the parlement of Paris, and in 1753 *maître des requêtes*. In 1754 he was a member of the *chambre royale* which sat during an exile of the parlement; in 1755 and 1756 he accompanied Gournay, then intendant of commerce, in his tours of inspection in the provinces, and in 1760, while travelling in the east of France and Switzerland, visited Voltaire, who became one of his chief friends and supporters. In Paris he frequented the salons, especially those of Mme Graffigny—whose niece, Mlle de Ligniville ("Minette"), afterwards Mme Helvétius and his lifelong friend, he is supposed at one time to have wished to marry—Mme Geoffrin, Mme du Deffand, Mlle de Lespinasse and the duchesse d'Enville. It was during this period that he met the leaders of the "physiocratic" school, Quesnay and Gournay, and with them Dupont de Nemours, the abbé Morellet and other economists. All this time he was studying various branches of science, and languages both ancient and modern. In 1753 he translated the *Questions sur la commerce* from the English of Josias Tucker, and wrote his *Lettre sur la tolérance*, and a pamphlet, *Le Conciliateur*, in support of religious tolerance. Between 1755 and 1756 he composed various articles for the *Encyclopédie*, and between 1757 and 1760 an article on *Valeurs et monnaies*, probably for the *Dictionnaire du commerce* of the abbé Morellet. In 1759 appeared his *Éloge de Gournay*.

In August 1761 Turgot was appointed intendant of the *généralité* of Limoges, which included some of the poorest and most over-taxed parts of France; here he remained for 13 years. He was already deeply imbued with the theories of Quesnay and Gournay (see Physiocratic School), and set to work to apply them as far as possible in his province. His first plan was to continue the work, already initiated by his predecessor Tourny, of making a fresh survey of the land (*cadastre*), in order to arrive at a juster assessment of the *taille*; he also obtained a large reduction in the contribution of the province. He published his *Avis sur l'assiette et la répartition de la taille* (1762–1770), and as president of the *Société d'agriculture de Limoges* offered prizes for essays on the principles of taxation. Quesnay and Mirabeau had advocated a proportional tax (*impôt de quotité*), but Turgot a distributive tax (*impôt de répartition*). Another reform was the substitution for the *corvée* of a tax in money levied on the whole province, the construction of roads being handed over to contractors, by which means Turgot was able to leave his province with a good system of roads, while distributing more justly the expense of their construction. In 1769 he wrote his *Mémoire sur les prêts à intérêt*, on the occasion of a scandalous financial crisis at Angoulême, the peculiar interest of which is that in it the question of lending money at interest was for the first time treated scientifically, and not merely from the ecclesiastical point of view. Among other works written during Turgot's intendancy were the *Mémoire sur les mines et carrières*, and the *Mémoire sur la marque des fers*, in which he protested against state regulation and interference and advocated free competition. At the same time he did much to encourage agriculture and local industries, among others establishing the manufacture of porcelain. During the famine of 1770–1771 he enforced on landowners "the obligation of relieving the poor" and especially the *métayers* dependent upon them, and organized in every province *ateliers* and *bureaux de charité* for providing work for the able-bodied and relief for the infirm, while at the same time he condemned indiscriminate charity. It may be noted that Turgot always made the *curés* the agents of his charities and reforms when possible. It was in 1770 that he wrote his famous *Lettres sur la liberté du commerce des grains*, addressed to the comptroller-general, the abbé Terray. Three of these letters have disappeared, having been sent to Louis XVI. by Turgot at a later date and never recovered, but those remaining demonstrate that free trade in corn is to the interest of landowner, farmer and consumer alike, and in too forcible terms demand the removal of all restrictions.

Turgot's best known work, *Réflexions sur la formation et la distribution des richesses*, was written early in the period of his intendancy for the benefit of two young Chinese students. Written in 1766, it appeared in 1769–1770 in Dupont's journal, the *Ephémérides du citoyen*, and was published separately in 1776. Dupont, however, made various alterations in the text, in order to bring it more into accordance with Quesnay's doctrines, which led to a coolness between him and Turgot (see G. Schelle, in *Journal des économistes*, July 1888). A more correct text is that published by L. Robineau ("Turgot," in *Petite bibliothèque économique*, 1889), and is followed by Professor W. J. Ashley in his translation (*Economic Classics*, New York, 1898), but the original MS. has never been found.

After tracing the origin of commerce, Turgot develops Quesnay's theory that the land is the only source of wealth, and divides society into three classes, the productive or agricultural, the salaried (*stipendiée*) or artisan class, and the land-owning class (*classe disponible*). After discussing the evolution of the different systems of cultivation, the nature of exchange and barter, money, and the functions of capital, he sets forth the theory of the *impôt unique*, *i.e.* that only the *produit net* of the land should be taxed. In addition he demanded the complete freedom of commerce and industry.[1]

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[1] For the controversy as to how far Adam Smith (*q.v.*) was influenced by Turgot, see S. Feilbogen, *Smith und Turgot* (1892); also E. Cannan's introduction to Smith's *Lectures on Justice*, &c. (Clarendon Press, 1896); and H. Higgs's review of the latter in the *Economic Journal*, Dec. 1896. The question may still be considered an open one. See also Neymarck, i. 332, footnote, for the French authorities. Condorcet's statement that Turgot corresponded with Smith is disproved by a letter of Smith to the duc de la Rochefoucauld, published in the *Economic Journal* (March 1896), p. 165, in which he says, "But tho' I had the happiness of his acquaintance

Turgot owed his appointment to the ministry to Maurepas, the "Mentor" of Louis XVI., to whom he was warmly recommended by the abbé Véry, a mutual friend. His appointment as minister of the marine on the 20th of July 1774 met with general approval, and was hailed with enthusiasm by the *philosophes*. A month later he was appointed comptroller-general (August 24). His first act was to submit to the king a statement of his guiding principles: "No bankruptcy, no increase of taxation, no borrowing." Turgot's policy, in face of the desperate financial position, was to enforce the most rigid economy in all departments. All departmental expenses were to be submitted for the approval of the comptroller-general, a number of sinecures were suppressed, the holders of them being compensated, and the abuse of the "acquits au comptant" was attacked, while Turgot appealed personally to the king against the lavish giving of places and pensions. He also contemplated a thorough-going reform of the *ferme générale*, but contented himself, as a beginning, with imposing certain conditions on the leases as they were renewed—such as a more efficient personnel, and the abolition for the future of the abuse of the *croupes* (the name given to a class of pensions), a reform which Terray had shirked on finding how many persons in high places were interested in them, and annulling certain leases, such as those of the manufacture of gunpowder and the administration of the *messageries*, the former of which was handed over to a company with the scientist Lavoisier as one of its advisers, and the latter superseded by a quicker and more comfortable service of diligences which were nicknamed "turgotines." He also prepared a regular budget. Turgot's measures succeeded in considerably reducing the deficit, and raised the national credit to such an extent that in 1776, just before his fall, he was able to negotiate a loan with some Dutch bankers at 4%; but the deficit was still so large as to prevent him from attempting at once to realize his favourite scheme of substituting for indirect taxation a single tax on land. He suppressed, however, a number of *octrois* and minor duties,[1] and opposed, on grounds of economy, the participation of France in the War of American Independence, though without success.

Turgot at once set to work to establish free trade in corn, but his edict, which was signed on the 13th of September 1774, met with strong opposition even in the *conseil du roi*. A striking feature was the preamble, setting forth the doctrines on which the edict was based, which won the praise of the *philosophes* and the ridicule of the wits; this Turgot rewrote three times, it is said, in order to make it "so clear that any village judge could explain it to the peasants." The opposition to the edict was strong. Turgot was hated by those who had been interested in the speculations in corn under the régime of the abbé Terray —among whom were included some of the princes of the blood. Moreover, the *commerce des blés* had been a favourite topic of the salons for some years past, and the witty Galiani, the opponent of the physiocrats, had a large following. The opposition was now continued by Linguet and Necker, who in 1775 published his treatise *Sur la législation et le commerce des grains*. But Turgot's worst enemy was the poor harvest of 1774, which led to a slight rise in the price of bread in the winter and early spring of 1774–1775. In April disturbances arose at Dijon, and early in May took place those extraordinary bread-riots known as the "guerre des farines," which may be looked upon as a first sample of the Revolution, so carefully were they organized. Turgot showed great firmness and decision in repressing the riots, and was loyally supported by the king throughout. His position was strengthened by the entry of Malesherbes into the ministry (July 1775).

All this time Turgot had been preparing his famous "Six Edicts," which were finally presented to the *conseil du roi* (Jan. 1776). Of the six edicts four were of minor importance, but the two which met with violent opposition were, firstly, the edict suppressing the *corvées*, and secondly, that suppressing the *jurandes* and *maîtrises*, the privileged trade corporations. In the preamble to the former Turgot boldly announced as his object the abolition of privilege, and the subjection of all three orders to taxation; the clergy were afterwards excepted, at the request of Maurepas. In the preamble to the edict on the *jurandes* he laid down as a principle the right of every man to work without restriction.[2] He obtained the registration of the edicts by the *lit de justice* of the 12th of March, but by that time he had nearly everybody against him. His attacks on privilege had won him the hatred of the nobles and the parlements, his attempted reforms in the royal household that of the court, his free trade legislation that of the "financiers," his views on tolerance and his agitation for the suppression of the phrase offensive to Protestants in the king's coronation oath that of the clergy, and his edict on the *jurandes* that of the rich bourgeoisie of Paris and others, such as the prince de Conti, whose interests were involved. The queen disliked him for opposing the grant of favours to her protégés, and he had offended Mme de Polignac in a similar manner (see Marquis de Ségur, *Au Couchant de la monarchie*, p. 305–306).

All might yet have gone well if Turgot could have retained the confidence of the king, but the king could not fail to see that Turgot had not the support of the other ministers. Even his friend Malesherbes thought he was too rash, and was, moreover, himself discouraged and wished to resign. The alienation of Maurepas was also increasing. Whether through jealousy of the ascendancy which Turgot had acquired over the king, or through the natural incompatibility of their characters, he was already inclined to take sides against Turgot, and the reconciliation between him and the queen, which took place about this time, meant that he was henceforth the tool of the Polignac clique and the Choiseul party. About this time, too, appeared a pamphlet, *Le Songe de M. Maurepas*, generally ascribed to the comte de Provence (Louis XVIII.), containing a bitter caricature of Turgot.

Before relating the circumstances of Turgot's fall we may briefly resume his views on the administrative system. With the physiocrats, he believed in an enlightened absolutism, and looked to the king to carry through all reforms. As to the parlements, he opposed all interference on their part in legislation, considering that they had no competency outside the sphere of justice. He recognized the danger of the recall of the old parlement, but was unable effectively to oppose it, since he had been associated with the dismissal of Maupéou and Terray, and seems to have underestimated its power. He was opposed to the summoning of the states-general advocated by Malesherbes (May 6, 1775), possibly on the ground that the two privileged orders would have too much power in them. His own plan is to be found in his *Mémoire sur les municipalités*, which was submitted informally to the king. In Turgot's proposed system landed proprietors alone were to form the electorate, no distinction being made between the three orders; the members of the town and country *municipalités* were to elect representatives for the district *municipalités*, which in turn would elect to the provincial *municipalités*, and the latter to a *grande municipalité*, which should have no legislative powers, but should concern itself entirely with the administration of taxation. With this was to be combined a whole system of education, relief of the poor, &c. Louis XVI. recoiled from this as being too great a leap in the dark, and such a fundamental difference of opinion between king and minister was bound to lead to a breach sooner or later. Turgot's only choice, however, was between "tinkering" at the existing system in detail and a complete revolution, and his attack on privilege, which might have been carried through by a popular minister and a strong king, was bound to form part of any effective scheme of reform.

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and, I flattered myself, even of his friendship and esteem, I never had that of his correspondence," but there is no doubt that Adam Smith met Turgot in Paris, and it is generally admitted that *The Wealth of Nations* owes a good deal to Turgot.

[1] For an account of Turgot's financial administration, see Ch. Gomel, *Causes financières*, vol. i.

[2] Turgot was opposed to all labour associations of employers or employed, in accordance with his belief in free competition.

The immediate cause of Turgot's fall is uncertain. Some speak of a plot, of forged letters containing attacks on the queen shown to the king as Turgot's, of a series of notes on Turgot's budget prepared, it is said, by Necker, and shown to the king to prove his incapacity. Others attribute it to the queen, and there is no doubt that she hated Turgot for supporting Vergennes in demanding the recall of the comte de Guines, the ambassador in London, whose cause she had ardently espoused at the prompting of the Choiseul clique. Others attribute it to an intrigue of Maurepas. On the resignation of Malesherbes (April 1776), whom Turgot wished to replace by the abbé Véry, Maurepas proposed to the king as his successor a nonentity named Amelot. Turgot, on hearing of this, wrote an indignant letter to the king, in which he reproached him for refusing to see him, pointed out in strong terms the dangers of a weak ministry and a weak king, and complained bitterly of Maurepas's irresolution and subjection to court intrigues; this letter the king, though asked to treat it as confidential, is said to have shown to Maurepas, whose dislike for Turgot it still further embittered. With all these enemies, Turgot's fall was certain, but he wished to stay in office long enough to finish his project for the reform of the royal household before resigning. This, however, he was not allowed to do, but on the 12th of May was ordered to send in his resignation. He at once retired to la Roche-Guyon, the château of the duchesse d'Enville, returning shortly to Paris, where he spent the rest of his life in scientific and literary studies, being made vice-president of the Académie des Inscriptions et Belles-lettres in 1777. He died on the 18th of March 1781.

In character Turgot was simple, honourable and upright, with a passion for justice and truth. He was an idealist, his enemies would say a doctrinaire, and certainly the terms "natural rights," "natural law," &c., frequently occur in his writings. His friends speak of his charm and gaiety in intimate intercourse, but among strangers he was silent and awkward, and produced the impression of being reserved and disdainful. On one point both friends and enemies agree, and that is his brusquerie and his want of tact in the management of men; Oncken points out with some reason the "schoolmasterish" tone of his letters, even to the king. As a statesman he has been very variously estimated, but it is generally agreed that a large number of the reforms and ideas of the Revolution were due to him; the ideas did not as a rule originate with him, but it was he who first gave them prominence. As to his position as an economist, opinion is also divided. Oncken, to take the extreme of condemnation, looks upon him as a bad physiocrat and a confused thinker, while Léon Say considers that he was the founder of modern political economy, and that "though he failed in the 18th century he triumphed in the 19th."

Bibliography.—G. Schelle, *Turgot* (Paris, 1909); and Marquis de Ségur, *Au Couchant de la monarchie* (Paris, 1910), contain much that is based on recent research. The principal older biographies are those of Dupont de Nemours (1782, enlarged in his edition of Turgot's *Works*, 1807–1811), and Condorcet (1786); the best modern ones are those of A. Neymarck (Paris, 1885), Léon Say (Paris, 1887); and W. W. Stephens (London, 1895). See generally, Oncken, *Geschichte der Nationalökonomie*, vol. ii. ch. 1; Schelle, *Dupont de Nemours et l'école physiocratique* (1888); Henry Higgs, *The Physiocrats* (1897); R. P. Shepherd, *Turgot and the Six Edicts* (1903), in Columbia Univ. Studies, vol. xviii. No. 2.

TURGUENIEV, IVAN (1818–1883), Russian novelist, the descendant of an old Russian family, was born at Orel, in the government of the same name, in 1818. His father, the colonel of a cavalry regiment, died when our author was sixteen years of age, leaving two sons, Nicholas and Ivan, who were brought up under the care of their mother, the heiress of the Litvinovs, a lady who owned large estates and many serfs. Ivan studied for a year at the university of Moscow, then at St Petersburg, and was finally sent in 1843 to Berlin. His education at home had been conducted by German and French tutors, and was altogether foreign, his mother only speaking Russian to her servants, as became a great lady of the old school. For his first acquaintance with the literature of his country the future novelist was indebted to a serf of the family, who used to read to him verses from the *Rossiad* of Kheraskov, a once celebrated poet of the eighteenth century. Turgueniev's early attempts in literature, consisting of poems and trifling sketches, may be passed over here; they were not without indications of genius, and were favourably spoken of by Bielinski, then the leading Russian critic, for whom Turgueniev ever cherished a warm regard. Our author first made a name by his striking sketches "The Papers of a Sportsman" (*Zapiski Okhotnika*), in which the miserable condition of the peasants was described with startling realism. The work appeared in a collected form in 1852. It was read by all classes, including the emperor himself, and it undoubtedly hurried on the great work of emancipation. Turgueniev had always sympathized with the *muzhiks*; he had often been witness of the cruelties of his mother, a narrow-minded and vindictive woman. In some interesting papers recently contributed to the "European Messenger" (*Viestnik evropy*) by a lady brought up in the household of Mme Turgueniev, sad details are given illustrative of her character. Thus the dumb porter of gigantic stature, drawn with such power in *Mumu*, one of our author's later sketches, was a real person. We are, moreover, told of his mother that she could never understand how it was that her son became an author, and thought that he had degraded himself. How could a Turgueniev submit himself to be criticized?

The next production of the novelist was "A Nest of Nobles" (*Dvorianskoe gniezdo*), a singularly pathetic story, which greatly increased his reputation. This appeared in 1859, and was followed the next year by "On the Eve" (*Nakanunge*)—a tale which contains one of his most beautiful female characters, Helen. In 1862 was published "Fathers and Children" (*Otsi i Dieti*), in which the author admirably described the nihilistic doctrines then beginning to spread in Russia. According to some writers he invented the word nihilism. In 1867 appeared "Smoke" (*Dim*), and in 1877 his last work of any length, "Virgin Soil" (*Nov*). Besides his longer stories, many shorter ones were produced, some of great beauty and full of subtle psychological analysis, such as *Rudin*, "The Diary of a Useless Man" (*Dnevnik lishnago chelovieka*), and others. These were afterwards collected into three volumes. The last works of the great novelist were "Poetry in Prose" and "Clara Milich," which appeared in the "European Messenger."

Turgueniev, during the latter part of his life, did not reside much in Russia; he lived either at Baden Baden or Paris, and chiefly with the family of the celebrated singer Viardot Garcia, to the members of which he was much attached. He occasionally visited England, and in 1879 the degree of D.C.L. was conferred upon him by the university of Oxford. He died at Bougival, near Paris, on the 4th of September 1883.

Unquestionably Turgueniev may be considered one of the great novelists, worthy to be ranked with Thackeray, Dickens and George Eliot; with the genius of the last of these he has many affinities. His studies of human nature are profound, and he has the wide sympathies which are essential to genius of the highest order. A melancholy, almost pessimist, feeling pervades his writings, a morbid self-analysis which seems natural to the Slavonic mind. The closing chapter of "A Nest of Nobles" is one of the saddest and at the same time truest pages in the whole range of existing novels.

The writings of Turgueniev have been made familiar to persons unacquainted with Russian by French translations. There are many versions in English, among which we may mention the translation of the "Nest of Nobles" under the name of "Lisa," by Ralston, and "Virgin Soil," by Ashton Dilke. There is also a complete and excellent translation by Mrs Garnett.

(W. R. M.)

TURI, a Pathan tribe on the Kohat border of the North-West Frontier Province of India. The Turis inhabit the Kurram valley, which adjoins the western end of the Miranzai valley and number nearly 12,000. Though now speaking Pushtu and ranking as Pathans, they are by origin a Turki tribe, of the Shiah sect, who subjected the Bangash Afghans some time early in the eighteenth century. They are strong, hardy, and courageous, and make first-rate horsemen. Their early dealings with the British government were inclined to turbulence, and they were concerned in the Miranzai expeditions of 1851 and 1855 (see Miranzai). But the only expedition specially sent against them was the Kurram expedition of 1856 (see Kurram). Since then they have settled down and engaged in trade. During the Second Afghan War they supplied Sir Frederick Roberts with guides and provisions. In 1892 they voluntarily accepted British administration, and they now furnish a large part of the tribal militia in the Kurram Valley.

TURIN, a city of Piedmont, Italy, capital of the province of Turin, formerly of the kingdom of Sardinia until 1860, and of Italy till the removal of the seat of government to Florence in 1865. Pop. (1906), 277,121 (town), 361,720 (commune), with a garrison of 8500, the town being the headquarters of the I. army corps. The area of the city is 4155 acres, and its octroi circle measures nearly 9 m. Its geographical position is excellent; built upon alluvial soil 784 ft. above sea-level at a short distance from the Alps, it stands upon the river Po, which here runs from south to north just above the confluence of the Dora Riparia. The streets and avenues, almost all of which are straight, cut each other at right angles, forming blocks of houses, here as elsewhere called "islands." As viewed from the east the city stands out boldly against the Alps. Taken as a whole it is modern in aspect, but its regularity of form is in reality derived from the ancient Roman town of Augusta Taurinorum, which formed its nucleus. The mean temperature at Turin (1871–1900) is 53° F. (winter 35°, summer 71°), with an average maximum of 90°, and an average minimum of 17°. Mists are frequent in the winter mornings, and to a less degree in autumn. Snow falls on an average only on seven days per annum. The rainfall averages 34 in.

The cathedral of St John the Baptist is a cruciform Renaissance building dating from 1492–1498, by the Florentine Meò da Caprina. The site was first occupied by a church erected, it is said, by the Lombard duke Agilulf (7th century). Behind the high altar of the cathedral (from which it is separated by a glass screen) is the chapel of the Sudario or Sindone, built (1657–1694) by Guarini as a royal burial-place. The "sudario" from which it takes its name is asserted to be the shroud in which Joseph of Arimathea wrapped the body of Jesus. La Beata Vergine della Consolata, another of Guarini's works, has a tower which originally belonged to the church of St Andrew, founded by the monk Bruning in 1014, and attracts attention by Vincenzo Vela's beautiful kneeling statues of Queen Maria Teresa and Queen Maria Adelaide, as well as by the image of the Madonna, which has the credit of having warded off the cholera in 1835. Other churches of some note are San Filippo Neri (1672–1772), the dome of which fell in just as it was approaching completion under the hands of Guarini and was restored by Juvara, and La Gran Madre de Dio, erected to commemorate the return of the royal family in 1814. Of the secular buildings the more interesting are the Palazzo Madama, first erected by William of Montferrat at the close of the 13th century on the Roman east gate of the town, remains of the towers of which were incorporated in it, and owing its name to the widow of Charles Emmanuel II., who added the west façade and the handsome double flight of steps from Juvara's designs; and the extensive royal palace begun in the 17th century. Many of the palaces have fine pillared courtyards of the baroque period, some of which are the work of Guarini. For the Porta Palatina and other remains of the ancient city walls see below. The citadel, erected in 1565, has been almost entirely demolished. There is practically nothing of the Renaissance period except the cathedral. The Castello del Valentino is a building partly in the French style of the middle of the 16th century. The university, founded in 1400 by Lodovico di Acaja, has faculties of jurisprudence, medicine and surgery, literature and philosophy, and the mathematical, physical and natural sciences. The number of students is about 2500. The old university buildings erected in 1713 by the Genoese architect Ricca proved too small; and new buildings, fitted more especially for the medical and scientific departments, have been erected. The original building contains the valuable library (now national), many of the treasures of which were destroyed by fire in 1906, and a collection of Roman antiquities. The academy of sciences was founded in 1757. It occupies a building erected in 1687 by Guarini as a Jesuit college. The museum of antiquities and the picture gallery, of which it has the custody, are both of high interest—the former for the local antiquities of Piedmont and Sardinia (notably from Industria) and for the Egyptian treasures collected by Donati and Drovetti, and the latter for its Van Dycks and pictures by north Italian masters. There is a museum of zoology and mineralogy in Palazzo Carignano (another of Guarini's buildings), and the royal palace contains the royal armoury (a fine collection made by Charles Albert in 1833) and the royal library with its rich manuscript collection and its 20,000 drawings, among which are sketches by Raphael, Michelangelo, and Leonardo da Vinci. The civic museum has a great variety of artistic and literary curiosities, among them a remarkable collection of autographs and the Lombard missal (1490).

There are many modern public monuments—considerably more than in other Italian towns—and some of them are fine. The Mole Antonelliana, built by Alessandro Antonelli, is the most important example of modern architecture in Turin. It belongs to the municipality, and is used for the Risorgimento Museum. It is the highest brick edifice in Europe, its summit being 510 ft. above ground. It is a square edifice with a large dome and lofty spire, the dome being raised upon a hall with three galleries, one above the other, so that from the floor to the top of the dome is over 300 ft.

Among the hospitals is that called by the name of its founder, Cottolengo, a vast institution providing for more than 5000 persons; there are also the Ospedale Maggiore di San Giovanni, the Ospedale Mauriziano, and many other hospitals for special diseases, as well as asylums and charitable institutions of all kinds.

The industries comprise metallurgy, machine-making, chemicals, silk and cotton weaving, tanning and leather-working. The manufacture of motor-cars has become of great importance, and Turin is the chief seat of the industry in Italy, nearly 5000 workmen being employed. Chocolate, liqueurs and vermouth are also made here. The application of electricity is widely developed on account of the proximity of Alpine valleys rich in torrents. The supply of drinking water is furnished by three aqueducts.

The opening of the St Gothard tunnel exercised a prejudicial influence upon the traffic of the network of railways of which Turin is the centre, and Milan, owing to its nearness both to this and to the Simplon, has become the most important railway centre of Italy. Turin has, however, the advantage of being the nearest to the Mont Cenis, while the completion of the line through Cuneo over the Col di Tenda affords direct communication with the French Riviera. Main lines run also from Turin to Vercelli and thence to Novara and Milan (the direct route), to Casale Monferrato, to Alessandria (and thence to Piacenza or Genoa), to Genoa via Asti and Acqui, to Brà and Savona, and branch lines to Lanzo, Torre Pellice, Aosta, Rivoli, Rivarolo, &c., and steam tramways in various directions.

For administrative purposes the city is divided into two municipal police sections and into seven government districts or *mandamenti*. The military organization is proportionate in importance to the strategical position of Turin near the French frontier. There is a military arsenal with laboratories, a military academy for artillery and engineer officers, a war school, and a military hospital.

Among the surroundings of Turin the Hill of Superga (2300 ft. above the sea) merits special mention. Victor Amadeus II. erected there a votive basilica in memory of the liberation of Turin from the French in 1706. King Charles Albert and other kings and princes of the Savoy dynasty are buried in the crypt. Not far from Turin are also the castles of Moncalieri, Stupinigi, Rivoli, Racconigi, Aglè, Venaria, and the ancient monastery of the Sagra di San Michele (753 metres above sea-level), famous for its view of the Alps as far as the beginning of the Lombard plain.

Turin was always a place of importance and military strength, in spite of numerous vicissitudes, till at length it was made the chief town of Piedmont by Amadeus, first duke of Savoy. Under Emmanuel Philibert it became the usual residence of the ducal family, and in 1515 the bishopric was raised to metropolitan rank by Leo X. Between 1536 and 1562 Turin was occupied by the French, and in 1630 it lost 8000 of its citizens by the plague. The French were masters once more from 1640 to 1706, and again from 1798 till 1814, when Piedmont was restored to the house of Savoy. From 1860 to 1865 Turin was the capital of Italy.

The ancient *Augusta Taurinorum* was a city of Gallia Cisalpina, the chief town of the Taurini. The natural advantages of its site and its position with relation to the pass over the Alps

Cottia (Mont Genèvre; see COTTII REGNUM) made it important in early times, though it cannot have been very strongly fortified, inasmuch as Hannibal, after crossing the Alps in 218 B.C., was able to take it after a three days' siege. It became a colony either under the triumvirs or under Augustus, and it was then no doubt that it was fortified. It was partly burned down in A.D. 69, but continued to be prosperous, as may be gathered from the remains of its fortifications and from the many inscriptions which have been discovered there. The Roman town formed a rectangle 2526 ft. by 2330; the line of the walls, which were 21 ft. high, 7 ft. thick at ground level and 3 ft. at the top, is well known, inasmuch as they were standing till about 1600; and the north gate, the Porta Palatina, still exists; it has a double opening, and two orders of arches above, and is flanked by two sixteen-sided brick towers. The east gate, similar in character, still exists in part within the Palazzo Madama. The north-west corner tower is also in part preserved, and traces of other parts of the enceinte have been found. The interior of the town was divided by seven streets from east to west and eight from north to south into 72 *insulae*; and the ancient pavement and the drains below it are frequently found under the streets of the central portion of the modern town, indicating that they follow the ancient lines (see especially *Notizie degli Scavi*, 1902, p. 277). In the great extensions which the city has undergone since 1600, the old rectangular arrangement has been followed. Remains of a theatre have been discovered beneath the Palazzo Vecchio, demolished in 1899 (A. Taramelli, in *Notizie degli Scavi*, 1900, p. 3).

See C. Promis, *Storia dell' antica Torino* (Turin, 1869); A. d'Andrade, *Relazione dell' ufficio regionale per la conservazione dei monumenti del Piemonte e della Liguria*, 7 seq. (Turin, 1899).

(T. As.)

TURKESTAN, a name conventionally employed to designate the regions of Central Asia which lie between Siberia on the N. and Tibet, India and Afghanistan on the S., the western limit being the Caspian Sea and the eastern Mongolia and the Desert of Gobi. Etymologically the term is intended to indicate the regions inhabited by Turkish races. How far this name was appropriate in the past need not be considered here; at present the regions called Turkestan not only contain races which do not belong to the Turk family, but it excludes races which do, *e.g.* the Turks of the Ottoman Empire. Nevertheless the term, in its dual application of West Turkestan and East or Chinese Turkestan, has long been established, and in default of any better designations cannot very well be dispensed with.

I.—WEST TURKESTAN

West Turkestan is very nearly, though not quite, coincident with the territories which Russia possesses and controls in Asia, Siberia excepted. Thus it includes (1) the governor-generalship of Turkestan, embracing the provinces of Ferghana, Samarkand, Semiryechensk, and Syr-darya; the provinces of Akmolinsk and Semipalatinsk, and sometimes that of Turgai belonging to the governor-generalship of the Steppes; the Transcaspian region; and the semi-independent states of Bokhara and Khiva. Its total area amounts approximately to 1,290,000 sq. m.

Physical Geography.—Physically this region is divided into two sharply contrasted parts, the mountainous and highland country in the east and the flat steppes and deserts in the west and north. The former are sufficiently described under the heading TIAN-SHAN. It will be enough to say here that the mountainous region belongs to the great orographical flange which runs from south-west to north-east along the north-western margin of the great plateau of Central Asia. Hence it consists (1) partly of ranges, mostly snow-capped, which stretch from south-west to north-east, and which in several cases terminate *en échelon* on the verge of the desert, and (2) partly of ranges which strike away from the above at various angles, but in a predominantly north-western direction. The latter, including such ranges as the Chingiz-tau, Chu-Ili Mountains, Kandyk-tau and Khan-tau, the Ferghana range, the Kara-tau and the Nura-tau, are geologically of later origin than the great border ranges of the Tian-shan proper, *e.g.* Trans-Alai, Alai, Kokshal-tau, Alexander range, Terskei Ala-tau, Kunghei Ala-tau, Trans-Ili Ala-tau and Dzungarian Ala-tau. The Tarbagatai Mountains, still farther north, are often classified as belonging to the Altai system. Generally speaking, the ranges of both categories run at 10,000 to 20,000 ft., though altitudes as high as 23,000 ft. are attained by individual peaks, such as Mt Kaufmann and Khan-tengri. Most of the loftier summits are capped with perpetual snow, and on some of them, *e.g.* Khan-tengri (Mushketov, Semenov, Inylchik) and the Kok-su Mountains (Fedchenko, Shurovsky), south of Peak Kaufmann, there are well-developed glaciers. Nearly all these border ranges rise abruptly and to great heights from the plains on the north or north-west, but have a much shorter and easier descent on the south or south-east. Hence the passes lie at great altitudes, ranging from about 9000 to 14,000 ft. On the other hand the fact of the ranges radiating outwards towards the west, and the further fact that they are in more than one place penetrated by deep depressions (*e.g.* Dzungaria, Kulja, Issyk-kul, Ferghana) for a considerable distance towards the east, greatly facilitate access to the loftier plateau lands of Central Asia, and have from time immemorial been the highways of human intercourse between East and West.

Lowland Plains.

Like the highlands of Siberia, those of Turkestan are fringed by a girdle of plains, having an altitude of 1000 to 1500 ft., and these again are skirted by an immense lowland area reaching only 400, 300 and 150 ft. above sea-level, or even sinking below the level of the ocean. Some geographers divide them into two sections—the higher plains of the Balkash (the Ala-kul and Balkash drainage areas) and the Aral-Caspian depression, which occupies nearly two-thirds of the whole and has been ably described by I. V. Mushketov under the appropriate name of Turanian basin—the Kara-tau Mountains, between the Chu and the Syr-darya rivers, being considered as the dividing line between the two. The Balkash plains, more than 1000 ft. above the sea, and covered with clay, with a girdle of loess at their foot, are well drained by the Ili and other feeders of Lake Balkash and support the numerous flocks and herds of the Kirghiz. To the south-west the clayey soil becomes saline. There is the Famine steppe (Bek-pak-dala), while in the Ak-kum steppe, which surrounds Lake Kara-kul, large areas consist of nothing but sands, partly shifting. The plains and lowlands of the Turanian basin are subdivided by a line drawn from north-east to south-west along a slight range of hills running from the sources of the Ishim towards the south-east corner of the Caspian (Bujnurd and Elburz edge of Khorasan). This low range, which most probably separated the lowlands of the Aral-Caspian region (submerged during the Post-Pliocene period) from the higher plains which had emerged by the end of the Tertiary period, now divides the Transcaspian steppes from the somewhat different higher plains. In the Turanian basin the contrast between desert and oasis is much stronger than in the Balkash region. Fertile soil, or rather soil which can be rendered fertile by irrigation, is limited to a narrow terrace of loess along the foot of the mountains, and is surrounded by barren deserts. Even where the loess stretches out over terraces at some distance from the mountains, as in the south-east of the Transcaspian region, it can be cultivated only when irrigated. Two rivers only—the Syr and the Amu—succeed in getting across the desert and reaching the Sea of Aral. But their former tributaries no longer run their full course: the glacier-fed Zarafshan dries up amid the gardens of Bokhara soon after emerging from the highlands; and the Tejeñ and the Murghab lose themselves in the recesses of the Kara-kum desert. The only tributaries which the Amu retains are those whose whole course is within the highlands. In the north such formerly important tributaries of the Syr-darya as the Chu, with its sub-tributary the Sary-su, now dry up some hundreds of miles before reaching the main stream.

Desiccation.

The whole area is now undergoing geological changes on a vast scale. Rivers have changed their courses, and lakes their outlines. Far away from their present shores the geologist finds indubitable signs of the recent presence of lakes in the shells they have left amid the sands. Traces of former rivers and channels, which were the main arteries of prosperous regions within the period of written history, have now disappeared. Of the highly developed civilizations which grew up and flourished in Bactria, Bokhara and Samarkand the last survivals are now undergoing rapid obliteration with the simultaneous desiccation of the rivers and lakes. The great "Blue Sea" of Central Asia, the Sea of Aral, which at a recent epoch (Post-Glacial) extended south-west as far as Sary-kamysh, and the shells of which are found north and east of its present shores 50 to 200 ft. above its present level (157 ft. above the ocean, and 248 above the Caspian), now occupies but a small portion of its former extent. It fills a shallow depression which is drying up with astonishing rapidity, so that the process of desiccation can be shown on surveys separated by intervals of only ten years; large parts of it, like Aibughir Gulf, have dried up since the Russians took possession of its shores. The whole country is dotted over with lakes, which are rapidly disappearing under the hot winds of the deserts.

Geology.[1]—Like the highlands of eastern Asia, those of Turkestan are mostly built up on Pre-Cambrian gneisses and metamorphic slates, resting upon granites, syenites, old orthoclase porphyries, and the like. These upheavals date from the remotest geological ages; and since the Primary epoch a triangular continent having its apex turned towards the north-east, as Africa and America have theirs pointing southward, rose in the middle of what now constitutes Asia. It is only in the outer foldings of the highlands that Palaeozoic fossiliferous deposits are found—Silurian, Devonian, Carboniferous and Permo-Carboniferous. Within that period the principal valleys were excavated, and their lower parts have been filled up subsequently with Jurassic, Cretaceous and Tertiary deposits. One of the most striking instances of this is the very thick Cretaceous and Tertiary deposits which cover the bottom of the valley of the Vakhsh (right tributary of the Amu) and are continued for about 300 m. to the north-east, as far as the Alai valley—probably along the edge of the Pamir plateau. The deposits of the Secondary period have not maintained their horizontal position. While upheavals having a north-eastern strike continued to take place after the Carboniferous epoch,[1] another series of upheavals, having a north-western strike, and occasioned by the expansion of diabases, dolerites, melaphyres and andesites, occurred later, subsequently at least to the close of the Tertiary period, if not also before it, dislocating former chains and raising rocks to the highest levels by the addition of new upheavals to the older ones. Throughout the Triassic and Jurassic periods nearly all Turkestan remained a continent indented by gulfs and lagoons of the south European Triassic and Jurassic sea. Immense fresh-water lakes, in which were deposited layers of plants (now yielding coal), filled up the depressions of the country. Cretaceous and Tertiary deposits occur extensively along the edge of the highlands. Upper and Middle Cretaceous, containing phosphates, gypsum, naphtha, sulphur and alum, attain thicknesses of 2000 and 5000 ft. in Hissar. Representatives of all the Tertiary formations are met with in Turkestan; but while in the highlands the strata are coast-deposits, they assume an open sea character in the lowlands, and their rich fossil fauna furnishes evidence of the gradual shallowing of that sea, until at last, after the Sarmathian period, it became a closed Mediterranean. During the Post-Pliocene period this sea broke up into several parts, united by narrow straits. The connexion of Lake Balkash with the Sea of Aral can hardly be doubted; but this portion of the great sea was the first to be divided. While the Sea of Aral remained in connexion with the Caspian, the desiccation of the Lake Balkash basin, and its break-up into smaller separate basins, were already going on. The Quaternary epoch is represented by vast morainic deposits in the valleys of the Tian-shan. About Khan-Tengri glaciers descended to a level of 6800 ft. above the sea,[2] and discharged into the wide open valleys or *syrts*. It is most probable that, when allowance has been made for the obliteration of glacial markings, and the region has been better explored, it will appear that the glaciation of Turkestan was on a scale at least as vast as that of the Himalayas. In the lowlands the Aral-Caspian deposits, which it is difficult to separate sharply from the later Tertiary, cover the whole of the area. They contain shells of molluscs now inhabiting the Sea of Aral, and in their petrographical features are exactly like those of the lower Volga. The limits of the Post-Pliocene Aral-Caspian sea have not yet been fully traced. It extended some 200 m. north and more than 90 m. east of the present Aral shores. A narrow strait connected it with Lake Balkash. The Ust-Urt plateau and the Mugojar Mountains prevented it from spreading north-westward, and a narrow channel connected it along the Uzboi with the Caspian, which sent a broad gulf to the east, spread up to the Volga, and was connected by the Manych with the Black Sea basin. Great interest, geological and historical, thus attaches to the recent changes undergone by this basin. Since the theory of geological cataclysms was abandoned, and that of slow modifications of the crust of the earth accepted, new data have been obtained in the Aral-Caspian region to show that the rate of modification after the close of the Glacial period, although still very slow, was faster than had been supposed from the evidence of similar changes now going on in Europe and America. The effects produced by desiccating agencies are beyond all comparison more powerful than those which result from the earthquakes that are so frequent in Turkestan. All along the base of the highlands, from Khojent to Vyernyi, earthquakes are frequent;[3] but their effects lie beyond the scope of our observational methods.

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[1] R. Pumpelly and others, *Explorations in Turkestan* (Washington, 1905), contains references to the geological literature to the date of publication.

Climate.—The climate of West Turkestan is exceedingly dry and continental. Although the country is approximately comprised within the latitudes of Sicily and Lyons, it has a south Norwegian January and a Persian summer. Temperatures of more than 100° F. in the shade are common, and the heat is rendered still more unbearable by the reflection from a soil destitute of vegetation. The winter is for the most part so cold that the average temperature of January is below the freezing point, and even reaches 0° F. Snow falls for several months on the lower Syr-darya, and, were it not blown away by the winds, sledge-communication would be possible. This river is frozen for an average of 123 days every year in its lower parts and nearly 100 days at Perovsk. At Tashkent there is snow during two months and temperatures of − 10° F. have been observed; on the other hand the maximum observation is 108°. To the south of Khojent the winter becomes more clement. Absence of rain is the distinctive feature of the climate. Although it rains and snows heavily on the mountains, only 11 in. of rain and snow fall throughout the year at Tashkent, at the base of the highlands; and the steppes of the lower Amu have less. A few showers are all that fall from the almost invariably cloudless sky above the Transcaspian steppes.

Fauna.—The fauna of Turkestan belongs to the zoo-geographical domain of northern Asia, and is only differentiated by the presence of species which have disappeared from the peripheral parts of the Old World and now find a refuge in the remotest regions of the uninhabited plateau. From the Palaeoarctic region it is distinguished by the presence of Himalayan species. The distinctive animal of the Pamir plateau is the magnificent *Ovis poli* (conjectured to be the ancestor of the common sheep). In the alpine tracts of the Tian-shan, on the borders of the Pamir, their horns and skulls are frequently met with, but there the place of the species is now taken by *Ovis karelini*. The wild horse, which occurred in Poland a few centuries ago, was discovered by Prezhevalsky in the highlands of Dzungaria. The wild camel inhabits the lonely plateaus south of the Ala-shan. The other mammals of Turkestan are mostly those which are met with elsewhere in north Asia. The Himalayan bear (*Ursus isabellinus*) has its home on the Pamir, and the smaller *Leuconyx* up to the highest levels on the Tian-shan. Antelopes, *Lepus lehmanni*, *Lagomys rutilus*, various species of *Arvicolae*, and the Himalayan long-tailed marmot (*Arctomys caudatus*), the most characteristic inhabitant of the alpine meadows, are the only mammals of the Pamir proper. In the alpine region are found the badger (*Meles taxus*), the ermine (*Putorius ermineus*) and six other Mustelidae, the wild dog (*Canis alpinus*), the common and the black-eared fox (*C. melanotis*), while the corsac fox (*C. corsac*) is met with only on the plains. Two species of lynx, the cheetah (*Felis jubata*), *F. manul*, and *F. irbis*, must be added to the above. The tiger is met with only on the lower Amu-darya, except when it wanders to the alpine region in pursuit of the maral deer (*Cervus maral*). The jackal is characteristic of the steppes; it banishes the wolves and foxes. Hares are represented by several species, *Lepus lehmanni* being the most characteristic. Both the common and the long-tailed marmot (*A. baibacinus* and *A. caudatus*) live at the foot of the mountains, as well as four species of *Spermophilus*, three of voles, two of the mouse and three of the hamster. The *Meriones* (four species) and the jerboa (five species) are only met with in the steppe region. Of ruminants, beside the sheep (*O. poli*, *O. karelini*, *O. nigrimontana*, *O. heinsii*), we find one moufflon (*Musimon vignei*), formerly known only in the Himalayas, the Chinese antelope (*Antilope subgutturosa*) and the saiga antelope in the steppes, the Siberian ibex and another goat, the yak, the zebu or Indian ox, the common ox, the camel and the dromedary. The wild boar is common in the reed thickets along the rivers and lakes, where it stays during the winter, migrating to the highlands in summer. The hedgehog and porcupine are common in the plains.

No fewer than 385 species of avifauna are recorded, most of them being middle-European and Mediterranean. A large number were formerly known only in the Himalayas, or in Persia, while others have their origin in East Asia. The commonest are mostly European acquaintances. The insect fauna is truly multitudinous. Among the Lepidoptera of the Pamir there is an interesting mixture of Tian-shan with Himalayan species. G. E. Grum-Grshimailo found on the Pamir the butterfly *Colias nastes*, a species characteristic of Labrador and Lapland; like the alpine plants which bear witness to a Glacial period flora in the Himalayas, this butterfly is a survival of the Glacial period fauna of the Pamir.[4] Of 50 species of molluscs found in Turkestan quite one half are peculiar to the region.

Flora.—As a whole the flora of Turkestan is identical with that of Central Asia, which was formerly continued by geo-botanists as far west as the steppes of Russia, but which must now be considered as a separate region subdivided into two—the Central Asian proper and that of the Gobi. It has its own habitus, notwithstanding the number of species it has in common with Siberia and south-east Russia on the one hand and with the Himalayas on the other, and this habitus is due to the dryness of the climate and the consequent changes undergone by the soil. Towards the end of the Glacial period the Tian-shan Mountains had a flora very like that of northern Caucasia, combining the characteristics of the flora of the European Alps and the flora of the Altai, while the prairies had a flora very much like that of the south Russian steppes. During the Stone Age the human inhabitants lived in forests of maple, white beech and apple trees. But the gradual desiccation of the country resulted

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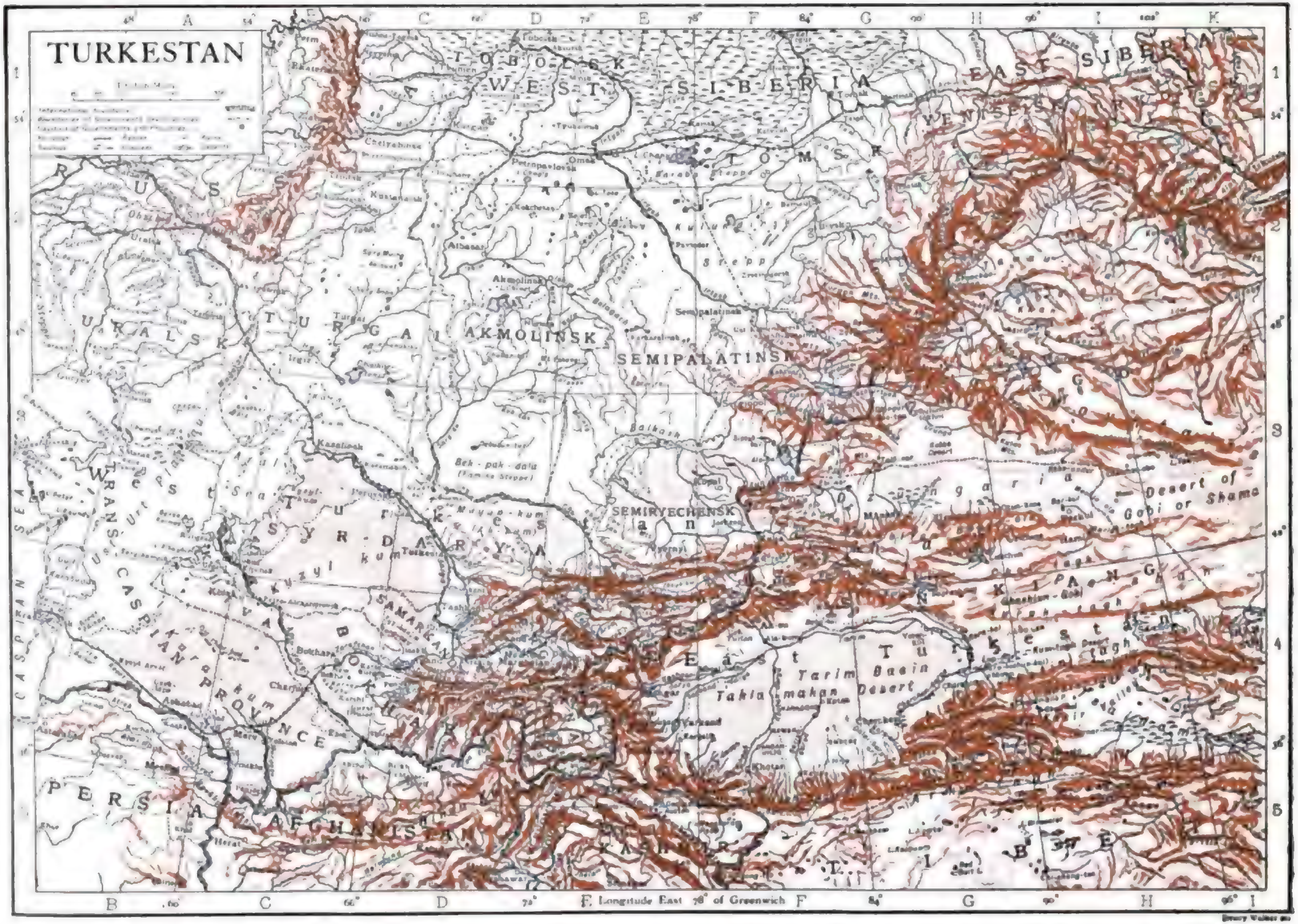
[1] I. V. Mushketov's *Turkestan* (pp. 35, 681) seems to justify this conclusion.

[2] See I. Ignatyev, in *Izvestia* of Russ. Geog. Soc. (1887), vol. xxiii.

[3] Ibid.; also Orlov in *Mem. of Kasan Naturalists* (1873), vol. iii.

[4] For ampler information, see N. A. Syevertsov's "Vertical and Horizontal Distribution of Turkestan Animals," in *Izvestia* of the Moscow Soc of Amateurs of Nat. Science (1873), A. P Fedchenko's "Travels in Turkestan" (vols. xi., xix., xxi , xxiv and xxvi. of the same *Izvestia*), forming a series of monographs by specialists which deal with separate divisions of the animal and vegetable kingdom (the flora by E A. Regel); Oshanin's *Zoo-Geographical Problems in Turkestan* (Tashkent, 1880); G. E. Grum-Grshimailo's "Flora and Fauna of Pamir," in *Izvestia* of Russ. Geog. Soc. (1886); *Works of the Aral-Caspian Expedition.*


TURKESTAN
TOBOLSK
WEST SIBERIA
EAST SIBERIA
YENISEISK
TOMSK
RUSSIA
URALSK
TURGAI
AKMOLINSK
SEMIPALATINSK
SEMIRYECHENSK
SYR-DARYA
SAMARKAND
BOKHARA
KHIVA
TRANS-CASPIAN PROVINCE
CASPIAN SEA
PERSIA
AFGHANISTAN
KASHMIR
TIBET
MONGOLIA
Dzungaria
Desert of Gobi or Shamo
East Turkestan
Tarim Basin
Takla makan Desert
Kizyl kum
Kara kum
Bek-pak-dala (Famine Steppe)
Kulunda Steppe
Balkash
Omsk
Petropavlovsk
Chelyabinsk
Akmolinsk
Semipalatinsk
Bokhara
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in the immigration from the Central Asian plateau of such species as could adapt themselves to the dry climate and soil, in the disappearance of European and Altaic species from all the more arid parts of the region, in the survival of steppe species, and in the adaptation of many of the existing species to the needs of an arid and extreme climate and a saline soil.[1] The Pamir vegetation and that of the Aral-Caspian steppes constitute two types with numberless intermediate gradations.

There is no arboreal vegetation on the Pamir, except a few willows and tamarisks along the rivers. Mountain and valley alike are carpeted with soft grass, various species of *Festuca* predominating. In the immediate vicinity of water the sedge (*Carex physoides*) grows, and sporadic patches of *Allium*. To these may be added a few Ranunculaceae, some *Myosotis*, the common *Taraxacum*, one species of *Chamomilla*, and a few Leguminosae. In the north and west the *Stipa* of the Russian steppes supersedes *Festuca* and affords splendid pasture for the herds of the Kara-Kirghiz. In the gorges and on the better-watered slopes of the mountains the herbaceous vegetation becomes luxuriant. Besides the above-named there are many other Gramineae, such as *Lasiagrostis splendens*, the whole seas of *Scabiosae*. *Eremurus*, 6 to 7 ft. in height, forms thickets along with *Scorodosma foetida*. The northern slopes of the Alai chain are richer in trees. Up to 12,000 ft. full-grown specimens occur of the *archa* or juniper (*Juniperus pseudo-Sabina*), characteristic of the whole northern slopes of the Turkestan highlands, the poplar, spruces, cedars, a very few birches (*B. Sogdiana*), and a copious undergrowth of shrubs familiar in European gardens, such as *Rhododendron chrysanthum*, *Sorbus aucuparia* (rowan), *Berberis heteropoda* (berberry), *Lonicera Tatarica* (honeysuckle) and *Crataegus* (hawthorn). Farther east and north comes the Turkestan pine (*Picea Schrenkiana*), while at lower levels there grow willows, black and white poplars, tamarisk, *Celtis*, as well as *Elaeagnus* (wild olive), *Hippophae rhamnoides* (sallow thorn), *Rubus fructicosus* (blackberry), *Prunus spinosa* (blackthorn) and *P. Armeniaca* (apricot). The characteristic poplar, *Populus diversifolia*, and the dwarf *Acer Lobelii*—very different from the European maple—also occur.

The above applies to most of the highlands of the Tian-shan. The drier southern slopes are quite devoid of arboreal vegetation. On the northern slopes, at the higher levels, *Juniperus pseudo-Sabina* is the only tree that grows on the mountains, and luxuriant meadow grasses cover the *syrts*. Lower down, at 7500 to 8000 ft. the coniferous zone begins, characterized by the *Picea Schrenkiana*. Of course the juniper and a few other deciduous trees also occur. The richest zone is that which comes next, extending downwards to 5000 and 4500 ft. There woods of birch, several species of poplar, the maple (*Acer Semenovii*), and thick underwoods spread over the mountain slopes. Orchards of apple and apricot surround the villages. The meadows are clothed with a rich vegetation—numberless *Paeoniae*, *Scabiosae*, Convolvulaceae, Campanulae, *Eremurus*, Umbelliferae, *Gallium*, Rosaceae, *Altheae*, *Glycyrrhizae*, *Scorodosma foetida* and Gramineae. But as soon as the soil loses its fertile humus it produces only a few *Phlomis*, *Alhagi camelorum*, *Psammae*, *Salsolaceae*, *Artemisiae*, *Peganum* and some poppies and *Chamomillae*, but only in the spring. The invading steppe plants appear everywhere in patches in the Turkestan meadows.

The "culture" or "apricot" zone is followed by the prairie belt, in which black-earth plants (*Stipa* and the like) struggle for existence against invading Central Asian forms. And then come the lowlands and deserts with their moving sandy *barkhans*, *shors* and *takyrs* (see TRANSCASPIAN REGION). Two species of poplar (*P. pruinosa* and *P. diversifolia*), *Elaeagnus angustifolia*, the ash, and a few willows grow along the rivers. Large areas are wholly destitute of vegetation, and after crossing 100 m. of such a desert the traveller will occasionally come upon a forest of *saksaul* (*Anabasis Ammodendron*). Contorted stems, sometimes of considerable thickness, very hard, and covered with a grey cracked bark, rise out of the sand, bearing green plumes with small greyish leaves and pink fruit. Sometimes the tree is a mere knot peeping above the sand with a sheaf of thin branches. In spring, however, the steppe assumes quite another aspect, being clothed, except where the sands are shifting, with an abundance of vegetation. Persian species penetrate into Bokhara and the region of the upper Amu.

Vegetable Products.—As already stated the climate of Turkestan varies considerably from north to south. In Akmolinsk and Semiryechensk most of the kinds of corn which characterize Middle Russia are grown. South of the Chu and the Syr-darya gardening is a considerable industry; and, although rye and wheat continue to be the chief crops, the cultivation of the apple, and especially of the apricot, acquired importance. Attempts are also made to cultivate the vine. The inhabitants of the neighbourhood of Tashkent and Samarkand, as well as those of the much more northern but better sheltered Kulja oasis, add the cultivation of the almond, pomegranate and fig. Vines are grown and cotton planted in those districts. Finally, about Khojent and in Ferghana, where the climate is milder still, the vine and the pistachio tree cover the hills, while agriculture and horticulture have reached a high degree of perfection. Successful attempts are being made to grow the tea-plant in the Transcaspian region. Large numbers of oleaginous plants are cultivated, such as sunflower.

Agriculture.—The arable land, being limited to the irrigated terraces of loess, occupies little more than 2% of the whole area of West Turkestan. The remainder is divided between pasture land (less than 44%) and desert (54%). Owing to a very equitable distribution of irrigation water in accordance with Moslem law, agriculture and gardening have reached a high stage of development in the oases. Altogether close upon 4,000,000 acres are irrigated, and the crops are usually taken every year. Wheat, barley, millet, pease, lentils, rice, sorghum, lucerne and cotton are the chief agricultural products. Carrots, melons, vegetable marrows, cucumbers and onions are extensively grown. Rye and oats are cultivated at Kazalinsk and Kopal. Corn is exported. Owing to the irrigation, total failure of crops and consequent famines are unknown, unless among the Kirghiz shepherds. The kitchen gardens of the Mahommedans are, as a rule, admirably kept. Potatoes are grown only by the Russians. The cultivation of cotton is extending rapidly—from 1300 acres in 1883 to 531,000 acres in 1902, of which 402,000 acres were in Ferghana. Sericulture, a growing industry, is chiefly carried on in Ferghana, whence silk cocoons are an important item of export, the output having doubled between 1892 and 1903 (3869 tons). Livestock breeding is extensively pursued. The flocks of sheep on the Kirghiz steppe are so large that the proprietors themselves do not know their exact numbers.

Minerals.—The mineral wealth of Turkestan is considerable. Traces of auriferous sands have been discovered at many places, but the percentage of gold is too poor to make the working remunerative. Silver, lead and iron ores occur in several localities; but the want of fuel is an obstacle to their exploitation. The vast coal-beds of Kulja and some inferior ones in Samarkand are not seriously worked. The petroleum wells of Ferghana and the beds of graphite about Zairamnor are neglected. There are abundant deposits of gypsum, alum, kaolin, marble and similar materials. Asphalt is obtained in Ferghana. Notwithstanding the salt springs of Ferghana and Syr-darya, the salt lakes of the region, and the rock-salt strata of the Alexander Mountains, salt is imported.

Industry and Trade.—Turkestan has no manufacturing industry carried on by means of machinery, except distilleries and establishments for dressing raw cotton. These last have greatly increased in number; over a score are driven by steam and about a hundred by water. But there is a great variety of artisan work, such as copper and brass, paper, knives (at Bokhara), silver filigree, shoes, caps (at Samarkand and Andijan) and carpets; but most of these have been for some time declining and now stand at a rather low level. Trade is very actively carried on. Tashkent and Bokhara are the chief commercial centres, the principal articles of export to Russia, via Orenburg and Semipalatinsk, being raw cotton and silk, cattle and their products, while manufactured wares are imported in return. There is also an import and export trade to and from Urumchi and China, via Kulja and Ak-su.

Population.—Turkestan has been the theatre of so many migrations and conquests that its present population could not fail to be very mixed. Both Aryans and Mongols have their representatives there, the former settled for the most part, the latter chiefly nomad. The Ural-Altaians are numerically the predominant element, and consist of Turkomans, Kirghiz, Uzbegs and Sarts. The Turkomans inhabit chiefly the Transcaspian region. They number less than a quarter of a million. The Kara-Kalpaks ("Black Bonnets") number about 104,000. They are supposed to be recent immigrants to Syr-darya, having come from the former Bulgarian Empire on the middle Volga. Their language and habits are the same as those of the Kirghiz; but for the last century and a half they have had some acquaintance with agrculture. Their pacific temper exposed them to the raids of the Kirghiz, who compelled them first to settle in Dzungaria, then to move their dwellings several times, and ultimately (in 1742) to recognize the sovereignty of Russia. Even since that time they have been driven by the persecution of their old enemies to cross the Aral-Caspian steppes and seek refuge near Astrakhan. The real masters of the steppes and highlands of Turkestan are the Kirghiz, of whom there are two branches—the Kazak (Cossack) Kirghiz, who number about 3,787,000, and the Kara (Black) Kirghiz or Burut, who number nearly 202,000. The Uzbegs, who played a predominant political part in Turkestan before the Russian conquest, are of Turko-Tatar origin and speak a pure Jagatai (Turkish) dialect; but they are mixed to a great extent with Persians, Kirghiz and Mongols. They are subdivided into clans, and lead a semi-nomadic life, preserving most of the attractive features of their Turkish congeners—especially their honesty and independence. They number some 726,500 in all. When settled they are mostly designated Sarts—a name which has reference more to manner of life than to anthropological classification, although a much stronger admixture of Iranian blood is evident in the Sarts, who also speak Persian at Khojent and Samarkand. Their numbers amount to very nearly 1,000,000. Taranchi or Taranji ("labourer" in Chinese) is the name given to those Sarts who were settled in the Kulja region by the Chinese government after the rising of 1758. They constitute about two-fifths of the population of Kulja. The origin of the Dzungans is somewhat problematical. They number nearly 20,000, and inhabit the valley of the Ili in Kulja and partly are settled in Russian Turkestan. They are Mahommedans, but have adopted Chinese manners of life. The Mongol branch is represented in Turkestan by Kalmucks (191,000) and Torgutes (Torgod) in the north-east and in Kulja, where they are intermingled with Solons, Sibos and Chinese. The Aryan Tajik, the aborigines of the fertile parts of Turkestan, were subdued by the Turko-Mongol invaders and partly compelled to emigrate to the mountains, where they are now known as Galchas. They number over 350,000 and constitute the intellectual element of the country and are the principal owners of the irrigated land—the Uzbegs being their labourers—merchants, and mollahs or priests. They are Sunnite Mussulmans. The other representatives of Aryan race in Turkestan are a few (8000) Persians, mostly liberated slaves; Indians (300), who carry on trade and usury in the cities; a few Gipsies (800), and the Russians. Among these last two distinct elements must be noticed—the Cossacks, who are settled on the borders of the Kirghiz steppe and have assumed many Kirghiz habits, and the peasant-settlers, who are beginning to colonize the valley of the Ili and to spread farther south. Inclusive of the military, the Russians number about 100,000. The total population numbers approximately 9,000,000.

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[1] See Krasnov's researches in *Isvestija* of Russ. Geog. Soc. (1887), vol. xxiii.

Notwithstanding immigration, the Russians still constitute a very small proportion of the population, except in the province of Semiryechensk, where the Cossacks, the peasants, and the artisans in towns number 130,000, and, with the Russian troops, constitute 14% of the aggregate population. The only other province containing any considerable number of Russians is Syr-darya, where there are about 10,000 settlers (less than 1% of the population). About 12,000 Russians are settled in Bokhara and about 4000 in Khiva. The total estimated population of Russian Turkestan in 1906 was 5,746,600.

There are several populous cities in Russian Turkestan. Its capital, Tashkent, in the Syr-darya province, had 156,414 inhabitants in 1897, and other cities of importance are Samarkand (58,194), Marghilan (42,855 in Old Marghilan, and 8977 in New Marghilan) in Ferghana, Khojent (31,881) in Syr-darya, Khokand (86,704), Namangan (61,388) and Andijan (49,682) in Ferghana.

Education.—In the way of education nearly everything has still to be done; but a technical school and an experimental agricultural station with a school have been opened at Tashkent.

Railways.—Turkestan possesses only two railway systems; the Transcaspian line and the Orenburg-Tashkent line. The former, built in 1880–1888, starts at Krasnovodsk on the Caspian and runs east-south-east between the Kara-kum desert and the Kopet-dagh Mountains until it reaches the oasis of Tejen. Then it turns north-east via Merv to Bokhara and Samarkand, the total distance being 940 m. From Samarkand it is continued east-north-east via Khojent to Andijan (330 m.), sending off on the way a branch to Tashkent (94 m.). This last city was in 1905 connected by rail via Perovsk, Kazalinsk, and Irgiz with Orenburg (1149 m.).

General Condition.—Populous cities adorned with fine monuments of Arabian architecture, numerous ruins of cities decayed, grand irrigation canals now lying dry, and written monuments of Arabian literature testify to a time when civilization in Turkestan stood at a much higher level than at present. This period was during the first centuries after its conversion to Islam. Now all is in decay. The beautiful mosques and *madrasas* (theological colleges) are dilapidated; no astronomers study the sky from the tops of their minarets; and the scholars of the *madrasas* waste their time on the most deplorably puerile scholasticism. The inspiration of early belief has disappeared; the ruling motive of the mollahs (priests) is the thirst for personal enrichment, and the people no longer follow the khojas or theologians. The agricultural labourer has preserved the uprightness, diligence and sobriety which characterize the Turkish peasant; but the richer inhabitants of the cities are grossly sensual.

It remains, however, an open question whether the Russians will be able to bring new vigour to the country and awaken intellectual life. The followers of Islam, whose common law and religion know only of a temporary possession of the land, which belongs wholly to the Prophet, cannot accept the principles of unlimited property in land which European civilization has borrowed from Roman law; to do so would put an end to all public irrigation works and to the system by which water is used according to each family's needs, and so would be fatal to agriculture. The Russians have abolished slavery; and their rule has put an end to the interminable intestine struggles which had weakened and desolated the whole region. The barbarous tortures and executions which rendered Khiva notorious in the East are no longer heard of; and the continual appeals of the khojas for "holy" war against their rivals find no response. But the Russian rule has imposed many new taxes, in return for which Turkestan only gets troops of Russian merchants and officials, who too often accept the worst features of the depraved Mussulman civilization of the higher classes of the country. Schools are being diligently built; but the wants of the natives are subordinated to the supposed necessities of Russification. A consulting hospital for Mahommedan women has been opened by women graduates in medicine at Tashkent.

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II.—EAST TURKESTAN

East or Chinese Turkestan, sometimes called Kashgaria, is a region in the heart of Asia, lying between the Tian-shan ranges on the north and the Kuen-lun ranges on the south, and stretching east from the Pamirs to the desert of Gobi and the Chinese province of Kan-su (98° E.). The country belongs to China, and to the Chinese is known as Sin-kiang; but administratively the Chinese province of Sin-kiang crosses over the Tian-shan and includes the valleys of Kulja or Ili and Dzungaria on the north.

Physical Geography.—Along with the desert of Gobi East Turkestan occupies the lower terrace of the great central Asian plateau, which projects from the Himalayas north-east towards the Bering Straits. But though it is in reality an elevated plateau, with a general altitude of 4600 down to 2675 ft., it is nevertheless a depression when compared with the girdle of mountains which surround it on every side except the east, and even on that side it is shut in by the crumbling remains of a once mighty mountain system, the Pe-shan (see GOBI). The region as a whole slopes very gently towards the Lop district, where the lake, or rather marsh, of Kara-koshun, in 39° 51′ N. and 89° 24′ E., lies at an altitude of 2675 ft. This is not, however, the absolutely lowest point in East Turkestan: that is found in the local depression of Turfan-Lukchun, south-east of Urumchi, between the Chol-tagh and the Bogdo-ola ranges of the Tian-shan. The deepest part of that depression lies 56–426 ft. *below* the level of the sea; but this remarkable pit in the surface is of very limited area, for within less than 30 m. to the north the level rises up to 250 ft. (at the town of Turfan) and to 3500 ft. in the Chol-tagh only 12 m. to the south, while at Pichang, 60 m. east, it is 3400 ft. above the sea, and immediately behind Turfan the Jargös Mountains run up to an altitude of 10,000 ft. There are also two other depressions which lie at a lower altitude than the Kara-koshun, but they lie, one (Kulja or Ili) among the Tian-shan ranges and the other (Dzungaria) beyond them. The town of Kulja, which stands about the middle of the Chinese part of the valley of the Ili river, has an altitude of 2165 ft., but the valley of Dzungaria ranges at 900 to 3000 ft., and in the lakes (*e.g.* Ebi-nor) which dot its surface it descends to 820 ft. The mountain ranges which shut off East Turkestan from the rest of the world rank among the loftiest and most difficult in Asia, and indeed in the world. The Kuen-lun on the south rise steeply from the flat deserts of the Takla-makan and Kum-tagh by successive terraces until they reach an elevation of 19,000 to 20,000 ft. on the summit of the Tibetan plateau. The passes in them range generally at altitudes of 10,000 ft. to 18,300 ft. (*e.g.* Kyzyl-davan, 16,900 ft.; Sughet-davan, 17,825 ft.; a pass in the Arka-tagh 18,300 ft.). On the west East Turkestan is generally approached from India by the famous pass of Karakorum (18,300 ft.), from Ferghana and West (Russian) Turkestan by the passes of Kyzyl-art (14,015 ft.) and Terek (12,730 ft.), and the mountains on this side attain to altitudes of 25,780 ft. in the Muztagh-ata or Tagarma, of 23,000 ft. in the Kaufmann Peak, in the Trans-Alai range, and of 19,680 ft. in the Alai range. The Tian-shan Mountains skirt East Turkestan on the north-east, where the Kokshal-tau range rises to 16,000 to 18,000 ft. and is crossed by passes (*e.g.* Bedel and Jan-art) which reach 13,000 to 14,500 ft., and on the north, where the mountain knot of Khan-tengri has an altitude of 22,800 ft. and the Bogdo-ola and Karlyk ranges run up to 15,000 to 18,000 ft., while the passes (*e.g.* Muz-art on the north-east shoulder of Khan-tengri) climb up to 8000 to 12,000 ft. But here two natural gaps or gateways, those of Urumchi at 2790 ft. and Otun-koza at 2390 ft., facilitate communication between the basins of the Tarim and the Ili (Dzungaria). The Pe-shan swelling, with its flanking ranges of the Chol-tagh and Kuruk-tagh, which, by gradually approaching the Nan-shan section of the Kuen-lun in about 98° E., narrow the desert, are a good deal lower, namely 5000 to 9000 ft.

Within this mountain girdle lies the basin of the Tarim, extending over an area of 354,000 sq. m., but of this 51·2% consists of arid and almost impassable deserts, namely the Takla-makan (*q.v.*), the desert of Lop, the Ghashiun Gobi, and the desert of Kum-tagh, which are described under GOBI. The principal stream is, of course, the Tarim, about 1000 m. in length. It is virtually composed of the Yarkand-darya, the Kashgar-darya, and the Ak-su-darya, with constant augmentation from the Koncheh-darya, which drains Lake Bagrash-kul (at the south foot of the eastern Tian-shan), and intermittent augmentation from the Khotan-darya and the Cherchen-darya from the south. The basin of the Tarim contains, indeed, numerous other streams, most of them summer torrents seaming the flanks of the encircling mountains, but once no doubt affluents of the Tarim, though now all swallowed up in the desert soon after quitting the shelter of the mountains. The Tarim, which is on the whole a sluggish, shallow, winding stream, fringes the great desert of Takla-makan on the west, north and east, and, after being extensively drawn upon for irrigation purposes in the oases (Yarkand, Kashgar, Maral-bashi, Ak-su), through which it passes, it eventually dies away in the salt reed-grown lake or marsh of Lop-nor (Kara-koshun). Along the south foot of the Tian-shan, and in the high valleys which intervene between the constituent ranges of that system, there exist numerous flourishing oases, such as Uch-turfan, Ak-su, Kucha, Korla, Kara-shahr, Hami, Barkul, Turfan, Urumchi, Manas and Kulja. A similar string of oases exist all along the north foot of the Kuen-lun, *e.g.* Kargalik, Khotan, Keriya, Niya, Cherchen, Charkhlik, Sa-chou, and An-hsi-chou, but these settlements, some of them of very great antiquity, have to maintain a constant fight against the encroachments of the desert sand. In broad, general terms the Takla-makan may be described as a tumbled sea of sand, with waves (*barkhans* or sand-accumulations) as much as 300 ft. in height, diversified by occasional patches of hard clay, mostly elongated from north-east to south-west, between the ridges of the dunes. In the deserts that lie east of the Lop-nor the sand is not piled up to such great heights, nor is it generally of such a shifting character. There are ampler expanses of hard saliferous clay (*shor*) and on the north side of the desert of Lop the surface has been carved and sculptured by the wind into innumerable flat, table-topped masses (*jardangs*) with vertical or even overhanging sides, separated from one another by deep-cut, wind-swept gullies, running from north-east to south-west. During the later Tertiary period all these desert regions would appear to have been covered by an Asian Mediterranean or, at all events, by vast fresh-water lakes, a conclusion which seems to be well warranted by the existence of salt-stained depressions of a lacustrine character; by traces of former lacustrine shore-lines, more or less parallel and concentric; by discoveries of vast quantities of fresh-water mollusc shells (*e.g. Limnaea* and *Planorbis*); the existence of belts of dead poplars, patches of dead and moribund tamarisks, and vast expanses of withered reeds, all these crowning the tops of the jardangs, never found in the wind-scooped furrows; the presence of ripple-marks of aqueous origin on the leeward side of the clay terraces and in other wind-sheltered situations; and, in fact, by the general conformation, contour lines, and shapes of the deserts as a whole. From the statements of older travellers, like the Venetian Marco Polo (13th century) and the Chinese pilgrim Hsüan Tsang (7th century), as well as from other data, it is perfectly evident, not only that this country is suffering from a progressive desiccation, but that the sands have actually swallowed up cultivated areas within the historical period.

Climate.—The climate is characterized by great extremes and a wide range of temperature, not only between summer and winter, but sometimes also in the course of twenty-four hours. In the desert of Gobi the thermometer descends as low as −19·3° F. in January, and in the desert of Cherchen as low as −26° in the same month, and snow falls in winter even in the heart of the latter desert. At Yanghi-kol (40° 52′ N. and 86° 51′ E.), beside the lower Tarim, the January mean is −1·3° F., the June mean 88°, and the lowest minimum recorded −14° (February). In both the desert of Gobi and in the desert of Lop a diurnal range of 44° has been observed. The lower Tarim begins to freeze early in November. As regards the summer temperature, as early as the 12th of March a reading of 70·5° has been obtained in the desert of Lop, and as high as 90° at Charkhlik early in May. In June beside the lower Tarim the thermometer has registered 104° before a buran, 77° during its continuance, and 48·7° at night. At Kashgar (alt. 4275 ft.) the mean temperature for the year is 55·4°, the January mean 21·2°, and the July mean 81·5°; at Yarkand (alt. 4165 ft.) the annual mean is 54·0°, the January mean 20·3°, and the July mean 81·4°. In the Lukchun depression (55 ft. below sea-level), which is situated at approximately the centre of the Asiatic continent (42° 42′ N. and 89° 42′ E.), the climate is fairly typical of Central Asia, the mean for the year being 55·5°, for January 16·7° and for July 89·6°; in other words, while the summer is as hot as in the Sahara, the winter is as cold as at St Petersburg. Minimal observations of −4·0° and −4·5° have been taken at Yarkand and Lukchun respectively, and maximal observations of 103·2° and 109·5° at the same two places. The atmosphere in the desert regions is remarkably dry, and though a little rain falls occasionally on the lower slopes of the mountains, scarcely any falls in the desert, at the most a smart shower at intervals of several years. At Kashgar the annual rainfall amounts to less than 18 in. During a large part of the year, and more especially in spring, the atmosphere is heavily charged with sand, and blinding sandstorms (*burans*) are of frequent occurrence.

Fauna.—In the more arid regions animal life is naturally not abundant. The tiger and wild boar haunt the thickets beside the Tarim, wild duck and wild geese throng its waters, and more especially the waters of its marginal and deltaic lakes. There also the wild swan is found. Antelopes, hares and occasionally the lynx, fox, deer, rats, vultures, crows, ravens, hawks, with lizards are other denizens of the borders of the deserts. The wild camel frequents the scattered oases along the margins of the desert and roams into the desert itself. Gadflies and mosquitoes are a veritable plague around the lakes of the lowlands in the hot weather In the higher mountainous parts animal life is more abundant, the typical forms being the wild yak, the *kulan* or wild ass, the arkhari or wild sheep, the orongo and other antelopes, the marmot, wolf, hare partridge and bear. Fish are plentiful in the lower Tarim and in its lakes.

Vegetable Products.—In the desert regions vegetation is, of course, extremely scanty, being restricted almost entirely to the tamarisk, *Elaeagnus*, tussock grass, and a few *Salsolaceae.* Poplars and in some places willows grow along the river-sides, and dense reed brakes, often 6 to 10 ft. high, fill the lakes and dot the quieter reaches of the river beds. But as the slopes of the mountains are ascended the rainfall becomes more copious and grass makes its appearance, together with a few species of arboreal vegetation, such as the juniper. What cultivation there is, is confined to the oases which nestle at the foot of the mountains all round the Tarim basin. The soil in them is of great fertility wherever it is irrigated, and despite the supineness of the Chinese authorities, irrigation is very extensively practised in nearly all the oases. Excellent crops of wheat, barley, maize, sesame, millet, cotton, opium, tobacco and rice are grown, and several of the oases, *e.g.* Khotan, Kashgar, Korla, Turfan and Hami, are famous for their orchards, in which cucumbers, the mulberry, apple, pear, apricot, peach, melon, grape, pomegranate and walnut ripen to perfection.

Population.—The people who inhabit the plains and mountain slopes of East Turkestan consist partly of Aryans and partly of races of Ural-Altaic stock, and are partly of mixed blood. In Dzungaria they are Dzungans or Dungans, a Turko-Tatar tribe who nominally profess Mahommedanism, and in Kulja they are Kirghiz, Tatars, Mongols, Dungans and others. The agricultural population of the oases are principally of Turkish stock, powerfully influenced by Aryan blood. The townsmen are more distinctly Turkish, *i.e.* Sarts and Uzbegs. The language universally spoken is Jagatai Turkish. Kirghiz graze the slopes of the Tian-shan. The trade is mostly in the hands of the Chinese, natives of West Turkestan (known as Andijanis from the town of Andijan) and Hindus. The total population, excluding Kulja and Dzungaria, is estimated by A. N. Kuropatkin at 1,200,000, by M. V. Pyevtsov at 2,000,000, and by Sven Hedin at 1,800,000 to 2,000,000. The last named distributes it thus—1,500,000 rural, 200,000 urban, and 100,000 shepherds. The principal towns and their populations are Yarkand, 100,000; Khotan, 40,000; Kashgar, 33,000; Ak-su, 15,000; Keriya, 12,000; and Kulja, 20,000. The population of Dzungaria is estimated at 600,000 and of Kulja at 150,000. The prevailing religion all over East Turkestan is Mahommedanism. The country belongs politically to China, and Chinese fill all the higher administrative positions and form the garrisons in the towns. The region is divided into the administrative districts of Kashgar, Yarkand, Ak-su and Urumchi. The capital is the town of Urumchi.

Industries.—In addition to agriculture, the breeding of livestock, more especially sheep, camels, horses and asses, fishing in the waters of the lower Tarim, and the transportation of merchandise are all important means of livelihood. East Turkestan contains several minerals, such as gold, mined to a very small extent in the Kuen-lun Mountains; lead found in the country west of Kashgar and once worked in the Kuruk-tagh, and copper and petroleum near Kashgar; coal exists in abundance in the Kulja valley and is found at Ak-su, Korla, Kara-shahr, Turfan and Hami on the northern verge of the deserts. Salt is obtained from stagnant lakes and from certain parts of the desert. Jade, which is very highly valued by the Chinese for making into ornaments, vases, cups, &c., has been extracted from time immemorial, and is still extracted to-day at Khotan. In a region like East Turkestan, where the settlements are so scattered and the population so thin, the arts and crafts are prosecuted necessarily on only a local scale. Nevertheless certain of the oases are famous individually for one or more handicrafts: for instance, Khotan for its silks, white carpets and felt goods; Kashgar and Turfan for cottons, Kucha and Kara-shahr for leather and saddlery, Ak-su for felts and leather and metal goods, Yarkand for silks, carpets and felts, and Urumchi and Uch-Turfan for sulphur.

Trade and Communications.—A considerable amount of trade is done in the export of wool, hides, cotton, carpets, silks, felts, cereals (wheat, barley, maize, rice), sheep, fruit and vegetables, and in tea, silver, porcelain and opium imported from China, cloth and groceries from India, and cloth, cottons, silks, sugar, matches and leather from West Turkestan and Russia. The entire trade with India does not exceed £200,000 per annum. Traffic is carried on principally by means of caravans of camels, horses, asses and oxen. The caravan routes mostly followed between China and the more populous centres (Kashgar and Yarkand) of East Turkestan start from An-si-chow and Sa-chow respectively, converge upon Hami on the north side of the Pe-shan swelling, and continue westward along the south foot of the Tian-shan Mountains through the oases of Turfan, Kara-shahr, Korla, Kucha, Ak-su and Uch-turfan. From Hami other routes proceed to Barkul and to the main caravan road which skirts the southern edge of the Dzungarian valley and leads to Vyernyi in the Russian province of Semiryechensk. A similar branch route strikes off at Turfan and cuts through the Tian-shan ranges at Urumchi. Ak-su is an important trading town. From it three routes start for West Turkestan; the one principally used climbs over the Bedel pass (13,000 ft.) in the Kokshal-tau and makes a detour round the east and along the north side of the Issyk-kul, while the others cross over the Muz-art pass (12,000 ft.), on the north-east shoulder of Khan-tengri, and the Terek pass (12,730 ft.) respectively, the latter into Ferghana. Kashgar has connexion with Ferghana and Bokhara over the Kyzyl-art pass (14,015 ft.) and down the Alai valley. Yarkand and Khotan communicate with India over the lofty pass of Karakorum (18,300 ft.) and through Leh in Ladak, and thence over the difficult pass of Zoji-la (11,500 ft.). There is another route between Kashgar and China along the southern edge of the desert via Lop-nor, but it is not much used. A telegraph line was constructed between Lanchow in the Chinese province of Kan-su and Turfan in 1893.

History.—It appears very probable that at the dawn of history East Turkestan was inhabited by an Aryan population, the ancestors of the present Slav and Teutonic races, and that a civilization not inferior to that of Bactria had already developed at that time in the region of the Tarim.[1] Our knowledge, however, of the history of the region is very fragmentary until about the beginning of the Christian era. When the Huns (Hiung-nu) occupied west and east Mongolia in 177–165 B.C., they drove before them the Yue-chi (Yutes, Yetes or Ghetes), who divided into two hordes, one of which invaded the valley of the Indus, while the other met the Sacae in East Turkestan and drove them over the Tian-shan into the valley of the Ili. Thus by the beginning of our era the Tarim region had a mixed population of Aryans and Ural-Altaians, some being settled agriculturists and others nomads. There were also several independent cities, of which Khotan was the most important. One portion of the Aryans emigrated and settled in what is now Wakhhan (on the Pamir plateau), the present language of which seems very old, dating anterior to the separation of the Vedic and Zend languages. Between 120 and 101 B.C. the Chinese extended their rule westwards over East Turkestan as far as Kashgar. But their dominion seems to have been merely nominal, for it was soon shaken off. By the end of the 5th century the western parts fell under the sway of the "White Huns" (Ephthalites, or Tochari), while the eastern parts were under Tangut (Thygun) dominion. The Chinese, however, still retained the region about Lop-Nor. Buddhism penetrated into the country at an early date, and possessed famous monasteries there in the 5th and 7th centuries. There were also at the same time followers of Zoroastrianism, of Nestorian Christianity, and even of Manichaeism. An active trade was carried on by means of caravans, corn and silk especially being mentioned at a very early date. The civilization and political organization of the country were dominated by the Chinese, but were also influenced to some extent by Graeco-Bactrian civilization, which had probably secured a footing in the country as early as the 3rd century B.C. Our information as to the history of this region from the 2nd century to the first half of the 7th is slight, and is derived chiefly from the *Journeys* of the Chinese pilgrims, Fa-hien in 399–415, Song-yun and Hwei-seng in 518–521, and Hsüan-Tsang in 629–645. By this time Buddhism had reached its culminating point: in Khotan there were 100 monasteries and 5000 monks, and the Indian sacred literature was widely diffused. But already there were tokens of its decay; even then the eastern parts of the Tarim basin seem to have been growing less and less populous. To the east of Khotan, cities which were prosperous when visited by Song-yun had a century later fallen into ruins.

Little is known about these regions during the 7th, 8th and 9th centuries. In the 7th century the Tibetan king, Srong-btsan, with the help of the western Turks, subjugated the western part of the Tarim basin. During the following century the Mahommedans under Kotaiba ibn Moslim, after several excursions into West Turkestan, invaded (712–13) East Turkestan, penetrating as far as Turfan and even China. The Chinese supremacy was not shaken by these invasions. But, on the outbreak of internal disturbances in China, the Tibetans took possession of the western provinces of China, and intercepted the communications of the Chinese with Kashgaria, so that they had to send their troops through the lands of the Hui-khe (Hoei-ke, or Hoei-hu). In 790 the Tibetans were masters of East Turkestan; but their rule was never strong, and towards the 9th century we find the country under the Hoi-he. Who these people were is somewhat uncertain. According to Chinese documents they came from the Selenga; but most Orientalists identify them with the Uighurs. In the opinion of M. Grigoriev,[2] the Turks who succeeded the Chinese in the western parts of East Turkestan were the Karlyk Turks, who extended farther south-west up to Kashmir, while the north-eastern parts of the Tarim region were subdued by the Uighurs. Soon Mongol hordes, the Kara-Kitais, entered East Turkestan (11th century), and then penetrated into West Turkestan. During the following century the Mongol conqueror Jenghiz Khan overran China, and Turkestan and Kashgaria fell under his rule in 1220, though not without strenuous resistance followed by massacres. The Mongol rule was, however, not very heavy, the Mongols merely exacting tribute. In fact, Kashgaria flourished under them, and the fanaticism of Islam was considerably abated. Women again acquired greater independence, and the religious toleration then established permitted Christianity and Buddhism to spread freely. This state of affairs lasted until the 14th century, when Tughlak Timur, who extended his dominions to the Kuen-lun, accepted Islam. He transferred his capital from Ak-su to Kashgar, and had a summer residence on the banks of the lake Issyk-kul. His son reigned at Samarkand, but was overthrown by Timur (Tamerlane), the Mongol sovereign of Samarkand, who, to put an end to the attacks of the wild Tian-shan tribes, undertook in 1389 his renowned march to Dzungaria, which was devastated, East Turkestan also suffering severely.

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[1] Such is the conclusion reached by C. Lassen, *Indische Alterthumskunde* (4 vols., Bonn, 1844–1861), and supported by M. Grigoriev (Ritter's *Asien* in Russ. trans.; addenda to "East Turkestan"). In connexion with the objection based upon the sub-boreal character of the regions which were the cradle of the Aryans, as proved by the so-called palaeontology of the Aryan languages, it may be observed that by the end of the Glacial, and during the earlier Lacustrine (Post-Glacial) period, the vegetation of Turkestan and of Central Asia was quite different from what it is now. It was Siberian or north European. The researches by M. Krasnov (in *Izvestia* of Russ. Geog. Soc., St Petersburg, 1887, vol. xxiii.) as to the characteristics of the former flora of the Tian-shan, and the changes it has undergone in consequence of the extremely rapid desiccation of Central Asia, must be carefully borne in mind in all speculations founded upon the testimony of language as to the original home of the Aryans.

[2] See Ritter's *Asien*: "East Turkestan" (Russ. trans.), ii. 282; also A. N. Kuropatkin's *Kashgaria* (1883).

The reintroduction of Islam was of no benefit to the Tarim region. In the 14th and 15th centuries Bokhara and Samarkand became centres of Moslem scholarship, and sent great numbers of their learned doctors to Kashgaria. Rubruquis, who visited East Turkestan in 1254, Marco Polo between 1271 and 1275, and Hols in 1680, all bore witness to great religious tolerance, but this entirely disappeared with the invasion of the Bokharian mullahs or Mahommedan priests. They created in East Turkestan the power of the *khojas*, or "theologians," who afterwards fomented the many intestine wars that were waged between the rival factions of the White and the Black Mountaineers. In the 17th century a powerful Kalmuck confederation arose in Dzungaria, and extended its sway over the Ili and Issyk-kul basins, having its capital on the Ili. To this power or to the Kirghiz the "Whites" and "Blacks" alternately appealed in their struggles, in which Yarkand supported the latter and Kashgar the former. These struggles paved the way for a Chinese invasion, which was supported by the White khojas of Kashgar. The Chinese entered Dzungaria in 1758, and there perpetrated an appalling massacre, the victims being estimated at one million. The Kalmucks fled, and Dzungaria became a Chinese province, with a military colonization of Sibos, Solons, Dahurs, Chinese criminals and Moslem Dzungars. The Chinese next re-conquered East Turkestan, marking their progress by massacres and transporting 12,500 partisans of independence to the Ili (Kulja) valley. Hereupon the dissentient khojas fled to Khokand in West Turkestan, and there gathered armies of malcontents and fanatic followers of Islam. Several times they succeeded in overthrowing the Chinese rule—in 1825, in 1830 and in 1847—but their successes were never permanent. After the "rebellion of the seven khojas" in 1847 nearly 20,000 families from Kashgar, Yarkand and Ak-su fled to West Turkestan through the Terek-davan pass, many of them perishing on the way. In 1857 another insurrection broke out; but a few months later the Chinese again took Kashgar. In the course of the Dzungarian outbreak of 1864 the Chinese were again expelled; and Yakub Beg became master of Kashgar in 1872. But five years later he had again to sustain war with China, in which he was defeated, and East Turkestan once more became a Chinese province.

Antiquities.—In 1896 Dr Sven Hedin discovered in the desert not far from the town of Khotan, in a locality known as Borasan, objects in terra-cotta, bronze images of Buddha, engraved gems, coins and MSS.; the objects, which display artistic skill, give indications of having been wrought by craftsmen who laboured to reproduce Graeco-Indian ideals in the service of the cult of Buddha, and consequently date presumably from the 3rd century B.C., when the successors of Alexander the Great were founding their kingdoms in Persia, Khwarezm (Khiva), Merv, Bactria (Afghanistan) and northern India, and from that date to the 4th or 5th century A.D. At the same time the same explorer excavated part of the ruins of the ancient city of Takla-makan (near the Keriya-darya), which had been overwhelmed by the moving sands of the desert. There he found mural paintings, some of which represented local lake or river scenes, carved woodwork, fragments of pottery, gypsum images of Buddha, and traces of gardens. These discoveries were followed by others made by Dr M. Aurel Stein in the same part of East Turkestan, though at other localities, namely, at Yotkan, the ancient capital of the kingdom of Khotan, and at Dandan-uiliq, Endere, Karadong, Rawak and other places, all lying east and north-east of the town of Khotan. His "finds" consisted of pottery, images, statues, coins, seals, frescoes, MSS. written in Sanskrit, Brahmi and Chinese characters, wooden tablets in the Kharoshti script, furniture and various cereals. These things appear to date from the very beginning of the Christian era, and continue down to the end of the 8th century. Again, in another part of the country, namely, in the heart of the desert of Lop, in approximately 40° 40′ N. and 90° E., Dr Sven Hedin was fortunate enough to discover early in 1901 the ruins of the ancient city of Lôu-lan or Shanshan, which was destroyed, apparently by a desert storm or by an inundation, or perhaps by both, towards the end of the 3rd century A.D. Among the objects found on this site were documents testifying to the name of the locality and furnishing materials for fixing the date.

A little before the date of these last discoveries, others of a somewhat similar nature were made by D. A. Klements in the Lukchun depression already mentioned. Here in 1898 the explorer discovered the ruins of ancient monasteries, dating from the beginning of the Christian era down to the 13th and 16th centuries. Among these ruins Klements found several very interesting MSS., some of them written in the language of the Uighurs, an ancient Turkish race, and others in tongues unknown. Finally, in 1904, Dr von Le Coq, when excavating the sand-buried ruins of Kara-khoja, between Turfan and Lukchun, discovered extremely valuable MSS., some written on Chinese paper, some on white leather, and some on wood, besides Buddhistic wall-paintings. The MSS. are written in ten different alphabets, and of the languages employed two are entirely unknown. The excavators also brought to light a vast number of human corpses in the garb of Buddhist monks. Other finds were subsequently made by the same explorer, in conjunction with Professor A. Grünwedel, at Kucha and Korla, two other oases at the south foot of the Tian-shan Mountains.

In 1906–1908 Dr Stein made a second and more important journey, principally for the purpose of antiquarian research, though he also carried out important geographical investigations, with the assistance of a native surveyor, in the Eastern Pamirs (about Mustagh-ata), in the Nissa valley south of Khotan, and elsewhere. His archaeological investigations were carried on chiefly in the following localities: (i.) at and about Tashkurghan. (ii.) North-east of Khotan, where a large Buddhist temple, with relievos derived from Graeco-Buddhist models, were investigated and numerous MSS. and wooden tablets were discovered, inscribed in Sanskrit, Chinese, Tibetan and the Brahmi script of Khotan, the arid conditions, here as elsewhere, having caused these and other perishable objects to remain remarkably well preserved. (iii.) At Niya, east of Keriya, where many Kharoshti documents on wood were recovered, sometimes retaining their clay seals of Greek type and wooden covers as envelopes, together with implements, furniture, &c. (iv.) At Miran, near the western extremity of Lop-nor, where Buddhist shrines with frescoes, &c., were investigated. (v.) At Lop-nor itself, where Chinese and Kharoshti records on paper, wood and silk were recovered, and flint implements and other evidences of prehistoric occupation were discovered. (vi.) At and about the oasis of Tung-hwang, east of Lop-nor. Here the explorer traced a Chinese wall with watch-towers, guard-stations, &c., for a considerable distance, and made an important archaeological collection. Evidence of settlement back to the close of the 2nd century A.D. was obtained, and also of commercial traffic from the distant west in the shape of records in Indian, Kharoshti and Brahmi scripts and an unknown script resembling Aramaic. The sacred grottoes known as the Halls of the Thousand Buddhas, south-east of Tung-hwang, were visited, with their frescoes and cave temples, and a large number of documents and examples of early Chinese art were recovered. Dr Stein also investigated sites in the neighbourhood of Kara-shahr and others to the north-east of the great desert.

BIBLIOGRAPHY.—The best and the most exhaustive accounts of East Turkestan are contained in Sven Hedin's *Scientific Results of a Journey in Central Asia, 1899–1902* (vols. i.–ii., Stockholm, 1905–1906), *Through Asia* (2 vols., London, 1898), and *Central Asia and Tibet* (2 vols., London, 1903). See also H. H. P. Deasy, *In Tibet and Chinese Turkestan* (London, 1901); F. Grenard, in vol. ii. of J. L. Dutreuil de Rhins's *Mission Scientifique dans la Haute Asie* (1890–1895, n.p., 1897); Futterer, *Durch Asien* (Berlin, 1901); N. M. Przhevalsky, *From Kulja across the Tian-shan to Lob-nor* (Eng. trans., by Delmar Morgan, London, 1879); G. E. Grum-Grshimailo, *Opisanie Puteshestviya v Sapadniy Kitai* (St Petersburg, 1897–1899); V. I. Roborovsky and P. K. Kozlov, *Trudy Ekspeditsiy Imp. Russ. Geog.*

Obshchestva po centralnoy Asiye, 1893–1895 (St Petersburg, 1897, &c.); V. I. Roborovsky, *Trudy Tibetskoi Ekspeditsiy, 1889–1890*; K. Bogdanovich, *Geologicheskiya Isledovaniya v. Vostochnom Turkestane* and *Trudy Tibetskoy Ekspeditsiy, 1889–1890* (St Petersburg, 1891–1892); V. A. Obruchev, *Centralnaya Asiya, Severniy Kitai i Nan-schan, 1892–1894* (2 vols., St Petersburg, 1899–1901); A. N. Kuropatkin, *Kashgaria* (Eng. trans., London, 1883); and P. W. Church, *Chinese Turkestan with Caravan and Rifle* (London, 1901). For the archaeological discoveries, see the books of Sven Hedin already quoted; M. A. Stein, *The Sand-buried Cities of Khotan* (London, 1903), and *Geographical Journal* (London, July and Sept., 1909); and D. A. Klements and W. Radlov, *Nachrichten über die von der k. Akademie der Wissenschaften zu St Petersburg im Jahre 1898 ausgerüsteten Expedition* (St Petersburg, 1899). Consult also books cited under TIAN-SHAN, LOP-NOR, GOBI and KUEN-LUN. (J. T. BE.; P. A. K.)

TURKESTAN, or HAZRET, a town of Russian Turkestan, in the province of Syr-darya, on the railway from Orenburg to Tashkent, from which it lies 165 m. to the N.N.W. Pop. (1897), 11,592. It lies on the right bank of the Syr-darya river, 20 m. from it, at an altitude of 833 ft. It has a very old mosque of the saint Hazret-Yassavi, which attracts many pilgrims. It is an important dépôt for hides, wool and other produce of cattle-breeding. The town was captured by the Russians in 1864.

TURKEY. The Turkish or Ottoman Empire comprises Turkey in Europe, Turkey in Asia, and the vilayets of Tripoli and Barca, or Bengazi, in North Africa; and in addition to those provinces under immediate Turkish rule, it embraces also certain tributary states and certain others under foreign administration. Turkey in Europe, occupying the central portion of the Balkan Peninsula, lies between 38° 46′ and 42° 50′ N. and 19° 20′ and 29° 10′ E. It is bounded on the N.W. by Montenegro and Bosnia, on the N. by Servia and Bulgaria, on the E. by the Black Sea and the Bosporus, on the S. by the Sea of Marmora, the Dardanelles, the Aegean Sea and Greece, and on the W. by the Ionian and Adriatic Seas. Turkey in Asia, fronting Turkey in Europe to the south-east, and lying between 28° and 41° N. and 25° and 48° E., is bounded on the N. by the Black Sea, on the N.W. by the Bosporus, the Sea of Marmora and the Dardanelles, on the W. by the Aegean Sea, on the E. by Persia and Transcaucasia, and on the S. by Arabia and the Mediterranean. So far as geographical description is concerned, the separate articles on ASIA MINOR, ALBANIA, ARMENIA, and other areas mentioned below—constituting the Turkish Empire—may be consulted. (For maps of Asiatic Turkey, see ARABIA; ARMENIA; ASIA MINOR; PALESTINE; SYRIA.)

The possessions of the sultan in Europe now consist of a strip of territory stretching continuously across the Balkan Peninsula from the Bosporus to the Adriatic (29° 10′ to 19° 20′ E.), and lying in the east mainly between 40° and 42° and in the west between 39° and 43° N. It corresponded roughly to ancient Thrace, Macedonia with Chalcidice, Epirus and a large part of Illyria, constituting the present administrative divisions of Stambul (Constantinople, including a small strip of the opposite Asiatic coast), Edirne (Adrianople), Salonica with Kossovo (Macedonia), Iannina (parts of Epirus and Thessaly), Shkodra (Scutari or upper Albania). To these must be added the Turkish islands in the Aegean usually reckoned to Europe, that is, Thasos, Samothrace, Imbros and, in the extreme south, Crete or Candia. In December 1898, however, Crete was granted practical independence, under the protection of Great Britain, France, Italy and Russia (see CRETE), and the suzerainty of the sultan is purely nominal.

Asiatic Turkey.—The mainstay of the Ottoman dynasty is the Asiatic portion of the empire, where the Mahommedan religion is absolutely predominant, and where the naturally vigorous and robust Turki race forms in Asia Minor a compact mass of many millions, far outnumbering any other single ethnical element and probably equalling all taken collectively. Here also, with the unimportant exception of the islands of Samos and Cyprus and the somewhat privileged district of Lebanon, all the Turkish possessions constitute vilayets directly controlled by the Porte. They comprise the geographically distinct regions of the Anatolian plateau (Asia Minor), the Armenian and Kurdish highlands, the Mesopotamian lowlands, the hilly and partly mountainous territory of Syria and Palestine and the coast lands of west and north-east Arabia. Asiatic Turkey is conterminous on the east with Russia and Persia; in the south-west it encloses on the west, north and north-east the independent part of Arabia. Towards Egypt the frontier is a line drawn from Akaba at the head of the Gulf of Akaba north-westwards to the little port of El Arish on the Mediterranean. Elsewhere Asiatic Turkey enjoys the advantage of a sea frontage, being washed in the north-west and west by the Euxine, Aegean and Mediterranean, in the south-west by the Red Sea, and in the south-east by the Persian Gulf.

Turkey's Arabian possessions comprise, besides El-Hasa on the Persian Gulf, the low-lying, hot and insalubrious Tehama and the south-western highlands (vilayets of Hejaz and Yemen) stretching continuously along the east side of the Red Sea, and including the two holy cities of Mecca and Medina.

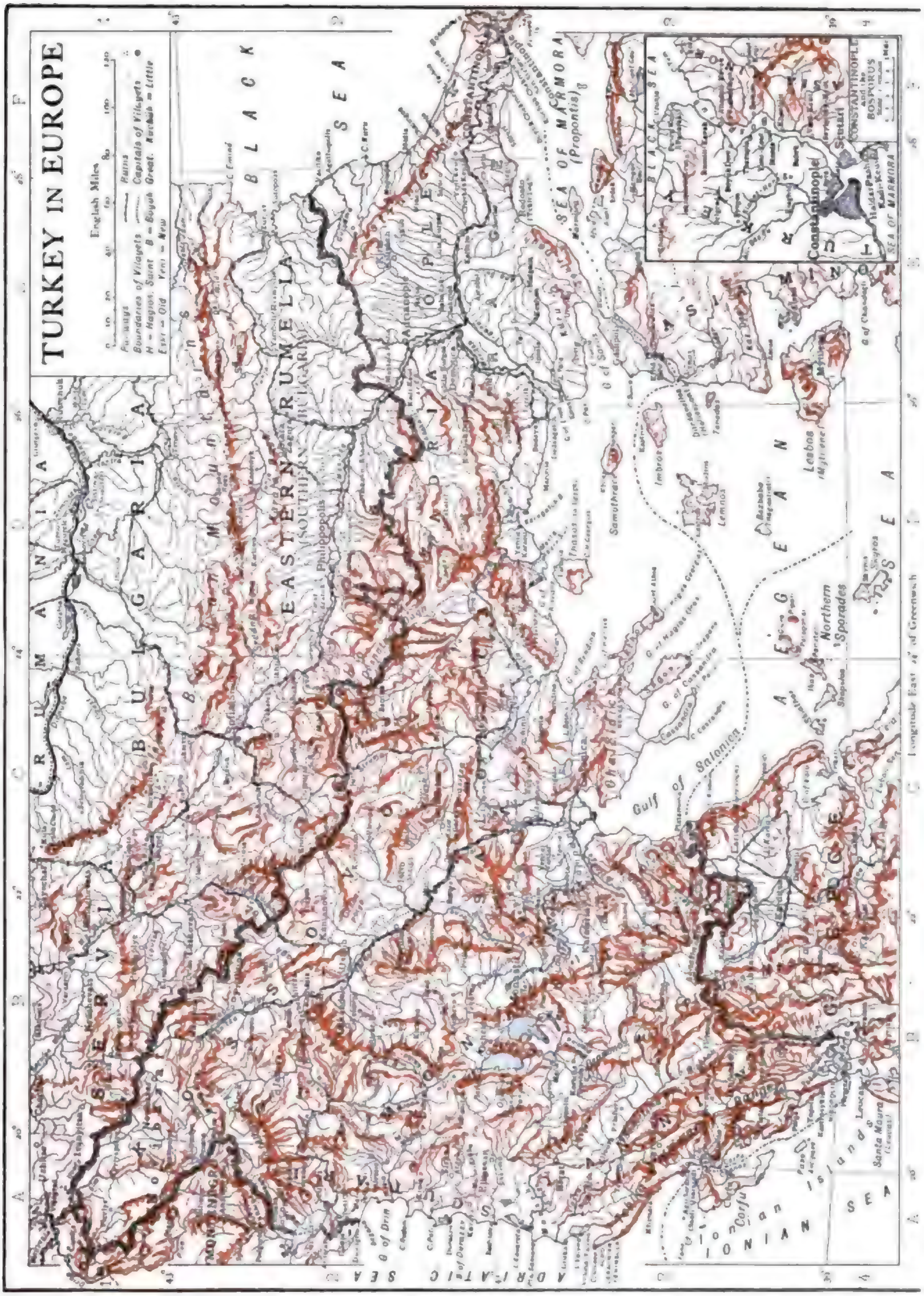
African Territories.—Turkey in Africa has gradually been reduced to Tripoli and Barca. Egypt, though nominally under Turkish suzerainty, has formed a practically independent principality since 1841, and has been *de facto* under British protection since 1881.

Population.—The total population of the Turkish Empire in 1910, including Egypt and other regions nominally under the sultan's suzerainty, was 36,323,539, averaging 25 to the square mile; in the provinces directly under Turkish government, 25,926,000.

The following towns have over 50,000 inhabitants each: Constantinople, 1,150,000; Smyrna, 250,000; Bagdad, 145,000; Damascus, 145,000, Aleppo, 122,000; Beirut, 118,000; Adrianople, 81,000; Brusa, 76,000; Jerusalem, 56,000; Caesarea Mazaca (Kaisarieh), 72,000; Kerbela, 65,000; Monastir, 53,000; Mosul, 61,000; Mecca, 60,000; Homs, 60,000; Sana, 58,000; Urfa, 55,000; and Marash, 52,000.

Race and Religion.—Exact statistics are not available as regards either race or religion. The Osmanlis or Turks (*q.v.*) are supposed to number some 10 millions, of whom 1½ million belong to Turkey in Europe. Of the Semitic races the Arabs—over whom, however, the Turkish rule is little more than nominal—number some 7 millions, and in addition to about 300,000 Jews there is a large number of Syrians. Of the Aryan races the Slavs—Serbs, Bulgarians, Pomaks and Cossacks—and the Greeks predominate, the other representatives being chiefly Albanians and Kurds. The proportion borne to one another by the different religions, as estimated in 1910, is: 50% Mussulman, 41% Orthodox, 6% Catholic, 3% all others (Jews, Druses, Nestorians, &c.). In the European provinces about two-thirds of the population are Christian and one-third Mahommedan. Full and fairly accurate statistics are available for a considerable portion of Asiatic Turkey. Out of a population of 13,241,000 (1896) in Armenia, Kurdistan and Asia Minor, 10,030,000 were returned as Mahommedans, 1,144,000 as Armenians, 1,818,000 as other Christians, and 249,000 as Jews. There are also about 300,000 Druses and about 200,000 Gipsies. The non-Mussulman population is divided into *millets*, or religious communities, which are allowed the free exercise of their religion and the control of their own monasteries, schools and hospitals. The communities now recognized are the Latin (or Catholic), Greek (or Orthodox), Armenian Catholic, Armenian Gregorians, Syrian, and United Chaldee, Maronite, Protestant and Jewish. The table on the following page, for which the writer is indebted to the kindness of Carolidi Effendi, formerly professor of history in the university of Athens, and in 1910 deputy for Smyrna in the Turkish parliament, shows the various races of the Ottoman Empire, the regions which they inhabit, and the religions which they profess.

Administration.—Until the revolution of 1908, with a very short interval at the beginning of the reign (1876) of the deposed sultan Abd-ul-Hamid, the government of Turkey had been essentially a theocratic absolute monarchy. It was subject to the direct personal control of the sultan, who was himself a temporal autocrat, which he now is not, and the most generally recognized caliph, that is, "successor," of the Prophet, and consequently the spiritual head of by far the greater portion of the Moslem world—as he still is. Owing principally to the fact that the system of the caliph Omar came to be treated as an immutable dogma which was clearly not intended by its originator, and to the peculiar relations which developed therefrom between the Mussulman Turkish conquerors and the peoples (principally Christian) which fell under their sway, no such thing as an Ottoman *nation* has ever been created. It has been a juxtaposition of separate and generally hostile peoples in territories bound under one rule by the military sway of a dominant race. Various endeavours have been made since the time of Selim III. (1789–1807), who initiated them, to break down the barriers to the formation of a homogeneous nation. The most earnest and



TURKEY IN EUROPE

English Miles
Railways
Boundaries of Vilayets
Capitals of Vilayets
Ruins
H = Hagios, Saint B = Buyuk, Great Kuchuk = Little
Eski = Old Yeni = New
RUMANIA
BULGARIA
SERVIA
MONTENEGRO
EASTERN RUMELIA
(SOUTHERN BULGARIA)
BLACK SEA
SEA OF MARMORA
(Propontis)
AEGEAN SEA
IONIAN SEA
ADRIATIC SEA
GREECE
ASIA MINOR
Gulf of Salonica
Northern Sporades
Lemnos
Lesbos
Samothrace
Imbros
Corfu
Ionian Islands
Constantinople
BOSPORUS
Longitude East 24° of Greenwich

Races.	Regions inhabited, or Vilayets.	Religions.
Albanians	Iannina, Scutari of Albania, Kossovo, Monastir	Mussulman, Orthodox, Catholic
Bulgarians	Salonica, Kossovo, Monastir	Orthodox (dissenting)
Servians	Kossovo	Orthodox
Greeks	Constantinople, Adrianople, Salonica, Monastir, Kossovo, Janina, Archipelago, Vilayets of Asiatic Turkey, (Hudavendighiar, Aidin, Konia, Angora, Kastamuni, Trebizond, Sivas, Adana Syria, Aleppo, Sanjak of Jerusalem) Crete	Orthodox and partly Greco catholic
Kutzo-Vlachs (See MACEDONIA)	Monastir, Iannina	Orthodox
Turks	The whole of European Turkey, Vilayets of Asia Minor, (Bitlis, Van, Mamuret-ul-Aziz, part of Mosul and certain islands of Vilayet of the Archipelago, of Cyprus, Crete)	Mussulman
Lazes	Trebizond and throughout the whole of Eastern Asia Minor	Mussulman and Orthodox
Kurds	Erzerum, Sivas, Seert, Angora, Mosul	Mussulman
Circassians	Spread over the whole of Asia Minor	Mussulman
Avchar	Adana, Angora, Sivas	Mussulman
Arabs	Adana, Aleppo, Syria, Bagdad, Sanjak of Jerusalem, Hejaz, Yemen, Beirut, Basna	Mussulman
Armenians	Constantinople and spread over the other Vilayets of Turkey in Europe; also Sivas, Angora, Trebizond, Adana, Erzerum, Bitlis, Mamuret-ul-Aziz, Mosul, Aleppo, Van	Gregorian and Catholic
Jews	Spread through Turkey in Europe and Asia, and largely congregated in the Sanjak of Jerusalem, and in the Vilayets of Bagdad, Mosul, Syria, Beirut.	Jew
Samaritans	Only in the Sanjak of Napluze (Vilayet of Beirut)	Samaritan Jew
Gipsies	Spread throughout the whole empire	Mussulman
Chaldaeans or Nestorians, speaking partly Syrochaldaic and partly Arabic (Syrochaldaic in their churches)	Bagdad, Mosul and partly Aleppo, Beirut and Mamuret-ul-Aziz	Nestorian Christian
Melchites, or Syrian Greco-Catholics (Greek in feeling, speaking Arabic)	Beirut, Aleppo, Syria	United Orthodox
Jacobite Syrians, speaking Arabic and partly Syrian (Syrian in their churches)	Beirut, Syria, Aleppo, Mosul, Mamuret-ul-Aziz	Monophysite and Jacobite
Monites (speaking Arabic and in their churches Syrian)	Mt Lebanon, Beirut	Monophysite (Catholic monothelite)
Druses	Mt Lebanon, Sanjak of Hauran	Druse
Mendaites or Ben-i-Yahya	Basra	Sabaean: or of the sect of the son of John the Baptist (Ben-i-Yahya) whom they regard as their only prophet.
Yezzites	Mosul, Bagdad, Basra	Yezzite (Mahommedan sect)

important of these attempts under Abd-ul-Mejid (1839-1861) proved, however, for various reasons abortive. So also did the "Midhat Constitution" promulgated by Abd-ul-Hamid almost immediately after his accession to the throne, owing largely to the reactionary spirit at that time of the *'Ulema* and of the sultan's immediate advisers, but almost, if not quite, in equal measure to the scornful reception of the Constitution by the European powers. The 'Ulema form a powerful corporation, whose head, the Sheik-ul-Islam, ranks as a state functionary almost co-equal with the grand vizier. Until quite recent times the conservative and fanatical spirit of the 'Ulema had been one of the greatest obstacles to progress and reform in a political system in which spiritual and temporal functions were intimately interwoven. Of late years, however, there has been a gradual assimilation of broader views by the leaders of Islam in Turkey, at any rate at Constantinople, and the revolution of 1908, and its affirmation in the spring of 1909, took place not only with their approval, but with their active assistance. The theoretical absolutism of the sultan had, indeed, always been tempered not only by traditional usage, local privilege, the juridical and spiritual precepts of the Koran and the *Sunnet*, and their 'Ulema interpreters, and the privy council, but for nearly a century by the direct or indirect pressure of the European powers, and during the reigns of Abd-ul-Aziz and of Abd-ul-Hamid by the growing force of public opinion. The enthusiastic spirit of reform which heralded the accession of the latter sultan never altogether died out, and from about the last decade of the 19th century has been rapidly and effectively growing in force and in method. The members and sympathizers of the party of reform who styled themselves "Young Turks," working largely from the European centres and from the different points in the Turkish Empire to which the sultan had exiled them for the purpose of repression—their relentless persecution by the sultan thus proving to be his own undoing—spread a powerful propaganda throughout the Turkish Empire against the old régime, in the face of that persecution and of the open and characteristic scepticism, and indeed of the hostile action, of some of the European powers. This movement came to a head in the revolution of 1908. In July of that year the sultan Abd-ul-Hamid capitulated to the Young Turks and restored by Iradé (July 24) the constitution which he had granted in December 1876 and suspended on the 14th of February 1878. A reactionary movement started in April 1909 was promptly suppressed by the Young Turks through the military occupation of Constantinople by Shevket Pasha and the dethronement of Abd-ul-Hamid, who was succeeded by his younger brother Reshad Effendi under the title of Mahommed V. A new constitution, differing from that of Abd-ul-Hamid only in some matters of detail, was promulgated by imperial Iradé of the 5th of August 1909.

In temporal matters the sultan is a constitutional monarch, advised by a cabinet formed of executive ministers who are the heads of the various departments of state, and who are responsible to the elected Turkish parliament. All Turkish subjects, of whatever race or religion, have equal juridical and political rights and obligations, and all discrimination as to military service has been abolished. The sultan remains the spiritual head of Islam, and Islam is the state religion, but it has no other distinctive or theocratic character. The grand vizier (*sadr-azam*), who is nominated by the sultan, presides *ex officio* over the privy council (*mejliss-i-khass*), which, besides the Sheikh-ul-Islam, comprises the ministers of home and foreign affairs, war, finance, marine, commerce and public works, justice, public instruction and "pious foundations" (*evkaf*), with the grand master of ordnance and the president of the council of state.

For administrative purposes the immediate possessions of the sultan are divided into vilayets (provinces), which are again subdivided into sanjaks or mutessarifliks (arrondissements), these into kazas (cantons), and the kazas into nahiés (parishes or communes). A vali or governor-general, nominated by the sultan, stands at the head of the vilayet, and on him are directly dependent the kaimakams, mutassarifs, deftardars and other administrators of the minor divisions. All these officials unite in their own persons the judicial and executive functions, under the "Law of the Vilayets," which made its appearance in 1861, and purported, and was really intended by its framers, to confer on the provinces a large measure of self-government, in which both Mussulmans and non-Mussulmans should take part. It really, however, had the effect of centralizing the whole power of the country more absolutely than ever in the sultan's hands, since the Valis were wholly in his undisputed power, while the *ex officio* official members of the local councils secured a perpetual Mussulman majority. Under such a system, and the legal protection enjoyed through it by Ottoman functionaries against evil consequences of their own misdeeds, corruption was rife throughout the empire. Foreigners settled in the country are specially protected from exactions by the so-called Capitulations (*q.v.*), in virtue of which they are exempt from the jurisdiction of the local courts and amenable for trial to tribunals presided over by their respective consuls. Cases between foreigners of different nationalities are heard in the court of the defendant, and between foreigners and Turkish subjects in the local courts, at which a consular dragoman attends to see that the trial is conducted according to law. (See further, as regards Turkish administration, the account given under *History* below, regarding the reforms instituted under the sultan Abd-ul-Mejid in 1839.)

Education.—The schools are of two classes: (1) public, under the immediate direction of the state; and (2) private, conducted either by individuals or by the religious communities with the permission of the government, the religious tenets of the non-Mussulman population being thus fully respected. State education is of three degrees: primary, secondary and superior. Primary education is gratuitous and obligatory, and superior education is gratuitous or supported by bursaries. For primary education there are three grades of schools: (1) infant schools, of which there is one in every village; (2) primary schools in the larger villages; (3) superior primary schools. Secondary education is supplied by the grammar school, of which there is one in the capital of every vilayet. For superior education there is (1) the university of Constantinople, with its four faculties of letters, science, law and medicine; and (2) special schools, including (*a*) the normal school for training teachers, (*b*) the civil imperial school, (*c*) the school of the fine arts and (*d*) the imperial schools of medicine.

Public instruction is much more widely diffused throughout the empire than is commonly supposed. This is due partly to the Christian communities, notably the Maronites and others in Syria, the Anatolian and Rumelian Greeks, and the Armenians of the eastern province and of Constantinople. Under the reformed constitution (Aug. 5, 1909) education is free, and measures have been taken largely to extend and to co-ordinate the education of all "Ottomans," without prejudice to the religious educational rights of the various religious communities. Primary education is obligatory. Among the Christians, especially the Armenians, the Greeks of Smyrna and the Syrians of Beirut, it has long embraced a considerable range of subjects, such as classical Greek, Armenian and Syriac, as well as modern French, Italian and English, modern history, geography and medicine. Large sums are freely contributed for the establishment and support of good schools, and the cause of national education is seldom forgotten in the legacies of patriotic Anatolian Greeks. Much educational work has also been done by American colleges, especially in the northern provinces of Asia Minor, in conjunction with Robert College (Constantinople).

Army.—In virtue of the enactments of May 1880, of November 1886, of February 1888 and of December 1903, military service had been obligatory on all Mussulmans, Christians having been excluded but under obligation of paying a "military exoneration tax" of £T50 for 135 males between the ages of 15 and 75. Under the new régime this system, which had greatly cramped the military strength and efficiency of the Ottoman Empire, has been changed, and all "Ottomans" are now subject to military service. Under certain conditions, however, and on payment of a certain exoneration tax, exemption may still be purchased. The revision of the whole military system was undertaken in 1910, especially as regards enrolment and promotion of officers, but, as things then stood, the term of service was twenty years (from the age of 20 to the age of 40), for all Ottoman male subjects: active service (*muasaff*) nine years, of which three with the colours (*nizam*), in the case of infantry, four in the case of cavalry and artillery; six and five respectively in the reserve (*ikhtiat*); Landwehr (*redif*) nine years; territorial (*mustahfiz*) two years. In case of supreme necessity all males up to 70 years of age can be called upon to join the colours. There are certain recognized rights to exemption from military service, such as some court officials, state officials, students in normal schools, medicine and law colleges, &c. The redifs form the principal part of the army in time of war, and are divided into two classes: *Class I.* comprises all men in the service who have completed their time with the nizam. In peace-time it is composed of weak *cadres*, on which falls the duty of guarding magazines and stores, and of carrying through musketry instruction and drill of the rank and file of the ikhtiat and the redif. *Class II.* was first established in 1898 under the name of *ilaweh*, and became "redif, class II." in 1903. This class is distributed in very weak cadres in time of peace. In time of war, it is completed by all troops not serving with the nizam, the redif class I. or the mustahfiz. As the organization proceeded, and stronger cadres were formed, the redif class II. would become completely absorbed in class I. The mustahfiz have no cadres in peace-time.

The army is divided into seven army-corps (*ordus*), each under the command of a field marshal, and the two independent commands of Tripoli (Africa) and the Hejaz. The headquarters of the ordus are I., Constantinople; II., Adrianople; III., Salonica; IV., Erzerum; V., Damascus; VI., Bagdad; VII., Yemen; 15th division, Tripoli; 16th division, Hejaz. Only the first six army-corps have, however, their proper establishment: the seventh ordu and the commands of Tripoli and the Hejaz have only garrison troops, and are fed by drafts from the first six ordus. Each ordu territory, from I. to VI., is composed of 8 redif brigade districts of 2 regimental districts of 4 battalion districts apiece, each ordu thus counting 64 battalion districts. The total strength of the Ottoman army in 1904 was returned at 1,795,350 men all told, made up as follows: (1) Active (4 years' service) 230,408 (called), reserve (ikhtiat) 251,511 (called), total 481,919; (2) nizam (class I., completely trained) 237,026 (called); (3) redif (class II., not completely trained), from 21–29 years old, 585,846; from 30–38 years old, 391,563; total 977,409 (uncalled); (4) mustahfiz, trained 53,715 (called), untrained 40,286 (uncalled), total 94,001.

The strength of the different arms is given as follows:—

Infantry.—79 nizam infantry regiments 1 to 80 (4 is missing), each regiment consisting of four battalions of four companies apiece. Allowing for certain battalions unformed, there are altogether 309 nizam battalions; 20 separate chasseur battalions, of four companies each; 4 special chasseur battalions stationed on the Bulgarian frontier—total, 333 battalions in the first line. There are 96 infantry battalions of redif class I.; each regiment composed of 4 battalions—total 384 battalions. (In 1904 the 4th battalion of the 94th regiment, and regiments 95 and 96 had not yet been formed, but, it was stated, had by 1910 been made good.) The projected strength of redif class II. was 172 regiments of 4 battalions each—total, 688 battalions. At the end of 1904 the organization of this class was stated as completed in Turkey in Europe at 40 battalions with a total of 160 regiments: how far the organization had progressed in 1910 in Asiatic Turkey was not known.

The following table shows the war strength of battalions, and the total war strength of the infantry arm:—

Class.	War Strength of Battalions.				Total War Strength of Infantry.			
	Officers.	N.C.O.'s and Men.	Draft Animals.	Rifles.	Officers.	N.C.O's and Men.	Draft Animals.	Rifles.
Special Chasseurs	26	800	200	650	520	16,000	4,000	13,000
Nizam	24	700	106	650	7,896	230,300	34,874	213,850
Redif I.	24	900	106	850	10,320	337,500	39,750	318,750
Redif II.	24	800	106	750	16,512	550,400	72,968	515,000
Mustahfiz	8–15	400–600	—	400–600	1,760	98,000	—	98,000

The troops are armed principally with Mauser repeating rifles (models 1887 and 1890) of which there are 1,120,000 issued and in store; there are also 510,000 Martini-Henry rifles in reserve.

Cavalry.—Cavalry of the Guard: 1 regiment "Ertogrul" or 5 squadrons, 2 regiments of hussars of 5 squadrons each, and 1 regiment of lancers of 5 squadrons. *Nizam Cavalry*: 38 regiments of 5 squadrons each, or 190 squadrons in all.

Redif Cavalry.—12 regiments of 4 squadrons each, or 48 squadrons in all, attached to the first three ordus. It was further proposed to appoint one regiment of redif cavalry to each redif division. On war footing the strength of a squadron of cavalry is 6 officers, 100 men, 80 horses (Ertogrul—140 men, 135 horses). The nizam cavalry is incorporated with the first six ordus, one cavalry division of 3 brigades of 2 regiments each being appointed to each ordu. The redif cavalry is not organized with large units, and in time of war would be employed as divisional troops. The total war strength of the cavalry is 54 regiments (210 squadrons); 1580 officers, 26,800 men, 21,900 horses. The cavalry is armed with repeating carbines (the N.C.O.'s with repeating revolvers) and swords.

Artillery.—From ancient times the artillery has formed an altogether independent command in the Turkish army. The grand master of ordnance is co-equal with the minister of war, and his department is classed separately in the budget; the artillery establishments, parts of the infantry and of the technical corps, and even hospitals are placed under his direct orders. The artillery is divided into (*a*) field artillery, horse artillery, mountain artillery and howitzer regiments; (*b*) fortress artillery; (*c*) artillery depôts. All artillery troops are nizam: there is no second line. On principle an ordu would have with it 30 batteries of field artillery, 3 batteries of horse artillery and 3 batteries of mountain artillery, or in all 36 batteries with 216 guns, all batteries being 6 guns strong. But the unequal strength of the ordus and political and other reasons have prevented this organization from being carried out.

On war-footing each field battery has 4 officers, 100–120 N.C. officers and men, 100–125 horses and draught animals, 3–9 ammunition wagons; each horse battery, 4 officers, 120 N.C. officers and men, 100 horses, &c., 3 ammunition wagons; each mountain battery, 3 officers, 100 N.C. officers and men, 87 horses, &c.; each howitzer battery, 4 officers, 120 N.C. officers and men, 100 horses, &c., 3 ammunition wagons.

In 1904 the total strength of the artillery was given as 198 field batteries (1188 guns), 18 horse batteries (108 guns), 40 mountain batteries (240 guns) and 12 howitzer batteries (72 guns): total 268 batteries (1608 guns). The guns are of various Krupp types. The ammunition train counts 1254 wagons. On a war-footing the strength of the artillery troops is 1032 officers and 29,360 men.

Technical Troops.—These are formed into battalions of pioneers, railway troops, telegraph troops, sappers and miners, &c.; in all 11 battalions (55 companies) numbering 245 officers and 10,470 men. Other non-combatant troops, such as military train, medical corps, &c., are undergoing reorganization. (For the history of the Turkish army, see ARMY, § 98.)

Navy.—The Turkish sea-power, already decayed owing to a variety of causes (for the effect of the revolt of the Greek islanders see GREEK INDEPENDENCE, WAR OF), was shattered by the catastrophe of Sinope (1853). Abd-ul-Aziz, however, with the aid of British naval officers, succeeded in creating an imposing fleet of ironclads constructed in English and French yards. Sultan Abd-ul-Hamid, on the other hand, pursued a settled policy of reducing the fleet to impotency, owing to his fear that it might turn against him as it had turned against Abd-ul-Aziz. He added, it is true, a few torpedo boats and destroyers, but he promptly had them dismantled on arrival at Constantinople. These now refitted, a cruiser ordered from Cramp's shipyard (America) and another from W. G. Armstrong, Whitworth & Co., and the battleship "Messudiyeh" (9100 tons displacement) reconstructed by the firm of Ansaldo (Genoa) in 1902, and re-armed by Vickers, Sons & Maxim, formed the only really effective war-ships at the disposal of Turkey in 1910, although a few armoured ships in addition might still serve for coast defence at a pinch, and a few more for training ships. Taking all into account, the available strength of the fleet might be put at 7 armour-clad ships, of which the "Messudiyeh" was one, the six others varying in displacement from 2400 to 6400 tons; two cruisers (unarmoured) of 3800 tons displacement; some 18 gunboats; 12 destroyers, 16 first-class torpedo boats and 6 second-class torpedo boats. There were also two Nordenfeldt submarine boats of doubtful efficiency.

Up to 1908 the personnel was found by yearly drafts of two to three thousand men from army recruits designated by the minister of war; the term of service was 12 years, of which 5 were in the first line, 3 in the reserve, 4 in the coastguard. The peace cadres (including 2 battalions of marines and 4 battalions of mechanics) were supposed to comprise 12,500 men on peace-footing, to be increased on declaration of war to 37,000; but these cadres were mainly on paper.

Under the "new régime" the Turkish government displayed commendable energy in reconstructing and reorganizing the sea-power of the empire. New construction to an amount of £T5,000,000, repayable over ten years at the rate of £T500,000 a year by national subscription guaranteed by the government, had by 1910 been voted by parliament. The programme of construction which this initial expenditure was to cover was fixed at two battleships of about 16,000 tons displacement, one armoured cruiser of about 12,000 tons displacement, some few auxiliary vessels (destroyers and gunboats), and a floating dock to lift about 17,000 tons. The main armament of the battleships was to be three pairs of 12-in. guns in three turrets, and three pairs of 9·2-in. in three turrets. The secondary armament was to be sixteen 4-in. Q.F. guns, and a few smaller guns (boat and field). The armoured cruiser was to carry four pairs of 9·2-in. guns in four turrets as main armament, and fourteen 4-in. Q.F. guns, and a few boat and field guns as secondary armament. British naval officers were engaged for training the personnel, and to assist in the reorganization of the fleet.

Communications.—A considerable hindrance to the development of the empire's resources has been the lack of an adequate system of communications; but although it is still deficient in good roads, much has been done of late years to develop railways, extend canals and improve river communications. From 1250 in 1885, of which 903 were in Europe and 347 in Asia, the mileage of railways had increased to some 4440 in 1909, of which 1377 are in Europe, 1810 in Asia Minor, 418 in Syria and 835 fall to the share of the Hejaz railway, including the Ed-Dera-Haifa branch. The construction of this last line is one of the most remarkable achievements of the reign of Abd-ul-Hamid. It may be said to be an absolutely autocthonous enterprise, no recourse having been had to foreign capital to find the means requisite for construction and equipment, which were provided by means of a "national subscription"—not entirely voluntary—and from other sources which, although the financial methods were not strictly orthodox, were strictly Turkish. The line was designed, surveyed and constructed by Turkish engineers—employing Ottoman navvies and labourers—in a highly efficient and economical manner, the average cost per mile having been £3230, although considerable engineering difficulties had to be overcome, especially in the construction of the Haifa branch. The line, stations, sheds and stores are all solidly built, and the rolling stock is sufficient and of the best quality (see further under *Finance*, below).

Production and Industries.—The Ottoman Empire is renowned for its productiveness, but enterprise and skill in utilizing its capabilities are still greatly lacking. For the introduction of improvements something, however, was done by the creation in 1892 of a special ministry of agriculture, to which is attached the department of mines and forests, formerly under the minister of finance. Since the year named an agricultural bank has been established, which advances money on loan to the peasants on easy terms. Schools of agriculture have been opened in the chief towns of the vilayets, and in connexion with those schools, and elsewhere throughout the empire, model farms have been instituted, where veterinary instruction can also be obtained.

To prevent the gradual destruction of the forests by unskilful management and depredations, schools of forestry have been founded, and means have been taken for regulating the cutting of wood and for replanting districts that have been partially denuded. About 21 millions of acres are under wood, of which over 3 millions are in European Turkey.

Wheat, maize, oats, barley and rye are the chief agricultural products. The culture of cotton is making rapid progress, immigrants who receive a grant of land being obliged to devote one-fourth of it to cotton culture. Tobacco is grown all over the empire, the most important market for it being Smyrna. Opium is mainly grown in Anatolia. All the more common fruit-trees flourish in most districts. In Palestine and elsewhere there is a large orange trade, and Basra, in Turkish Arabia, has the largest export of dates in the world. The vine is largely cultivated both in Europe and Asia, and much Turkish wine is exported to France and Italy for mixing purposes. The chief centres of export are Adrianople (more than half), Constantinople and Smyrna, the others being Brusa, Beirut, Ismid, Mytilene and Salonica. Under the auspices of the Ottoman public debt administration silk culture is also carried on with much success, especially in the vilayets of Brusa and Ismid. In 1888 a school of sericulture was founded by the public debt administration for the rearing of silkworms according to the Pasteur method. The production of salt is also under the direction of the public debt administration. About a fourth of the salt produced is exported to foreign countries, and of this about three-fourths goes to British India. Since 1885 great attention has been paid to the sponge fisheries of Tripoli, the annual value of which is about £30,000. With its extensive sea-coast, and its numerous bays and inlets, Turkey has many excellent fishing-grounds, and the industry, the value of which is estimated at over £200,000 a year, could be greatly developed. Its general progress may be seen in the increase of the fishery revenue—derived from duties, permits, &c.—of the public debt administration. Among other important productions of the Ottoman Empire are sesame, coleseed, castor oil, flax, hemp, aniseed, mohair, saffron, olive oil, gums, scammony and liquorice. Attar of roses is produced in large quantities both in European and Asiatic Turkey, and to aid in furthering the industry numerous rose plants are distributed gratuitously. The empire is rich in minerals, including gold, silver, lead, copper, iron, coal, mercury, borax, emery, zinc; and only capital is needed for successful exploitation. The silver, lead and copper mines are mainly worked by British capital. The more special industries of Turkey are tanning, and the manufacture of muslin, velvet, silk, carpets and ornamental weapons.

Shipping and Commerce.—The figures obtainable with respect to shipping are approximate, the statistical data not being altogether complete. In 1890–1891 the number of steamers that entered and cleared Turkish ports was 38,601, and of sailing vessels 140,726, the total tonnage of both classes of vessels being 30,509,861. In 1897–1898 the number of steamers was 39,680 of 32,446,320 tons, the number of sailing vessels being 134,059 of 2,207,137 tons, thus giving a total tonnage of 34,653,457. In 1904–1905 the number of steamers was 49,235 of 44,180,000 tons, and of sailing vessels 133,706, with a tonnage of 2,506,000 tons, the total tonnage being thus 46,686,000 tons. In 1909 the total tonnage was 43,060,515. About a third of the tonnage belongs to British vessels. The number of steamships belonging to Turkey in 1899–1900 was 177 of 55,938 tons, as compared with 87 of 46,498 tons in 1897–1898, the number of sailing vessels in the same years being respectively 2205 of 141,055 tons and 1349 of 252,947 tons. The following tables show the total value of exports and imports arranged according to countries of origin or destination for 1905–1906 and 1908–1909; the same information for the year 1905–1906 with respect to the principal ports of the empire, and the tonnage of vessels cleared thereat during the year 1908–1909; and the value of the principal articles imported and exported for the year 1905–1906.

Value of Principal Articles Imported and Exported for the year 1905–1906.

Nature of Goods.	Imports.	Exports.
	£	£
Barley	—	658,462
Rice	944,950	—
Opium	—	639,630
American Cloth	1,404,803	—
Grapes	—	2,065,642
Figs	—	791,473
Cotton	—	449,628
Valonia	—	548,442
Crude Iron and Iron Bars	432,091	—
Sheepskins and Goatskins	—	528,282
Carpets, &c.	506,353	478,991
Flour	995,165	—
Cotton Thread	1,287,243	—
French Beans, Chick Peas and Beans	—	508,441
Cashmere Cloth	561,246	—
Coffee	830,325	—
Madapollam	916,715	—
Ores	—	486,037
Wool	—	439,066
Woollen Fabrics	785,622	—
Eggs	—	441,282
Cotton Print (Calico)	2,014,968	—
Tiftik (Silk-waste)	—	801,755
Cocoons	—	970,169
Petroleum	909,735	—
Sugar	2,263,928	—

Value of Goods Imported into, and Exported from, together with Number and Tonnage of Vessels cleared at, Principal Ports of Turkish Empire.

Port.	Value of the Goods Imported into, or exported from, Turkey, during the year 1905–1906.		Table indicating the number of Vessels, (Steamships and Sail-Boats), and Tonnage, cleared at the following ports of the Ottoman Empire, in the year 1908–1909.	
	Imports.	Exports.	Number of Vessels	Tonnage.
	£	£		
Constantinople	8,470,095	1,381,432	17,792	16,214,947
Dependencies of Constantinople	673,699	2,453,758	—	—
Smyrna	3,724,525	5,722,273	5,888	2,989,863
Beirut	3,568,437	1,578,691	3,076	1,740,312
Salonica	3,111,957	1,650,552	2,962	1,151,273
Prevesa	358,586	259,585	—	—
Yemen	603,731	259,553	—	—
Jidda	801,927	26,154	—	—
Adrianople	587,653	585,810	—	—
Bagdad	1,510,430	777,402	—	—
Alexandretta	1,669,231	887,326	685	676,137
Tripoli in Africa	565,331	328,164	575	376,214
Trebizond	1,507,771	1,083,515	1,389	776,698
Scutari, Albania	257,397	135,850	—	—
Erzerum	103,280	96,405	—	—
Basra	—	—	—	—
Kavala	—	—	1,410	283,256
Samsun	—	—	1,064	976,803
Tripoli in Syria	—	—	1,306	919,222
Jaffa	—	—	1,241	1,210,261
Chios	—	—	2,732	915,880
Aivali	—	—	1,489	124,804
Dedeagatch [1]	—	—	404	50,469
Total	27,514,050	17,256,470		

Value of the Goods Imported from or Exported to Principal Countries during the years 1905–1906 and 1908–1909.

Country of Origin or Destination.	Imports from				Exports to			
	1905–1906		1908–1909		1905–1906		1908–1909	
	Amount	%	Amount	%	Amount	%	Amount	%
	£		£		£		£	
England	9,641,931	35·05	8,256,793	29·96	5,552,703	32·18	4,506,344	27·86
Germany	1,162,538	4·22	1,697,957	6·16	1,076,929	6·24	1,008,750	6·23
Austria-Hungary	5,715,914	20·77	3,574,724	12·96	1,874,827	10·87	2,173,453	13·43
Italy	2,145,789	7·79	2,150,064	7·79	872,641	5·06	883,358	5·46
Spain	118	—	15,588	0·06	21,827	0·13	17,332	0·10
Persia	643,641	2·34	485,887	1·77	57,443	0·33	82,530	0·51
Switzerland	63,324	0·23	105,026	0·39	640	—	3,056	0·02
United States	252,247	0·92	360,446	1·30	431,684	2·50	616,951	3·81
Belgium	865,040	3·15	762,543	2·76	427,998	2·48	152,517	0·94
Denmark	33	—	—	—	201	—	—	—
Russia	1,596,631	5·80	2,187,868	7·94	520,916	3·02	504,291	3·13
Rumania	697,631	2·54	1,107,120	4·01	350,876	2·03	336,663	2·08
Japan	1,821	—	2,374	0·01	214	—	—	—
Servia	89,329	0·33	441,050	1·60	172,220	0·99	86,602	0·53
Holland	524,116	1·91	555,972	2·01	509,688	2·96	220,489	1·36
France	2,341,086	8·51	2,956,643	10·72	4,220,006	24·46	3,187,376	19·72
Montenegro	2,928	0·01	6,633	0·02	24,686	0·15	20,228	0·12
Greece	492,037	1·79	347,287	1·26	476,829	2·76	382,484	2·37
Egypt	812,466	2·96	1,019,952	3·70	—	—	1,453,274	8·98
Bulgaria	409,727	1·49	1,188,981	4·31	663,139	3·84	498,414	3·09
Samos	1,210	0	181,965	0·66	—	—	10,319	0·08
Tunis	54,495	0·19	47,524	0·17	—	—	2,363	0·01
Other Countries			119,738	0·44	—	—	27,833	0·17
	£27,514,052	100·00	£27,572,135	100·00	£17,255,467	100·00	16,174,627	100·00

The revenues produced by the customs duties for the five years 1905–1906 to 1909–1910 are as follows:—

Year.	Export Duties.	Import Duties.	Total.
	£	£	£
1905–1906	160,037	1,928,957	3,088,994
1906–1907	151,677	2,260,382	2,412,059
1907–1908	143,210	2,704,347	2,847,557
1908–1909	143,378	3,138,534	3,281,912
1909–1910	162,252	3,533,405	3,695,657

FINANCE

Preliminary Sketch.—From the outset of their history the Osmanli Turks adapted to their own needs most of the political, economic and administrative institutions which existed before them. Primarily their system was based on the great principles enunciated by the immediate successors of the Prophet, especially by Omar, involving the absolute distinction between, and impartiality of treatment of, the Mussulman conquerors and the races which they conquered; and from this point of view a careful study of the financial history of Turkey will afford most valuable insight into the Eastern Question.

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[1] As Dedeagatch is gaining, and will gradually gain, importance, it has been included in this table.

In reward for the brilliant services rendered him by Ertoghrul (the father of Osman) and by Osman himself, Ala-ud-din, the last of the Seljuk sultans, conferred certain provinces in fief upon these two great warriors. They in their turn distributed the lands so acquired among their sons and principal emirs on strictly feudal principles, the feudatory lands being styled *siamet* and *timar*, a system long continued by their successors in regard to the territories which they conquered. The conquered peoples fell into an inferior caste, made to work for, and to pay for the subsistence of, their conquerors, as under the Arab domination; the principal taxes exacted from them were the *kharaj*, a tax of indeterminate amount upon realty, based on the value of lands owned by unbelievers—(in contradistinction to the tithe [*âshâr*] which was a tax of fixed amount upon lands owned by believers)—and levied in payment of the privilege of gaining means of existence in a Mussulman country, and the *jisiyé*, a compulsory payment, or poll-tax, to which believers were not subjected, in lieu of military service. The conquerors were feudatories of the reigning prince or sultan, and their payments consisted principally in providing fighting forces to make up the armies of the prince. The *kharaj*, the *jisiyé*, and the whole feudal system disappeared in theory, although its spirit, and indeed in some respects its practice, still exists in fact, during the reforming period initiated by Sultan Selim III., culminating in the Tanzimat-i-Khairiyé (1839) of Abd-ul-Mejid, and the Hatt-i-Humâyun issued by the same sultan (1856). The administration of the state revenues was managed by a government department known as the Beit-ul-Mal or Maliyé, terms generally employed throughout Islamic countries since the commencement of Islam. But the entire financial authority resided in the sultan as keeper, by right, of the fortune of his subjects. The public revenues were passed under three principal denominations: (1) the public treasury; (2) the reserve, into which was paid any surplus of revenues over expenses from the treasury; (3) the private fortune (civil list) of the prince. Expenditure, as under the Seljuk sultans, was defrayed partly in cash, partly in "assignations" (*havalé*).

The Osmanli sultans, as also the Mamelukes and the Seljuks, were accustomed to give *largesse* to their military forces on their accession to the throne, or on special occasions of rejoicing, a custom which still is practised in form, as for instance on the first day of the year, or the birthday of the Prophet (*mevlûd*). Largesse was especially given on the field of victory, and was, moreover, liberally distributed to stifle sedition and mutiny among the troops, the numerical strength of which was continually increased as the empire enlarged its borders. This vicious system, grafted as it was upon an inefficient administration, and added to the weight of a continually depreciated currency, debased both by ill-advised fiscal measures and by public cupidity, formed one of the principal causes of the financial embarassements which assailed the treasury with ever increasing force in the latter part of the 16th and during the 17th and 18th centuries. The Turkish historian, Kutchi Bey, attributes the origin of the decline of the empire to the reign of Suleiman the Magnificent (1520–1566), when the conversion of many *emiriyé* lands into *vakufs* was effected, and the system of farming out revenues first introduced. Impoverished by these different causes, as well as by prodigal extravagance in interior expenditure, by shameless venality among the ruling classes, and by continual wars, of which the cost, whether they were successful or not, was enormous, the public treasury was frequently empty. So long as the reserve was available it was drawn upon to supply the void; but when that also was exhausted recourse was had to expedients, such as the borrowing, or rather seizure, of the *vakuf* revenues (1622) and the sale of crown properties; then ensued a period of barefaced confiscation, until, to restore public confidence in some measure, state budgets were published at intervals, viz. the partial budget of Ainy-Ali (in 1018 or A.D. 1609), the budget of Ali Aga (in 1064, or 1653) and that of Eyubi Effendi (in 1071, or 1660). At this time (1657–1681) the brilliant administration of the two Kuprilis restored temporary order to Ottoman finance. The budget of Eyubi Effendi is particularly interesting as giving the statement of revenue and expenditure for an average year, whereas the budget of Ainy-Ali was a budget of expenditure only, and even in this respect the budget of Eyubi Effendi is far more detailed and complete. The budget of Ali Aga is almost identical with that of Eyubi Effendi, and is worthy of special note for the conclusions which accompanied it, and which although drawn up 250 years ago, described with striking accuracy some of the very ills from which Turkish finance was suffering throughout the reign of Abd-ul-Hamid.

Apart from unimportant modifications, the form of the budget must have remained unchanged until the organic reforms of Selim III., while its complete transformation into European shape dates only from the year 1278 (1862), when Fuad Pasha attached a regular budget to his report on the financial situation of the empire. Since that time there had been no further change worth noting until the "new régime" was established in 1908. Although the publication of the budget had only taken place at very irregular intervals, it must also be observed that the published budgets were by no means accurate. From the time of Eyubi Effendi until the end of the grand vizierate of Ibrahim Pasha (1730), the empire experienced periodical relief from excessive financial distress under the series of remarkable grand viziers who directed the affairs of state during that time, but the recovery was not permanent. Ottoman arms met with almost systematic reverses; both the ordinary and the reserve treasuries were depleted; a proposal to contract a foreign loan (1783) came to nothing, and the public debt (*duyun-i-umumiyé*) was created by the capitalization of certain revenues in the form of interest bearing bonds (*sehims*) issued to Ottoman subjects against money lent by them to the state (1785). Then came forced loans and debased currency (1788), producing still more acute distress until, in 1791, at the close of the two years' war with Russia, in which the disaster which attended Ottoman arms may be largely ascribed to the penury of the Ottoman treasury, Selim III., the first of the "reforming sultans," attempted, with but little practical success, to introduce radical reforms into the administrative organization of his empire. These endeavours were continued with scarcely better result by each of the succeeding sultans up to the time of the Crimean War, and during the whole of the period the financial embarrassment of the empire was extreme. Partial relief was sought in the continual issue of debased currency (*beshlik*, *altilik* and their subdivisions), of which the excess of nominal value over intrinsic value ranged between 33 and 97%, and finally paper money (*kaimé*) which was first issued in 1839, bearing an interest of 8%, reduced in 1842 to 6%, such interest being paid on notes of 500 piastres, but not on notes of 20 or 10 piastres, which were issued simultaneously. Finally, usage of paper money was restricted to the capital only, and in 1842 this partial reform of the paper currency was followed by a reform of the metallic currency, in the shape of an issue of gold, silver and copper currency of good value. The gold coins issued were 500, 250, 100, 50, and 25 piastres in value, the weight of the 100-piastre piece (Turkish pound), 7·216 grammes, ·916⅔ fine. The silver coins were of 20, 10, 5, 2, 1 and ½ piastre in value, the 20-piastre piece weighing 24·055 grammes, ·830 fine. The copper money was in pieces of a nominal value of 40, 20, 10, 5 and 1 paras, 40 paras being equal to 1 piastre. In 1851 further attempts were made to withdraw the paper money from circulation, but these were interrupted by the Crimean War, and the government was, on the contrary, obliged to issue notes of 20 and 10 piastres. Finally, at the outbreak of the Crimean War Turkey was assisted by her allies to raise a loan of £3,000,000 in London, guaranteed by Great Britain and France; in 1855 an organic law was issued regulating the budget, and in the same year a second guaranteed loan of £5,000,000 was contracted in Great Britain. In 1857 an interior loan of 150,000 purses in bonds (*eskam-i-mumtazé*), repayable in three years and bearing 8% interest, was raised; the term of repayment was, however, prolonged indefinitely. In the same year another series of bonds (*hazine tahvili*), bearing 6% interest, and repayable in 1861, was issued; in 1861 the term of reimbursement was prolonged until 1875. In 1858 a third loan was contracted in Great Britain for £5,000,000, and thereafter foreign loans followed fast on one another in 1860, 1862, 1863, 1864, 1865, 1869, 1872, 1873 and 1875, not to mention the two Egyptian tribute loans raised on Egyptian credit in 1871 and 1877. In 1859 the settlement of palace debts gave rise to the issue of 1,000,000 purses of new interior bonds (*eskam-i-jedidé*) spread over a period of three years, repayable in twenty-four years, and bearing interest at 6%. Further 6% bonds, repayable in ten years, and styled *serguis*, were issued in the same year. Seeing the rapid increase of the financial burdens of the state, a commission of experts, British, French and Austrian, was charged, (1860) with setting the affairs in order, and with their assistance Fuad Pasha drew up the budget accompanying his celebrated report to the sultan in 1862. Meanwhile *kaimé* was being issued in great quantities (about 60,000 purses a month) and fell to a discount (December 1861) of 75%. In 1862 further *sehims* were issued, and these and the loan of 1862 (£8,000,000) were devoted to the withdrawal of the *kaimé*. Later, however, the *kaimé* was again issued in very large amounts, and the years succeeding 1872 up to the Russian War (1877) presented a scarcely interrupted course of extravagance and financial disorder, the result of which is described below.

The Budget was supposed to be drawn up according to an excellent set of regulations sanctioned by imperial decree, dated the 6th of July 1290 (1875), of which the first article absolutely prohibited the increase, by the smallest sum, of any of the expenses, or the abandonment of the least iota of the revenues fixed by the budget. Under these regulations the revenues were divided into two categories, viz. the direct and the indirect. The first category included the "imposts" properly so called, the fixed contributions (*redevances fixes*) to be paid by the "privileged provinces," and the military exoneration tax. In the second were comprised tithes, mine-royalties, forests and domains, customs, sheep-tax, tobacco, salt, spirits, stamps and "various." The expenses were also divided into two categories—(1) "Periodic and fixed" expenditure, which admitted of neither reduction nor delay; and (2) the credits allowed to the various departments of state, which might be increased or diminished according to circumstances. The expenditure of the first category was made up of the service of foreign loans, of the general debt, of the dotations replacing *siamet* and *timarat* (military fiefs) and of fixed contributions such as *vakufs*. In the second category were included the imperial civil list, the departments of the Sheikh-ul-Islamât and of religious establishments, the ministries of the interior, war, finance, public instruction, foreign affairs, marine, commerce (including mines and forests), and public works, and, finally, of the grand master of ordnance. For every province (*vilayet*) a complete budget of receipts and expenditure was drawn up by its *defterdar* (keeper of accounts) under the supervision of the *vali* (governor); this budget was forwarded to the minister of finance, while each state and ministry of department received communication of the items appertaining to it. Each ministry and department then sent in a detailed budget to the Sublime Porte before the end of November of each year. (The Turkish financial year is from the 1st of March to the 28th of February o.s.). The Sublime Porte forwarded these budgets, with its own added thereto, to the minister of finance, who thereupon drew up a general budget of receipts and expenses and addressed it to the Sublime Porte before the 15th of December. This was summarily considered by the council of ministers, and then referred to the budget commission, which was to be composed not only of State functionaries, but of private persons "worthy of confidence, and well versed in financial matters," and which was invested with the fullest powers of investigation and inquiry. The report drawn up by the commission on the results of its labours was submitted to the Council of Ministers, which then finally drew up a general summary of the definitive budget and submitted it by *mazbata* (memorandum) for the imperial sanction. When this sanction had been accorded the budget was to be published. The remaining regulations set forth the manner in which extra-budgetary and extraordinary expenses were to be dealt with, and the manner in which the rectified budget, showing the actual revenues and expenditure as proved at the close of the year was to be drawn up with the assistance of the state accounts department (*divân-i-mouhassebât*). This rectified budget, accompanied by an explanatory memorandum, was examined by the budget commission and the Council of Ministers, and submitted for the imperial sanction, after receiving which it was ordered that both be published. Special instructions and regulations determined the latitude left to each department in the distribution of the credits accorded to it among its various heads of expenditure, the degree of responsibility of the functionaries within each department and the relations regarding finance and accounts between each department and its dependencies. These regulations provide carefully and well for all contingencies, but unfortunately they were only very partially carried out. It may indeed be said that it was only the *previsionary* budget (*anglicè*, the estimates) that received any approximately proper care on the lines laid down, while the rule that both the estimates and the definite budget (at the close of each year) should be published was almost wholly honoured in the breach; until 1909, when the Constitution had been re-established the budget had only twice been published, in 1880 and 1897, since the regulations were put into force. Not only were the budgets not published, but no figures whatever were allowed to transpire in regard to the true position of the Turkish treasury—which laid the accuracy of even the limited number of budgets published open to suspicion.

All this has now been changed, and the above regulations are conscientiously carried out with the differences in procedure necessary for compliance with constitutional methods, and with the submission of the Budget to the houses of parliament. The Budget is now published in full detail and that for the year 1326 (1910–1911), with the explanatory memorandum which prefaces it, is an admirable work, mercilessly exposing the financial shortcomings and sins of the previous system, or rather want of system, while unshrinkingly facing the difficulties which the present government has inherited. The account thus presented to us of what the previous confusion was, underlines and attests the summary exposition of it given in the last edition of this work. It was there stated that, on the most favourable estimate, the normal deficit of the Turkish treasury was £T2,725,000, (upwards of £T,1,700,000 below the truth as now declared) and the following observations were appended:—

"This budget represents the normal situation of Ottoman finance; it does not tally with the budget published in 1897, which was prepared with a special object in view, and was obviously full of inaccuracies, nor indeed does it agree with figures which could be officially obtained from the Porte. It is, however, compiled from the best sources of information, and it exaggerates nothing. The formidable deficit is met principally in three ways. (1) By leaving the salaries of state officials and the army unpaid. In many parts of the empire the soldiers rarely receive more than eight months' pay in the year, although in Constantinople the arrears are not so large. The reverse is the case with the civil officials, whose salaries in the provinces are paid more regularly than in Constantinople, owing to their being charged on the provincial budgets; the average arrears are from two to three months in Constantinople, and from one to three in the provinces. The arrears in civil and military salaries average annually about £T1,750,000. (2) By means of loans, both public and from individuals. By financial expedients of this kind payments were effected by the treasury in fifteen years (1881–1896) amounting to £T11,666,000 or at the rate of nearly £T800,000 per annum. (3) By anticipating the revenues of future years. This is the method so frankly condemned by Ali Aga, as was seen above, in 1653. Delegations (*havalè*) are granted on the provincial treasuries for one or two years in advance, sometimes for a series of years, in order to pay pressing debts too heavy to be met in a single payment. No better description of the financial distress and disorder of the empire can be given than that set forth in the official report of the budget commission of 1888. "It has hitherto been considered necessary owing to financial embarrassment, to commence financial years with unbalanced budgets. Later, without taking into consideration the effective amounts in cash at the disposal of the vilayets, considerable sums were drawn upon them, by means of *havalès*, out of proportion to their capacity. For these reasons, during the last two or three months of the financial year, the vilayets have not a para to remit to the central administration, and it has been considered imperatively necessary to draw on the revenues of the following year. Thus, especially during the last two years, urgent extraordinary expenses have been perforce partially covered by the proceeds of the ordinary revenues, the revenues of 1303 (1887) were already considerably anticipated in the course of 1302 (1886). The former year naturally felt the effect of this, and the tithes which should have been encashed in the last months of the year were discounted and spent several months in advance. Moreover, in order to meet to some extent the deficit arising as well from the accumulation of arrears of state departments since 1300 (1884) as, to a large degree, from gross deficiencies due to the neglect of the civil officials of the government to encash the revenues—to meet, further, the needs of the central administration, and above all, the urgent military expenses of the empire, and to provide a guarantee for bankers and merchants in business relations with the government and the treasury, part of the revenues of 1304 were perforce spent in 1303." This commission proved the deficit of the year to be £T4,370,000. It set out also at length the very defective and disorderly condition of the state accounts. During the finance ministry of Agop Pasha (1889 to 1894) a good deal was done to set matters in order, but most of the ground then gained has since been lost."

To this may be added a short extract from the Explanatory Preface to the Finance Bill for the year 1910–1911. After pointing out the immense difficulties which he had had to encounter owing to the absence of any regular accounts, and above all of any of "those statistics which constitute the soul, indeed the very life of a public administration," and that it was therefore impossible for him to pretend that he had been able to free himself altogether from the effects of the past, the minister continues; "every time we have endeavoured to have recourse to the previous elements of appreciation, we found ourselves faced by the chaos which characterized former years. We have sometimes ascertained things so strange that we cannot forbear expressing our astonishment at the idea that a great power such as ours could maintain itself under such conditions." M. Ch. Laurent, the financial adviser to the Turkish government, stated in a lecture on Turkish Finance, delivered in Paris on the 22nd of April 1910, that the Ministry of Finance has now been largely reorganized. Officials, he says, with grand titles and no responsible duties have been abolished, and departments with responsible chiefs created. The agents of the finance ministry, instead of being mere clerks, are now employed in "the assessment and collection of taxes, the control of expenditure, the preparation and execution of the budget, the estimates of the necessary cash required at different points of the empire—all that, in fine, constitutes the real financial administration of a great empire." Laurent points out that direct taxes furnish 54% of the revenues of the empire, that agriculture is accordingly very heavily taxed, and that the tax on realty is both excessive and unfairly administered. The summary history given above of the origin of the system of taxation prevailing in Turkey explains how this came about. Reform of this system, and, further, very necessary reforms of the methods of collection of the wines and spirits revenue (which is protection turned upside down, the home-growers being far more heavily taxed than importers), and of the customs (in which almost every possible administrative sin was exemplified), were also undertaken. Three bills, moreover, were presented to parliament, the first regulating Public Accountancy, the second regulating the Central Accounts Department, and the third the service of the Treasury. By this last the centralization of receipts and expenditure and the movement of funds in the provinces were to be confided to the Imperial Ottoman Bank, which extended and perfected its own organization for the purpose.

Passing now to the examination of the budget, it should be observed that the method of estimating the revenues—a matter of great difficulty owing to the previous want of method—is described by Laurent as follows: "For every nature of receipts the total effective collections for the five last known years were set out, the averages were taken of these and the increase or decrease of the yearly average of those same years was worked out and added to or deducted from the figure previously obtained. The only exception made to this rule was in the case of revenues showing a yearly increase, such as Post Office revenue, tobacco, salt, for which were taken the figures of 1323 (1907) increased by a certain average." The expenditure was arrived at in the manner previously described—and when the general budget came to be made up the severest pruning was found necessary, the original demands of the various ministries and departments having resulted in a deficit of upwards of £T9,000,000. It is thought better here, for the sake of clearness, to reserve observations on revenues specially assigned to the international administration of the Ottoman Public Debt, and on the expenditure of that administration, and to deal with that subject separately, while, however, including the total figures of both in the general figures in order to reproduce exactly the totals shown in the budget of the empire. The principal items of revenue and expenditure are as follows, the figures being taken from the published budget above-mentioned.

Revenue. Direct Taxes.[1]—The tax on realty (*verghi*) is estimated to yield £T2,599,420. Duties on profession (*temettü*) consist (*a*) of a fixed duty leviable at rates declared in a schedule forming part of the special law (Dec. 8, 1907) regulating the tax, and (*b*) of a proportional duty at the rate of 3 % on the value of buildings occupied by companies or individuals in the prosecution of their business; of 3 % on salaries (subject to certain deductions) of employés of such companies and individuals; and on government contractors and revenue farmers, at the rate of 3 % of 10 % of the value of contracts filled and of revenues farmed. The law is defective and unfair in its incidence, and it is not applicable to foreigners. The government promised in 1910 to remedy the law with the assent of the Great Powers, and, if successful in its negotiations, to present an amended law. The duties are estimated to produce £T393,107; other professional duties £T110,887—together £T503,994. A "Military Exoneration tax" is levied on male Ottoman subjects between the ages of 15 and 75 to the amount of £T50 for 135 persons—certain exceptions such as priests, religious orders, &c., are allowed. The estimated revenue from this source is £T1, 289,612. "Prestations" are payments in lieu of services (apart from military service) to the state, such as maintenance of highways, &c.—in effect, purchase of exoneration from forced labour. These duties vary in different parts of the empire: in the vilayets of Constantinople, Bagdad and Adrianople, and in the sanjaks of Bigha and Tchatalja the day's work is calculated at 5 piastres (about 11d.); in the vilayets of Aleppo, Trebizond, Angora, Iannina, Konia, Sivas and Kastamuni at 4 piastres (about 9d.); and in most other parts of the empire at 3 piastres (about 7d.). These taxes were formerly levied either in cash or in kind: it has now been decided to levy them in cash only, although this change was expected to cause some arrears. Allowing for these, the estimated revenue is £T553,938. The "tax on sheep, camels, buffaloes and hogs" (*aghnam*, meaning literally "sheep," but for taxing purposes the other animals are included under the same name), formed originally part of the "tithe." It was transformed long since into a fixed amount per head of the animals taxed, which amount varies according to the region in which the tax is levied, the highest tariff being in the sanjak of Jerusalem (7½ piastres) and the lowest in the Yemen (1 piastre). The estimated receipts are, from sheep £T1,799,720, from camels and buffaloes £T144,520, and from hogs £T8890, or together £T1,814,152. "*Tithes*" are the direct descendant of the *kharaj* already alluded to above. It should here be noted that, from the fiscal point of view, the reforms instituted at the commencement of the 19th century may be summarized thus. In permanent remuneration of certain services to be rendered to the state, the sovereign assigned to civil or military functionaries territorial regions for the purpose, and with the power, of collecting land taxes imposed by Mussulman and Imperial law, *i.e.* the *kharaj* or tithe, and transfer and succession duties. The tithes were originally based on one-tenth of the agricultural produce of the country, but this proportion was gradually raised under the euphemistic pretence of "public instruction," but really, under financial pressure, to 12 % and again in 1900 for military "equipments" (Tejhizāt-i-'Askeriyeh) by a further ½% to 12½%. This last surtax, which produces about £T90,000 per annum, was specially affected to a loan, known as the "Tejhizāt-i-'Askerieh of 1905," of £T2,640,000, by virtue of a contract between the government and the Deutsche Bank (April 17, 1905). The estimated receipts from the "Tithes" (including tobacco and silk, both hypothecated to the Public Debt Administration) are £T6,731,107. The remaining taxes under the category "direct" are the forest-dues (generally speaking 15 % of the value of wood cut), estimated to produce £T130,094; the mining dues (being a fixed duty of 10 piastres per 10,000 sq. metres of the superficial area covering the mine, and a proportional duty varying from 1 % to 20 % of the gross value of metal contained in the ore, according to the kind of metal and the method of extraction of the ore), £T45,141; and tax-papers (*Teskĕrĕs*), £T58,434. The total "direct taxes" (inclusive of tobacco and silk tithes) are thus estimated to amount to £T13,725,892.

Section II. of the budget is composed entirely of revenues from *stamp-duties*. Of these, commercial stamps are among the revenues specifically hypothecated to the Public Debt Administration, £T460,079; the others, consisting of legal stamps of various kinds, registration and transfer-duties, &c., are estimated to produce £T653,373 forming a combined total of £T1,113,452.

Under Section III. fall the "indirect contributions" as now reclassified. The first revenue specified among these in the budget is that accruing from the wine and spirit duties, which is again among those assigned to the Public Debt, £T283,079. Licenses for sale of Tumbĕki, a variety of Persian tobacco used for the *narghilĕ*, £T2046. By far the most important "indirect" revenue is that produced by the customs, consisting of import, export and transit duties, and various unspecified receipts. Under the old commercial treaties which lapsed about 1890—but which have been maintained "provisionally" in force until one or other of the great powers consents to set a term to the negotiation of fresh treaties—an *ad valorem* duty of 8 % was imposed on all articles imported into the Turkish empire. In 1905 financial resources had to be found for the special administration of the three European vilayets as insisted upon by the powers, and to this end the Porte initiated negotiations with the latter to increase the import duties by 3%. As is usual in Turkey, this opportunity was seized for the demand of redress of grievances by such powers as considered they had any, and the negotiations were protracted until July 1907, when France finally gave in her adhesion. Since then the import duties have been collected at the rate of 11 % *ad valorem* under the supervision of the Public Debt Administration, the bondholders having certain rights, under the decree of Muharem, described below, over any increase of revenue arising from modification of the commercial treaties. By the provisions of the "Annex Decree," also described below, three-quarters of the additional revenue is assigned to the Turkish government, and one-quarter to the Public Debt Administration to swell the sinking-fund. Fresh negotiations were also undertaken to increase the import-duties by a further 4% in order to balance the deficit shown in the budget. In the year 1910–1911 the import duties were estimated to produce £T3,980,395, the transit duties £T20,275, and the export duties (1% *ad valorem*, which it was hoped the government might soon afford to abolish) £T168,993—total customs revenue, £T4,217,752. The remaining "indirect contributions" are port and lighthouse dues, £T148,426. Sanitary taxes, £T20,519, and fisheries and sporting licenses affected to the service of the public debt, £T153,990. The revenues figuring under "indirect contributions" thus reach a total of £T4,825,812.

Monopolies form Section IV. of the budget, and include in the first place the salt revenue (£T1, 227,750), which is assigned to the Public Debt Administration, and tobacco revenues of which the larger part, £T865,737, is assigned to the same administration, the total (including share of Tumbĕki profit) producing £T965,754; the remaining monopolies are: fixed payment from the Tumbĕki Company, £T40,000; explosives, £T106,323; seignorage (Mint), £T10,466; and posts and telegraphs, £T912,129. The "Monopolies" thus render a total revenue of £T3,262,424.

Section V. includes receipts from commercial and industrial undertakings belonging to the state These are the Hejaz railway, £T152,000; the Dolma-Bagtchĕ gas-works, £T59,130; technical school, £T8536; the Tigris and Euphrates steamships, £T62,513; and mines (Heraclea coal and other), £T120,710; forming a combined total of £T402,889.

Section VI. is composed of receipts from "State Domains" of which a large proportion was formerly included in the civil list. Under the deposed sultan the Civil List Administration had encroached in every direction not only on the revenues properly accruing to the state, but upon private and upon state property in most parts of the empire. Thus it is explained in the preface to the budget that the revenues "proceeding from the deposed sultan" are not classed together under one heading, but that they have been apportioned to the various sections under which they should fall "whether taxes on house property or property not built upon, tithes, aghnam, forests, mines, cadastre, sport, military equipment, private domains of the state, various receipts, proceeds of sales, rents"—a truly comprehensive list which by no means set a limit to the private resources of Abd-ul-Hamid II., who looked upon the customs also as a convenient reserve on which he could, and did, draw when his privy purse was short of money. Apart from the sources of revenue specified above, of which the amounts actually transferred from the civil list are not stated, Section VI. is estimated to produce £T513,651. In the previous budget there had been a special heading, "Proceeds of Domains transferred from the Civil List," estimated to produce £T620,233, which may have been intended to include all the various receipts above enumerated.

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[1] It should be noted that the classification of the revenues included respectively under the "direct" and "indirect" categories has now been quite properly changed, the sheep-tax, tithes, mining royalties and forest royalties being comprised under "direct taxes"; stamps and registration duties are placed in a special category, and salt and tobacco under "monopolies."

Section VII., formed of the tributes of dependencies of which the two principal are the Egyptian, £T765,000, and that of Cyprus, £T102,590 (assigned to the public, debt) comprises a total revenue of £T871,316. Finally, various receipts of which the principal separately specified are government share of railway receipts (Oriental railways and Smyrna-Cassaba railway), £T201,710, and "subscriptions" for the Hejaz railway, £T264,600, form Section VIII.

The total revenues of the empire are thus estimated to produce £T25,848,332, and seeing the careful and moderate manner in which the estimates have been framed, this may be looked upon rather as a minimum than a maximum. The minister of finance stated in his budget speech to parliament, delivered on the 23rd of April 1910, that the revenues for the year 1909–1910, which had been estimated to produce £T25,000,000, had as a matter of fact produced £T26,500,000.

Expenditure. Ministry of Finance.—The first item of expenditure shown in the budget is the service of the public debt, amounting to £T8,288,394. The Public Debt Administration plays so considerable a part in the finances of the Ottoman Empire, and its history is of such importance that a special section of this article will be devoted to it below. Under the budgetary heading "Public Debt" is included, as it should be, all expenditure in connexion not only with the public debt proper, but also with advances from banks and others, railway guarantees, an account of which will also be found below, and all capitalized liabilities, as far as known, contracted by the state.

It is explained in the preface to the budget that one of the abuses of the previous régime had been to obtain advances from credit establishments at high rates of interest varying from 7 % to 9 %, when it was found impossible to issue a public loan. The rates on these advances have now been generally reduced to 6 % with the exception of that on the advances from the lighthouse administration, which refused to allow any reduction below 7 %. In the years 1908–1909 the advances were reduced by £T688,000, in addition to repayments allowed for in the budget, and the credit agreed for the year 1909–1910 is £T663,000, as compared with £T1,160,000 for the previous year. In the year 1910–1911 the outstanding advances were to be so far paid off that the credits to be opened under this head would be still further reduced by £T500,000.

The civil list has been reduced to the definite amount of £T443,880, which, without the consent of parliament, cannot be increased. The sultan receives an annual allocation for himself and household of £T240,000, the crown prince one of £T24,000, and a sum of £T153,000 is assigned to the Imperial princes and the sultanas. The deposed sultan was allowed £T12,000 a year, and a similar amount was set aside to provide dowries for two sultanas who were just about to be married. The debts of the former are stated in the preface to the budget to be very large, and as payments are effected fresh creditors present themselves with undeniable vouchers in their hands, causing much embarrassment to the minister of finance: no figures, however, are given. The Finance Bill provides that these debts are to be paid out of supplementary credits.

Under the reformed constitution every senator is entitled to a salary of £T100 per month, any remuneration which he may receive from the government for other services to be deducted from the senatorial allowance which, however, it may of course exceed. Deputies are allowed £T300 for each session of parliament, and £T50 per month in addition should the session exceed its legal duration. They are further allowed travelling expenses from and to their constituencies on the basis of rules governing journeys of functionaries receiving a monthly salary of £T50. The amount reserved in the budget for these purposes is £T181,871.

The ministry of finance absorbs £T2,989,600. In this are included the expenses of the administration of both the central and provincial departments of the finance ministry, the mint, charitable allowances, expenses and presents in connexion with the holy cities (£T121,410), pension funds of state officials (£T628,038), administrative allowance made to the agricultural bank (£T225,380) and various other expenses. Various administrative reforms were in hand in 1910–1911, by which it was expected considerably to reduce the credits demanded by the finance ministry—especially those in connexion with the holy cities. Special attention was called by the minister to the fact that the system of contributions of officials to the pension funds has been modified, the deduction from salaries being now 10 % instead of 5 %, and the contributions to the funds being made as to one-third by the treasury, and two-thirds by the officials, instead of the reverse as formerly: the economy effected is about £T300,000. A credit of £T17,124 is allowed for the central accounts department. The total credits for the ministry of finance are, then, as follows: Ottoman public debt, £T8,288,394; House of Osman, £T443,880; legislative corps, £T181,871; treasury, £T2,989,600; central accounts department, £T17,124; forming an aggregate of £T11,920,869.

Indirect contributions, or more familiarly "customs," are allowed a credit of £T512,670. The minister of finance points out the immense importance of the thorough reorganization of the customs administration. The services of a first-rate English expert (Mr R. F. Crawford) were obtained, and much has been done at Constantinople, but the provincial customs offices are still lamentably defective. These were immediately to be taken in hand, and considerable sums are being voted for repairs of existing customs buildings and the construction of new buildings. The reforms already accomplished have resulted in a marked increase in the customs revenues.

Posts and telegraphs, which absorbed a credit of £T782,839 in 1910–1911, have also long been in urgent need of extension and better administration. An additional credit of £T90,000 was granted, as compared with the previous year, and increased expenditure was foreshadowed for the future; on the other hand, it was confidently expected that the post office receipts would increase in far more rapid ratio than the expenditure.

The ministry of the interior was estimated to require £T1,157,230. This sum covered "immigration expenses," *i.e.* assistance given in settling Mussulmans immigrating from provinces detached from the Ottoman Empire. There can be no doubt that this expenditure is remunerative, since many rich regions of Asia Minor have long suffered from want of population.

Military expenditure, including the three departments of war, is as follows: the army (excluding artillery), £T8,280,452; ordnance, £T356,439; and gendarmerie, £T1,694,778. As regards the first of these, it is curious to observe that the budget decree of 1880 stringently limited the peace strength of the Ottoman army to 100,000 men, "including officers and generals," in order to put a stop to the rapidly increasing military expenditure; but this was merely the expression of a pious wish, at a time when European financial good will was indispensable, that expenditure might be kept down. No real attempt has ever been made to observe the decree, and indeed observance has been impossible seeing the dangers which never cease to menace the empire. To some extent the real level of military expenditure has been masked by the separation of certain payments into "extraordinary" expenditure, a course which, it is understood, has not been followed in the budgets of the "new régime," and which will not be revived. It should however, be remarked that out of an "extraordinary" budget, which will be mentioned below, sums of £T709,305 and of £T27,827 were allocated to the ministry of war and the ordnance department respectively in 1909. It is not expected that military expenditure can be much reduced, except in the direction of supply contracts, which have been the cause in the past of iniquitous waste of means.

The official budget shows a credit for admiralty expenditure of £T1,000,327, which is apparently less than that for the previous year by some £T220,000. This, however, is not a real decrease, salaries of functionaries not on the active list having been removed to the region of supplementary credits, as are those of civil departments. As a matter of fact, the marine budgets of the two years are almost identical. The vote of £T500,000 a year for ten years for the reconstruction of the Ottoman navy by "national subscription," as already mentioned, was not included in the official budget, nor was there any allusion to it in the prefatory memorandum. The minister of finance did, however, allude to it in his budget speech, (April 23, 1910), and stated that four destroyers purchased in Germany had been paid for from the national subscription only, without touching the ordinary state revenues. It should be added that the Greek War (1897) revealed to the sultan the decrepit state into which the Ottoman navy had fallen, and considerable "extraordinary" expenditure—much of which was wasted—has been incurred since (and including) 1902 to put the least out-of-date warships into a serviceable condition.

The ministry of commerce and of public works absorbed £T883,161 a reduction of some £T180,000 on the previous year. The government acknowledges the unavoidable necessity of greatly extending and improving the internal communications of the country, but cannot see its way to doing so satisfactorily out of the ordinary resources of the country. This question was being seriously studied, and it was hoped that a comprehensive scheme would be presented ere long. The Hejaz railway figures in the budget for £T550,180, and it is explained that this will not only cover working expenses, but also the final completion of the line.

Floating Debt.—This is really an accretion of undetermined liabilities which has been indefinitely, and probably alternately, advancing and receding for a great number of years, and which no previous minister of finance, or Turkish government, had the courage to face. Now and then it has been dealt with piecemeal, when some particular class of creditors has become too pressing, but it is more than probable that the piece got rid of has been more or less rapidly replaced by fresh liabilities occasioned by budgetary deficits, or by the mere accumulation of interest on debts allowed to run on.

In March 1897 the floating debt was calculated by a financial authority in the *Fortnightly Review* to amount to upwards of £T55,000,000, which might be compressed to £T25,000,000 since a large proportion was certainly composed of salaries in arrear and other items of a similar kind which the government would never, under any circumstances, make good. Laurent tells us that the present government having found it absolutely impossible to arrive at even an approximate estimate of this "occult debt," recourse was had, in order to fix it, to the creditors themselves, and a short act of parliament was passed declaring all debts prescribed which should not be claimed by a fixed date. In consequence of this 560,000 claims were received, and a first examination showed that the aggregate amount reached by these claims was not less than £T13,000,000. Considering the dilatory methods of Orientals, even when they are creditors, it is doubtful whether this sum adequately covers the whole of the claims outstanding, and it may be found difficult, even for a parliament, to refuse claims which should equitably be admitted and which may be preferred later. High authority in Constantinople put the true amount of the floating debt in 1910–1911 at the amount previously estimated, viz. £T25,000,000. No provision was then made in the budget to meet these liabilities, nor did the minister in his prefatory memorandum make any allusion to them; in his budget speech, however, he announced that a scheme for dealing with them would be presented with the budget for 1911–1912. Under the heading "Floating Debt" in the budget for 1910–1911 are placed the advances before described.

No other items in the budget call for special remark, but in order that the information given may be complete, each head of expenditure is shown separately below, and the budget for 1910–1911, as first placed before the Turkish parliament, presents the following picture, from which it may be observed that the public debt absorbs 26% of the revenue, war service 38% and civil services 36%.

Expenditure.

	£T
Public debt	8,288,395
Civil list . .	443,880
Legislative corps .	181,870
Finance .	2,989,600
Accounts (central) .	17,124
Customs	512,670
Posts and telegraphs	782,840
Cadastre . .	109,820
Grand vizierate .	25,096
Council of state .	33,050
Interior . .	1,157,230
Public security . .	400,405
Foreign affairs . .	213,400
War	8,280,453
Ordnance	356,440
Gendarmerie . . .	1,694,778
Marine	1,000,328
Sheikh-ul-Islamât	483,341
Justice	751,580
Public instruction .	744,086
Forests, mines and agriculture . .	370,520
Public works and commerce . . .	883,160
Hejas railway . .	550,180
Total . .	£T30,270,246

Revenue.
(See above for details of general headings here given.)

	£T
"Direct contributions" .	13,725,892
Stamps and registration duties	1,113,452
"Indirect contributions"	4,825,812
Monopolies	3,262,424
State undertakings, commercial and industrial . . .	402,889
Domains	513,651
Tributes	871,316
Various receipts . .	1,132,896
Total . . .	£T25,848,332
Deficit . .	£T4,421,914
Total . .	£T30,270,246

This deficit was increased, by the action of parliament, to £T9,678,000. Almost immediately after the budget was drawn up a change of government took place, and largely owing to this fact the parliamentary budget commission introduced various modifications on the expenditure side of the account, which increased the estimated deficit to the account just mentioned.[1] The principal increase is due to the war departments, according to the budget speech of the minister of finance (April 23, 1910), although he states that some increase is apparent in all departments. The actual figures of the increase are not, however, given. Exaggerated importance must not be attributed to the swollen deficit. The demands of the various departments of state had been much cut down, and according to the minister of finance's own statement much of the reduction was merely unavoidable expenditure deferred; the fact that some of this expenditure, which had been jealously scrutinized, was to be undertaken at once, meant that demands on future years would be relatively reduced. A loan of £T7,040,000 was arranged with a German group headed by the Deutsche Bank. This loan followed upon one of £T4,700,000 in 1908, and another of £T7,000,000 in 1909 (of which the service is provided by the revenues assigned to the Russian War indemnities amounting to £T350,000 per annum, of which payment has been deferred for forty years), the year 1909 having shown a realized deficit of about that amount—a condition of affairs which would appear alarming were it not that the Turkish Empire was passing through absolutely abnormal times, and was attempting to convert the unstable morass of disorder, ineptitude and corruption left by the previous system into a solid foundation for good and orderly constitutional government. With the two previous loans above mentioned, £T5,500,000 capital liabilities were paid off, the work of reorganization had made considerable progress, and £T2,000,000 remained in hand at the beginning of 1910–1911 to continue it. As before stated reorganization was quickly followed by a marked increase of revenue, and it seemed probable that the forecast of the minister of finance that within a comparatively short time that increase would amount to £T5,000,000 was not excessive. Negotiations were undertaken to increase the customs import duties by a further additional 4%. This measure would produce about £T1,250,000 per annum.

Further expenditure was voted in the course of 1909, to be met by an extraordinary budget. On the receipts side of this budget were comprised the Austrian indemnity for the annexation of Bosnia and Herzegovina (£T2,500,000), cash and securities belonging to the deposed sultan (£T1,600,000), sale of old guns (£T300,000), sale of lands and other property recovered from civil list encroachments (£T908,000), and finally the unexpected balance of the proceeds of the 1908 loan (£T655,000), the whole forming an aggregate total of £T5,963,000. It was intended to assign to the war department £T3,804,918, to the grand master of ordnance £T358,108, to the admiralty £T93,912, and to the ministry of finance £T2,443,202 for the payment of the war indemnities in Thessaly and other urgent liabilities, the estimated aggregate extraordinary expenditure thus amounting to £T6,700,140. Some of the assets above mentioned proved, however, not to be easily realizable. Ready buyers were not found for the state lands, and the sale of the ex-sultan's securities was disputed by the German Reichsbank with which they were deposited, while the government did not consider it good policy to sell the Anatolian railway shares, which it seized at Yildiz, so that only £T450,000 were encashed by the ministry of finance from these sources. Of the sums really received the ministry of finance expended some £T3,000,000, in payment of the Greek indemnity, in repayment of £T1,000,000 of advances to the treasury and by assigning the credit voted to the ordnance department, and it was stated that these payments exhausted the extraordinary resources so far as it has been possible to realize them.

Collection of Taxes.—The Ottoman Empire possesses a very complete system of local self-government within certain limits. Every village or town district has a kind of mayor (*mukhtar*) appointed by election and approved by the official provincial authorities, and a "council of ancients" whose members are elected directly. The taxes are collected by means of the *mukhtars*, termed for this purpose *kabz-i-mal* (receiver of treasure), and under the supervision of gendarmes specially named, termed *taksildar* (collectors). The official authorities provide lists of all the taxes to be collected to the *tahsildars*, who hand them, against formal receipt, to the *kabz-i-mals*. The latter are bound to pay in to the local authorities all sums collected in five days in town districts, and in fifteen days in villages, if under 1500 piastres; sums of 1500 piastres and over are paid in at once. The *taksildars* check the accounts of the *kabz-i-mals*, and, if they discover peculation, send them at once to be dealt with by the chief official authorities of the *caza* (department); all the electors of a *mukhtar* are, *ipso facto*, joint sureties for him. If the tax-payer declines to pay his due, he is brought before the proper authorities by the *tahsildar*; if he persists in his refusal, all his goods, except those indispensable for his dwelling and the pursuit of his trade, are sold by auction, without recourse to a judgment by tribunal. If he has no goods which may be seized, he may be summarily imprisoned for a term not exceeding 91 days: two imprisonments for the same debt are not permitted. The military exemption tax is not collected as above, but by the spiritual chiefs of the various religious communities. None of the above regulations apply to Constantinople, where no military exemption tax is imposed, and where separate official regulations for the collection of taxes are in force. The system of farming out the revenues is admitted, and is almost invariably followed in the case of the tithes. When this is done, the revenues to be farmed are put up to public auction and sold to the highest bidder, provided he can prove himself amply solvent and produce sufficient sureties. Elaborate regulations are in force for this method of collection to secure the state receiving its full due from the farmers, who, on the other hand, are entitled to full official assistance to enforce their rights.

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[1] On the 25th of June 1910 the chamber finally passed the budget for 1910–1911. The figures were as follows:—

Ordinary expenditure, £T32,997,000; extraordinary expenditure, £T2,696,000; revenue £T26,015,000, leaving a deficit of £T9,678,000, which was brought up to over £T10,500,000 by special credits for the pension fund, the payment of debts incurred by Abd-ul-Hamid and indemnities to officials. On the other hand, the minister of finance reckoned that the revenue would probably show an increase of £T1,500,000, while about £T2,000,000 of expenditure would remain undisbursed, which, with a reserve of £T2,000,000 from 1909, would reduce the deficit to roughly £T5,000,000.

Assessment of Taxes.—For the purposes of assessment the taxes may be divided roughly into two classes: (1) variable taxes; (2) non-variable taxes. Under the first head would be included proportional taxes dependent upon the value of the property taxed; under the second, taxes whose amount does not depend upon that value. The first class contains such revenues as the *emlak verghi-si* (duty on realty), *'ashār* (tithes), *temettū* (professional tax), &c. In all such cases the taxable values are fixed by a commission of experts, sometimes chosen by the tax-payers themselves, sometimes by the official authorities; in all cases both tax-payers and authorities are represented on the commissions, whose decisions may be appealed against, in last resort, to the council of state at Constantinople, whose decision is final. Revenues composing the second class such as the *tapu* (registration tax) do not vary, unless by special decree, and the assessment is automatic.

The systems, both of assessment and collection, were equitable and far from oppressive in theory. In practice they left almost everything to be desired. The officials, already too numerous and underpaid, frequently, as has been stated above, found such pay as they had far in arrear. They were therefore naturally open to bribery and corruption, with the result that, while the rich often got off almost scot free, the poor were unduly taxed, and often cruelly oppressed by the tax collectors and farmers of revenue. In all departments there ensued, thus, an alarming leakage of revenue, amounting, it was credibly estimated, to quite 40%. The new government energetically proceeded to remedy this state of affairs.

International Administration of the Ottoman Debt.—In consequence of the piling up of the exterior public debt as described above, it amounted after the issue of "general debt" in 1875 to £T190,750,000, and swallowed up annually upwards of £T10,000,000, or nearly half the revenue of the empire as it was then constituted. The revolt of various disaffected provinces brought matters to a climax; in September 1875 one-half of the service of the interest was suspended, paper certificates known as "Ramazans" (since they were issued in the Arabic month of that name) being issued for that half in lieu of cash, and in the following March it was suspended altogether. After the war with Russia, in order to obtain credit from the Imperial Ottoman Bank and local financiers, who refused any further accommodation unless their previous and further advances were amply secured, revenues known as the "six indirect contributions" were handed over to a committee of local bankers (by decree of Nov. 22, 1879), to be administered and collected directly by them. These "six indirect contributions" were the revenues from tobacco, salt, wines and spirits, stamps (commercial), certain specified fisheries, and the silk tithe in specified provinces. Two years later, partly in view of the recommendations of the Congress of Berlin, partly to overcome insuperable difficulties in obtaining any kind of credit, the sultan authorized the Sublime Porte to issue an invitation to the various bondholders' committees in Europe to send delegates to Constantinople for the purpose of negotiating a resumption of payments. These "committees" were the "Council of Foreign Bondholders" for Great Britain, the Imperial Ottoman Bank and its "group" for France, Herr S. Bleichröder for Berlin, the Credit-Anstalt and its "group" for Austria-Hungary, and the Chamber of Commerce and of Arts of Rome for Italy. The Dutch bondholders placed their interests in the hands of the British council. Russia declined to countenance the negotiations in any way. Delegates from the various committees assembled in Constantinople in the early summer of 1881. The commission formed by them in conjunction with the delegates of the Sublime Porte is more generally known as the "Valfrey-Bourke commission," from the leading parts played by the Right Hon. R. Bourke (Lord Connemara), the British delegate, and M. Valfrey, the French delegate. The outcome of the negotiations was the issue of an imperial decree, known as the "Decree of Muharrem," owing to its bearing the date (Turkish style) of the 28th of Muharrem (Dec. 20) 1881. By this decree the outstanding capital of the exterior debt, to which were added the Ramazan certificates above mentioned, and all interest fallen due, making a grand total of £252,800,000, was scaled down to £106,437,234 (£T117,080,958). On this reduced capital a minimum interest of 1% was to be paid, the rate of interest to be increased by quarters per cent. as the revenues set aside for the service of the reduced debt permitted. For purposes of sinking fund the old loans were combined into four groups:[1] group i. containing the 1858 and 1862 loans, with a reduced nominal capital of £T7,902,259; group ii. the 1860, 1863, 1864 and 1872 loans, with a reduced nominal capital of £T11,265,153; group iii. the 1865, 1869 and 1873 loans, with a reduced nominal capital of £T33,915,762, and group iv. the "general debt," of which the last issue was in 1875, with a reduced nominal capital of £T48,365,236, and the "lottery bonds" (railway loan), with a reduced nominal capital of £T15,632,548, the total of group iv. being thus £T63,997,784. As security for the service of the new reduced debt it was provided that an international council should be formed, composed of one delegate each from the bondholders of the United Kingdom, France, Germany, Austria-Hungary, Italy and Turkey, and one representing the "priority bondholders," a term which will be explained later. On this council the Turkish government has the right of naming an imperial commissioner with "consultative voice," *i.e.* no voting power, but the right to express his opinion on the proceedings of the council, who would make all reports he considered necessary to his government. The government was empowered also to name controllers to whom all the accounts of the administration should be open for inspection on demand. In all other respects the council, provided that it kept within the limits of the laws the administration of which was entrusted to it, was to be entirely independent of the Ottoman government, free to appoint and dismiss its own officials from highest to lowest, and to carry on its administration on such lines as it thought best. Proposals made by the council for the modification and improvement of the existing laws and regulations which concerned it were to receive an answer from the government within six months; this provision has remained a dead letter. Any difference between the government and the council, if not possible of adjustment, was to be settled by arbitration.

To this council, with these extended powers, was handed over the absolute administration, collection and control of the "six indirect contributions" above enumerated, for the benefit of the bondholders, and in addition, it was to encash for the same purpose bills on the customs, to be drawn half-yearly in its favour by the minister of finance, amounting annually to £T180,000, representing the tax on Tumbēki (£T50,000) and the surplus revenue of Cyprus (£T130,000); and the Eastern Rumelian annuity, originally fixed at £T245,000, but gradually reduced by force of circumstances, until after frequent suspensions of payment it reached in 1897 the level of £T114,000, and has, since the declaration of Bulgarian independence, been definitely stopped. In order to assist the young kingdom of Bulgaria, which could only with great difficulty and with much damage to its resources have found means to indemnify Turkey for this serious breach of treaty engagements, the Russian government intervened, and proposed as compensation to the Turkish government the deferment for forty years of the annual payment (£T350,000) of the 1877 war indemnity. This proposal was accepted by the Turkish government, which undertook to continue the annual payment of £T114,000 to the public debt administration until the extinction of the debt. The public debt council consented with good grace, although the minister of finance, by omitting to consult that council during the progress of negotiations, lost sight of the fact that a sum of £T87,823 was due to the public debt administration on account of arrears of the Eastern Rumelian annuity up to December 1887, and that a further sum of £T430,741 was due by the Bulgarian to the Turkish government itself in compensation for the Rustchuk-Varna railway under the Treaty of Berlin. As pointed out by Sir Adam Block, the representative of the British and Dutch bondholders, in his report for 1908–1909, the above arrangement would have been prejudicial to the bondholders had the public debt not been "unified" (as described below) since, however, as a result of that unification, the ceded revenues now produced a sum more than sufficient for the service of the debt, it was only the surplus of revenue reverting to the government which was affected. There were further handed over, under the Muharrem decree, to the public debt council, the tribute of Bulgaria, the amount of which has never even been fixed, but as compensation for which the tobacco tithe up to a yearly amount of £T100,000 was ceded to the council in the same conditions as the "six indirect contributions"; the proportional shares (generally known as the "contributive parts ") of the Ottoman public debt to be borne by Bulgaria, Servia, Greece and Montenegro, which according to the Treaty of Berlin were to be adjudged by the representatives of the Great Powers at Constantinople, one of whom (the Russian) never succeeded in obtaining his instructions, and which therefore have never been fixed; and, finally, the excess of revenue resulting from a revision of the commercial treaties. The ceded revenues, exclusive of the "contributive parts" and the excess from commercial treaties, were estimated by Bourke, in his report to the bondholders on the decree of Muharrem, at £1,812,562 (£T1,993,818). A substantial reduction however, had to be made in favour of the 5% "priority bonds," which were bonds issued to the local banks before mentioned in satisfaction of their claims, and formed an annual first charge of £T590,000 on the whole of the revenues ceded to the bondholders; the capital amount of the "priority bonds" was £T8,169,986, which was to be extinguished by 1906. Four-fifths of the net product of the revenues, after deduction of the first charge of £T590,000, was to be applied to the service of the interest on the new reduced debt, and provided that the four-fifths were sufficient to allow the distribution of 1% interest, one-fifth was to be devoted to sinking fund; but this latter fifth was to be reduced, if necessary, by an amount sufficient to maintain the rate of interest at 1%. The interest on bonds amortized was to be added to the funds available for sinking fund. The sinking fund was to work as follows: First ¼% on the whole reduced capital was to be applied to group i.; if there were any surplus this was to be applied to group ii., until that also received the same full ¼%, and so on for group iii. and group iv., until the whole sinking fund amounted to 1% on the reduced capital. It was to be applied by redemption at the best price possible on the market, until that price stood at £T66·66, when, if the rate of interest served were 1%, it was to proceed by drawings; if the interest were anything more than 1%, and less than 3%, the limit of price for redemption was to be raised to £T75; if the interest were between 3% and 4% inclusive, the limit was to be raised to par. Any surplus of revenue beyond that necessary to provide 4% interest and 1% sinking fund was to be handed over to the government. The lottery bonds receive a special treatment both in regard to interest and sinking fund; full information as to the intricate arrangements made for these bonds will be found in the decree of Muharrem and the published reports of the council of administration of the Ottoman public debt. In 1890 the sinking fund was increased by the conversion of the "priority loan" into a 4% loan and the extension of the term of its redemption for 15 years. In this manner an annuity of £T159,500 was set free, of which £T11,000 per annum was allotted as "extraordinary sinking fund" to series A and £T49,500 per annum each to series B, C and D; the lottery bonds were originally excluded from this arrangement, and special compensation was granted to these later. Each series receives the benefit of the interest on bonds belonging to it amortized by this special annuity. Thus, in the financial year 1900–1901 the total amount of the fund had risen from £T159,500 to £T231,500.

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[1] For simplicity's sake, the lottery bonds having a special treatment different from that of the rest of the loans, these groups, when the new bonds of the reduced debt were exchanged against the old bonds of the original loans, became "series" thus: Series A, group i.; series B, group ii.; series C, group iii.; series D, group iv. and lottery bonds.

The arrangement set forth in and sanctioned by the decree of Muharrem on the whole worked admirably. Gradually, however, it became apparent that it would be desirable to give Turkish state securities, of which those governed by the decree of Muharrem formed the principal part, a better standing in European financial markets than was possible for bonds bearing so low a rate of interest; to obliterate thus, as far as possible, the effects of the past bankruptcy; and, further, to give the Turkish government a joint interest with the bondholders in the progress of the ceded revenues. The French bondholders, who hold by far the largest proportion of Turkish securities, took the principal initiative in this matter, and, after protracted negotiations with the Turkish government and the other "syndicates" of bondholders, they succeeded, in 1903, in obtaining the following modifications of the original decree of Muharrem.

Series B, C and D (series A having already been completely redeemed by the action of the sinking fund) were replaced by the creation of new 4% bonds to a nominal amount of £T32,738,772, with a sinking fund of 0·45% per annum, bearing identical rights and privileges, and ranking immediately after, the priority bonds. The rates at which the series were respectively exchanged against the new unified bonds were £100 series B against £70 unified, £100 series C against £42 unified and £100 series C against £37, 10s. unified. Bonds of the old series not presented for exchange within a period of fifteen years are prescribed. The amortization is to proceed by purchase when the unified bonds are below par, and when at or above par, by drawings. Coupons and drawn bonds not presented within six and fifteen years respectively of their due dates of payment are prescribed. Interest on amortized bonds goes to swell the sinking fund. When the net product of the ceded revenues amounts to £T2,157,375, the surplus is divisible as to 75% to the Turkish government and 25% to the public debt administration. A variation from this was provided as soon as the priority bonds should become extinct; but these bonds having since been repaid (as mentioned below) by a further issue of unified bonds, this variation lapses. The above 25% is to be employed as additional sinking fund for the unified debt and lottery bonds, in the proportion of 60% and 40% respectively. A reserve fund was created of which the nucleus was the sum already standing to the credit of the "Reserve fund for increasing the rate of interest" (£T1,113,865), plus £T300,000 at least in cash by the issue of sufficient unified bonds to produce that amount and the sum of £T150,000 to be paid by the government to the public debt at the rate of £T15,000 per annum. It should be added that the total issue was made sufficient to reserve also £T1,460,000 for expenses, after taking into account £100,000 in cash paid by the government to the public debt administration out of the said issue. The reserve fund was created primarily to make good any deficiency in the revenues below the amount required to pay the interest due. If such drafts upon the reserve fund become necessary they are to be made good in the following years out of the surplus above mentioned. The reserve fund is increased by the interest it may earn, but when the capital amount of the fund reaches £T2,000,000 the interest earned is merged in the general receipts of the public debt administration. As soon as the unified debt is reduced to £T16,000,000 the reserve fund is to be reduced to £T1,000,000, the surplus over this last amount being paid to the government. The unified bonds and coupons are exempt from all Turkish taxation existing or to come. Further special stipulations regarding the Turkish lottery bonds were made, but these are, as before, omitted. They will be found in art. x. of the "Annex-Decree" of September 1–14, 1903, which gave the modifications to the Muharrem decree here described force of law. Finally the Imperial Ottoman government reserved to itself the right of paying off the whole unified debt at par at any moment, and all the dispositions of the decree of Muharrem not modified by the new "Annex-Decree" were formally confirmed and maintained. In 1906 a further modification took place in the shape of the final and complete repayment of the priority bonds by the additional issue of £T9,537,000 of unified bonds for the purpose, taken firm by the Ottoman bank at 86. The rate at which the exchange was effected was par with a cash bonus of 6%. The previous annuity required for the service of these bonds having been £T430,500, and the additional charge for the service of the unified debt as a result of the operation being £T424,396, while the government received £T1,272,600 in cash for its own purposes, there was a slight immediate advantage to be found in it: as, however, the priority debt would have been completely extinguished in 1932, the financial wisdom of the change is not apparent.

The ceded revenues administered directly by the public debt council have shown remarkable expansion, and may be fairly looked upon as exemplifying what would occur in the general revenues of the empire when good and honest administration and regular payment of officials finally took the place of the carelessness, corruption and irregularity which existed up to the change of régime. The council has not limited its duties to the collection of the revenues placed under its administration, but has taken pains to develop commercially the revenues capable of such development. A large and remunerative export trade in salt to India is now established, whereas formerly not one grain found its way there; the first steps in this direction were taken in 1892 when works were begun to place the great rock-salt salines of Salif, on the coast of the Red Sea, on a commercial footing. The gross receipts from this export trade amounted in the year 1908–1909 to £T99,564, and the profits approximately to £T12,000, in spite of the contest between Liverpool and Spanish salt merchants on the Calcutta market, which led to a heavy cutting of prices. Pains, moreover, have been taken by the public debt council to develop the sale of salt within the empire. These efforts have been rewarded by the increase of the salt revenue from £T635,000 in 1881–1882, the year preceding the establishment of the council, to £T1,075,880 in 1907–1908. Again, in the early years of the administration (1885), the Pasteur system of selection of silk-worms' eggs for the rearing of silkworms was introduced, and an "Institute of Sericulture" on modern lines was erected (1888) at Brusa for gratuitous instruction in silk-rearing to students from all parts of the empire. Up to the end of 1907–1908, 919 students had received the diploma of the institute, and 465 silk-growers in addition had passed through the course of instruction. These men, returning to their various districts, impart to others the instruction they have received, and thus spread through the regions adapted to sericulture the proper methods of selection and rearing. As a result some 60,000,000 mulberry trees were planted in Turkey during 1890–1910, involving the plantation of about 130,090 acres, and new *magnaneries* and spinning factories sprang up in every direction; while the revenue (silk tithe) increased in the regions administered by the council from £T17,000 in 1881–1882 to

£T125,000 in 1906–1907, the value of the silk crop in those regions having thus advanced by over £T1,000,000. But the regions not under its administration benefited at least equally by the methods above described. Thus the total value of the silk tithe in Turkey increased in the period named from about £T20,000 to £T276,500, and the total annual value of the crop from about £T200,000 to £T2,765,000, or by nearly 2½ millions pounds sterling.

Table A gives the produce of the revenues in 1881–1882, the last year of the administration of the "Galata Bankers," the average product of the first, second, third, fourth and fifth quinquennial periods since the public council was established, and of the year 1907–1908.

Table B shows the total indebtedness of the Ottoman Empire, exclusive of tribute loans.

Tobacco Régie.—From the beginning of the year 1884 the tobacco revenue has been worked as a monopoly by a company formed under Ottoman law, styled "La Régie Impériale Cointéressée des Tabacs Ottomans." This company has the absolute monopoly of the manufacture and of the purchase and sale of tobacco throughout the Ottoman Empire, with the exception of the Lebanon and Crete, but exportation remains free. It is bound to purchase all tobacco not exported at prices to be agreed between itself and the cultivators; if no agreement can be arrived at, the price is fixed by experts. It is obliged also to form entrepôts for the storage of the crops at reasonable distances from each other, and, on certain conditions, to grant advances to cultivators to aid them in raising the leaf. The cultivators, on the other hand, may not plant tobacco without permits from the régie, although the power of refusing a permit, except to known smugglers or persons of notoriously bad conduct, seems to be doubtful; nor may they sell to any purchaser, unless for export, except to the régie, while they are bound to deposit the whole of the tobacco crops which they raise in any one year in the entrepôts of the régie before the month of August of the year following,

TABLE A.—*Showing Revenues ceded to Ottoman Public Debt Administration at Various Periods to 1907–1908.*

Heads of Revenue.	Last year of Galata Bankers, 1881–1882.	Average for First Five Years of Council of Public Debt, 1882–83, 1886–87.	Average for Second Five Years of Council of Public Debt, 1887–88, 1891–92.	Average for Third Five Years of Council of Public Debt, 1892–93, 1896–97.	Average for Fourth Five Years of Council of Public Debt 1897–98, 1901–2.	Average for Fifth Five Years of Council of Public Debt, 1902–3, 1906–7.	1907–8.
	£T	£T	£T	£T	£T	£T	£T
Six Indirect Contributions:—*							
Tobacco	881,563	822,633	755,489	788,384	725,641	815,923	899,352
Salt	634,936	651,057	702,150	755,978	861,406	987,417	1,123,866
Stamps	129,833	146,822	185,930	212,815	221,856	321,193	366,255
Spirits	177,163	198,356	229,059	258,848	269,482	273,893	283,301
Fisheries	26,064	34,356	44,307	44,337	47,294	53,032	69,549
Silk	17,118	24,145	39,398	56,393	69,012	98,731	131,218
Extra Budgetary Receipts †	—	—	—	—	2,797	25,757	—
Total of Six Indirect Contributions	1,866,677	1,937,369	1,956,333	2,116,755	2,197,488	2,575,946	2,873,561
Tobacco Tithe	not collected	72,340	81,866	104,688	99,276	172,473	210,068
Eastern Rumelian Annuity	"	150,040	126,688	129,222	88,682	159,628	114,020
Excess of Cyprus Revenues	"	130,000	113,557	102,596	102,596	102,596	102,596
Tax on Tumbĕki	"	50,000	50,000	50,000	50,000	50,000	50,000
Total Gross Revenue	1,866,677	2,339,749	2,328,444	2,503,261	2,538,042	3,060,643	3,350,245‡
Expenses	378,789	388,000	392,403	346,143	418,537	522,798	572,850
Total Net Revenue	1,487,888	1,951,749	1,936,041	2,157,118	2,119,505	2,537,845	2,777,395

* Exclusive of £T50,000 representing the retrocession of the reftish (Egyptian tax, abolished in 1895) to the régie.

† Up to 1902–1903 the extra-budgetary receipts and fines had been carried to account of the respective revenues concerned; after that date they were placed under a special heading. After 1905–1906 extra-budgetary receipts relating to expenditure previously effected have been deducted from "General Expenses."

‡ The 3% customs surtax is not included in this table. It came into force on the 13th of July 1907, and produced during the remainder of the financial year £T544,987; 25% of this revenue is ceded to the public debt; the remainder reverts to the government.

TABLE B.—*Position of the Ottoman Public Debt on the 1st of March 1326 (March 14, 1910).*

Designation of Loans.		Nominal Capital issued.	Annuities.	Nominal Capital redeemed at 1st March 1326 (1910).	Nominal Capital in circulation on 1st March 1326 (1910).
		£T	£T	£T	£T
Debt controlled by the administration of the Ottoman Public Debt.	Unified Debt 4%[1]	42,275,772	1,887,375	2,345,010	39,930,762
	Turkish Lottery Bonds[1]	15,632,548	270,000	3,599,592	12,032,956
	4% Loan 1890	4,999,500	249,975	1,509,200	3,490,300
	5% " 1896	3,272,720	180,000	289,300	2,983,420
	4% " 1903 Fisheries	2,640,000	118,800	105,424	2,534,576
	4% " Bagdad 1st Series	2,376,000	97,120	15,642	2,360,358
	4% " " 2nd "	4,752,000	200,000	8,426	4,743,574
	4% " 1904	2,750,000	123,750	57,090	2,692,910
	4% " 1905 Military Equipment	2,640,000	118,800	83,556	2,556,444
	4% " 1901–1905	5,306,664	238,800	123,420	5,183,244
	4% " 1908	4,711,124	212,000	—	4,711,124
		91,356,328	3,696,620	8,136,660	83,219,668
Debt in the service of which the administration of the Ottoman Public Debt does not intervene.	4% Loan 1893 Tumbĕki	1,010,010	50,000	239,800	760,210
	4% " 1894	1,760,000	76,560	136,202	1,623,798
	4% " 1902[1]	8,600,020	390,000	367,180	8,232,840
	4% " 1855	5,500,000	167,869	1,303,280	4,196,720
	4% " 1891	6,948,612	308,686	777,700	6,170,912
	3½% " 1894	9,033,574	362,174	852,808	8,180,766
	4% " 1909	7,000,004	350,000	—	7,000,004
	Total	131,198,548	5,401,909	11,813,630	119,384,918

[1] The capital in circulation for these loans, established on the 1st of March 1326 (1910), is approximate.

and may not move any tobacco from the place where they cultivate it without the régie's express authority. In order to facilitate supervision, a minimum area of one-half of a *deunum* (a deunum = about one-fourth of an acre) is fixed for ground upon which tobacco may be cultivated; in the suburban districts of Constantinople and some other towns, and in enclosures surrounded by walls and attached to dwelling-houses, it is altogether prohibited. For its privileges the régie has to pay a rent of £T750,000 per annum to the government (assigned to bondholders), "even if it has no revenues at all," and after the payment of a dividend of 8 % to its shareholders, and certain other deductions, it has to share profits with the government and the bondholders according to a sliding scale agreed upon between the three parties. The régie did badly during the first four years of its existence, owing principally to two causes: (1) its ineffectual power to deal with contraband to which the system described above leaves the door wide open; (2) the admission of other than Turkish tobaccos into Egypt, which deprived it at once of about £T100,000 per annum. So great were its losses that in the year 1887–1888 it was obliged to write them off by reducing its capital from £2,000,000 to £1,600,000. At the same time it was granted an extension of penal powers, and the losses on *reftiek* (duty on tobacco exported to Egypt) were to be partially borne by the public debt administration. Things went better with it from that time until 1894–1895, when, owing to internal troubles in the empire, and the consequent fear of creating worse disorders, by the strict enforcement of the monopoly, the government withdrew most of its support, and contraband enormously increased. The following table shows the movement of the revenue of the régie from the year 1887–1888 to 1908–1909 inclusive:—

Average for 5 years.	Gross receipts from all sources.	Total expenses, including fixed charges.	Net revenue.
	£T	£T	£T
1887–1892	1,924,264	1,735,896	188,368
1892–1897	2,330,786	2,037,190	*293,596
1897–1902	2,098,537	1,898,646	*199,891
1902–1907	2,511,921	2,104,739	407,182
Year 1907–8	2,660,895	2,146,864	514,031
„ 1908–9	2,597,909	2,167,795	430,114

* There was a heavy fall in the receipts in the four years 1895–1896 to 1898–1899 inclusive. The climax was reached in 1897–1898 when the net revenue amounted to only £63,975 as compared with £T352,000 in 1894–1895, and it did not revert to its previous level until 1902–1903. This was the result of the Armenian massacres, the wholesale emigration of Armenians of all classes, the accompanying profound political unrest throughout the country, and the great extension of contraband which ensued from it.

Negotiations were initiated in 1910 for the prolongation of the concession of the tobacco monopoly, which reaches its term in 1913.

Railway Guarantees.—Up to 1888 the only railways existing in the Turkish Empire (exclusive of Egypt) were, in Europe, the Constantinople-Adrianople-Philippopolis line and the Salonica-Mitrovitza line (finished in 1872); and in Asia Minor, the Smyrna-Aidin (completed in 1866), the Smyrna-Cassaba (completed in 1866), the Constantinople-Ismid (completed in 1872), the Mersina-Adana (completed in 1886). The want of railways in Asia Minor was urgently felt, but no capitalists were willing to risk their money in Turkish railways without a substantial guarantee, and a guarantee of the Turkish government alone was not considered substantial enough. In 1888 it was proposed by the public debt administration to undertake the collection of specified revenues to be set aside for the provision of railway guarantees, the principle to be followed being, generally, that such revenues should consist of the tithes of the districts through which the railways would pass, and that the public debt should hand over to guaranteed railway companies the amounts of their guarantees before transmitting to the imperial government any of the proceeds of the revenue so collected. The government adopted this proposal, and laid down as a principle that it would guarantee the gross receipts per kilometre of guaranteed railways, such gross receipts to be settled for each railway on its own merits. Considerable competition ensued for the railway concessions under this system. The first granted was for the extension of the Constantinople-Ismid railway to Angora to a group of German and British capitalists in 1888. The Germans having bought out the British rights, this concession became a purely German affair, although a certain proportion of the capital was found in London. Since that time various other concessions have been granted to French and German financial groups, principally the Imperial Ottoman Bank group of Paris and the Deutsche Bank group of Berlin.

The systems of guarantee above described are clearly faulty, since theoretically the railway company which ran no trains at all would, up to the limit of its guarantee, make the largest profits. The concessionaire companies have, however, wisely taken the view that it is better to depend upon their own revenues than upon any government guarantee, and have done their best to develop the working value of the lines in their charge. The economic effect of the railways upon the districts through which they run is apparent from the comparative values of the tithes in the regions traversed by the Anatolian railway in 1889 and 1898 in which years it so happened that prices were almost at exactly the same level, and again in 1908–1909, when they were only slightly higher. Thus in 1889 they produced £T145,378, in 1898 £T215,470, and in 1908–1909 £T281,919.

A different system, still more uneconomic than the kilometric guarantee pure and simple, was adopted in the case of the Bagdad railway. In January 1902 the German group holding the Anatolian railway concession was granted a further concession for extending that railway from Konia, then its terminus, through the Taurus range and by way of the Euphrates, Nisibin, Mosul, the Tigris, Bagdad, Kerbela and Nejef to Basra, thus establishing railway communication between the Bosporus and the Persian Gulf. The total length, including branches to Adana, Orfa (the ancient Edessa) and other places was to exceed 1550 m.; the kilometric guarantee granted was 15,500 francs (£620). It should be noted that this concession was substituted for one negotiated by the same group, and projected to pass through Diarbekr. This raised strong objections on the part of Russia, and led to the Black Sea Basin agreement reserving to Russia the sole right to construct railways in the northern portion of Asia Minor. The Anatolian railway company, apparently unable to handle the concession above described, initiated fresh negotiations which resulted in the Bagdad railway convention (March 5, 1903). This convention caused much excitement and irritation in Great Britain, owing to the encroachment of German influence sanctioned by it on territories bordering the Persian Gulf, hitherto considered to fall solely within the sphere of British influence. Attempts were made by the German group, assisted by their government, to secure the participation of both Britain and France in the concession. These were successful in France, the Imperial Ottoman Bank group agreeing to undertake 30% of the finance without, however, any countenance from the French government—the "Glarus Syndicate" being formed for apportioning interests. The British government seemed, at one time, rather to favour a British participation, but when the terms of the convention were published, the strongest objection was taken to the constitution of the board of directors which established German control in perpetuity, while it was evident from the general tenor of the convention that a political bias informed the whole; in the end public feeling ran so high that any British participation became impossible.

The financial advantages, however, granted by the Turkish government were singularly favourable to the concessionnaires and onerous to itself. The kilometric guarantee of 15,500 francs (£620) was split into two parts, 4500 francs (£180) being granted as the fixed working expenses of the line, all receipts in excess of which amount were to be credited to the Turkish government in reduction of the remaining 11,000 francs (£440) which took the form of an annuity to be capitalized as a 4 % state loan redeemable in 99 years, that being the period fixed for the duration of the concession. The line was to be constructed in sections of 200 kilometres (125 m.) each, and as the complete plans and drawings of each were presented at the times and in the order specified in the convention, the government was to deliver to the concessionnaires government securities representing the capitalization of the annuity accruing to that section. The capital sum per section was fixed, in round figures, at 54,000,000 francs (£2,160,000), subject to adjustment when the section was completed and its actual length definitely measured up. A minimum net price of 81¼ % was fixed for the realization of these securities on the market. The bonds are secured on the surplus of the revenues assigned to the guarantee of the Anatolian railway collected by the Public Debt Administration, on the excess revenue, after certain deductions, accruing to the government under the "Annex-Decree to the Decree of Muharrem" above described, on the sheep tax of the vilayets of Koniah, Adana and Aleppo, and on the railway itself. The first series (54,000,000 francs or £2,160,000), was duly handed over to the concessionaires in 1903, and was floated in Berlin at 86·4% realizing the sum of £1,868,000. The division of the line into equal sections of 200 kilometres apiece produced at once a somewhat ridiculous result. The little town of Eregli, some 190 kilometres distant from Konia, presented the only excusable locality for the terminus of the first section, and even that place is 90 kilometres distant from Karaman, the last town of any importance for some hundreds of miles on the way to the Euphrates valley, the country between the two towns being desolate and sparsely inhabited. But the Bagdad Railway Company[1] (the share capital of which is £600,000 half paid up), naturally anxious to earn the whole of the capitalized subvention, completed the construction of the entire 200 kilometres. The line was thus continued to a station taking its name from Bulgurlu, a small straggling village four miles away, between which and Eregli there is not a single habitation. But even this did not quite complete the distance, and the line was carried on for still another kilometre and there stopped, "with its pair of rails gauntly projecting from the permanent way" (Fraser, *The Short Cut to India*, 1909). The outside cost of construction of the first section, which lies entirely in the plains of Konia, is estimated to have been £625,000; the company retained, therefore, a profit of at least 1¼ millions sterling on this first part of the enterprise. In the second section the Taurus range is reached, after which the construction becomes much more difficult and costly. On the 2nd of June 1908 a fresh convention was signed between the government and the Bagdad Railway Company providing, on the same financial basis, for the extension of the line from Bulgurlu to Helif and of the construction of a branch from Tel-Habesh to Aleppo, covering a total aggregate length of approximately 840 kilometres. The principle of equal sections of 200 kilometres was thus set on one side. The payments to the company were to be made in two lump sums forming "series 2 and 3" of the "Imperial Ottoman Bagdad railway loan," series 2 amounting to £4,320,000, which was delivered to the company on the signature of the contract, and series 3 to £4,760,000. The Bagdad railway must for much time be a heavy weight on the Turkish budget, the country through which it passes—with the exception of the sections passing from Adana to Osmanieh, through the Killis-Aleppo-Euphrates district (that is, the first point at which the line crosses the Euphrates some 600 m. from Bagdad), and to a lesser extent through the plains of Seruj and Harran—being very sparsely populated, while the financial system adopted offers no inducement to the concessionaire company to work for increasing earnings. It should be mentioned that the Bagdad Railway Company has sublet the working of the line to the Anatolian Railway Company at the rate of £148 per kilometre, as against the £180 per kilometre guaranteed by the Turkish government

Ottoman Railways worked at end of 1908.

Designation of Main Lines.	Length in Miles (including branch lines).	Amount Kilometric Guarantees.
Turkey in Europe:—		£
Oriental Railways[2]	815	Nil
Salonica-Monastir	137	572
Salonica-Constantinople	317	620
Total European Turkey	1269	
Turkey in Asia:—		
Hamidie Railway of the Hejaz[3]	932	Nil.
Anatolian Railway	635	Varies from £270 to £600.
Bagdad Railway (Konia-Bulgurlu section)[4]	124	£620: Annuity £440 Working Expenses £180.
Mudania-Brusa	26	Nil.
Smyrna-Aidin	320	Nil.
Smyrna-Cassaba	322	For main-line and Burnabat and Manisa-Soma branches the government guarantees £92,400 as half the annual receipts. For the Alashehr-Karahissar extension, there is a kilometric guarantee of £755.
Damascus-Hama	361	520
Mersina-Adana[5]	42	Nil.
Jaffa-Jerusalem	54	Nil.
Total Asiatic Turkey	2816	
Grand Total	4085	

Results of 1908 according to the Nationality of the Capital.

Nationality of the Capital.	Companies or Societies.	Lengths Worked.		Gross Receipts for the Year 1908.	Guarantees paid by the State for the Year 1908.	Rents paid to the State for the Year 1908.	Totals per Companies.	Totals per Nationalities.	Average receipts per mile per Nationality.
		per Company.	per Nationality.						
		Miles.	Miles.	£	£	£	£	£	£
Ottoman	Hejaz Railway	932	932	150,435	—	—	150,435	150,435	161
German	Salonica-Monastir Railway	137	938	129,854	—	243	129,611	841,081	885
	Bagdad Railway	124		14,578	108,155	—	122,733		
	Mersina-Adana Railway	42		36,400	—	—	36,400		
	Anatolia—								
	Haidar Pasha-Angora			209,105	117,030				
	Eskishehr-Konia	635		102,570	118,755	—	552,337		
	Hamidie-Adabazar			4,877	—	—			
English	Aidin Railway	320	320	293,104	—	—	293,104	293,104	916
Austro-German	Oriental Railways	815	815	607,619	—	115,679	491,940	491,940	604
French	Salonica-Constantinople Junction	317	1,054	113,505	199,728	—	313,233	1,092,957	1,037
	Smyrna Kassaba and Extensions	322		223,643	146,980	—	—		
	Damascus-Hama and Extensions (Rayak-Aleppo)	301		269,934	94,801	—	364,735		
	Jaffa-Jerusalem	54		44,366	—	—	44,366		
Various	Mudania-Brusa	26	26	15,039	—	—	15,039	15,039	579
	Totals	4,085	4,085	2,215,029	785,449	115,922	2,884,556	2,884,556	697

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[1] Specially formed by the Anatolian railway group for the execution, which the Anatolian Railway Company guarantees under the Bagdad Railway Convention, of the Bagdad railway concession.

[2] The line from Mustafa-Pasha to Vakarel now lies in the kingdom of Bulgaria.

[3] Constructed and worked by the State.

[4] Extension of Anatolian Railway.

[5] The Anatolian Railway group (German) has obtained control of this little railway, which was originally British.

—an additional indication, if any were needed, of the thriftlessness of the latter in the matter. Moreover, the Anatolian railway receives, under the original Bagdad railway convention (1) an annuity of £14,000 per annum for thirty years as compensation for strengthening its permanent way sufficiently to permit of the running of express trains, and (2) a second annuity of £14,000 in perpetuity to compensate it for running express trains—this to begin as soon as the main Bagdad line reaches Aleppo.

It was stated in the preface to the budget of 1910 that the government would grant no more railway concessions carrying guarantees. The amount inscribed for railway guarantees in the budget of 1910 was £746,790. The tables on p. 440 show the respective lengths of the various Ottoman railways open and worked at the end of 1908 and the amount of kilometric guarantees which they carried—and the lengths, &c., of railways worked by the various companies according to the nationality of the concessionaire groups.

Banks.—At the close of the Crimean War a British bank was opened in 1856 at Constantinople under the name of the Ottoman Bank, with a capital of £500,000 fully paid up. In 1863 this was merged in an Anglo-French bank, under a concession from the Turkish government, as a state bank under the name of the *Imperial Ottoman Bank*, with a capital of £2,700,000, increased in 1865 to £4,050,000 and in 1875 to £10,000,000, one-half of which is paid up. The original concession to the year 1893 was in 1875 extended to 1913, and in 1895 to 1925. The bank acts as banker to the government, for which it has a fixed annual commission, and it is obliged to make a permanent statutory advance to the government of £T1,000,000, against the deposit by the government of marketable securities bearing interest at a rate agreed upon. The bank has the exclusive privilege of issuing bank-notes payable in gold. Its central office is in Constantinople, and it is managed by a director-general and advisory committee appointed by committees in London and Paris.

The National Bank of Turkey (a limited Ottoman Company) is a purely British concern with a capital of £1,000,000, founded by imperial firman of the 11th of April 1909, under the auspices of Sir Ernest Cassel. It is understood that it was originated at the unofficial instigation of both the British and Ottoman governments, with the idea of forming a channel for the more generous investment of British capital in Turkey under the new régime, so that British financial interests might play a more important part in the Ottoman Empire than has been the case since the state bankruptcy of 1876. This bank brought out the Constantinople municipal loan of 1909 (£1,000,000). Other banks doing business in Constantinople are the *Deutsche Bank*, the *Deutsche-Orient Bank*, the *Crédit Lyonnais*, the *Wiener Bank-Verein*, the *Russian Bank for Commerce and Industry*, the *Bank of Mitylene*, the *Bank of Salonica* and the *Bank of Athens*.

Monetary System.—The monetary system presents a spectacle of perplexing confusion, which is a remnant of the complete chaos which prevailed before the reforms initiated in 1844 by Sultan Abd-ul-Mejid. The basis of the system adopted was the double standard with a fixed relation of 1 to 15·09, and free coinage. The unit was the piastre (=2¼d.), nominally subdivided into 40 paras. The gold pound (18s. 2d.) was equivalent to 100 piastres; the gold pieces struck were £T5, £T1, £T½ and £T¼; the standard is 0·916⅔ fine, and the weight 7·216 grammes. The silver coinage consisted of the mejidie (weight 24·055 grammes, 0·830 fine), equivalent to 20 piastres, and its subdivisions 10, 5, 2, 1, and ½ piastre pieces. The altilik, beshlik and metallik currencies struck, the first and last in the reign of Mahmud II. and Abd-ul-Mejid, and the second in the reign of Mahmud only, were not included in the reform; these were debased currencies bearing a nominal value, the altilik of 6, 3 and 1½ piastres, the beshlik of 5 and 2½ piastres, the metallik of 1, ½ and ¼ piastres; they represented the last degree of an age-long monetary depreciation, the original piastre having had a value of about 5s. 7d., which had fallen to 2¼d. The heavy depreciation in silver causing large losses to the government, free coinage was suspended in 1880, and the nominal value of the mejidie was reduced by decree to 19 piastres (105·26 piastres thus = £T1), while in the same year the debased currencies were reduced, altilik, the 6-piastre piece to 5 piastres, the 3-piastre piece to 2½ piastres, the 1½-piastre piece to 1¼ piastre; beshlik, the 5-piastre piece to 2½ piastres, the 2½-piastre piece to 1¼-piastre; metallik, the 1-piastre piece to ½ piastre, the ½-piastre piece to ¼ piastre, the ¼-piastre piece to ⅛ piastre—these values representing approximately the intrinsic value of the silver, at mejidie standard, contained in the debased coins. The copper coinage (113,000,000 piastres) and the paper currency (kaimè) (1,600,000,000 piastres) referred to in the above sketch were withdrawn in 1880 by repudiation. The 20-piastre mejidie currency, in spite of the further enormous depreciation of silver since 1880, has scarcely varied in the Constantinople market, but has always remained at a discount of about 3% (between 108 and 109 piastres to the pound) under government rate; this is doubtless due to the fact that the demand and supply of the coins in that market are very evenly balanced. The parity thus working out at 102·60, gold continued to be held away from the treasury, and in 1909 the government decided to accept the Turkish pound at the last named rate. The fractional mejidie coins (5, 2 and 1 piastres) are quoted at a separate rate in the market, usually at a premium over the 20-piastre piece. In the last twelve years of the 19th century the altilik currency was almost entirely withdrawn, and replaced by fractional mejidie; a large proportion of the beshlik has also been withdrawn, but the metallik has not been touched. These debased currencies are usually at a premium over gold owing to the extreme scarcity of fractional coinage. The standard of the altilik is about 0·440 fine, that of the beshlik is 0·185 to 0·225 fine, that of the metallik is 0·170 fine. Foreign gold coins, especially the pound sterling (par value 110 piastres) and the French 20-franc piece (par value 87½ piastres) have free currency. Throughout Arabia and in Tripoli (Africa) the principal money used is the silver Maria Theresa dollar tariffed by the Ottoman government at 12 piastres. The Indian rupee and the Persian kran are widely circulated through Mesopotamia; in Basra transactions are counted in krans, taking as a fixed exchange £T1 = 34·15 krans. The general monetary confusion is greatly intensified by the fact that the piastre unit varies for almost every province; thus, while the pound at Constantinople is counted at 108 piastres silver, it is at about 127 piastres for one kind of transaction and 180 for another in Smyrna, 135 piastres at Adrianople, 140 at Jerusalem, and so forth, accounts being kept in "abusive piastres," which exist no longer. In some towns, *e.g.* Adrianople, small change is often supplemented by cardboard tickets, metal discs, &c., put into circulation by private establishments or individuals of good credit.

A commission (the successor of many) was instituted at the ministry of finance in 1910, to draw up proposals for setting this confusion in order. In his 1910 budget speech the minister of finance, Javid Bey, demanded authority to create a new aluminium coinage of 5, 10, 20 and 40 para pieces, of which he would issue, in the course of three years, a nominal amount of £T1,000,000 to those provinces in which there was a great scarcity of small coins. The amounts of Turkish gold, silver and debased coinage in circulation are approximately £T16,500,000, in gold, £T8,700,000 (940,000,000 piastres at 108) in silver mejidies and fractions, and 200,000,000 piastres in beshlik and metallik.

Tenure of Property.—Real property is held in one of four various ways: either *mulk*, *emiriyè*, *vakuf* or *khaliyè*. (1) *Mulk* is the absolute property of its owner, and can be disposed of by him as he wills without restrictions, save those enumerated lower down (*General Dispositions*) as general for all the four classes. *Mulk* property is governed chiefly by the *Sheri* (sacred law). A duty of 10 per mille on its estimated value has to be paid on transfer by sale, donation or testament; 5 per mille on transfer by inheritance; and a registration duty on expenses of transfer. (2) *Emiriyè* is practically "public domains." The state may grant land of this category to private persons on payment by the latter of the value of the proprietary right—the tithes, ground-rent (should there be private buildings upon it), and the land-tax. It is administered by imperial functionaries called *arazi-mèmuru*; it is with the consent of the latter only that the proprietary rights can be sold. These rights are of simple possession, but they are transmissible in certain degrees to the heirs of the possessor. *Emiriyè* cannot be mortgaged, but can be given as security for debt on condition that it be restored when the debt has been repaid. The creditor may demand the *arazi-mèmuru* to proceed to a forced sale, but the *arazi-mèmuru* is not obliged to comply with that demand; no forced sale may take place after the decease of the debtor. *Emiriyè* is not transmissible by will, but may be transferred by donation, which returns to the donor should he outlive the beneficiary. Should a proprietor of *emiriyè* plant trees or vines, or erect buildings upon it, with the consent of the state, they are considered as *mulk*; an annual tax representing the value of the tithes on the portions of *emiriyè* thus utilized is levied. The *emiriyè* then becomes *mulk*, with certain restrictions as to transfer dues. A transfer duty of 5 % on the estimated value of *emiriyè* is paid on transmission by sale, inheritance or donation, of 2½ % on the amount of the debt in case of mortgage or release from mortgage, and of 10 % on expenses of registration. A different scale is established for *emiriyè* with *moukataa* (rent paid for *emiriyè* with *mulk* property established upon it). (3) *Vakuf* is "all property dedicated to God, of which the revenue is consecrated to His poor"; or "property of which the usufruct, such as tithe, taxes and rents, is attributed to a work of charity and of public interest." When once a property has been registered as *vakuf* it can never be withdrawn. There are two classes of *vakuf*: (*a*) Land so declared either directly by the sovereign or in virtue of imperial authority; (*b*) lands transformed by their proprietors from *mulk* into *vakuf*. The laws and regulations concerning *vakuf* are too intricate to be described; generally it may be said that they form a great obstruction to dealing with a large proportion of the most valuable property in Turkey, and therefore to the prosperity of the country. The *vakufs* are administered by a special ministerial department (*evkaf nazareti*), whose property, on behalf of the state, they theoretically are. The effect of the original system was that a *vakuf* property became the inalienable property of the state, and the original proprietor a mere tenant. All fundamental repairs thus fell to the charge of the state, which could not afford to effect them, and the *vakuf* revenues decreased so rapidly that already in the reign of Selim I. (1511–1520) a serious effort was made to deal with the difficulty. But this resulted in so heavy a burden upon the public that the law had again to be altered to extend hereditary rights, and to admit a system of mortgage which was assimilated to that for *emirsyĕ*; but the evils were little more than palliated. The curious gilds called *guedik* must here be mentioned. They were established at a time when industry was not free, and the government fixed the number of artisans of every kind of trade in each town, no one having the right to increase that number. The *guedik*, then, had the right to erect buildings on *vakuf* property and supply it with the tools, &c., necessary to exercise a trade. The ancient *guediks* have not been abolished, the government not daring to deprive them of their privileges; but since the Tanzimât no new ones have been created, industry being declared free. The various special dues payable on *vakuf* form too long a list to be inserted; the highest is 30 per mille. (4) *Khalsyĕ*. This property is also styled *mevad*. It consists of uncultivated or rough lands, such as mountains, stony ground, &c., which are useless without clearance, to which no possession is claimed, and which are at such a distance from the nearest dwelling that the human voice cannot be made to reach them from that dwelling. Any one can obtain a gratuitous permit to clear and cultivate such lands; the laws governing ordinary agricultural lands then apply to them. The permit is withdrawn if the clearance is not effected within three years. If the clearance is effected without the necessary permit, the land is nevertheless granted on application, and on the payment of the *tapu* or sum paid by the proprietor to the state for the value of the land.

General Dispositions.—By the "protocol of the 7th Sefer 1284 A.H." foreigners may enjoy the rights of proprietorship on the same conditions as Ottoman subjects throughout the empire, save in the Hejaz. The transmission of property from a foreigner to his heirs is therefore governed by the Ottoman laws, and not those of the country to which he belongs. The real property of a Mussulman does not pass by inheritance to non-Mussulman heirs, but may pass to his Mussulman heirs of a foreign nationality, and vice versa. Property of an individual who has abandoned Ottoman nationality without legal authority so to do does not pass to heirs, whether Ottoman or foreign, but devolves to the state; if legal authority has been granted the government under which the foreign heirs live must have accepted the protocol above cited. An heir who has voluntarily caused the death of the person from whom he should inherit loses all rights of succession. It is not proposed to trace the formalities of transfer and transmission of real property here; they will be found in vol. iii. of the *Dustur* (Ottoman Code). Minerals are worked according to the law of the 14th Sefer 1324 (March 26, 1906). Mines can only be exploited in virtue of an imperial iradĕ. The concessions are to be for 99 years with the exception of chrome, emery, boracite and other minerals found only in the form of deposits, which may be granted for not less than 40 years or more than 99 years. They may be disposed of under certain conditions to third parties, and they may be inherited. Immovable property, working plant, tools and fixtures, cannot be seized for payment of debts. For the discovery of mines, special permits of research, on which there is a fee of £T5 to £T15, are necessary; full details of the requisite formalities are given in the law. No researches are permitted in boroughs and villages or in forests, pasturages, &c., if it be considered that they would interfere with public convenience. Two permits are not granted for the same mineral within the same area, until the first has lapsed. Specimens may be sent to Europe for expert examination up to an aggregate weight of 2000 tons, on paying the requisite duties. Explosives are under the control of the local authorities. In order to obtain permits foreigners must first have adhered to the law of 1293 (A.H.). The original discoverer of a mine is entitled to a certain indemnity for "right of discovery" to be paid by the concessionaire of that mine, should the discoverer be unable to work it. To obtain a concession, formalities detailed in the law must be complied with, under a penalty of £T100 to £T1000. Should a different mineral from that specified in the imperial firman for a mining concession be discovered in a free state, a fresh firman is necessary to exploit it. Discovered mines not registered by the government, or not worked for a period of 99 years before the promulgation of the law of the 26th of March 1906, are considered as non-discovered. On the promulgation of the firman for the exploitation of a mine, a fee of £T50 to £T100 becomes payable. Two categories of rent, fixed and proportional, are payable to the state by mine-owners. The fixed rent is 10 piastres per *jerib* (about 10,000 square metres), to be paid whether the mine is worked or not. The proportional rent is from 1% to 5% on the gross products of mines of vein formation, and from 10% to 20% on those of mines of deposit formation; the percentages are calculated on the value of the mineral after deduction of freight, &c. to Europe and of treatment. The proportional rents are fixed by the Mines Administration according to the wealth, area and facility of working of the mine, and are inserted in the imperial firman governing the mine, and must be paid before the minerals are exported. Yearly returns, under a penalty of £T5 to £T25, of the results of working have to be rendered to the Mines Administration. If payments due to the government are not made within two months of due date, the mines may be seized by the authorities and sold to the highest bidder. The working of the mine must begin within two years of the date of the delivery of the mine to the concessionaire. Certain specified plans must be delivered annually, under penalty of £T5 to £T25, to the Mines Administration, and, under similar penalties, all information and facilities for visiting the mines in detail must be afforded to government inspectors. Should a mine-owner, in the course of developing his mine, damage the mine of a neighbouring owner, he must pay him an agreed indemnity. With the exception of the engineer and foreman, the employés must be Ottoman subjects. No part of the subterranean working of a mine may be abandoned without official permission obtained according to formalities specified in the law. Owners of the land in which a mine is located have a prior right to work such mine under imperial firman, on the obtention of which a duty of £T4 is payable; if they do not work it the concession may be granted to others, on payment of a certain compensation to the landowner. The research of a mine in no way impairs the rights of ownership of the land in which the mine is located. If a mining concession is granted within lands which are private property or which are "real *vakuf* lands" (*arazi-i-mevkufĕ-i-sahika*) only one-fifth of the proportional rent is payable to the state, the other four-fifths reverting to the land-owner or the *vakufs*, as the case may be. As to ancient coins, and all kinds of treasure of which the proprietor is unknown, reference must be made to the *Dustur*, No. 4, p. 89.

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History

Legend assigns to Oghuz, son of Kara Khan, the honour of being the father of the Ottoman Turks. Their first appearance in history dates from A.D. 1227. In that year a horde, variously estimated at from two to four thousand souls, with their flocks and their slaves, driven originally from their Central Asian homes by the pressure of Mongol invasion, and who had sought in vain a refuge with the Seljukian sultan Ala-ud-din Kaikobad of Konia, were returning under their chief Suleiman Shah to their native

Ertoghrul, 1230-1288.

Osman I, 1288-1326.

land. They were crossing the Euphrates, not far from the castle of Jaber, when the drowning of their leader by accident threw confusion into their ranks. Those who had not yet crossed the river refused, in face of this omen, to follow their brethren; the little band, numbering 400 warriors (according to others, consisting of 2000 horsemen) decided to remain under Ertoghrul, son of the drowned leader. Ertoghrul first camped at Jessin, east of Erzerum; a second appeal to Ala-ud-din was more successful—the numbers of the immigrants had become too insignificant for their presence to be a source of danger. The lands of Karaja Dagh, near Angora, were assigned to the new settlers, who found there good pasturage and winter quarters. The help afforded by Ertoghrul to the Seljukian monarch on a critical occasion led to the addition of Sugut to his fief, with which he was now formally invested. Here Ertoghrul died in 1288 at the age of ninety, being succeeded in the leadership of the tribe by his son Osman. When, exhausted by the onslaughts of Ghazan Mahmud Khan, ruler of Tabriz, and one of Jenghiz Khan's lieutenants, the Seljukian Empire was at the point of dissolution, most of its feudatory vassals helped rather than hindered its downfall in the hope of retaining their fiefs as independent sovereigns. But Osman remained firm in his allegiance, and by repeated victories over the Greeks revived the drooping glories of his suzerain. His earliest conquest was Karaja Hissar (1295), where first the name of Osman was substituted for that of the sultan in the weekly prayer. In that year Ala-ud-din Kaikobad II. conferred on him the proprietorship of the lands he had thus conquered by the sword, and presented him at the same time with the horse-tail, drum and banner which constituted the insignia of independent command. Osman continued his victorious career against the Greeks, and by his valour and also through allying himself with Keussĕ Mikhal, lord of Harman Kaya, became master of Aïnĕgeul, Bilejik and Yar Hissar. His marriage with Mal Khatun, the daughter of the learned sheikh Edbali, has been surrounded by poetical legend; he married his son Orkhan to the beautiful Greek Nilofer, daughter of the lord of Yar Hissar, whom he carried off from her destined bridegroom on her marriage-day; the fruits of this union were Suleiman Pasha and Murad. In 1300 the Seljukian Empire crumbled away, and many small states arose on its ruins. It was only after the death of his protector and benefactor Sultan Ala-ud-din II. that Osman declared his independence, and accordingly the Turkish historian dates the foundation of the Ottoman Empire from this event. Osman reigned as independent monarch until 1326. He pursued his conquests against the Greeks, and established good government throughout his dominions, which at the time of his death included the valleys of the Sakaria and Adranos, extending southwards to Kutaiah and northwards to the Sea of Marmora. Infirmity had compelled him towards the end of his life to depute the chief command to his younger son Orkhan, by whom in 1326 the conquest of Brusa was at last effected after a long siege.

Orkhan, 1326-1359.

Orkhan's military prowess secured for him the succession, to the exclusion of his elder brother Ala-ud-din, who became his grand vizier. At that time a number of principalities had replaced the Seljukian state. Though Yahsha Bey, grandson of Mahommed Karaman Oghlu, had declared himself the successor of the Seljukian sultans, the princes of Aidin, Sarukhan, Menteshĕ, Kermian, Hamid, Tekkĕ and Karassi declined to recognize his authority, and considered themselves independent, each in his own dominions. Their example was followed by the Kizil Ahmedli Emir Shems-ed-din, whose family was afterwards known as the house of Isfendiar in Kastamuni. The rest of the country was split up among Turcoman tribes, such as the Zulfikar in Marash and the Al-i-Ramazan in Adana. At his accession Orkhan was practically on the same footing with these, and avoided weakening himself in the struggle for the Seljukian inheritance, preferring at first to consolidate his forces at Brusa. There he continued to wrest from the Greeks the lands which their feeble arms were no longer able to defend. He took Aidos, Nicomedia, Hĕrĕkĕ, and, after a siege, Nicaea; Tarakli and Gemlik fell to his arms, and soon the whole of the shore of the Marmora up to Kartal was conquered, and the Byzantines retained on the continent of Asia Minor only Ala Shehr and Biga. These acquisitions were made between 1328 and 1338; in the latter year Orkhan achieved his first conquest from Mussulman hands by the capture of Karassi, the pretext being the quarrel for the succession on the death of the prince, Ajlan Bey.

At this period the state of the Byzantine Empire was such as to render its powers of resistance insignificant; indeed the length of time during which it held out against the Turks is to be attributed rather to the lack of efficacious means at the disposal of its assailants than to any qualities possessed by its defenders. In Constantinople itself sedition and profligacy were rampant, the emperors were the tools of faction and cared but little for the interests of their subjects, whose lot was one of hopeless misery and depravity. On the death of the emperor Andronicus III. in 1341 he was succeeded by John Palaeologus, a minor; and Cantacuzenus, the mayor of the palace, appealed to Orkhan for assistance to supplant him, giving in marriage to the Ottoman prince his daughter Theodora. Orkhan lent the desired aid; his son Suleiman Pasha, governor of Karassi, crossed into Europe, crushed Cantacuzenus's enemies, and penetrated as far as the Balkans, returning laden with spoil. Thus the Turks learnt the country of the Greeks and their weakness. In 1355 Suleiman crossed over from Aidinjik and captured the fortress of Gallipoli, which was at once converted into a Turkish stronghold; from this base Bulair, Malgara, Ipsala and Rodosto were added to the Turkish possessions. Suleiman Pasha was killed by a fall from his horse near Bulair in 1358; the news so affected his father Orkhan as to cause his death two months later. The institution of the Janissaries (*q.v.*) holds a prominent place among the most remarkable events of Orkhan's reign, which was notable for the encouragement of learning and the foundation of schools, the building of roads and other works of public utility.

Murad I, 1359-1389.

Orkhan was succeeded by his son Murad. After capturing Angora from a horde of Turkomans encamped there who were attacking his dominions, at first with some success, in 1361 Murad prepared for a campaign in Europe. At that time the Greek emperor's rule was confined to the shores of the Marmora, the Archipelago and Thrace. Salonica, Thessaly, Athens and the Morea were under independent Greek princes. The Bulgarians, Bosnians and Servians had at different periods invaded and conquered the territories inhabited by them; the Albanians, original natives of their land, were governed by princes of their own. When, on the death of Cantacuzenus, John Palaeologus remained sole occupant of the imperial throne, Murad declared war against him and conquered the country right up to Adrianople; the capture of this city, the second capital of the emperors, was announced in official letters to the various Mussulman rulers by Murad. Three years later, in 1364, Philippopolis fell to Lala Shahin, the Turkish commander in Europe. The states beyond the Balkan now began to dread the advance of the Turks; at the instigation of the pope an allied army of 60,000 Serbs, Hungarians, Walachians and Moldavians attacked Lala Shahin. Murad, who had returned to Brusa, crossed over to Biga, and sent on Haji Ilbeyi with 10,000 men; these fell by night on the Servians and utterly routed them at a place still known as the "Servians' coffer." In 1367 Murad made Adrianople his capital and enriched it with various new buildings. He continued to extend his territories in the north and west; the king of Servia and the rulers of Kiustendil, Nicopolis and Silistria agreed to pay tribute to the conquering Turk. Lala Shahin Pasha was appointed feudal lord of the district of Philippopolis, and Timur Tash Pasha became beylerbey of Rumelia; Monastir, Perlepĕ, and parts of Bosnia and Herzegovina were next taken, and the king of Servia consented to furnish to Murad a fixed contingent of auxiliary troops, besides paying a money tribute. In 1381 Murad's son Yilderim Bayezid married Devlet Shah Khatun, daughter of the prince of Kermian, who brought him in dowry Kutaiah and its six dependent provinces. In the same year Bey Shehr and other portions of the Hamid principality were acquired by purchase from their ruler Hussein Bey, as the Karamanian princes were beginning to cast covetous eyes on them; but the Karamanians were unwilling to resign their claims to be heirs of the Seljukian sultans, and not until the reign of Mahommed II. were they finally suppressed. Ali Bey, the prince at this time, took advantage of Murad's absence in Europe to declare war against him; but the Ottoman ruler returning crushed him at the battle of Konia. Meanwhile the king of Bosnia, acting in collusion with the Karamanian prince, attacked and utterly defeated Timur Tash Pasha, who lost 15,000 out of an army of 20,000 men. The princes and kings who had consented to pay tribute were by this success encouraged to rebel, and the Servian troops who had taken part in the battle of Konia became insubordinate. Indignant at the severity with which they were punished, Lazarus, king of Servia, joined the rebel princes. Murad thereupon returned to Europe with a large force, and sent Chenderēli Zadē Ali Pasha northwards; the fortresses of Shumla, Pravadi, Trnovo, Nicopolis and Silistria were taken by him; Sišman III., rebel king of Bulgaria, was punished and Bulgaria once more subjugated. Ali Pasha then joined his master at Kossovo. Here Lazarus, king of Servia, had collected an army of 100,000 Serbs, Hungarians, Moldavians, Walachians and others. On the 27th of August 1389 the greatest of the battles of Kossovo was fought. A lightning charge of Yilderim Bayezid's dispelled the confidence of the enemy, scattering death and dismay in their ranks. The king of Servia was killed and his army cut to pieces, though the Turks numbered but 40,000 and had all the disadvantage of the position. After the battle, while Murad was reviewing his victorious troops on the field, he was assassinated by Milosh Kabilovich, a Servian who was allowed to approach him on the plea of submission.

Murad maintained a show of friendly relations with the emperor John Palaeologus, while capturing his cities. A review held by him in 1387 at Yeni Shehr was attended by the emperor, who, moreover, gave one of his daughters in marriage to Murad and the other two to his sons Bayezid and Yakub Chelebi. These princes were viceroys of Kermian and Karassi respectively; the youngest son, Sauji Bey, governed at Brusa during his father's absence. Led away by evil counsellors, Sauji Bey plotted with Andronicus, son of the emperor, to dethrone their respective fathers. The attempt was foiled; Andronicus was blinded by his father's orders and Sauji was put to death (1387).

Bayezid I., 1389-1403.

After being proclaimed on the field of Kossovo, Bayezid's first care was to order the execution of his brother Yakub Chelebi, and so to preclude any repetition of Sauji's plot. The young prince Andronicus, who had not been completely blinded, sent secretly to Bayezid and offered him 30,000 ducats to dethrone his father John Palaeologus and make him emperor. Bayezid consented; later on John Palaeologus offered an equivalent sum and, since he engaged to furnish an auxiliary force of 12,000 men into the bargain, Bayezid replaced him on the throne. By the aid of these auxiliaries the fort of Ala Shehr was captured (1392), Manuel Palaeologus, son of the emperor, being allowed, in common with many other princes, the privilege of serving in the Turkish army, then the best organized and disciplined force extant. The principalities of Aidin, Menteshē, Sarukhan and Kermian were annexed to Bayezid's dominions to punish their rulers for having joined with the Karamanian prince in rebellion. The exiled princes took refuge with the Kizil Ahmedli, ruler of Kastamuni, who persuaded the Walachians to rebel against the Turks. By a brilliant march to the Danube Bayezid subjugated them; then returning to Asia he crushed the prince of Karamania, who had made head again and had defeated Timur Tash Pasha. Bayezid now consolidated his Asiatic dominions by the capture of Kaisarieh, Sivas and Tokat from Tatar invaders, the relics of Jenghiz Khan's hordes. Sinope, Kastamuni and Samsun were surrendered by the prince of Isfendiar, and the conquest of Asia Minor seemed assured.

On the death of John Palaeologus in 1391 his son Manuel, who was serving in the Turkish army, fled, without asking leave, to Constantinople, and assumed the imperial dignity. Bayezid determined to punish this insubordination: Constantinople was besieged and an army marched into Macedonia, capturing Salonica and Larissa (1395). The siege of the capital was, however, unsuccessful; the pope and the king of Hungary were able to create a diversion by rousing the Christian rulers to a sense of their danger. An army of crusaders marched upon the Turkish borders; believing Bayezid to be engaged in the siege of Constantinople, they crossed the Danube without precaution and invested Nicopolis. While the fortress held out with difficulty Bayezid fell upon the besiegers like a thunderbolt. The first onslaught of the Knights of the Cross did indeed rout the weak irregulars placed in the van of the Turkish army, but their mad pursuit was checked by the steady ranks of the Janissaries, by whom they were completely defeated (1396). King Sigismund of Hungary barely escaped in a fishing boat; his army was cut to pieces to a man; among the prisoners taken was Jean Sans Peur, brother of the king of France. To the usual letter announcing the victory the caliph in Egypt replied saluting Bayezid with the title of "Sultan of the lands of Rum."

After the victory of Nicopolis the siege of Constantinople was resumed, and the tower of Anatoli Hissar, on the Asiatic side of the Bosporus, was now built. However, by sending heavy bribes to Bayezid and his vizier, and by offering to build a mosque and a Mussulman quarter, and to allow Bayezid to be named in the weekly prayer, Manuel succeeded in inducing Bayezid to raise the siege. The mosque was destroyed later on and the Mussulman settlers driven out. Between 1397 and 1399 Bayezid overran Thessaly, while in Asia his lieutenant Timur Tash was extending his conquests. Meanwhile Timur (Tamerlane) had started from Samarkand on his victorious career. With incredible rapidity his hosts spread and plundered from Bagdad to Moscow. After devastating Georgia in 1401 he marched against the Turks. Some of the dispossessed princes of Asia Minor had repaired to Timur and begged him to reinstate them; accordingly Timur sent to Bayezid to request that this might be done. The tone of the demand offended Bayezid, who rejected it in terms equally sharp. As a result Timur's countless hordes attacked and took Sivas, plundering the town and massacring its inhabitants. Then, to avenge an insult sustained from the ruler of Egypt, Timur marched southwards and devastated Syria, thence turning to Bagdad, which shared the same fate. He then retraced his steps to the northwest. Bayezid had taken advantage of his absence to defeat the ruler of Erzingan, a protégé of Timur. All attempts to arrange a truce between the two intractable conquerors were in vain. They met in the neighbourhood of Angora. Timur's army is said to have numbered 200,000, Bayezid's force to have amounted to about half that figure, mostly seasoned veterans. The sultan's five sons were with the army, as well as all his generals; 7000 Servian auxiliaries under Stephen, son of Lazarus, took part in the battle (1402). Prodigies of valour on the part of Bayezid's troops could not make up for the defection of the newly-absorbed levies from Aidin, Sarukhan and Menteshē who went over to their former princes in Timur's camp. The rout of the Turkish army was complete. Bayezid, with many of his generals, was taken prisoner. Though treated with some deference by his captor, who even promised to reinstate him, Bayezid's proud spirit could not endure his fall, and he died eight months later at Ak Shehr.

Interregnum, 1403-1413.

After the disaster of Angora, from which it seemed impossible that the Ottoman fortunes could ever recover, the princes fled each with as many troops as he could induce to follow him, being hotly pursued by Timur's armies. Only Mussa was captured. Timur reached Brusa, and there laid hands on the treasure of Bayezid; one after another the cities of the Turks were seized and plundered by the Tatars. Meanwhile Timur sent letters after the fugitive sons of Bayezid promising to confer on them their father's dominions, and protesting that his attack had been due merely to the insulting tone adopted towards him by Bayezid and to the entreaties of the dispossessed princes of Asia Minor. Most of the latter were reinstated, with the object of reducing the Turkish power. Timur did not cross into Europe, and contented himself with accepting some trifling presents from the Greek emperor. After capturing Smyrna he returned to Samarkand (1405). Some years of strife followed between the sons of Bayezid, in which three of them fell; Mussa, seizing Adrianople, laid siege to Constantinople, and Manuel Palaeologus, the emperor, appealed for aid to Mahommed, the other son, who had established himself at Brusa.

Mahommed I., 1413-1421.

In 1413 Mahommed defeated Mussa, and thus remained sole heir to Bayezid's throne; in seven or eight years he succeeded in regaining all the territories over which his father had ruled, whereas Timur's empire fell to pieces at the death of its founder. Two years after his accession Mahommed overcame a rebellion of the prince of Karamania and recaptured his stronghold Konia (1416), and then, turning northwards, forced Mircea, voivode of Walachia, who in the dispute as to the succession had supported Prince Mussa, to pay tribute. The Turkish dominions in Asia Minor were extended, Amasia, Samsun and Janik being captured, and an insurrection of dervishes was quelled. In 1421 the sultan died. His services in the regeneration of the Turkish power can hardly be over-estimated; all agree in recognizing his great qualities and the charm of his character; even Timur is said to have admired him so much as to offer him his daughter in marriage. The honour was declined, and Mahommed took a bride from the house of Zulfikar. Amid the cares of state he found time for works of public utility and for the support of literature and art; he is credited with having sent the first embassy to a Christian power, after the Venetian expedition to Gallipoli in 1416, and the Ottoman navy is first heard of in his reign.

Murad II., 1421-1451.

At the time of Mahommed's death his eldest son Murad was at Amasia; and, as the troops had lately shown signs of insubordination, it was deemed advisable to conceal the news of the sultan's death and to send a part of the army across to Asia. The men, however, refused to march without seeing their sultan, and the singular expedient was resorted to of propping up the dead monarch's body in a dark room and concealing behind it an attendant who raised the hands and moved the head of the corpse as the troops marched past. Shortly after Murad's accession the emperor Manuel, having applied in vain for the renewal of the annual subsidy paid him by the late sultan for retaining in safe custody Mustafa, an alleged son of Bayezid, released the pretender. Adherents flocked to him, and for a whole year Murad was engaged in suppressing his attempts to usurp the throne.

At last the armies of sultan and pretender met at Ulubad (Lopadion) on the Rhyndacus in Asia Minor; Mustafa's troops fled at the first onset; Lampsacus, where the pretender took refuge, was captured with the aid of the Genoese galleys under Adorno. Mustafa, who had crossed the strait and fled northwards, was taken, brought to Adrianople, and hanged from a tower of the serai (1422). Murad now laid siege to Constantinople to avenge himself on the emperor, and on the 24th of August the desperate valour of the defenders succeeded in driving back an assault led by a band of fanatical dervishes. The siege was raised, however, not owing to the bravery of the defence, but because the appearance of another pretender, in the person of Murad's thirteen-year-old brother Mustafa, under the protection of the revolted princes of Karamania and Kermian, called the sultan to Asia. Mustafa, delivered up by treachery, was hanged (1424); but Murad remained in Asia, restoring order in the provinces, while his lieutenants continued the war against the Greeks, Albanians and Walachians. By the treaty signed on the 22nd of February 1424, shortly before his death, the emperor Manuel II., in order to save the remnant of his empire, agreed to the payment of a heavy annual tribute and to surrender all the towns on the Black Sea, except Selymbria and Derkos, and those on the river Strymon. Peace was also made at the same time with the despot of Servia and the voivode of Walachia, on the basis of the payment of tribute. By 1426 the princes of Kermian and Karamania had submitted on honourable terms; and Murad was soon free to continue his conquests in Europe. Of these the most conspicuous was that of Salonica. Garrisoned only by 1500 Venetians, the city was carried by storm (March 1, 1428); the merciful precedent set by Mahommed I. was not followed, the greater part of the inhabitants being massacred or sold into slavery, and the principal churches converted into mosques.

The capture of Salonica had been preceded by renewed troubles with Servia and Hungary, peace being concluded with both in 1428. But these treaties, each of which marked a fresh Turkish advance, were short-lived. The story of the next few years is but a dismal record of aggression and of reprisals leading to fresh aggression. In 1432 the Turkish troops plundered in Hungary as far as Temesvár and Hermannstadt, while in Servia Semendria was captured and Belgrade invested. In Transylvania, however, the common peril evoked by the Turkish incursion and a simultaneous rising of the Vlach peasantry had knit together the jarring interests of Magyars, Saxons and Szeklers, a union which, under the national hero, the voivode János Hunyadi (*q.v.*), was destined for a while to turn the tide of war. In 1442 Hunyadi drove the Turks from Hermannstadt and, at the head of an army of Hungarians, Poles, Servians, Walachians and German crusaders, succeeded in the ensuing year in expelling them from Semendria, penetrating as far as the Balkans, where he inflicted heavy losses on the Turkish general. Meanwhile, again confronted by a rebellion of the prince of Karamania, Murad had crossed into Asia and reduced him to submission, granting him honourable terms, in view of the urgency of the peril in Europe. On the 12th of July 1444 a ten years' peace was signed with Hungary, whereby Walachia was placed under the suzerainty of that country; and, wearied by constant warfare and afflicted by the death of his eldest son, Prince Ala-ud-din, Murad abdicated in favour of his son Mahommed, then only fourteen years of age, and retired to Magnesia (1444). The pope urged the king of Hungary to take advantage of this favourable opportunity by breaking the truce solemnly agreed upon, and nineteen days after it had been concluded a coalition was formed against the Turks; a large army headed by Ladislaus I., king of Hungary, Hunyadi, voivode of Walachia, and Cardinal Cesarini crossed the Danube and reached Varna, where they hoped to be joined by the Greek emperor. In this emergency Murad was implored to return to the throne; to a second appeal he gave way, and crossing over with his Asiatic army from Anatoli Hissar he hastened to Varna. The battle was hotly contested; but, in spite of the prowess of Hunyadi, the rout of the Christians was complete; the king of Hungary and Cardinal Cesarini were among the killed. Murad is said to have abdicated a second time, and to have been again recalled to power owing to a revolt of the Janissaries. In 1446 Corinth, Patras and the north of the Morea were added to the Turkish dominions. The latter years of Murad's reign were troubled by the successful resistance offered to his arms in Albania by Scanderbeg (*q.v.*). In 1448 Hunyadi, now governor of Hungary, collected the largest army yet mustered by the Hungarians against the Turks, but he was defeated on the famous field of Kossovo and with difficulty escaped, while most of the chivalry of Hungary fell. Little more than two years later Murad died at Adrianople, being succeeded by his son Mahommed.

Mahommed II. the Conqueror, 1451-1481.

After suppressing a fresh revolt of the prince of Karamania, the new sultan gave himself up entirely to the realization of the long-cherished project of the conquest of Constantinople. He began by building on the European side of the Bosporus the fort known as Rumeli Hissar, opposite that built by his grandfather Bayezid. Tradition avers that but forty days were needed for the completion of the work, six thousand men being employed night and day; guns and troops were hurriedly put in, and all navigation of the Bosporus was stopped. After completing his preparations, which included the casting of a monster cannon and the manufacture of enormous engines of assault, Mahommed began the siege in 1453. Constantine Palaeologus, the last occupant of the imperial throne, took every measure that the courage of despair could devise for the defence of the doomed city; but his appeal to the pope for the aid of Western Christendom was frustrated through the bigoted, anti-Catholic spirit of the Greeks. The defenders were dispirited and torn by sedition and dissensions, and the emperor could rely on little more than 8000 fighting men, while the assailants, 200,000 strong, were animated by the wildest fanatical zeal. The siege had lasted fifty-three days when, on the 29th of May 1453, a tremendous assault was successful; the desperate efforts of the Greeks were unavailing, Constantine himself falling among the foremost defenders of the breach. The sultan triumphantly entered the palace of the emperors, and the next Friday's prayer was celebrated in the church of St Sofia (see Roman Empire, Later).

After some days' stay in Constantinople, during which he granted wide privileges to the Greeks and to their patriarch, the sultan proceeded northwards and entirely subdued the southern parts of Servia. A siege of Belgrade was unsuccessful, owing to the timely succour afforded by Hunyadi (1456). Two years later internal dissensions in Servia brought about the conquest of the whole country by the Turks, only Belgrade remaining in the hands of the Hungarians. The independent princes of Asia Minor were now completely subjugated and their territories finally absorbed into the Turkish dominions; Walachia was next reduced to the state of a tributary province. Venice having adopted a hostile attitude since Turkey's conquests in the Morea, greater attention was devoted to the fleet; Mytilene was captured and the entrance to the straits fortified. The conquest of Bosnia, rendered necessary by the war with Venice, was next completed, in spite of the reverses inflicted on the Turks by the Hungarian king Matthias Corvinus, the son of János Hunyadi. The Turks continued to press the Venetians by land and sea; Albania, which under Scanderberg had for twenty-five years resisted the Ottoman arms, was overrun; and Venice was forced to agree to a treaty by which she ceded to Turkey Scutari and Kroia, and consented to pay an indemnity of 100,000 ducats (Jan. 25, 1478). The Crimea was next conquered and bestowed as a tributary province on the Tatar khan Mengli Girai. Mahommed now endeavoured to strike a blow at Rhodes, the stronghold of the Knights of St John, preparatory to carrying out his long-cherished plan of conquering Italy. A powerful naval expedition was fitted out, but failed, an armistice and treaty of commerce being signed with the grand master, Pierre d'Aubusson (1479). But a land attack on southern Italy at the same time was successful, Otranto being captured and held for a time by the Turks. In 1481 the sultan was believed to be projecting a campaign against the Circassian rulers of Syria and Egypt, when he died at Gebzé. He is said to have been of a merry and even jocular disposition, to have afforded a generous patronage to learning, and, strange to say for a sultan, to have been master of six languages.

Mahommed II. was the organizer of the fabric of Ottoman administration in the form which it retained practically unchanged until the reforms of Mahmud II. and Abd-ul-Mejid. He raised the regular forces of the country to a total exceeding 100,000; the pay of the Janissaries was by him increased, and their ranks were brought up to an effective of upwards of 12,000. He established the system whereby the lands conquered by the arms of his troops were divided into the different classes of fiefs, or else assigned to the maintenance of mosques, colleges, schools and charitable institutions, or converted into common and pasturage lands. Many educational and benevolent foundations were endowed by him, and it is to Mahommed II. that the organization of the ulema, or legist and ecclesiastical class, is due.

Bayezid II., 1481-1512.

Upon Bayezid II. succeeding to his father a serious revolt of the troops took place, which led to the institution of the regular payment of an accession donative to the Janissaries. At the outset of the reign Bayezid's brother, Prince Jem, made a serious attempt to claim the throne; he was defeated, and eventually took refuge with the knights of Rhodes, whom Bayezid bribed to keep him in safe custody. The unfortunate prince was led from one European stronghold to another, and, after thirteen years' wandering, died at Naples in 1494 (see Bayezid II.). Freed from the danger of his brother's attacks, the sultan gave himself up to devotion, leaving to his ministers the conduct of affairs in peace and war. But, though of an unambitious and peace-loving temper, the very conditions of his empire made war inevitable. Even when peace was nominally in existence, war in its most horrible forms was actually being waged. On the northern frontier border raids on a large scale were frequent. Thus, in 1492 the Turks made incursions into Carinthia as far as Laibach, and into Styria as far as Cilli, committing unspeakable atrocities; in 1493 they overran both Styria and Croatia. The Hungarians retaliated in kind, burning and harrying as far as Semendria, torturing and murdering, and carrying off the saleable inhabitants as slaves. In 1494 a crushing victory of the emperor Maximilian drove the Turks out of Styria, which they did not venture again to invade during his reign. In 1496 the temporary armistice between the Poles and Turks, renewed in 1493, came to an end, and John Albert, king of Poland, seized the occasion to invade Moldavia. The efforts of Ladislaus of Hungary to mediate were vain, and the years 1497 and 1498 were marked by a terrible devastation of Poland by the Ottomans; only the bitter winter, which is said to have killed 40,000 Turks, prevented the devastation from being more complete. By the peace concluded in 1500 the sultan's dominions were again extended. Meanwhile, in June 1499, war had again broken out with Venice, mainly owing to the intervention of the pope and emperor, who, with Milan, Florence and Naples, urged the sultan to crush the republic. On the 28th of July the Turks gained over the Venetians at Sapienza their first great victory at sea; and this was followed by the capture of Lepanto, at which Bayezid was present, and by the conquest of the Morea and most of the islands of the archipelago. By the peace signed on the 24th of December 1502, however, the *status quo* was practically restored, the sultan contenting himself with receiving Santa Maura in exchange for Cephalonia.

Meanwhile in Asia also the Ottoman Empire had been consolidated and extended; but from 1501 onwards the ambitious designs of the youthful Shah Ismail in Persia grew more and more threatening to its security; and though Bayezid, intent on peace, winked at his violations of Ottoman territory and exchanged friendly embassies with him, a breach was sooner or later inevitable. This danger, together with the growing insubordination of the aged sultan's sons, caused his ministers to urge him to abdicate in favour of Selim, the younger but more valiant. This prince pushed his audacity so far as to attack his father's troops, but the action merely increased his popularity with the Janissaries, and Bayezid, after a reign of thirty-one years, was obliged to abdicate in favour of his forceful younger son; a few days later he died. This reign saw the end of the Mussulman rule in Spain, Turkey's naval power not being yet sufficient to afford aid to her co-religionists. It also saw the first intercourse between a Russian tsar and an Ottoman sultan, Ivan III. exchanging in 1492 friendly messages with Bayezid through the Tatar khan Mengli Girai; the first Russian ambassador appeared at Constantinople three years later.

Selim I., 1512-1520.

When he had ruthlessly quelled the resistance offered to his accession by his brothers, who both fell in the struggle for the throne, Selim undertook his campaign in Persia, having first extirpated the Shia heresy, the prevalent sect of Persia, in his dominions, where it threatened to extend. After an arduous march and in spite of the mutinous behaviour of his troops, Selim, crushed the Persians at Chaldiran (1515) and became master of the whole of Kurdistan. He next turned against the Mameluke rulers of Egypt, crushed them, and entering Cairo as conqueror (1517), obtained from the last of the Abbasid caliphs,[1] Motawakkil, the title of caliph (*q.v.*)

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[1] After the fall of the caliphs of Bagdad (1258), descendants of the Abbasids took refuge in Cairo and enjoyed a purely titular authority under the protection of the Egyptian rulers.

for himself and his successors (see Egypt: *History; Mahommedan Period*). The sultan also acquired from him the sacred banner and other relics of the founder of Islam, which have since been preserved in the Seraglio at Constantinople. Egypt, Syria and the Hejaz, the former empire of the Mamelukes, were added to the Ottoman dominions. Towards the end of Selim's reign the religious revolt of a certain Jellal, who collected 200,000 adherents, was the cause of much trouble; but he was eventually routed and his force dispersed near Tokat. While preparing an expedition against Rhodes to avenge the repulse sustained forty years before by Mahommed II., the sultan died at Orashkeui, near Adrianople, at the spot where he had attacked his father's troops. His reign of eight years had almost doubled the extent of the Turkish dominions.

Suleiman I., 1520-1566.

He was succeeded by his son Suleiman "the Magnificent," in whose long and eventful reign Turkey attained the highest point of her glory. Selim's Asiatic conquests had left his successor free to enter upon a campaign in Europe, after the suppression of a revolt of the governor of Damascus, who had thought to take advantage of the new sultan's accession to restore the independent rule of the Circassian chiefs. In 1521 war was declared against the king of Hungary on the pretext that he had sent no congratulations on Suleiman's accession. Belgrade was besieged and captured, a conquest which Mahommed II. had failed to effect. In the next year an expedition was undertaken against Rhodes, the capture of which had become doubly important since the acquisition of Egypt. The siege, which was finally conducted by the sultan in person, was successful after six months' duration; the forts of Cos and Budrum were also taken. The European war was now renewed; in 1526 the sultan, marching from Belgrade, crossed the Danube and took Peterwardein and Esseg; on the field of Mohács he encountered and defeated the Hungarians under king Louis II., who was killed with the flower of the Hungarian chivalry (see Hungary: *History*). Budapest hereupon fell to the Turks, who appointed John Zápolya king of Hungary (1528). But the crown of Hungary was claimed by the archduke Ferdinand, brother of the emperor Charles V., as being king Louis's brother-in-law. This brought Turkey into collision with the great emperor. Moreover, Francis I. of France, who had just been defeated by Charles, sent to the sultan ambassadors and messages dwelling on the danger of allowing Charles's power to become too great, and imploring the assistance of Suleiman as the only means of preserving the balance of power in Europe. Meanwhile Ferdinand's troops captured Budapest, driving out Zápolya, who at once appealed to Suleiman for aid. Suleiman decided against Charles, and marched north (1529). Zápolya joined the Turks at Mohács, and a joint attack was made on Budapest. After five days' siege the Austrians were driven out, and Zápolya was reinstated on the throne of Hungary. The Turks then marched on Vienna, which was bombarded and closely invested, but so valiant was the resistance offered that after three weeks the siege was abandoned (Oct. 14, 1529). Suleiman now prepared for a campaign in Germany and sought to measure himself against Charles, who, however, withdrew from his approach, and little was done save to ravage Styria and Slavonia. In 1533 a truce was arranged, Hungary being divided between Zápolya and Ferdinand.

During the Hungarian campaign the Shia sectaries had been encouraged to revolt, and the Persians had overrun Azerbāijān and recaptured Tabriz. Suleiman, therefore, turned his arms against them, reaching Bagdad in 1534, and capturing the whole of Armenia. The naval exploits of Khair-ed-din Pasha (see Barbarossa) are among the glories of the reign, and led to hostilities with Venice. After capturing Algiers, an attack by this famous admiral on Tunis was repulsed with the aid of Spain, but in the Mediterranean he maintained a hotly-contested struggle with Charles's admiral, Andrea Doria. Venice was in alliance with Charles, and her possessions were consequently attacked by Turkey by land and by sea, many islands, including Syra and Tinos, falling before Barbarossa's assaults. Corfu was besieged, but unsuccessfully. At Preveza Barbarossa defeated the papal and Venetian fleets under Doria. In 1540 the fort of Castelnuovo, the strongest point on the Dalmatian coast, was taken by the Venetians and recaptured by Barbarossa. Peace was then made on the terms that Turkey should retain her conquests and Venice should pay an indemnity of 300,000 ducats. Friendly relations had subsisted between Suleiman and Ferdinand during the expedition to Persia; but on the death of Zápolya in 1539 Ferdinand claimed Hungary and besieged Budapest with a large force. Suleiman determined to support the claims of Zápolya's infant son, John Sigismund, and in 1541 set out in person. At the end of August he appeared before Budapest, the siege of which had already been raised by the defeat of the Austrians; the infant John Sigismund was carried into the sultan's camp, and the queen-mother, Isabella, was peremptorily ordered to evacuate the royal palace, though the sultan gave her a diploma in which he swore only to retain Budapest during the minority of her son. On the 2nd of September Suleiman entered the city, and to the ambassadors of Ferdinand, who came to offer a yearly sum if the sultan would recognize his claim to Hungary, he replied that he had taken possession of it by the sword and would negotiate only after the surrender of Gran, Tata, Visegrád and Székesfehérvár. The war now continued vigorously by sea and land. The great expedition of the emperor Charles V. against Algiers ended in failure, his fleet being destroyed by a sudden storm (Oct. 31, 1541); and his diplomatic efforts to wean Barbarossa from his allegiance to the sultan fared no better. In 1542 a formal alliance was concluded between Suleiman and Francis I.; the Ottoman fleet was placed at the disposal of the king of France, and in August 1543, the Turks under Barbarossa, and the French under the duke of Enghien, laid siege to Nice. The town surrendered; but the citadel held out until, on the 8th of September, it was relieved by Andrea Doria. Meanwhile on land Suleiman had taken full advantage of the European situation to tighten his grip on Hungary. The attempt of the imperialists, under Joachim of Brandenburg, to retake Budapest (September 1542), failed ignominiously; and in the following year Suleiman in person conducted a campaign which led to the conquest of Siklós, Gran, Székesfehérvár and Visegrád (1544). Everywhere the churches were turned into mosques; and the greater part of Hungary, divided into twelve sanjaks, became definitively a Turkish province. A truce, on the basis of *uti possidetis*, signed at Adrianople on the 19th of June 1547 for five years, between the sultan, the emperor and Ferdinand I. king of Hungary, recognized the Turkish conquests in Hungary; while, for the portion left to him, Ferdinand consented to pay an annual tribute of 30,000 ducats. John Sigismund was recognized as independent prince of Transylvania and of sixteen adjacent Hungarian counties, Queen Isabella to act as regent during his minority.

Suleiman was now free to resume operations against Persia. In the spring of 1548 he set out on his eleventh campaign, which ended in the capture of Erzerum (August 16) and the conquest of Armenia and Georgia. But the Persian War dragged on, with varying fortune, for years, till after Suleiman had ravaged Persia it was concluded by the treaty—the first between shah and sultan—signed at Amasia on the 29th of May 1555.

Meanwhile the war in Hungary had been resumed. Neither side had been careful to observe the terms of the treaty of 1547; the Turkish pashas in Hungary had raided Ferdinand's dominions, while Ferdinand had been negotiating with Frater Geörgy (see Martinuzzi) with a view to freeing Transylvania from the Ottoman suzerainty. When the sultan discovered that Martinuzzi, who was all-powerful in Transylvania, had actually arranged to hand over the country to Ferdinand, he threw the Austrian ambassador into prison, and in September 1551 sent an army, 80,000 strong, under Mahommed Sokolli over the Danube. Several forts, and the important town of Lippa on the Marosch, fell at once, and siege was laid to Temesvár. This was raised after two months, and Martinuzzi took advantage of the retirement of the Turks to raise an army and recapture Lippa. Before the surrender of the city, however, he was murdered by Ferdinand's orders on strong suspicion of treachery. The campaign of 1552 was disastrous for the Austrians; the Turks, under the command of Ahmed Pasha, defeated them at Szegedin and captured in turn Veszprém, Temesvár, Szolnok and other places. Their victorious career was only checked, in October, by the raising of the siege of Erlau. In the spring of 1553 the victories of the Persians called for the sultan's presence in the East; a truce for six months was now concluded between the envoys of Ferdinand and the pasha of Budapest, and Austrian ambassadors were sent to Constantinople to arrange a peace. But the negotiations dragged on without result; the war continued with hideous barbarities on both sides; and it was not until the 1st of June 1562 that it was concluded by the treaty signed at Prague by Ferdinand, now emperor. Suleiman kept the possessions he had won by the sword, Temesvár, Szolnok, Tata and other places in Hungary; Transylvania was assigned to John Sigismund, the Habsburg claim to interference being categorically denied; Ferdinand bound himself to pay, not only the annual tribute of 30,000 ducats, but all the arrears that had meanwhile accumulated. Even this treaty, however, was but an apparent settlement. A year passed before the Latin and Turkish texts of the treaty were harmonized; and meanwhile irregular fighting continued on all the borders. In 1564 Ferdinand died, and was succeeded by Maximilian II. The new emperor attacked Tokaj, which was in Turkish possession; the tribute had been allowed again to fall into arrears; and to all this was added that Mahommed Sokolli, the new grand vizier (1565), pressed for new war to wipe out the disgrace of the failure of the Ottoman attack on Malta (May-September 1565). In May 1566 the war broke out, Suleiman, now seventy-two years old, again leading his army in person. In August he laid siege to Szigetvár with 100,000 men; but on the 5th of September, while preparations were being made for a final assault, the sultan died. His death was, however, kept secret, and on the 8th the fortress fell.

The reign of Suleiman the Magnificent marked the zenith of the Ottoman power. At the time of his death the Turkish Empire extended from near the frontiers of Germany to the frontiers of Persia. The Black Sea was practically a Turkish lake, only the Circassians on the east coast retaining their independence; and as a result of the wars with Persia the whole Euphrates valley, with Bagdad, had fallen into the sultan's power, now established on the Persian Gulf. The Venetians had been driven from the Morea and the islands of the Archipelago; and, except a strip of the Dalmatian coast and the little mountain state of Montenegro, the whole of the Balkan peninsula was in Turkish hands. In the Mediterranean, Crete and Malta yet survived as outposts of Christendom; but the northern coasts of Africa from Egypt to Morocco acknowledged the supremacy of the sultan, whose sea power in the Mediterranean had become a factor to be reckoned with in European politics, threatening not only the islands, but the very heart of Christendom, Italy itself, and capable—as the alliance with France against Charles V. had shown—of being thrown with decisive weight into the balance of European rivalries.

The Turkish Sea Power.

The power of the Ottomans at sea was maintained during this period by a series of notable captains, such as Khair-ed-din and his son Hassan, Pialé, Torgud, Sali Reis and Piri Reis. Of these the two first are separately noticed (see BARBAROSSA). Pialé, a Croatian who had been brought up in the imperial harem and succeeded Sinan as capudan-pasha, crowned a series of victories over the galleys of Andrea Doria by the capture of the island of Jerba, off Tripoli (July 31, 1560). For this he was rewarded with the hand of one of the sultan's grand-daughters. He later became the second vizier of the empire, and, as a supporter of Sokolli, was in power till his death in 1575. Torgud, also the son of Christian parents, was a native of the sanjak of Mentesha in Asia Minor, and began his career as a soldier in the Ottoman sea service. After spending some time as a Genoese galley-slave, he turned corsair and became the terror of the Mediterranean coasts. He seized Mahdia, a strong post on a tongue of land about 43 m. south of Susa in Tunisia, and made this the centre of his piracies till, during his absence raiding the Spanish coasts, it was bombarded and destroyed by an expedition sent by Charles V. (September 10, 1550). Torgud was now summoned to Constantinople to answer for piracies committed on the friendly galleys of Venice; but he sailed instead to Morocco, and there for two years defied the sultan's authority. But Suleiman, who needed the aid of the corsairs against Malta, pardoned him, and he was given the command of the expedition against Tripoli, which he captured. He now turned against Corsica, captured Bastia (August 1553) and on his return to Constantinople, laden with booty and slaves, chastised the insurgent Albanians. He was rewarded by Suleiman with the governorship of Tripoli, which he held till his death. He was killed during the unsuccessful attack on Malta, which he commanded (1565). Sali Reis, also by birth a Christian of Asia Minor, was likewise successful as a corsair; he distinguished himself especially at the capture of Tunis, and succeeded Hassan Barbarossa as beylerbey of Algiers.

Other captains carried the Turkish arms down the Arabian and Persian gulfs far out into the Indian Ocean. Of these the most remarkable was Piri Reis, nephew of Kamil Reis, the famous corsair who, under Bayezid II., had swept the Aegean and Mediterranean. Piri sailed into the Persian Gulf, took Muscat, and laid siege to Ormuz. But the approach of the Portuguese fleet put him to flight; some of his vessels were wrecked; and on his return by way of Egypt he was arrested at Cairo and executed. He had compiled a sea-atlas (the *Bahrije*) of the Aegean and Mediterranean seas, every nook and cranny of which he had explored, with an account of the currents, soundings, landing-places, inlets and harbours.

Another literary seaman of this period was Sidi Ali, celebrated under his poetic pseudonym of Katibi (or Katibi Rumi, to distinguish him from the Persian poet of the same name). He was no more successful than Piri or his successor Murad in fighting the elements and the Portuguese in the Persian Gulf; but he was happier in his fate. Driven, with the remnant of his ships, into the Indian Ocean, he landed with fifty companions on the coast of India and travelled back to Turkey by way of Sind, Baluchistan, Khorassan and Persia. He wrote an account of this three years' journey, for which he was rewarded by Suleiman with an office and a pension. He was the author also of a mathematical work on the use of the astrolabe and of a book (*Muhit*, "the ocean") on the navigation of the Indian seas.

Reforms of Suleiman I.

At the close of Suleiman's reign the Turkish army numbered nearly 200,000 men, including the Janissaries, whose total he almost doubled, raising them to 20,000. He improved the laws and institutions established by his predecessors and adapted them to the requirements of the age; to him are due important modifications in the feudal system, aimed at maintaining the fiefs in a really effective condition. The codes of law were by him revised and improved, and he was the first sultan to enter into relations with foreign states. In 1534 Jean de La Forêt, a knight of St John of Jerusalem, came to Constantinople as first permanent French ambassador to the Porte, and in February 1535 were signed the first Capitulations (*q.v.*) with France.

Ottoman Polity in the 16th Century.

A short sketch of the administration and state of the country at this time may find place here. Successively transferred from Brusa to Adrianople and thence to Constantinople, the seat of government was at first little more than the camp of a conqueror. After the conquest of the imperial city the sultans began to adopt the pomp and splendour of eastern sovereigns, and largely copied the system, ready to hand, of the Byzantine emperors. Affairs of state were at first discussed at the imperial divan, where the great dignitaries were convened at appointed hours. Until the reign of Mahommed the Conqueror the sultan presided in person; but a rough Anatolian peasant penetrating one day to the council and exclaiming, "Which of you might be the sultan? I've come to make a complaint!" it was thought that in future it would be more consonant with the imperial dignity for the sovereign to remain concealed behind a grating where, unseen, he could hear all that was said. Towards the middle of Suleiman's reign even this practice was abandoned, and the sultans henceforth attended the divans only on the distribution of pay to the troops or the reception of a foreign ambassador, which occasions were usually made to coincide. The divan accompanied the sultan on military expeditions.

As established by Mahommed II., the officials of the state were divided into four classes: (1) administrative; (2) ecclesiastical; (3) secretarial and (4) military. The administration of *kazas*, or cantons, was usually entrusted to the cadis and the holders of the more important fiefs; the *sanjaks*, or departments, were ruled by *alai beys* or *mir-i-livas* (colonels or brigadiers), pashas with one horse-tail; the *vilayets*, or provinces, by *beylerbeys* or *mir-i-mirans* (lord of lords), pashas with two horse-tails; these were all originally military officers, who, in addition to their administrative functions, were charged with the duty of mustering and commanding the feudal levies in war time. Above them were the beylerbeys of Anatolia and Rumelia, who served under the orders of the commander-in-chief. The title of vizier was borne by six or seven persons simultaneously; the grand vizier was the chief of these and exercised supreme authority, being invested with the sultan's signet. He often commanded an army in person, and was then given the title of *serdar-i-ekrem* (generalissimo); one of the subordinate viziers remained behind as *kaïmmakam*, or locum tenens. The duties of the other viziers were limited to attending the divan; they were called *kubbè* or cupola viziers from the fact that the council met under a cupola; they were pashas with three horse-tails, and were attended by large retinues, having generally achieved distinction as beylerbeys. These officers were usually chosen from among the more promising of the youths selected by the *devshurmè*, or system of forced levy for manning the ranks of the Janissaries: hence so many of the statesmen of Turkey were of non-Mussulman origin. Besides these members of the secretarial class, such as *nishanjis* and *defterdars*, as well as regular army officers, and occasionally members of the ecclesiastical class, or ulema, rose to the rank of vizier.

The highest dignitaries of the ecclesiastical class were at first the *kazaskers*, or military judges, of Europe and Asia; later the office of Sheikh-ul-Islam was created as the supreme authority in matters relating to the Church and the sacred law. Promotion was regular, but was obtainable only by entering at an early age one of the *medressès* or colleges; the student, after passing through the successive degrees of *danishmend*, *mulazim* and *muderris*, became first a molla, then a judge, rising to the higher ranks as fortune and opportunity offered. In the time of Bayezid II. the post of *nakib-ul-eshrāf*, or registrar of the *sherifs*, or descendants of the Prophet, was created.

The secretarial class consisted of six categories: the *nishanjis*, the *defterdars*, the *reïs*, the *defter emini*, the *shakk-i-sāni* (or second class) *defterdars* and the *shakk-i-sālis* (or third class) *defterdars*. The first named were charged with the duty of revising and duly executing the decisions of the divan respecting the assignment of lands to warriors and the apportioning of conquered territories. They were men of great culture, and many historians, poets and writers belong to this class. The *defterdar* was practically the minister of finance. The *reïs* was the secretary-general of the divan, and in more modern times became minister for foreign affairs. The *defter emini* kept the registers for the *nishanji*, whose place he took on emergency, the others acted as secretaries and clerks.

The military class was divided into two categories: (1) the regular paid troops who were quartered in barracks and were known as "slaves of the palace"; (2) the feudal levies who received no pay and were called upon to serve only in war-time. The Janissaries (*q.v.*) belonged to the first category. The rigid regulations for admission to their ranks were soon relaxed: at the close of the Persian war in 1590 their total amounted to 50,000. The regular troops comprised also armourers (*jebeji*), from 6000 to 8000 men, and six squadrons of cavalry; these were recruited in the same way as the Janissaries, and their numbers were raised by Murad III. to 20,000. There were also *bostanjis*, or forest-guards, numbering about 5000, besides local troops in distant and frontier provinces, and about 20,000 *akinjis*, or light troops, in Europe, who carried out forays in the enemies' country.

The fiefs were not hereditary, and were held directly from the sultan. On the conquest of a country the lands were apportioned by the *nishanjis*, who first computed the tithe revenue of each village, its population, woods, pasturage, &c.; and divided it into the three classes of *fiefs* (*khās*, *ziamet* and *timar*), or into *vakūf* (pious endowments) or pasturage. Any estate with a revenue exceeding 100,000 aspres was a khās, and was conferred on a prince or on a high dignitary as long as he held his post; for each 5000 aspres of revenue one armed warrior had to be furnished in war. Fiefs with a revenue of from 20,000 to 100,000 aspres were called ziamets and were conferred on similar terms on inferior officers, usually for life or during good behaviour. Fiefs with a revenue of from 3000 to 20,000 aspres were timars, furnishing one armed warrior for every 3000 aspres' revenue; the grant of a fief was conditional on obligatory residence. The peasants owning the land remained undisturbed in their proprietorship, paying to their feudal lord the tithe, as well as the fixed duties on transfer, &c. Abuses in the system first began in the time of Khosrev Pasha, Suleiman's grand vizier.

The governors of the more distant provinces enjoyed a considerable amount of independence, which in the case of the Barbary states was more or less complete; these entered into treaties with foreign powers, and by their piratical outrages frequently caused the Porte considerable embarrassment. The *sherif* of the Hejaz, Abu-'l-berekāt, made submission to Sultan Selim I. After the subjugation of the Yemen, the absorption of the holy places was also attempted, and in Suleiman's reign judges were appointed thither from Constantinople. But it was found politic to continue the office of the grand *sherif* of Mecca in the sherifian family.

The princes of the Crimea were invested with many of the prerogatives of independence, *e.g.* that of coining money; the ruler of Transylvania was allowed to retain the royal title, nor were Turkish troops quartered in the country. The Danubian principalities were also ruled by native princes until the Phanariote period (see PHANARIOTES).

Selim II., 1566-1574.

On the 17th of February 1568, two years after the accession of Suleiman's son Selim, peace was concluded with Austria on the basis of the former terms, the emperor Maximilian having sent ambassadors to congratulate the new sultan on his accession. A disastrous attack on Astrakhan, with the object of carrying out Sokolli's plan for uniting the Don and the Volga, first brought the Turks into collision with the Russians. Expeditions against the Yemen and Cyprus were successful, but the loss of Cyprus, accompanied as it was by the barbarous murder of the Venetian commander, Marco Antonio Bragadino, by the seraskier pasha Mustafa's orders, in violation of the terms of the capitulation of Famagusta (August 1571), roused the bitter resentment of the Venetians, previously incensed by Turkish raids on Crete. Already, on the 25th of May, had been concluded the holy league between the pope, Venice and Spain for a new crusade against the infidel, in spite of the efforts of France to prevent the adhesion of the republic. Preparations were hurried on and at the end of September the great allied fleet, under Don John of Austria, sailed into the archipelago. On the 7th of October was fought the naval battle of Lepanto, which broke for ever the tradition of the invincibility of the Turks at sea. The immediate results of the battle were not, however, as decisive as might have been expected. In June 1572 a fresh Ottoman fleet of 250 sail took the sea; and the jealousy of the allies and the incompetence of their commanders made any repetition of their former victory impossible. After a series of indecisive engagements Venice broke from the league and, under the mediation of France, concluded a treaty with the Porte practically on the basis of *uti possidetis* (March 7, 1573). With Spain the war continued, and on the 24th of August 1574 Tunis—which had been taken by Don John of Austria in 1572—was recaptured by the Turks, who from this new base proceeded, under Sinan Pasha and Kilij Ali, to ravage Sicily.[1] In the same year Selim II. died. Known in history as the "Sot," he had allowed his able grand vizier Mahommed Sokolli to rule the country.

Murad III., 1574-1595.

The character of Murad III., who succeeded his father Selim II. at the age of twenty-eight, was not calculated to arrest the progress of decay within the Ottoman Empire. He was a weakling, swayed by his favourites in the harem, especially by his Venetian wife Safié; and, though he kept Sokolli in office, he was suspicious of the too powerful vizier, whose wise influence he allowed his minions to undermine. Thus eminent servants of the state such as Mustafa Pasha, Sokolli's nephew—who for twelve years had ruled the sanjak of Budapest with conspicuous enlightenment and success—were deposed or executed to make way for the nominees of the harem. In even weightier matters the opinion of the grand vizier was slighted. Thus it was against his advice that, at the beginning of 1578, advantage was taken of the disorders arising on the death of Shah Tahmasp of Persia to attack that country. The war lasted for twelve years, during which Tiflis, Shirvan and Daghestan were taken; finally Shah Abbas established himself on the Persian throne and in 1590 made peace with Turkey, who retained her conquests in Georgia, Azerbāijān and Shirvan. But this short-sighted policy is criticized by Turkish historians, who censure Murad III. for thus weakening the neighbouring Mussulman states such as Persia and Daghestan, thereby facilitating Russia's future expansion at their cost. Sokolli's assassination, on the 11th of October 1578, had meanwhile thrown the country into disorder. There was now no authority left to hold in check the corrupt influences of the harem. The avenues to power were through bribery and yet more unspeakable paths; the fiefs which formed the basis of the feudal array were bestowed on favourites' favourites, or sold to the highest bidder, and the sultan himself shared in the corrupt plunder. At last that final expedient of weak governments, the debasing of the coinage, led to a crisis. In 1589 mutinies of troops took place all over the empire, and in the two following years there were several risings of the Janissaries at Constantinople, the pretext being everywhere that the soldiers were being robbed of their pay. At this juncture a fresh crisis in the relations with Austria arose. The peace concluded in 1568 and thrice renewed (in 1573, 1576 and 1584) had not prevented the continuance of raids and forays, from either side of the frontier, that at times assumed the dimensions of regular campaigns. The climax came in 1593. All through the preceding year Hassan "Tilli," beylerbey of Bosnia, had raided in Croatia, taking border fortresses and driving off the inhabitants into slavery. In June 1593, with an army of 30,000 men, he laid siege to Sissek; the Austrian and Hungarian levies hurried to its relief; and on the 22nd the Turks were routed with immense slaughter on the banks of the Kulpa, Hassan himself, with many other beys and two of the imperial princes, being among the slain. Though not yet formally declared, the "long war" was now in full progress. In August, Sinan Pasha, the grand vizier—now eighty years of age—took command of the troops for the Hungarian War and left Constantinople, dragging with him the Austrian ambassador in chains. The capture of Veszprém and of Raab (1594) and the failure of the archduke Matthias to take Gran seemed to promise another rapid victory of the Ottoman arms; but Sinan was ill-supported from Constantinople, the situation was complicated by the revolt of Walachia and Moldavia, and the war was destined to last, with varying fortunes, for fourteen years. On the 16th of January 1595 Murad III. died.

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[1] It was ten years before a formal truce was signed with Spain (1584); two hundred years passed before the signature of a definitive treaty of peace and commerce (Sept. 14, 1782).

In spite of the internal corruption which, under Murad III., heralded the decay of the empire, the prestige of the Ottomans in Europe was maintained during his reign. Even the emperor had to be content to be treated by the sultan as an inferior and tributary prince; while France had to suffer, with no more than an idle protest, the insult of the conversion of Catholic churches at Constantinople into mosques. In spite of frequent causes of friction, good relations were maintained with Venice, through the influence of the sultana Safié, and the capitulations with the republic of St Mark were renewed in 1589. Those with France were also renewed (July 6, 1581); and capitulations were signed for the first time with the grand duke of Tuscany (1578) and with England (1580).[1] In the following year permanent diplomatic relations were established by England with the Porte by the despatch of William Harebone as ambassador, Queen Elizabeth urging as her special claim to the sultan's friendship their common mission to fight "idolators."

Mahommed III., 1595-1603.

The new sultan, Mahommed III., Murad's son, succeeded to the throne at a moment when the Turkish arms were suffering reverses in Hungary and in the revolted Danubian provinces; the Janissaries, too, were ill-content and mutinous, and to put an end to their murmurings Mahommed was persuaded by Sinan Pasha to lead them to the war in person. The immediate effect was good; Erlau was captured in October 1596, and a three days' battle in the plain of Keresztes (Oct. 23 to 26) ended in the disastrous rout of the allied troops under the archduke Maximilian and Sigismund, prince of Transylvania. But the Turks did not profit much by their victory. The new grand vizier, Cicala, by his severity to the soldiers, mainly Asiatics, who had shown cowardice in the battle, drove thousands to desert; and the sultan, who had himself little stomach for the perils of campaigning, returned to Constantinople, leaving the conduct of the war to his generals. The campaign of 1598 began with the loss of Raab, and continued unfavourable to the Turks, who lost Totis, Veszprém and Pápa, and were hard pressed in Buda-pest. In October want of supplies and a mutiny of the Janissaries compelled the commander-in-chief to retreat into winter quarters at Belgrade. In 1599 the first peace overtures were made, but came to nothing; and the confused fighting of this and the following year culminated in the capture of Kanizsa by the Turks (September 1600). The attempt of the archduke Ferdinand, at the head of 30,000 men, to retake it a year later was defeated. In August 1602 Székesfehérvár again fell into the hands of the Turks; in November the siege of Buda by the archduke Matthias, who had taken Pest by storm, was raised by the grand vizier Hassan.

Trouble had, however, meanwhile broken out in other parts of the Ottoman dominions. The deserters from Cicala's army, distributed in armed bands throughout Asia Minor, had become centres round which all the elements of discontent gathered, and formed the mainstay of the Jellali sectaries who, at this time, rose in insurrection and ravaged Anatolia. In Constantinople, early in 1603, there was, moreover, a serious rising of the spahis; and, finally, in September Shah Abbas of Persia took advantage of what is known in Turkish history as "the year of insurrections" to declare war and reconquer Tabriz. In the midst of this crisis, on the 22nd of December 1603, Sultan Mahommed III. died, and was succeeded by his elder son, Ahmed I., a boy of fourteen.

Ahmed I., 1603-1617.

Though negotiations for peace were at once begun, it was not till three years after Ahmed's accession that the peace of Sitvatorok, concluded on the 11th of November 1606, at last put an end to the war in Europe. By this treaty the annual tribute payable by Austria was abolished, but an indemnity of 200,000 florins was paid "once for all" by the emperor, who was henceforth to be given his proper imperial title (padishah) in Turkish official documents. The peace of Sitvatorok (or Zeidevn, as it is also called) marks the close of Turkey's period of conquest. No longer haughtily imposed on the vanquished, as was the case with former treaties, it was submitted to the examination and discussion of both parties before being signed. It freed Austria from the humiliating tribute to which the treaty of 1547 had subjected her, and established relations between the two monarchs on a footing of equality. It was thus the first manifest sign of Turkey's decadence from the glory of Suleiman I.'s reign, when King Ferdinand stooped to call the sultan's vizier his brother. For the remainder of the reign the Persian War was continued fitfully, a treaty of peace, signed in 1611, not being observed.

Mustafa I., 1617-1618 and Osman II., 1618-1622.

In 1617 the sultan died, and was succeeded by his brother Mustafa; but the latter being declared incompetent to reign, his brother Osman took his place on the throne. The war in Persia was terminated by the renewal in 1618 of the treaty of 1611, whereby all the conquests effected by Murad III. and Mahommed III. were given up. Peace, however, left the rebellious Janissaries leisure to engage in plots against the sultan, and in order to occupy them and to remove them from the capital advantage was taken of the king of Poland having intervened in the affairs of Transylvania and the principalities to declare war against him. Osman marched against Khotin, but failed to capture it, and his unpopularity with the army was increased by rumours that he designed to collect such troops as were loyal to him, under pretence of going on

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[1] They were renewed with England in 1593, 1603, 1606, 1622, 1624, 1641, 1662 and 1675.

Mustafa I., 1622-1623, and Murad IV., 1623-1640.

pilgrimage to Mecca, in order to destroy the Janissaries and reform the country. They therefore rose and dethroned him, soon afterwards putting him to death. For a few months Mustafa was replaced on the throne; when he abdicated in favour of his nephew Murad IV. Turkey seemed to be at the point of dissolution. Profiting by the mutiny of the army, the Persians invaded Turkey, capturing Bagdad; at Constantinople and in the provinces alike anarchy was everywhere prevalent. This continued until the new sultan had acquired age and experience; but, nine years after his accession, he successfully crushed the military rebels, and thereafter ruled with a severity amounting to bloodthirsty cruelty. In 1638 he marched in person against the Persians and succeeded in recapturing Bagdad. Peace was made in 1639, leaving the Turco-Persian frontier practically as it now stands. In the next year the sultan died at the age of thirty-one, being succeeded by his brother Ibrahim. In his reign the Cossacks were driven from Azov and the expedition against Crete was begun, the immediate cause being the plunder of a Turkish vessel by Maltese corsairs who took their capture to Crete. War was therefore declared against Venice, to whom Crete belonged (1644), and continued in the island for twenty-five years.

Ibrahim, 1640-1648.

Mahommed IV., 1648-1687.

The anarchy and misgovernment of Turkey now reached such a pitch that Ibrahim was dethroned and murdered, and his son Mahommed IV. was proclaimed in his stead. For the first eight years of his reign successive grand viziers were unable to restore order to the country. In 1656 Mahommed Kuprili (*q.v.*) became grand vizier, and by dint of firmness and resolution repaired the falling fortunes of the country. The fleet was restored, and recaptured Lemnos and other islands which had passed into the hands of the Venetians; the revolts caused by Kuprili's severity were put down, and tranquillity was re-established in Transylvania. After five years' tenure of office the grand vizier died and was succeeded by his son, Ahmed Kuprili. In 1663 the disturbances which had broken out again in Transylvania led to war with Austria. Ahmed Kuprili attacked the Austrians, at first with success, but was routed by Montecuculi at the battle of St Gotthard Abbey and eventually consented to the treaty of Vasvár (Aug. 10, 1664), by which a twenty years' truce was agreed upon; Transylvania was evacuated by both parties, but remained tributary to Turkey. The Kuprilis, both father and son, had by their haughty and uncompromising demeanour done much to alienate the old-standing friendship with France, and at the battle of St Gotthard 6000 French, under Coligny, fought on the Austrian side. The result was that the Turks in retaliation deprived the Catholics, always under the protection of France, of some of their privileges in connexion with the holy places, which were now granted to the Orthodox Church. Meanwhile the Cretan campaign continued, and here also France lent her aid to the Venetians; this assistance could not, however, prevent the capture of Candia in 1669; on the 5th of September of that year Morosini, the Venetian commander, signed a treaty of peace with the Turks by which, after twenty-five years' warfare, they were placed in possession of the fortress of Candia, and with it of the effective rule over the whole island, Venice retaining only the fortresses of Suda, Grabusa and Spinalonga, and the islets along the coast.

Dissensions among the Cossacks led to the recognition by Turkey of Doroshenko, the hetman of the Sari Kamish, as ruler of the Ukraine; the Zaporog Cossacks, his antagonists, applied for aid to Russia. However, Michael Wiesnowiecki, king of Poland, considering the Ukraine as under his protection, sought to intervene, with the result that Turkey declared war against him (1672). The Turks captured Kamenets, Lemberg and Lublin. Hereupon the Poles sued for peace, and a treaty was signed at Buczacs (Oct. 18, 1672) whereby Podolia was ceded to Turkey, the Ukraine was left to the Cossacks, and Poland agreed to pay to Turkey an annual tribute of 22,000 sequins. But John Sobieski, who succeeded shortly afterwards to the throne of Poland, refused to abide by the terms of this treaty; the war was renewed and continued for four years, when the treaty of Buczacs was reaffirmed at Zuravno by both parties, the tribute clause alone being abrogated (Oct. 16, 1676). A few days later Ahmed Kuprili died.

Suleiman II., 1687-1691.

Ahmed II., 1691-1695.

Mustafa II., 1695-1703.

Doroshenko now deserted the Turkish alliance for the Russian; in consequence an expedition was sent into the Ukraine which was both costly and useless. In 1678 the Turks succeeded in taking Cehrin, but their losses were very heavy, and on the 8th of January 1681 a treaty was signed at Radzyn whereby the territory in dispute was ceded to Russia. A revolt of the Hungarian Protestants, in consequence of the persecuting policy of the house of Habsburg, now led to a renewal of the war between Turkey and Austria, due in part to the overweening ambition of Kuprili's successor, Kara Mustafa, who desired to immortalize his tenure of office by some great exploit, and who cherished dreams of founding for himself a western Moslem Empire. The war is blamed by Turkish historians as unjustifiable and untimely, the country needing reform. A vast Turkish army marched to the walls of Vienna and closely beleaguered the imperial city, from which the emperor and his court fled. All hope seemed lost, when by a brilliant feat of arms John Sobieski, king of Poland, drove away the besiegers in hopeless confusion and saved the cause of Christianity, 1683. This was the signal for a general coalition against Turkey; Venice, Poland and the pope allied themselves with the Austrians; Russia, Tuscany and Malta joined in the attack. Turkey now sought for a *rapprochement* with France, and endeavoured to bring about her intervention in return for concessions as regards the holy places. But the French had just before bombarded Algiers and Tripoli, even menacing Chios (Scio), where some pirates had put in with French captives; and the mediation of France was not very actively exercised. One after another the Hungarian forts were captured by the Austrians; the Venetians were equally successful in Greece and the Morea; the Russians pressed on the Crimea, and Sobieski besieged Kamenets. The troops now mutinied and deposed the sultan, placing his brother Suleiman on the throne. But the disorder in the army and the administration continued, and the advance of the Austrians and the Venetians met with little opposition. In this emergency Mustafa Kuprili (*q.v.*) was appointed grand vizier (1689). His prudent measures at once re-established some degree of order in the army and the fleet, while he sought by a wise tolerance to improve the position and conciliate the sympathies of the non-Moslem subject races. At first eminently successful, he drove the Austrians across the Danube, recapturing Nish, Vidin, Semendria and Belgrade; repulses were also inflicted on the Venetians and the Russians. In the course of the campaign the sultan died, being succeeded by his brother Ahmed. The successes of the Turks were not maintained, the Austrians inflicting on them a crushing defeat at Slankamen, where Mustafa Kuprili was killed, and driving them from Hungary. After four years of disaster Ahmed died; he was succeeded by his nephew Mustafa. The tide of success now turned again in favour of the Turks, who recaptured Karansebes and Lippa, and at Lugos exterminated by the weight of overwhelming numbers an Austrian force under Field-marshal Count Friedrich von Veterani (1630–1695), the hero of many victories over the Turks, who was killed in the battle. Elsewhere, too, the Ottoman arms were victorious; in February the Venetians suffered a double defeat in the roadstead of Chios, and the island fell into the hands of the Turks. But Prince Eugene's genius restored the Austrian fortunes, and the Turks were utterly routed at Zenta on the Theiss, losing more than 15,000 men (1697). Russia, driven from Azov in 1695, succeeded in capturing it in the following year; Venice continued to press the Turks; in this condition of affairs Hussein Kuprili (*q.v.*) was called to office; England and Holland urged Turkey to make peace, and after long negotiations a series of treaties were concluded in January 1699 at Karlowitz, that with Poland being signed on the 16th and those with Austria and Venice on the 26th. The main provisions of these were, that Turkey retained the Banat, while Austria kept Transylvania; Poland restored the places captured in Moldavia, but retained Kamenets, Podolia and the Ukraine; Venice restored her conquests north of Corinth, but kept those in the Morea and Dalmatia. On the 4th, Russia concluded a two years' armistice, but remained in possession of Azov, which was formally ceded to her by the definitive treaty of peace signed at Constantinople on the 13th of June 1700. The peace of Karlowitz marks the definitive termination of Turkey's power of offence in Europe. Apart from the heavy losses which it imposed on her, it constitutes a fresh departure in her history, as putting an end to her splendid isolation and rendering her dependent on the changes of European politics. It is noteworthy also as being the first occasion on which representatives of the mediating powers took part in the peace negotiations. The grand vizier's efforts to take advantage of the peace to introduce order in the country were unavailing; he was driven from office, and disorders ensued which led to the sultan's abdication.

Ahmed III., 1703-1730.

The troubles were not ended by the accession of Ahmed III., and many high dignitaries of state were sacrificed to the lawlessness and insubordination of the Janissaries. Meanwhile Turkey found herself again involved with Russia. After the defeat of Charles XII. of Sweden at Poltava, this monarch took refuge in Turkey, and was allowed to reside at Bender. The Russians pursued him into Turkish territory; which led to a Turkish declaration of war (1710). The Turks succeeded in surrounding Peter the Great near the Pruth, and his army was menaced with total destruction, when the Turkish commander, the grand vizier Baltaji Mahommed Pasha, was induced by the presents and entreaties of the empress Catherine to sign the preliminary treaty of the Pruth (July 21, 1711), granting terms of peace far more favourable than were justified by the situation of the Russians. These were: the cession to Turkey of Azov with all its guns and munitions, the razing of all the forts recently built on the frontier by Russia, the renunciation by the tsar of all claim to interfere with the Tatars under the dominion of the Crimea or Poland, or to maintain a representative at Constantinople, and Russia's consent to Charles's return to Sweden.[1] It was long, however, before the latter relieved Turkey of his presence. During the campaign Peter had entered into alliance with the hospodars of Moldavia and Walachia, respectively Demetrius Cantemir and Constantine Brancovano, from whom he had received material assistance. These were naturally dismissed after the defeat of the Russians; the former made good his escape to Russia, the latter was executed. The sultan determined henceforth to appoint Greeks to the principalities as more likely to be subservient to his will than the natives hitherto appointed. This system was continued until the Greek insurrection of 1821.

Russia having thus lost all the advantage gained by the peace of Karlowitz, Venice was next taken in hand, she having invaded the Bosnian frontier and incited the Montenegrins to revolt, besides capturing Turkish ships in the Mediterranean. These acts were held to be infractions of the treaty, and war was declared (1715). The result was the stamping out of the insurrection in Montenegro and the capture of the whole of the Morea. The fleet also took Tinos and Cerigo, as well as the three forts still remaining to the Venetians in Crete. Turkey's action, and the preparations being made for the siege of Corfu, now brought about the intervention of Austria. Charles VI., weary of the war for the Spanish succession, had shortly before concluded the peace of Rastadt (1715) and was anxious that Venice should not be too hardly pressed. He therefore urged Turkey to give up to Venice certain places in Dalmatia as a compensation for the loss of the Morea. The Porte was at first disposed to comply, but the party of resistance finally prevailed. War was declared against Austria (1716); the fleet sailed for Corfu and the army crossed the Save from Belgrade to Semlin. Near Peterwardein a great battle was fought, in which the Austrians completely routed the Turks; pursuing their advantage they took Temesvàr and overran the Banat; in 1717 they captured Belgrade, the Turks retreating to Adrianople. England and Holland now urged their mediation, and after negotiations the treaty of Passarowitz (Pozharevats in Servia) was signed (July 21, 1718); Venice ceded the Morea to Turkey but kept the strongholds she had occupied in Albania and Dalmatia; Belgrade, Temesvàr and Walachia as far as the Olt were retained by Austria.

Meanwhile relations with Russia continued strained. The peace of 1712 had been concluded only for a term of years, and the neglect of the tsar to carry out its provisions had all but led to a fresh outbreak of hostilities when the intervention of the other powers led in 1713 to the renewal of the treaty; and in November 1720 it was superseded by a treaty of "perpetual peace," signed at Constantinople. But, though the questions at issue between Russia and Turkey in Poland and the northern littoral of the Black Sea were thus for the time settled, the aggressive designs of Russia in the Caucasus and in Persia soon caused a renewal of anxiety at Constantinople. Again war all but broke out; but, through the intervention of France, a treaty of partition was signed at Constantinople on the 23rd of June 1724, whereby the shores of the Caspian from the junction of the Kur and the Arras (Araxes) northwards should belong to Russia, while the western provinces of Persia should fall to the share of Turkey. These provinces had not yet been conquered by Turkey; and, when a part of them had been taken, a treaty was concluded with the Afghan Ashraf Shah, who had risen to supreme power in Persia, by which Turkey should retain them on condition of recognizing him as shah (Oct. 23, 1727). But Nadir Kuli Khan came forward as the champion of Shah Tahmasp II., the rightful ruler, and drove the Turks from these provinces, capturing Tabriz. This news caused consternation at Constantinople; the inevitable revolt of the Janissaries followed, headed this time by one Patrona Khalil, and the sultan was forced to abdicate in favour of his nephew Mahmud. With difficulty the rebellion was suppressed; in 1733 the war with Persia was resumed, and after three years of fighting Nadir succeeded in 1736 in inducing Turkey to recognize him as shah of Persia and to restore the territory captured since the reign of Murad IV.

Mahmud I., 1730-1754.

War of Polish Succession.

Russia's designs on Poland now brought about war. On the death of Augustus II., king of Poland (1733), France had put forward as candidate Stanislaus Leszczynski, Louis XV.'s father-in-law. Austria and Russia supported Augustus III., elector of Saxony, and the empress Anne marched an army into Poland and compelled the election of her candidate, though Russia had bound herself by the treaty of 1711 and again by that of 1720 to abstain from all interference with Poland. France thereupon declared war against Russia and her ally Austria, and her envoy, the marquis de Villeneuve, urged Turkey to join by representing the danger of allowing Russian influence to extend. Turkey had cause of complaint against Russia for refusing to allow the Crimean troops to march through Daghestan during the Persian campaign, and on the 28th of May 1736, war was declared, in spite of the efforts of England and Holland. The Russians had not waited for the formal declaration of war; and on the very day that this was notified by the hanging out of the horse-tails before the Seraglio at Constantinople a Russian army under Marshal Münnich stormed the ancient wall that guarded the isthmus of the Crimea. While Münnich conducted a systematic devastation of the peninsula, forces were detached under his lieutenants Leontiev and Lascy to attack Kinburn (Kilburun) and Azov. Both these places fell; and in July of the following year Münnich captured Ochakov.

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[1] The definitive treaty was signed at Constantinople on the 16th of April 1712 (renewed June 5, 1713).

Meanwhile the western sea-powers had made earnest efforts to restore peace, and in August 1737 the plenipotentiaries of the combatant powers met at Niemirov to arrange terms under their mediation. But Austria, which had made a great show of seconding their efforts, now began to unmask her real aims, which were to take advantage of Turkey's embarrassments to push her own claims in the principalities and the Balkan Peninsula. To the refusal of the sultan's representatives to concede any of her demands, Austria replied by revealing the existence of an alliance with Russia, which she threatened to make actively offensive if her terms were refused. In November the conferences broke up; in the spring of the following year Austrian divisions advanced simultaneously into Bosnia, Servia and Walachia; and in July the main army, under the prince of Lorraine, crossed the frontier and captured Nish. In spite of this initial success, however, the campaign proved disastrous to the Austrians; and France, which had meanwhile come to terms with the emperor, endeavoured to mediate a peace in conjunction with Sweden and Holland. But the Ottomans, though the negotiations continued throughout 1738, were in no hurry to come to terms; for the tide of war had turned against both Austrians and Russians; Ochakov and Kinburn were recaptured; and the victorious Turks crossed the Danube and penetrated far into the Banat. Not till the middle of 1739 would they consent to negotiate seriously for peace. The conferences were opened at the close of July in the camp of the grand vizier, who was pressing Belgrade hard and demanded the surrender of the city as a *sine qua non*. This was conceded; on the 1st of September, under the mediation of the French ambassador Villeneuve, the preliminaries were signed; on the 4th the grand vizier made his formal entrance into the city, where on the 18th the definitive treaties with Austria and Russia were signed. By the former Austria gave up Belgrade and the places on the right bank of the Save and the Danube which she had gained by the treaty of Passarowitz, together with the Austrian portions of Walachia. The treaty with Russia provided that Azov should be razed and its territory devastated to form a barrier, Russia having the right to erect a new fortress at Cherkask, an island in the Don, near Azov, and Turkey to build one on the border of Kuban near Azov. But Taganrog was not to be refortified, and Russia was to have no war-ships on the sea of Azov or the Black Sea. The Kabardias, great and little, were to remain independent, to serve as a barrier between the two empires. By the 12th article the Ottoman government agreed "amicably to discuss" the question of recognizing the tsar's claim to the imperial title, and by the 13th admitted his right to send to Constantinople representatives of whatever rank he might judge fitting (Noradounghian, *Recueil*, i. 258).

Scarcely two years after the signature of the treaty of Belgrade sinister rumours reached Constantinople from Persia, where Nadir Shah, on his return from India, was planning an attack on Mesopotamia. The war, which broke out in 1743, was waged with varying fortunes, and the peace by which it was concluded on the 5th of September 1746, beyond stipulating for a few privileges for Persian pilgrims to the holy places, altered nothing in the settlement arranged ten years before with Murad IV. In the war of the Austrian Succession, which followed the accession of Maria Theresa to the Habsburg throne, Turkey, in spite of the urgency of France, would take no share, and she maintained the same attitude in the disorders in Persia following the death of Nadir Shah.

Osman III., 1754-1757.

Mustafa III., 1757-1773.

In 1754 the Sultan Mahmud died. He was succeeded by his brother Osman, whose three years' reign was marked by no political event of special importance. Osman III. was succeeded by his cousin Mustafa. At the outset of his reign negotiations were actively pursued for the conclusion of a treaty with Prussia, to counteract the alliance between France and Austria contracted in 1756; and these resulted in the signature of Capitulations, or a treaty of friendship and commerce (March 22, 1761). The attitude of the northern powers, however, and especially of Russia, towards Poland was beginning to excite the sultan's liveliest suspicions; and these the accession, in 1762, of the masterful Catherine II. to the Russian throne was not calculated to allay In 1763, Catherine took advantage of the death of Augustus III. of Poland to force her favourite, Stanislaus Poniatowski, on to the vacant throne. From the committee of patriots at Warsaw complaints and warnings were carried to Constantinople; and the cession of Podolia was offered as the price of a Turkish attack on Russia. The sultan, though inclined to take up the cause of the Polish dissidents, was slow to move, and contented himself for a while with protests and threats. But the aggressive policy of Russia in the direction of the Caspian and Black Seas became more and more evident; complaints reached the Porte of a violation of the neutrality of Kabardia, of a seditious propaganda in Moldavia by Russian monks, and of Russian aid given to the malcontents in Servia and Montenegro. Added to all this was the news of the continual Russian military aggressions in Poland, against which the Catholic confederation of Bar continued to appeal for aid. At last, on the 6th of October 1768, on the refusal of the Russian minister to give guarantees for the withdrawal of the Russian troops from Poland and the abandonment of Russia's claim to interfere with the liberties of the republic, war was declared and the Russian representative was imprisoned in the Seven Towers.

The war that followed marks an epoch in the decay of the Ottoman Empire and in the expansion of Russia. When, in the spring of 1769, the first serious campaign was opened by a simultaneous attack by three Russian armies on the principalities, the Crimea and the buffer state of Kabardia, the Turks, in spite of ample warning, were unprepared. They were hampered, moreover, by an insurrection in the Morea, where a Russian expedition under Orlov had stirred up the Mainotes, and by risings in Syria and Egypt. It was not, however, till September that the fall of Khotin in Bessarabia marked the first serious Russian success. The following year was more fatal. In May the Ottoman fleet was attacked and destroyed off Cheshme, and the Russian war-ships threatened to pass the Dardanelles. In June Romanzov's victory at Kartal made him master of the principalities, and by November the fortresses of Izmail and Kilia, guarding the passage of the Danube, and those of Akkerman and Bender on the Dniester had fallen into the hands of the Russians. The campaign of 1771, which opened with a gleam of success in the capture of Giurgevo, proved yet more disastrous to the Turks, the Russians passing the Danube and completing the conquest of the Crimea. Prussia and Austria now offered their mediation; and in June conferences were opened at Focshani, which led to no result. In the following year a conference, from which the Austrian and Prussian representatives were excluded, was opened at Bucharest (November 1772). In February 1773 the Russian plenipotentiary delivered his ultimatum, of which the most important demands were the cession of Kerch, Yenikale and Kinburn, the free navigation of the Black Sea and Archipelago for Russian trading and war vessels, and the recognition of the tsar's right to protect the Orthodox subjects of the sultan. These conditions were submitted to Constantinople, and rejected after a stormy debate in the divan. The conference of Bucharest now broke up, and the war continued. The successful defence of Varna and Silistria seemed to justify the stubbornness of the Porte.

Abd-ul-Hamid I., 1773-1789.

On the 24th of December 1773 Mustafa III. died, and was succeeded by his brother Abd-ul-Hamid I., a weakling, from whose character nothing could be expected to retrieve the now desperate fortunes of the war. The exhaustion of the treasury was evidenced by the absence of the usual donative to the troops; and the demoralization in both army and court made further resistance useless. At the beginning of July the Russians, under Kamenskiy, were before Shumla; and a few days later the grand vizier and his army, their communications with the capital severed, were surrounded in the fortress. Negotiations for peace were now opened and on the 21st of July—chosen by the Russian plenipotentiary as the anniversary of the humiliating convention of the Pruth—the treaty of Kuchuk Kainarji was signed. Its terms were the most onerous as yet imposed on the Ottoman sultans. The Tatars from the frontier of Poland to the shores of the Caspian, including those of the Crimea and Kuban, were declared independent under their own khan of the race of Jenghiz, saving only the religious rights of the sultan as caliph of Islam. Russia, however, retained the fortresses of Kerch, Yenikale and Kinburn, with the desert country between the Bug and the Dnieper, while Ochakov was left to the Turks. Bessarabia, with the fortresses of Akkerman, Izmail and Kilia, was restored to Turkey. Moldavia and Walachia were likewise restored, but under conditions which practically raised them to the position of semi-independent principalities under Russian protection (art. xvi.). Azov and its district were annexed to Russia, and the two Kabardias were transferred subject to the consent of the khan of the Crimea. Russia undertook to evacuate Mingrelia and Georgia. The recognition of the imperial title (*padishah*) was at last conceded to the Russian tsars.

Treaty of Kuchuk Kainarji, 1774.

Commerce and navigation in the Black Sea and the Mediterranean were free to both countries. Turkey was to pay a war indemnity of 15,000 purses, the Russian fleet was to withdraw and the islands captured by it to be restored. By article vii. of the treaty the Sublime Porte undertook "to protect the Christian religion and its churches" and conceded to the ministers of Russia the specific right to "make representations in favour of the new church" which, under article xiv. of the same treaty, the Russian government was empowered to build, in addition to the embassy chapel "in the street named Bey Oglu." This article is of great historical importance as forming the basis of the later claim of Russia to possess by treaty the right to protect the Orthodox subjects of the Porte.[1] Poland, the original cause of the war, was not even mentioned in the treaty, having been partitioned in 1772.

After yielding to these hard conditions, Turkey took advantage of her respite to strengthen the frontier defences and to put down the rebellions in Syria and Egypt; some effort was also expended on the hopeless task of reforming the Janissaries. It was not long before Russia showed that it was not the independence but the absorption of the Crimea which she desired. In 1779 a rupture on this account was only averted through the mediation of the French ambassador, coupled with the fact that Turkey was in no condition to enter upon hostilities, owing to the outbreak of plague in her army. The Porte, unable to resist, was obliged to consent to the convention of Ainali Kavak (March 10, 1779) whereby the Russian partisan, Shahin Girai, was recognized as khan of the Crimea, the admission of Russian vessels to navigate Turkish waters was reaffirmed and Russia's right of intervention in the affairs of the Danubian principalities was formally recognized. Five years later Potemkin induced the chiefs of the Crimea and Kuban to hold a meeting at which the annexation of their country to Russia was declared, Turkey giving her consent by a convention, signed at Constantinople, on the 8th of January 1784, by which the stipulations as to the liberty of the Tatars contained in the treaty of Kuchuk Kainarji and the convention of Ainali Kavak were abrogated. In 1786 Catherine made a triumphal progress through the Crimea in company with her ally, Joseph II., who had succeeded to the imperial throne on the death of his mother. These events and the friction caused by mutual complaints of infringements of the treaty stirred up public opinion in Turkey, and the British ambassador lent his support to the war party. In 1788 war was declared, but Turkey's preparations were inadequate and the moment was ill-chosen, now that Russia and Austria were in alliance, a fact of which Turkey became aware only when the horse-tails were planted for the campaign. The Turks drove back the Austrians from Mehadia and overran the Banat (1789); but in Moldavia Romanzov was successful and captured Jassy and Khotin. After a long siege Ochakov fell to Potemkin, and all its inhabitants were massacred. This news affected the sultan so deeply as to cause his death.

Selim III., 1789-1807.

Selim, the late sultan's nephew, who succeeded, made strenuous preparations for continuing the war, but his generals were incompetent and his army mutinous; expeditions for the relief of Bender and Akkerman failed, Belgrade was taken by the Austrians, Izmail was captured by Suvorov, and the fall of Anapa completed the series of Turkey's disasters. Sultan Selim was anxious to restore his country's prestige by a victory before making peace, but the condition of his troops rendered this hope unavailing; while Prussia, though on the 31st of January 1790 she had signed an offensive treaty with Turkey,[2] gave her no help during the war. Accordingly a treaty was signed with Russia at Jassy (Jan. 9, 1792) by which the Crimea and Ochakov were left to Russia, the Dniester was made the frontier in Europe, and the Asiatic frontier remained unchanged. Joseph II. had died, and his successor, Leopold II., was averse from the Russian alliance. Through the mediation of England, Holland and Prussia, Turkey and Austria concluded on the 4th of August 1791 the treaty of Sistova, by which Belgrade and the other conquests made by Austria were restored.

The conclusion of peace was welcomed by Selim as the opportunity for carrying out reforms, of which he thoroughly realized the necessity in every branch of the administration, and especially in the army, to whose defects the disasters of the state were due. Accordingly it was decided to form troops known as *nizam-i-jedid*, affiliated to the Janissaries so as to disarm the jealousy of the latter, properly drilled and wearing a distinctive uniform. The fleet was reorganized, military schools were established, and skilled instructors were obtained from Europe. These reforms excited much opposition, which was at first unheeded. Meanwhile Turkey came into conflict with France. Throughout all the vicissitudes of the Revolution the relations between the two states had remained unimpaired, and Turkey had been one of the first countries to recognize the republic. Bonaparte's sudden occupation of Egypt (1798) came therefore as a complete surprise. This expedition was in reality directed against English rule in India. Nelson's destruction of the French fleet at the battle of the Nile disconcerted Bonaparte's plans; he hoped to pursue his designs through Syria, and laid siege to Acre, which, however, successfully held out. Turkey now joined Great Britain and Russia against France.[3] The Russian and Turkish fleets attacked and took the Ionian Islands, which had become French by the treaty of Campo Formio, and certain towns, hitherto unconquered, on the Albanian coast. An expeditionary force was also sent against Bonaparte, now practically blockaded in Egypt. This was routed and driven into the sea at Abukir (July 15, 1799). For the subsequent operations in Egypt, which ended in its evacuation by the French after the British victory at Alexandria, see EGYPT: *History*.

The War with France.

Servian Rising.

Meanwhile in Turkey disorder prevailed in almost every province of the empire, and the local governors in many places became entirely independent, oppressing the people under their rule and often driving them to revolt. This was notably the case in Servia, where the temporary domination of Austria, to which the treaty of Sistova (1791) put an end, had had the effect of awakening the national spirit of the people. But no armed manifestation of revolt had taken place until the lawless and savage conduct of the Janissaries, who had made themselves masters of the country, assisted by the notorious governor of Vidin, Pasvan Oglu, and his band of outlaws, drove the peaceful rayas to rebel. The insurgents chose as their captain one George Petrovich, nicknamed Kara Georgi (*i.e.* Black George), and under his able leadership succeeded in capturing Belgrade and in breaking the power of the Janissaries. The Porte also sent an army against Pasvan Oglu, but after reducing him to submission reinstated him in his government. A serious outbreak took place at Adrianople in 1804, where 20,000 of the new troops had been sent, ostensibly to put down the revolt in Servia, but really to try to bring about the reform of the European provinces. So strong was the opposition that the troops were recalled, and the anti-reform party was greatly strengthened. The Wahhābi movement in Nejd now began to assume serious proportions. These religious sectaries attacked and plundered all Mussulmans not conforming to their peculiar tenets; they overran Kerbela and the Hejaz, sacking the holy cities and closing the pilgrim routes. Only in the reign of Mahmud II. were they put down (see WAHHABIS).

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[1] See G. F. de Martens, *Recueil des traités*, 1st series, vol. ii. p. 286, also Noradounghian, *Recueil*, p. 319.

[2] Text in Martens, *Recueil*, 2nd series, vol. iv. p. 466.

[3] The treaty of alliance with Russia was signed on the 23rd of December 1798, that with Great Britain on the 5th of January 1799.

Complications with Russia.

In 1802, by a treaty of peace signed at Paris on the 25th of June, France resumed her former terms of friendship with Turkey. Russia, desirous of deriving some return for the support which she had given the sultan during his rupture with the French, induced the Porte to address to her a note in which the right of intervention in the affairs of the principalities, conferred on her by the treaty of Kainarji and reaffirmed in the convention of Ainali Kavak, was converted into a specific stipulation that the hospodars should be appointed in future for seven years and should not be dismissed without the concurrence of the Russian ambassador at Constantinople. In pursuance of this agreement Constantine Ypsilanti was appointed to Walachia and Alexander Muruzi to Moldavia—both devoted to Russian interests. Their intrigues in favour of the Greek and other revolutionary movements induced the Porte to dismiss them in 1806, contrary to the arrangement of 1802. Russia and England hereupon used threatening language, and Turkey replaced the hospodars. But war was nevertheless declared on the 27th of December 1806, and Russia occupied the principalities. The British ambassador sought by every means in his power to induce Turkey to give way to Russia, going so far as to guarantee the withdrawal of the Russian troops from Moldo-Walachia if the Porte remained at peace, and threatening that if Turkey persisted in her opposition England would join with Russia against her. But France's influence, backed by the strong personality of her ambassador, General Sebastiani, was sufficient to enable the sultan to withstand these arguments, and the British ambassador broke off relations and withdrew to the fleet at Tenedos (February 1807). Helped by a strong south wind, the British war-ships passed up the straits and anchored off the Seven Towers. An ultimatum was presented ordering Turkey within twenty-four hours to dismiss the French ambassador, hand over the Turkish fleet, and make peace with Russia. With Sebastiani's encouragement the Porte resisted these demands; in one day a thousand guns were ranged along both sides of the Bosporus; and after a stay of ten days the British fleet was ordered to leave, and was considerably damaged by the fire of the forts while passing down.

Revolt against Selim.

Meanwhile the sultan's whole efforts were directed towards the reform of the country; the newly-instituted militia was in every respect a success; it grew in numbers, and hopes were entertained that it would gain popularity. But the Janissaries and the corrupt officials were fundamentally opposed to the scheme, and the conservatives joined with them against such reforms of European origin. The rulers of the provinces shared these views; the consequence was disquiet and confusion throughout the empire. At this difficult moment the army was obliged to march to the Danube, leaving the government in the hands of men hostile to reform. In 1807 the garrisons of the Black Sea forts at the entrance of the straits rose in rebellion, headed by one Kabakji Mustafa, and killed their officers. The sultan sought to appease them by pacific means, but the movement spread to the Janissaries, who insisted upon the abolition of the new troops. But even this concession did not satisfy them; they dethroned Selim and proclaimed his nephew Mustafa. The new sultan was obliged to abolish all the reforms, and during practically the whole of his fourteen months' reign the Janissaries were in rebellion, even while facing the Russians. All officers who were partisans of the reforms were obliged to take refuge in flight; and Turkey's position would have been desperate but for the conclusion of the peace of Tilsit (July 7, 1807) between Russia and France, to which Turkey also became a party. The army hereupon retired to Adrianople, and the powerful pasha of Rustchuk, Mustafa Baïrakdar, who had distinguished himself by his resistance to the Russians, and who thoroughly shared Selim's desire for reform, was now induced by the many officers who held similar views to march on Constantinople to restore Selim to the throne. But he arrived too late; Selim had already been killed; the unworthy Mustafa was put to death, and Mahmud, the sole survivor of the house of Osman, became sultan. Mustafa Baïrakdar, who was now raised to the dignity of grand vizier, succeeded in inspiring the Janissaries with a wholesome respect, due to their dread of the 10,000 irregulars known as *kirjalis* by whom he was accompanied. The remnants of the abolished new troops were collected and formed into regiments affiliated to the Janissaries under the name of *seymen-i-jedid*; the dignitaries of state were called upon to take an oath of fidelity and loyalty. The feast of Ramazan hereupon occurring, the grand vizier unwisely allowed his own troops to disperse. Taking advantage of this opportunity, the Janissaries rose by night and besieged the house of the grand vizier, who eventually blew himself up in the arsenal. Fighting became general and extended to the fleet, which bombarded the capital. The Janissaries slaughtered all the "new troops" whom they met, and finally extorted an amnesty from the terrified government.

Mustafa IV., 1807–1808.

Mahmud II. 1808–1839.

Treaty of Bucharest: Troubles in Servia.

After the peace of Tilsit an armistice had been agreed upon with Russia (Aug. 24, 1807). Turkey was at this time the only neutral state in Europe; it was of vital importance that she should not be absorbed into the Napoleonic system, as in that case Russia would have been exposed to a simultaneous attack from France, Austria, Turkey and Persia. Accordingly, though France made every attempt to induce Turkey to adopt her side, the young Stratford Canning succeeded in causing the resumption of the peace negotiations at Bucharest, broken off through Russia's terms being considered too onerous, and followed by the capture of Izmail and Bender. The British diplomatist secured his first triumph in the signature of the treaty of Bucharest (May 28, 1812) whereby Khotin, Bender, Kilia and Akkerman were left to Russia; the frontier was fixed at the Pruth; the Asiatic boundary was slightly modified. The treaties as to the principalities were renewed; and though Servia was restored to the direct rule of Turkey it was stipulated that clemency was to be observed in the Porte's dealings with the country, which was given the power of regulating its own affairs.

The vagueness of these latter provisions at once gave rise to disputes, and in 1813 the Turkish troops occupied the country. The new pasha of Belgrade appointed one Milosh Obrenovich headman of his own district, but a few years later Milosh raised a successful revolt, drove out the Turks, and re-established Servian semi-independence. Karageorge, who had fled to Austria in 1812, was induced to return, but Milosh caused him to be murdered, and in 1817 was by a popular vote named hereditary prince of Servia.

The affairs of Servia, however, were not the only question left unsettled by the treaty of Bucharest. In the course of the war with Persia Russia had received permission from the Ottoman government to use, for a limited time, the easy road from the Black Sea to Tiflis by way of the valley of the Rion (Phasis) for the transport of troops and supplies, and this permission had been several times renewed. Wishing to make this important privilege permanent, Russia by secret articles of the Treaty of Bucharest had secured the cession of this district, in return for an undertaking to destroy the forts of Kilia and Izmail on the Danube. But the sultan refused to ratify these articles, and the relations between Russia and Turkey were therefore determined by the patent treaty only, which positively stipulated for the evacuation by the Russians of every spot occupied by them on Turkish soil in Asia. When the Russians showed no signs of withdrawing from the valley of the Rion, the sultan threatened to renew the war, the sole result of which was to reveal the determination of the tsar not to be bullied into concessions. The dispute, at first of little importance, developed in seriousness during the next year or two, owing to the avowed intention of Russia, which by conquest or treaties with independent chiefs had acquired all the high land between the Caspian and the Black Sea, to take possession of the low lands along the coast, between Anapa and Poti, of which the sultan claimed the sovereignty.

Congress of Vienna.

Such was the situation when the question of a European guarantee of Turkey was raised at the Congress of Vienna. In view of the multiple dangers to which the Ottoman Empire was exposed, both from without and from within, and of the serious consequences to the world's peace which would result from its break-up, there was a strong feeling among the powers in favour of such a guarantee, and even the emperor Alexander was willing to agree to it in principle. But nothing could be done until the Porte should have come to terms with Russia as to the Treaty of Bucharest; for, as the British ambassador, Sir Robert Liston, was instructed to point out to the Ottoman government, "it is impossible to guarantee the possession of a territory of which the limits are not determined." With the consent of the tsar, it was proposed to submit the questions at issue to the decision of Great Britain, France and Austria; and the Porte was informed that, in the event of its accepting this arrangement, the powers would at once proceed to guarantee the integrity of the Ottoman Empire. But the sultan could not bend his pride to suffer foreign intervention in a matter that touched his honour, and the return of Napoleon from Elba threw the Eastern Question into the background. The Ottoman Empire thus remained outside the European concert; Russia maintained her claim to a special right of isolated intervention in its affairs; and the renewal of war between Russia and Turkey was only postponed by the preoccupation of Alexander with his dream of the "Confederation of Europe."

Egypt.

Meanwhile, within the Ottoman Empire there was every sign of a rapidly approaching disintegration. In Egypt Mehemet Ali had succeeded in establishing himself as quasi-independent ruler of the country. By his action during Napoleon Bonaparte's invasion, and later when the British fleet after leaving Constantinople in 1807 proceeded to Egypt, he had to some extent acquired the goodwill of the Turkish government. In 1811 he was called upon by the Porte to put down the Wahhâbi insurgents (see ARABIA, vol. ii. p. 268), his success in this matter, and especially in the recovery of the holy cities, adding greatly to his prestige.

Greek Revolt.

Sultan Mahmud now devoted himself to breaking the overgrown power of the local governors, which had for many years practically annihilated that of the central authority. Their extortions impoverished the whole country, yet the abolition of the system might perhaps have been carried out more gradually and with greater precaution, and Turkey more than once felt the want of their aid, questionable as its value often was. Thus Ali (*q.v.*), Pasha of Iannina, the most famous of these, though insubordinate and inclined to intrigue with foreign powers in the hope of making himself independent, had used his influence to keep the Greeks quiet; and it was only after his power had been broken in 1821 that the agitation of the *Hetairia* issued in widespread dangerous revolt. The first hope of emancipation from the Turkish yoke had been founded by the Greeks on Peter the Great, who had planned the expulsion of the Turks from Europe and had caused the inscription "Petrus I., Russo-Graecorum Monarcha" to be placed beneath his portrait engraved at Amsterdam. Catherine II. following in his footsteps, aspired to found a Greek empire, the throne of which was to be occupied by her nephew, Constantine, specially so baptized, and brought up by Greek nurses (see CONSTANTINE PAVLOVICH). During the war of 1770 the Greeks had risen in an abortive rebellion, promptly crushed by the Turks. But the idea of liberation continued to grow, and about 1780 the Society of Friends (Ἑταιρία τῶν φιλικῶν) was founded at Bucharest by the fervent patriot and poet, Constantinos Rhigas (*q.v.*). The secret organization, temporarily checked by Rhigas's arrest and execution in 1798, was revived at Odessa in 1814; it extended throughout Turkey, and in 1820 the insurrection took shape, a favourable opportunity being afforded by the outbreak of hostilities between Ali Pasha and the Porte. (See GREEK INDEPENDENCE, WAR OF.)

On the 6th of March 1821 Prince Alexander Ypsilanti, son of the hospodar Constantine, and a general in the Russian service, crossed the Pruth, proclaiming the revolt of the Greeks against the sultan and the intention to restore the Greek Empire of the East. But in the principalities, where the Vlach peasants regarded the Phanariots as worse oppressors than the Turks, the movement had little chance of success; it was doomed from the moment that the emperor Alexander disavowed Ypsilanti's claim to his support (see ALEXANDER I.). After some initial successes the Greeks were finally routed at the battle of Dragashani (June 19, 1821). It was far otherwise with the insurrection which broke out at the beginning of April in the Morea. The Mussulman population of the Morea, taken unawares, was practically exterminated during the fury of the first few days; and, most fatal of all, the defection of the Greeks of the islands crippled the Ottoman navy by depriving it of its only effective sailors. The barbarous reprisals into which Sultan Mahmud allowed himself to be carried away only accentuated the difficulty of the situation. The execution of the patriarch Gregorios, as technically responsible for the revolt, was an outrage to all Christendom; and it led at once to a breach of diplomatic relations with Russia.

To prevent this breach developing into war was now the chief study of the chanceries. Public opinion throughout Europe was violently excited in favour of the Greeks; and this Philhellenic sentiment was shared even by some of the statesmen who most strenuously deprecated any interference in their favour. For at the outset Metternich was not alone in maintaining that the war should be allowed to burn itself out "beyond the pale of civilization." The mutual slaughter of barbarians in the Levant seemed, even to George Canning, a lesser evil than a renewed Armageddon in Europe; and all the resources of diplomacy were set in motion to heal the rupture between Turkey and Russia. In spite of the emperor Alexander's engagements to the Grand Alliance and the ideal of European peace, this was no easy matter; for the murder of the patriarch was but the culmination of a whole series of grievances accumulated since the Treaty of Bucharest. Moreover, the Porte was thrown into a suspicious mood by the contrast between the friendly language of the western powers and the active sympathy of the western peoples for the Greeks, who were supported by volunteers and money drawn from all Europe. But, though the sultan remained stubborn, the emperor Alexander, who since the Congress of Laibach had been wholly under Metternich's influence, resisted the clamour of his people for war, and dismissed his Greek minister Capo d'Istria (*q.v.*). The Congress of Verona (1822) passed without any serious developments in the Eastern Question.

The stubborn persistence of the Greeks, however, dashed Metternich's hope that the question would soon settle itself, and produced a state of affairs in the Levant which necessitated some action. In the instructions drawn up, shortly before his death, for his guidance at Verona, Castlereagh had stated the possibility of the necessity for recognizing the Greeks as belligerents if the war continued. The atrophy of the Ottoman sea-power had left the archipelago at the mercy of the Greek war-brigs; piracy flourished; and it became essential in the interests of the commerce of all nations to make some power responsible for the policing of the narrow seas. On the 25th of March 1823 accordingly, Canning announced the recognition by Great Britain of the belligerent character of the Greeks.

This roused the emperor Alexander to action, since it seemed as though Great Britain was aiming at ousting Russian influence in the Levant. He suggested a joint intervention of the powers; but the conference, which met at St Petersburg in April 1824, came to nothing, since Turkey and the Greeks alike refused to be bound by its decisions, and Canning would not hear of coercion being applied to either. The sole outcome of the conference was the offer in March 1825 of the joint mediation of Austria and Russia, which the Porte rejected.

Meanwhile Mahmud, realizing the impossibility of crushing the Greek revolt unaided, had bent his pride to ask the help of Mehemet Ali, who was to receive as his reward Crete, the Morea and the pashaliks of Syria and Damascus. The Egyptian fleet and disciplined army were now thrown into the scale; and from the moment when Ibrahim Pasha landed at Modon (Feb. 24, 1825), the fate of the Greeks seemed sealed. The Morea was quickly overrun; in April 1826 Missolonghi fell, after a heroic defence; in June 1827 Athens was once more in the hands of the Turks. Crowds of Greek captives were being sent as slaves to Cairo; and, should the powers not intervene, there was every prospect of Greece being depopulated and colonized with Mussulman negroes and fellahin.

At the close of 1825 an isolated intervention of Russia had seemed probable. A great army was assembled in the south of Russia, and the emperor Alexander had gone to place himself at its head when he died (Dec 22, 1825). It was to prevent such an intervention that Canning seized the opportunity of the accession of Nicholas I. to send the duke of Wellington to St Petersburg in order to concert joint measures. The result was the protocol of St Petersburg of the 4th of April 1826, by which Great Britain was empowered to offer to the Ottoman government a settlement of the Greek question based on the establishment of Greece as a vassal and tributary state. Should the Porte refuse, the two powers were to take the earliest opportunity, either separately or in common, of establishing a reconciliation on the basis of the protocol.

Convention of Akkerman.

Russia, meanwhile, had seized the occasion to send to Constantinople an ultimatum demanding satisfaction for her own particular grievances; the Porte resented the intrusion of new demands before the others had been dealt with, and hurried on preparations for war. The reform of the army, however, involved the destruction of the Janissaries (*q.v.*), and though their massacre on the 15th of June left the sultan free to carry out his views with regard to the army, it left him too weak to resist the Russian demands. On the 7th of October, accordingly, these were conceded by the Convention of Akkerman. Its terms were: the confirmation of the Treaty of Bucharest and the opening of the navigation of the Black Sea to the Russian flag; a stipulation that the hospodars of Walachia and Moldavia should be elected by the boyars for seven years, their election being confirmed by the Porte which, however, had no power to dismiss them without the concurrence of the Russian ambassador at Constantinople; finally, Servia's autonomy was recognized, and, save in the fortresses, no Mussulman might reside there.

Agreement of the Powers as to Greece.

The Greek question was however, not yet settled. Months passed without any action being taken under the protocol of the 4th of April; and Russia suspected Great Britain of merely using the protocol to prevent her own isolated intervention. The situation was however materially altered by the end of August 1826; for the Greeks, driven to desperation, had formally invited the mediation of England, thereby removing Canning's objection to an unasked intervention. He now invited the co-operation of Russia in representations to the Porte on the basis of the protocol, and, in the event of its refusal to come to terms, suggested certain measures of coercion. The tsar consented, and proposed that the coercion should take the form of a pacific blockade of the Morea, so as to force Ibrahim, by cutting off his supplies, to evacuate the country. To this Great Britain agreed in principle; for Canning clearly saw the need for yielding on the question of a joint intervention, if the isolated intervention of Russia were to be prevented. In the conference of the five powers of the Grand Alliance opened at London in the early summer of 1827, however, a divergence of views at once became apparent. Austria and Prussia protested against any coercion of the Porte "to serve revolutionary ends" and, failing to carry their views, withdrew from the conference. France thereupon proposed to convert the protocol of the 4th of April into a treaty; Russia and Great Britain agreed; and on the 6th of July the Treaty of London was signed by the three powers.

By the patent articles of the treaty the powers agreed to secure the autonomy of Greece under the suzerainty of the sultan, but without any breach of friendly relations with Turkey. By additional secret articles it was agreed that, in the event of the Porte not accepting the offered mediation, consuls should be established in Greece, and an armistice proposed to both belligerents and enforced by all the means that should "suggest themselves to the prudence" of the high contracting powers. In general it was allowed that these means should be the "pacific blockade" proposed by the tsar. Instructions to this effect were sent to the admirals commanding in the Levant.

Navarino.

The armistice, accepted by the Greeks, was refused by Ibrahim, pending instructions from Constantinople, though he consented to keep his ships in the harbour of Navarino. The Greeks, having put themselves in the right with the powers, were free to continue the war; and the destruction of a Turkish flotilla off Salona on the 23rd of September followed. Ibrahim, taking this as a breach of the convention, set sail from Navarino northwards, but was turned back by Sir Edward Codrington, the British admiral. Then, the Russian and French squadrons having joined, it was determined to put further pressure on the Egyptian commander, and the allied fleets, on the morning of the 20th of October, stood into the bay of Navarino. A chance scuffle led to a battle, and by the evening the Turkish and Egyptian fleets had ceased to exist (see NAVARINO, BATTLE OF).

The effect on the passionate sultan of this "unparalleled outrage on a friendly power in time of peace" is easy to imagine. In spite of the weak efforts of the British government to palliate the significance of this "untoward incident," Turkey broke off diplomatic relations with the three powers concerned, and on the 20th of December Mahmud, giving full vent to his rage, issued a *hatt-i-sherif* denouncing the cruelty and perfidy of the Christian powers, declaring the convention of Akkerman null and void, and summoning the faithful to a holy war. The struggle that followed was, however, destined once more to be a duel between Russia and Turkey. Great Britain, when Canning was no longer at the helm of state, had reverted to the traditional policy of preserving Ottoman integrity at all costs; the invitation of the tsar to accept the logical consequences of Navarino was refused; and Russia was left to settle her account with Turkey.

War with Russia.

The war that followed proved once more the wonderful resisting power of the Turks. In spite of the confusion due to the destruction of the Janissaries and army reforms as yet hardly begun, it cost the tsar two hardly fought campaigns before the audacious strategy of General Diebitsch enabled him to dictate the terms of the treaty of Adrianople (Sep. 14, 1829). Meanwhile the other powers had taken advantage of the reverses of the Russian arms to discount the effect of their ultimate victory by attempting to settle the Greek question. In July 1828 France had been commissioned to oust Ibrahim from the Morea; and though by a convention, concluded on the 9th of

August by Codrington with Mehemet Ali, the principle of evacuation by the Egyptian troops had already been settled before the arrival of the French expedition, the Morea remained for the time in French occupation. On the 16th of November a protocol of the London conference placed the Morea, with the neighbouring islands and the Cyclades, under the guarantee of the powers; and on the 22nd of March 1829 another protocol extended the frontier thus guaranteed to the line Arta-Volo and included the island of Euboea. According to this instrument Greece was to be erected into a tributary state, but autonomous, and governed by an hereditary prince chosen by the powers.

Greek Independence.

The Treaty of Adrianople, by which the Danubian principalities were erected into practically independent states, the treaty rights of Russia in the navigation of the Bosporus and Dardanelles confirmed, and the districts of Anapa and Poti in Asia ceded to the tsar, included also a settlement of the Greek question on the terms of the protocol of the 22nd of March. This fact, which threatened to give to Russia the whole prestige of the emancipation of Greece, spurred the other powers to further concessions. The acceptance of the principle of complete independence, once more warmly advocated by Metternich, seemed now essential if Greece was not to become, like the principalities, a mere dependency of Russia. On the 3rd of February 1830 was signed a protocol embodying the principle of an independent Greece under Leopold of Coburg as "sovereign prince." This was ultimately expanded, after the fall of the Wellington ministry, into the Treaty of London of the 7th of May 1832, by which Greece was made an independent kingdom under the Bavarian prince Otto. (See GREECE: *History*.)

Syria.

Before the final settlement of the Greek question a fresh crisis had arisen in the affairs of Turkey. Her lessened prestige had already received a severe blow from the bombardment and capture of Algiers by the French in 1830, and her position was further embarrassed by revolts in Bosnia and Albania, when news reached Constantinople that Mehemet Ali had invaded Syria (Nov. 1, 1831), nominally in order to punish his enemy Abdullah, pasha of Acre, really in order to take by force of arms the pashaliks of Syria and Damascus promised as a reward for his services in Greece. An account of the collapse of the Turkish power before Mehemet Ali, and of the complicated diplomatic developments that followed, is given in the article MEHEMET ALI. Here it must suffice to say that the recognition of Mehemet Ali's claims, forced on the sultan by France and Great Britain, was followed in 1833 by the signature of the Treaty of Unkiar Skelessi, which seemed to place Turkey wholly in the power of Russia, after which Sultan Mahmud concentrated his energies on creating a force strong enough to crush his rebellious vassal.

At last, in 1839, his eagerness would no longer be restrained, and without consulting his ministers, and in spite of the warnings of all the powers, he determined to renew the war. On the 21st of April the Ottoman army, which had been massed under Hafiz Pasha at Bir on the Euphrates, crossed the stream, by the sultan's orders, and advanced on Damascus. On the 23rd of June it was attacked by Ibrahim at Nezib and annihilated. As for Mahmud, the news of the disaster reached Constantinople when he was unconscious and dying. Early on the 1st of July he was dead, and his son Abd-ul-Mejid, a lad of eighteen, reigned in his stead (see MAHMUD II.).

Abd-ul-Mejid, 1839–1861.

The Eastern Question had now suddenly once more entered an acute phase. The news of Nezib was immediately followed by that of the treason of Ahmed Pasha, the Ottoman admiral, who, on the plea that the sultan's counsellors were sold to Russia, had sailed to Alexandria and handed over the fleet to Mehemet Ali. With an inexperienced boy on the throne, divided and untrustworthy counsels in the divan, and the defences of the empire shattered, the house of Osman seemed doomed and the Turkish Empire about to dissolve into its elements. If Russia was to be prevented from using the Treaty of Unkiar Skelessi for her own purposes, it was essential that the powers should concert measures to deal with the situation. The story of the diplomatic negotiations that followed is told elsewhere (see MEHEMET ALI). Here it may suffice to say that the desire of the emperor Nicholas to break the entente between Great Britain and France led him to waive his special claims under the Treaty of Unkiar Skelessi, and that in the ultimate concert by which the question was settled France, which throughout supported Mehemet Ali, had no part. The intervention of the powers, based on the convention of London of the 15th of July 1840, led to the withdrawal of Ibrahim from Syria, and the establishment by the *firman* of the 13th of February 1841 of Mehemet Ali as hereditary pasha of Egypt under conditions intended to safeguard the sovereign rights of the Ottoman sultan. On the 10th of July the four signatory powers of the convention of London signed a protocol recording the closure of the incident (*protocole de clôture*), and on the 13th France united with them in signing another protocol (*protocole des détroits*) by which the powers engaged to respect the principle proclaimed by the sultan as to the closing of the Dardanelles to foreign warships.

Reform Policy in Turkey. The Tanzimât.

The severe crisis through which the Ottoman Empire had passed accentuated the need for strengthening it by a drastic reform of its system. For such an experiment, though hampered by continual insurrections within and troubles without, Mahmud had done something to pave the way. The destruction of the Janissaries and the suppression of the quasi-independent power of the *dĕrĕbeys* had removed the worst disturbing elements; the government had been centralized; a series of enactments had endeavoured to secure economy in the administration, to curb the abuses of official power, and ensure the impartiality of justice; and the sultan had even expressed his personal belief in the principle of the equality of all, Mussulman and non-Mussulman, before the law. It was therefore no sudden revolution when, on the 15th of November 1839 Abd-ul-Mejid signalized his accession by promulgating the Tanzimât, or Hatt-i-Sherif of Gulhané, a decree abolishing the arbitrary and unlimited power hitherto exercised by the state and its officials, laying down the doctrine of the perfect equality of all Ottoman subjects of whatever race or creed, and providing for the regular, orderly and legal government of the country and the security of life, property and honour for all its inhabitants. Yet the feelings of dismay and even ridicule with which this proclamation was received by the Mussulmans in many parts of the country show how great a change it instituted, and how strong was the opposition which it encountered among the ruling race. The non-Mussulman subjects of the sultan had indeed early been reduced to such a condition of servitude that the idea of their being placed on a footing of equality with their Mussulman rulers seemed unthinkable. Preserved merely as taxpayers necessary to supply the funds for the maintenance of the dominant and military class, according to a foreign observer in 1571, they had been so degraded and oppressed that they dared not look a Turk in the face. Their only value was from a fiscal point of view, and in times of fanaticism or when anti-foreign sentiment ran high even this was held of little account, so that more than once they very nearly became the victims of a general and state-ordered massacre. Thus Sultan Ibrahim was dissuaded from such a step in 1644 only by the refusal of the Sheikh-ul-Islam to sanction the proceeding. The humane and tolerant measures provided for in the "nizam-i-jedid," or new regulations for the better treatment of the Christians enacted by Mustafa Kuprili during his grand vizierate (1689–1691), did for a time improve the position of the rayas. But the wars with Russia and other Christian powers, and the different risings of the Greeks and Servians, helped to stimulate the feelings of animosity and contempt entertained towards them by the ruling race; and the promulgation of the Tanzimât undoubtedly heralded for the subject nationalities the dawn of a new era.

Remodelling of the Administration.

The reforms introduced by Sultan Mahmud and by the Tanzimât necessitated the remodelling of nearly all the departments of state. Towards the end of Mahmud II.'s reign ministries had been instituted, and a council of ministers had been established, presided over by the grand vizier. In 1837 the "council of the Sublime Porte" and the "supreme council of legal affairs" were established: the latter was the tribunal to which were referred all complaints against officials or claims pending between the state and private individuals; the council of the Sublime Porte was in 1839 transferred to the ministry of commerce; the supreme council of legal affairs after undergoing various modifications was in 1868 absorbed in the council of state. In 1837 a "council of public works" was instituted, converted ten years later into a separate ministry. In 1835 the "ministry of administration" was formed; two years later its title was changed to ministry of the interior. Regulations prescribing the duties of the local governors and officials of all ranks were drawn up only in 1865 and 1870, but since Mahmud's time their functions were exclusively civil and administrative. A regular hierarchical order was elaborated for the official classes, both civil and military, whereby the rank of each person was clearly defined.

The military reorganization dates from the destruction of the Janissaries (June 15, 1826). On that day Aga Hussein Pasha was appointed "Seraskier (commandant) of the victorious Mahommedan troops"; at first only two divisions were established, quartered respectively at Constantinople and Scutari. In 1833 the reserves were instituted, and three years later reserve commandants were appointed in six principal provinces. In 1843 the *corps d'armée* of Constantinople, Rumelia, Anatolia and Arabia were formed, and a military council was appointed. In 1847 a recruiting law was promulgated, reducing the period of service (until then unlimited in point of time), to five years. Military schools were founded. For the reorganization carried out from 1908 to 1910 see section *Army*, above.

After the Greek revolution the system of manning the navy from the Christian natives of the archipelago and the Mediterranean littoral was abandoned, and recruits for the navy are now selected under the ordinary law. A naval school and a modern factory and arsenal were established. The direction of the police, formerly left to the Janissaries, was formed into a ministry, and a body of gendarmerie was instituted. For the financial reforms see the section *Finance*, above.

Education.

The ministry of public instruction was established in 1857; until the reign of Selim III. (when a few military schools were established) the only schools had been the colleges of the Ulema and such preparatory schools as had been founded by private munificence. In 1838 the council of education had been created and several secondary state schools were founded. In 1860 the regulations for public education were promulgated; schools were everywhere opened, and in 1882 a portion of the receipts from certain *vakufs* were appropriated to their maintenance. As all the preparatory schools founded by the state were for Mussulman children only (the various Christian communities maintaining their own schools), *idadi* or secondary schools were established in 1884 for the instruction of children of all confessions. In 1868 the Imperial Lycée of Galata Serai was founded; most of the later generation of officials received their education there. Special state schools of medicine, arts, science, crafts, &c., have been created successively, and in 1901 a university was founded. Educational affairs in the provinces are now superintended by special officials.

Justice.

After the promulgation of the reforms, the judicial duties of the Imperial Divan, which with other functions also exercised those of a kind of supreme court of appeal, were transferred to the Sheikh-ul-Islam. The codification of the civil law, which soon became necessary, was effected by the promulgation in 1859 of the *Mejellé*, or civil code. Commercial and criminal codes, as well as codes of procedure, were drawn up, largely on the basis of the Code Napoléon. The rules regulating the Ulema were amended, a school for judges was founded, and the Sheikh-ul-Islam was charged with the duty of revising all judgments. In 1865 the court of cassation was founded.

Foreign Relations.

In 1835 the Reis-ul-Kuttab, to whom the superintendence of foreign affairs was entrusted, received the designation of minister for foreign affairs. Turkey had originally maintained no representatives abroad, and appointed such only for special occasions as *e.g.* the signature of a treaty or the announcement of a new sultan's accession. Selim III. was the first sultan who entered into regular relations with foreign powers, and employed permanent ambassadors; the practice was discontinued at the time of the Greek revolution and the consequent rupture with the powers. Later, during the Egyptian negotiations, ambassadors were accredited to London, Paris and Vienna. Sultan Abd-ul-Aziz's journey to Europe and the return visits paid by foreign princes strengthened Turkey's relations with foreign states.

The ministry of the *Evkaf* or pious foundations was established in 1827 and extended ten years later. Such foundations had been created from the earliest times, and the execution of the testator's wishes was generally left to his descendants, under the supervision of some high official designated in the act of endowment. In case of failure in the line of succession an administrator was appointed by the state. But many such foundations fell into disorder, and the ministry was created to exercise the requisite supervision.

Results of Reforms.

Though the provisions of the Tanzimât were not fully observed, they afforded convincing proof that reform was entirely practicable in Turkey. Reforms were effected in every direction; the finances and the army were reorganized, military instructors being procured from Europe; the administration was gradually centralized, and good relations were cultivated with the powers, the only serious international controversy arising in 1848–1849 over the refusal by Turkey, with the support of England, to surrender the Hungarian and Polish insurgents who had taken refuge within her borders. It cannot indeed be said that complete tranquillity prevailed throughout the country meanwhile; disturbances in the principalities and in the Lebanon gave serious trouble, while in 1842 the unsettled state of the Turco-Persian frontier nearly led to war. By the mediation of England and Russia the Treaty of Erzerum was signed (1847) and a frontier commission was appointed. But as the frontier was not definitely demarcated the door was left open for controversies which have occurred frequently up to the present day.

Russian Policy since 1829.

Turkey's progress in the path of reform was viewed with some uneasiness in Russia, the cardinal principle of whose policy since 1829 had been to maintain her own influence at Constantinople by keeping the Ottoman government weak. In favour of this view the traditional policy of Peter the Great and Catherine II. had been deliberately given up, and by the secret convention signed at Münchengrätz on the 18th of September 1833 the emperor Nicholas had agreed with his brother sovereigns of the revived "Holy Alliance" to maintain the integrity of Turkey, where Russian influence seemed to have been rendered supreme and permanent by the Treaty of Unkiar Skelessi. The crisis which ended in 1841, however, materially altered the situation from the Russian point of view. By his concert with the other powers in the affair of Mehemet Ali, the tsar had abdicated his claim to a unique influence at Constantinople, and he began to revive the idea of ending the Ottoman rule in Europe, an idea which he had only unwillingly abandoned in 1829 in response to the unanimous opinion of his advisers. In 1844 he took advantage of his visit to England to propose to British ministers a plan of partition, under which Great Britain was to receive Egypt and Crete, Constantinople was to be erected into a free city, and the Balkan states were to become autonomous under Russian protection. This proposal, as might have been expected, only served to rouse suspicions as to Russia's plans; it was politely rejected, and the whole Eastern Question slumbered, until, early in 1850, it was awakened by an incident trivial enough in itself, but pregnant with future trouble: a quarrel of Catholic and Orthodox monks about the holy places in Palestine.

The Holy Places.

By the Capitulations signed on the 28th of May 1740 on behalf of Sultan Mahmud I. and Louis XV. "emperor of France," not only French pilgrims to Jerusalem, but all members of "Christian and hostile nations" visiting the Ottoman Empire, had been placed under the protection of the French flag, and by a special article the Frank, *i.e.* Roman Catholic, ecclesiastics had been guaranteed certain rights in the holy places. These stipulations of the treaty, which were in effect a confirmation of the firman granted in 1620 by Murad IV. to Louis XIII., had fallen into oblivion during the age of Voltaire and the turmoil of the Revolution; and meanwhile, every advance of Russia had been marked by further encroachments of the Orthodox clergy in Palestine on the ancient rights of their Latin rivals. The quarrels of these monks might have been left to the contempt they deserved, had not Napoleon III. seen in the situation an opportunity at once for conciliating the clericals in France and for humiliating Russia, which had given to his title but an equivocal recognition. His ambassador, accordingly, handed in at Constantinople a formal demand for the restitution of the Catholics in all their property and rights. The Ottoman government, seeking to gain time, proposed a "mixed commission" of inquiry; and to this France agreed, on condition that no documents later than 1740 should be admitted as evidence. To this suggestion, which would have excluded the Treaty of Kuchuk Kainarji, the emperor Nicholas replied by a haughty demand that nothing should be altered in the *status quo*. It was now clear that no less an issue was involved than a contest between France and Russia for paramount influence in the East, a contest into which Great Britain would inevitably be dragged. The British government did its best to help the Porte to evolve a compromise on the questions immediately at issue, and in March 1852 a firman was issued, which to Protestants and Mahommedans might well seem to have embodied a reasonable settlement. Concessions were made to one side and the other; and the question of the right of "protection" was solved by the Turkish government itself undertaking the duty. But neither Napoleon nor Nicholas desired a settlement. The French emperor wanted a war for dynastic reasons, the tsar because he conceived his honour to be involved, and because he judged the moment opportune for expelling the infidel from Europe. France, he believed, would never come single-handed to the assistance of Turkey; Austria would be bound at least to benevolent neutrality by "gratitude" for the aid given in 1849; the king of Prussia would sympathize with a Christian crusade; Great Britain, where under the influence of John Bright and Richard Cobden the "peace at any price" spirit seemed to be in the ascendant, would never intervene. Nicholas even hoped for the active sympathy of Britain. Lord Aberdeen made no secret of his dislike for the Turks, and openly expressed his disbelief in the reality of their reforms; and in January 1853 the tsar, in conversation with Sir Hamilton Seymour, the British ambassador at St Petersburg, spoke of the Ottoman Empire as "the Sick Man," and renewed the proposals for a partition made in 1844.

Early in 1853 the Russian army was mobilized, and Prince Menshikov, a bluff soldier devoted to the interests of Orthodoxy and tsardom, was sent to present the emperor's ultimatum at Constantinople. He demanded the recognition of the *status quo* in the holy places, and of the tsar's right, under the Treaty of Kuchuk Kainarji, to the protectorate of all Orthodox Christians in the Ottoman dominions. The Porte, in alarm, turned to Great Britain for advice and assistance. Lord Stratford de Redcliffe, who reached his post at Constantinople shortly after the arrival of Menshikov, at once grasped the essential facts of the situation. The question of the holy places was insignificant in itself—it might be settled if France were granted political compensation elsewhere; that of the protectorate claimed by Russia over the Christians involved the integrity of the sultan's sovereignty. With great address he succeeded in persuading Menshikov to present the two demands separately. On the 22nd of April the French, Russian and British ministers came to an agreement on the question of the holy places; with the result that, when the question of protectorate was raised, Menshikov found himself opposed by the ambassadors of all the other powers. On the 5th of May, nevertheless, in obedience to his peremptory instructions, he presented his ultimatum to the Ottoman government, which, backed now by all the other powers, rejected it. On the 22nd Menshikov and the whole of the Russian diplomatic staff left Constantinople; and it was announced that, at the end of the month, the tsar's troops would enter the Danubian principalities. On the 22nd of June the Russian army, under Prince Gorchakov, crossed the Pruth, not—as was explained in a circular to the powers—for the purpose of attacking Turkey, but solely to obtain the material guarantees for the enjoyment of the privileges conferred upon her by the existing treaties. The news of this aggression roused intense excitement in England; but the British government still exerted itself to maintain peace. In August a conference of the four powers assembled at Vienna, but the settlement they proposed, which practically conceded everything demanded by Russia except the claim to the protectorate, though accepted by the tsar, was rejected by the Porte, now fallen into a mood of stubborn resentment at the Russian invasion. At the beginning of October Turkey formally declared war; on the 22nd the French and British fleets passed the Dardanelles. Lord Aberdeen still hoped to secure peace, and the Russian government was informed that no *casus belli* would arise so long as Russia abstained from passing the Danube or attacking a Black Sea port. To the emperor Nicholas this was tantamount to a declaration of war; and in effect it was so. On the 30th of November the Russian fleet attacked and destroyed a Turkish squadron in the harbour of Sinope; on the 3rd of January the combined French and British fleets entered the Black Sea, commissioned to "invite" the Russians to return to their harbours.

Crimean War.

The emperor Nicholas had been singularly misled as to the state of public opinion in Europe. The news of the affair of Sinope, rather wanton slaughter than a battle, raised excitement in England to fever heat; while the excellent bearing and consistent successes of the Turkish troops during the first months of the campaign on land excited the admiration of all Europe. The belief in the rejuvenation of Turkey seemed to be justified; and when, on the 27th of March 1854, Great Britain and France declared war on Russia, the action of the governments was supported by an overwhelming public opinion. As regards Austria, too, the emperor Nicholas was no less mistaken. If she maintained neutrality, it was due to no impulse of gratitude, and it was far from "benevolent." As the Russians withdrew from the Danubian principalities, Austrian troops occupied them, and by a convention with the Porte the Austrian government undertook to resist by arms any attempt of the Russians to return. So far as the extreme claims of the tsar were concerned, neither Austria nor Prussia was willing to concede them, and both had joined with France and Great Britain in presenting, on the 12th of December 1853, an identical note at St Petersburg, drawn up at the Conference of Vienna, reaffirming the principles of the treaty of 1841. Save for the benevolent neutrality of Prussia, therefore, which enabled her to obtain supplies from the north, Russia was pitted single-handed against a coalition of Turkey, Great Britain and France, to which Sardinia was added later.

The events of the war that followed are told elsewhere (see Crimean War). The main operations were confined to the Crimea, where the allied troops landed on the 14th of September 1854, and they were not concluded, in spite of the terrible exhaustion of Russia, till in December 1855 the threatened active intervention of Austria forced the emperor Alexander II. to come to terms. These terms were ultimately embodied in the Treaty of Paris of the 30th of March 1856. Its provisions, held by some to be so unduly favourable to Russia as to justify the question whether she had not been victorious in the war, were as follows: Russia abandoned all pretensions to exercise a protectorate over the Christians in Turkey, or to an exclusive right of interference in the Danubian principalities, to which Bessarabia was restored; the navigation of the Danube was made free and placed under the supervision of an international commission; the Black Sea was closed to warships, while open to the commercial flags of all countries; the Asiatic frontier between the two empires remained unchanged; Turkey was admitted to the concert of Europe, and all the contracting parties agreed to respect her independence and the integrity of her territory; moreover, the provisions of the Tanzimāt were reaffirmed in a fresh decree of the sultan, which was incorporated in the treaty, and further provided for a large measure of local autonomy for the Christian communities. It was stipulated that Turkey's promises of reform gave no power the right of interference on behalf of the Christians.

The New Era.

The Treaty of Paris was regarded as opening a new era in the progress of Turkey. Admitted on equal terms to the European family of nations, the Ottoman government had given a solemn guarantee of its intention to make the long-promised reforms a reality. But it soon became apparent that the time was scarcely come for liberal measures; and fanatical outbreaks at Jidda (1858) and in Syria (1860) gave proof that the various sections of the population were not yet prepared to act together in harmony. The Syrian disturbances brought about a French occupation, which Fuad Pasha, ably seconded by Ahmed Vefyk Effendi, the Turkish ambassador in Paris, contrived to restrict, and to terminate as soon as possible. The immediate local result was the institution, by a *règlement*,[1] signed at Constantinople on the 6th of September 1864, of autonomy for the Lebanon under a Christian governor appointed by the powers with the concurrence of the Porte, an arrangement which has worked satisfactorily until the present day. In 1859 the Danubian principalities, deliberately left separate by the Congress of Paris, carried out their long-cherished design of union by electing Prince Cuza both in Moldavia and in Walachia, a contingency which the powers had not taken into account, and to which in the end they gave a grudging assent (see RUMANIA).

Abd-ul-Aziz, 1861-1876.

On the 25th of June 1861 Sultan Abd-ul-Mejid died, being succeeded by his brother Abd-ul-Aziz. The new sultan's reign marked, if not the beginning, at least the high tide of that course of improvident and unrestrained expenditure, facilitated by the enthusiasm created in Europe by Turkey's admission to the ranks of the powers which loosened for her the purse-strings of the foreign investor. The viceroy of Egypt, Ismail Pasha, followed his suzerain's example in this respect, and was lavish in his bribes to his imperial overlord to obtain the extension of his own privileges and the establishment in Egypt of succession from father to son; these concessions were granted to him by the *firmans* of the 27th of May 1866 and the 8th of June 1867, in the latter of which the viceroy is addressed for the first time as "khedive." Abd-ul-Aziz is said to have yielded the more readily as being desirous of bringing about a similar alteration in the succession in Turkey, in favour of his own eldest son, Prince Yussuf Izz-ed-din; public opinion was, however, opposed to so sweeping a change, and the succession to the throne in Turkey still goes to the eldest surviving member of the house of Osman. Though the foreign relations of Turkey remained untroubled, disturbances in Servia, Montenegro and Crete continued throughout the "sixties." Servia had long resented the occupation of her fortresses by Turkish troops; frequent collisions arising from this source resulted in June 1862 in the bombardment of Belgrade; some slight concessions were then made to Servia, but it was not until 1867 that, through the mediation of England and other powers, she succeeded in obtaining the withdrawal of the Turkish garrisons. The Cretan insurrection rose to a formidable height in 1868–69, and the active support given to the movement by Greece brought about a rupture of relations between that country and Turkey. The revolt was suppressed, the Turko-Greek conflict was settled by a conference of the powers in Paris, and Crete received a charter of local self-government which for a time pacified the island.[2]

Abd-ul-Aziz had visited the Paris Exhibition of 1867 and had paid his respects to Queen Victoria, who conferred on him the order of the Garter. In 1869 the visit was returned by many sovereigns and princes on their way to the opening of the Suez Canal, among these being the empress Eugénie. An important event not to be passed over without mention is the grant on the 10th of March 1870 of the *firman* instituting the Bulgarian exarchate, thus severing the Bulgarian Church from the jurisdiction of the Greek patriarch of Constantinople. This concession, given under strong pressure from Russia, aroused the deepest resentment of the Greeks, and was the principal factor in the awakening of the Bulgarian national spirit which subsequent events have done so much to develop. Russian influence at Constantinople had been gradually increasing, and towards the end of 1870 the tsar took advantage of the temporary disabling of France to declare himself no longer bound by those clauses of the Treaty of Paris which restricted Russia's liberty of possessing warships on the Black Sea. An international conference convoked in London early in 1871 laid down the principle that treaty engagements were binding, and then proceeded to abrogate this particular engagement. Russia and Turkey thus regained full liberty as regards their naval forces and armaments in the Euxine; the passage of the straits remained interdicted to ships of war.

A reform not unworthy of notice was effected by the law promulgated on the 18th of June 1867 whereby foreigners were for the first time allowed to hold landed property throughout the Ottoman Empire (save in the Hejaz) on condition of their being assimilated to Ottoman subjects, *i.e.* divested of their right to the protection of their own authorities in every respect concerning such property.

Deposition of Abd-ul-Aziz.

Meanwhile in Turkey national bankruptcy was brought within measurable distance by the sultan's extravagance and the incompetence of his ministers; it was staved off only by loans contracted almost annually to pay the interest on their predecessors. External influences and latent fanaticism were active; a serious insurrection broke out in Bosnia and Herzegovina in 1875, and the efforts to quell it almost exhausted Turkey's resources; the example spread to Bulgaria, where abortive outbreaks in September 1875 and May 1876 led to those cruel measures of repression which were known as "the Bulgarian atrocities."[3] Mussulman public feeling was inflamed, and an attempt at Salonica to induce a Christian girl who had embraced Islam to return to her faith caused the murder of two foreign consuls by a fanatical mob. The finances of Turkey now collapsed, and the inevitable bankruptcy was declared, whereby more than through any other cause she lost such sympathies as she possessed in western Europe. Turkey's distress was Russia's opportunity; the sultan fell entirely under the influence of General Ignatiev, the tsar's ambassador, and it became evident that the country was hastening to its dissolution. A conspiracy to bring about a change was hereupon formed by certain prominent statesmen, whose leaders were Midhat Pasha, Mehemed Rushdi Pasha and Mahmud Damad Pasha, the husband of a princess of the blood, sister to Prince Murad. These succeeded in gaining over the Sheikh-ul-Islam, and in obtaining from him a *fetva* for the deposition of Abd-ul-Aziz.

In virtue of this judgment of the supreme legal authority, and with the aid of the fleet, Abd-ul-Aziz was deposed, being shortly afterwards found dead, apparently by his own hand. Murad V. reigned in his stead. But the change of sultans brought no relief to the troubled state: Servia and Montenegro declared war, and in less than three months it had become evident that Murad was incapable of governing.

Accession of Abd-ul-Hamid II., 1876.

Murad's brother Abd-ul-Hamid was accordingly proclaimed sultan on the 31st of August 1876. The diplomacy of Europe had been searching in vain since the autumn of 1875 for the means of inducing Turkey to institute effective administrative reforms and to grant to its European provinces that autonomy which now appeared essential. But the new sultan was as averse from accepting any of the formulae proposed as were his predecessors: Servia and Montenegro were with great difficulty pacified, but it was plain that Russia, whose Slavonic and Orthodox sympathies had been strongly aroused, would soon begin hostilities herself. Turkey now made a show of going even beyond the demands formulated by Europe, and the international conference which met at Constantinople during

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[1] Text in Holland, p. 212.

[2] "Correspondence . . . respecting the rupture of diplomatic relations between Turkey and Greece, &c.," in *State Papers*, lix. 584, &c., *Protocols of Conferences*, p. 813, &c.

[3] See Mr Baring's reports in *Parl. Papers* (1878), lxxxi.

Russo-Turkish War.

Treaty of San Stefano.

the last days of 1876 was startled by the salvo of artillery which heralded the promulgation of a liberal constitution, not for the European provinces only, but for the whole empire, and the institution of a Turkish parliament. The decisions of the conference, moderate though they were, in the end requiring merely the nomination of an international commission to investigate the state of the European provinces of Turkey, and the appointment by the sultan, with the approval of the powers, of governors-general for five years, were rejected by the Porte. The statesmen of Europe still continued their efforts to avert a conflict, but to no purpose. On the 24th of April 1877 Russia declared war and her troops crossed the Turkish frontiers. Hostilities were conducted both in Europe and Asia for nearly a year. Rumania joined the Russians, and in Europe no effective opposition was encountered by the invaders until the assaults on Plevna and the Shipka Pass, where the valiant resistance of the Turks won for them the admiration of Europe. By November the defence of the Turks in Asia Minor had entirely collapsed. Plevna surrendered on the 9th of December 1877 after a heroic struggle under Osman Pasha. Thereafter the Russians advanced practically unchecked (see RUSSO-TURKISH WARS). An armistice and preliminaries of peace were signed on the 31st of January 1878 at Adrianople, and a definitive treaty was concluded at San Stefano on the 3rd of March 1878. Its terms were: the creation of an autonomous tributary principality of Bulgaria extending from the Black Sea to the Aegean; the recognition by Turkey of the independence of Rumania, Servia and Montenegro, with increased territories; the payment of a war indemnity; the introduction of reforms in Bosnia and Herzegovina; the cession to Russia of Bessarabia and the Dobruja; the opening of the passage of the straits at all times to the merchant vessels of neutral states; and the razing of the fortresses on the Danube.

Congress of Berlin, 1878.

Great Britain had throughout the war preserved strict neutrality, but, while making it clear from the outset that she could not assist Turkey, had been prepared for emergencies. Turkey's severity in repressing the Bulgarian insurrection had raised up in England a storm of public opinion against her, of which the Liberal opposition had taken the fullest advantage; moreover the suspension of payments on the Ottoman debt had dealt Turkey's popularity a blow from which it had never recovered. But upon the approach of the Russians to Constantinople the British reserves were called out and the fleet was despatched to the Bosporus. Accordingly, and as her line of retreat might be threatened by Austria, Russia consented to a revision of the Treaty of San Stefano at a congress to be held at Berlin. Before the meeting of this congress, which assembled on the 13th of June 1878, the powers principally interested had arrived at an understanding as to the modifications to be introduced in the treaty, and by a convention concluded with Turkey on the 4th of June 1878 England had undertaken to defend the Asiatic dominions of the sultan by force of arms, provided that his majesty carried out all the necessary reforms, to be agreed upon later, and assigned to England the island of Cyprus, which was however to be restored if Turkey fulfilled her engagements as to reforms and if Russia gave back to her Kars, Ardahan and Batum. On the 13th of July 1878 the Treaty of Berlin was signed: the Great Bulgaria of the San Stefano Treaty was diminished to an autonomous province north of the Balkans, the south-eastern portion, no longer extending to the Aegean, was formed into a self-governing tributary province styled Eastern Rumelia; Turkey abandoned all pretension to suzerainty over Montenegro; Servia and Rumania received their independence (but the last named was made to cede Bessarabia to Russia, receiving instead the Dobruja); the Asiatic frontier was readjusted, Kars, Ardahan and Batum becoming Russian. It was further provided that Bulgaria should pay to Turkey an annual tribute, and should moreover (as well as the other Balkan states receiving accessions of territory at Turkey's expense) bear a portion of the Ottoman debt. The sums payable by the different countries were to be fixed by the powers; but no effect has so far been given to this reasonable stipulation, which may now be looked upon as null and void. Turkey undertook to pay to Russia a war indemnity of 300,000,000 roubles, and the status of the straits remained unchanged. Measures of reform in Armenia were also provided for; as also the convocation of an international commission for drawing up a reform scheme for the European provinces left to Turkey. The organic law for Crete was to be carried out, and special laws enacted for other parts of Turkey. Bosnia and Herzegovina were handed over to the administration of Austria; Montenegro and Greece received accessions of territory to which only strong pressure coupled with a naval demonstration induced Turkey to consent three years later.

The Egyptian Question.

Peace once restored, some attempt was made by Turkey in the direction of complying with her engagements to institute reform. Financial and military advisers were procured from Germany. English officers were engaged to reform the gendarmerie, and judicial inspectors of foreign nationality were to travel through the country to redress abuses. It was not long before the unsubstantial character of all these undertakings became apparent, the parliament was dissolved, the constitution was suspended and its author exiled. Egyptian affairs next threatened complications. In May 1879 the misgovernment of Ismail Pasha and the resulting financial crisis rendered the deposition of the khedive inevitable; in order to anticipate the action of England and France, who would otherwise have expelled the erring viceroy, the sultan deposed him himself; the succession devolved upon his son Mahommed Tewfik Pasha. (For the subsequent history of the Egyptian question see EGYPT: *History*.) The revolt of Arabi Pasha in 1881 broke up the Anglo-French condominium in Egypt and led to outrages at Alexandria followed by a bombardment on the 11th of July 1882. The occupation of the country by Great Britain gradually took a more permanent form, and though negotiations were more than once entered into with Turkey with a view to its termination, these either proved abortive or were rendered so (as *e.g.* the Drummond-Wolff convention of 1887) by the action of other powers. The Anglo-French agreement of 1904 left England in undisputed mastery.

Public Debt.

The financial straits of Turkey after the war became so acute that the sultan was compelled to consent to a measure of foreign control over the finances of the country, the administration of the public debt being established in December 1881. (See *Finance*, above.)

In 1885 the practically bloodless revolution of Philippopolis on the 18th of September united Bulgaria and Eastern Rumelia, severed by the Treaty of Berlin. A conference held at Constantinople sanctioned the union on terms which were rendered acceptable to the sultan, but Said Pasha, who had assisted the sultan in centralizing at Yildiz Kiosk the administration of the country, and who had become grand vizier, was a strong adherent of the policy of armed intervention by Turkey, and the consequence was his fall from office. His successor in the grand vizierate, Kiamil Pasha, was soon called upon to deal with Armenian unrest, consequent on the non-execution of the reforms provided for in the Treaty of Berlin and the Cyprus Convention, which first found vent about 1890. But Kiamil Pasha was not subservient enough to his imperial master's will, and his place was taken by a military man, Jevad Pasha, from whom no independence of action was to be apprehended.

German Activity in Turkey.

It is from this period that the German ascendancy in Constantinople is noticeable. Railway concessions were given to Germans over the heads of British applicants already in possession of lines from which they were expropriated, thus affording the nucleus of the Bagdad railway (of which Germany obtained the concession in November 1899). (See BAGDAD, vol. iii. p. 197.)

From 1890 Crete was frequently the scene of disturbance; the Christian communities in other parts of Turkey began to chafe under the attempted curtailing of their privileges; about Christmas 1893 the Greek patriarch caused all the Orthodox churches to be closed as a protest; and the Armenian agitation

Armenian Troubles.

entered upon a serious phase. The Kurds, the constant oppressors of that people, had received official recognition and almost complete immunity from the control of the civil law by being formed into a yeomanry frontier-guard known as the Hamidian cavalry. The troubles arising from this cause and from greater energy in the collection of taxes led the Armenians in outlying and mountainous districts to rise against the authorities. The repression of these revolts in the Sassun district in the autumn of 1894 was effected under circumstances of great severity by Turkish troops and Kurdish irregulars. A commission composed of British, French and Russian officials held an inquiry into the events which had occurred, and early in 1895 England, France and Russia entered actively into negotiations with a view to the institution of reforms. The scheme propounded by the three powers encountered great objections from the Porte, but under pressure was accepted in October 1895. Its acceptance was however the signal for a series of massacres in almost every town of importance throughout Asia Minor, which there is but too strong evidence for suspecting were committed with the connivance of the authorities, and in which upwards of 200,000 persons are computed to have perished. In 1896 Lord Salisbury induced the other powers to unite in urging the execution of the reforms, but no agreement could be come to for the use of coercion, and Europe could but look on and protest. Changes of ministry at Constantinople were powerless to bring about an improvement, and early in 1896 Cretan affairs became so serious as to call for the intervention of the powers. In September yet another Cretan charter of self-government was promulgated. Shortly before, a revolutionary attack by an Armenian band on the Ottoman bank at Constantinople brought about a general massacre of Armenians in the capital (where a widespread revolutionary organization undoubtedly existed), in which at least 3000 victims fell, and the persecution of Armenians became the order of the day.

Greek War of 1897.

The neglect of the Porte to carry out all the stipulations of the Cretan arrangement of 1896 led to a renewal of the disturbances, and Greece began to take steps for the invasion of the island; in February 1897 Colonel Vassos sailed from the Piraeus with an armed force, intending to proclaim the annexation of Crete to Greece, and Greek troops were massed on the Thessalian frontier. Diplomacy busied itself with fruitless attempts to avert hostilities; on the 17th of April 1897 war was declared by Turkey. The resistance offered by Greece was feeble in the extreme: Europe was obliged to intervene, and Turkey gained a rectification of frontier and a war indemnity of £4,000,000, besides the curtailment by the treaty eventually signed of many privileges hitherto enjoyed by Hellenic subjects in Turkey. But Europe was determined that the Cretan question should be definitely settled, at least for a period of some years, and, after an outbreak at Candia, in which the lives of British troops were sacrificed, the four powers (Germany and Austria having withdrawn from the concert) who had taken over the island *en dépôt* handed it over in October 1898 to Prince George of Greece as high commissioner (see CRETE: *History*).

Revolts in Arabia.

Crete being thus removed from the scope of her action, Turkey found ample occupation in the almost constant turbulence of the Yemen, of Albania and of Macedonia. After 1892 the revolts, frequently renewed, of the so-called imam of Sana, necessitated the despatch of large and costly expeditions to Arabia, in which thousands of Turkish troops have fallen in guerrilla warfare or through the inhospitable climate; in Albania disturbance became almost endemic, owing to the resistance offered by the intractable population to successive attempts of the central authorities to subject the country to regular taxation and the operation of the laws.

Unsettled claims by French citizens led to a breaking off of relations and the occupation of Mitylene by France in November 1901; the rupture was of short duration and Turkey soon gave way, according complete satisfaction both in this matter and on certain other French demands. In 1901 and 1902 Turkish encroachments on the hinterland of Aden brought about a dangerous state of tension between Great Britain and Turkey, which had its parallel in 1906 in similar trespasses by the Ottoman authorities on the Egyptian land frontier near Akaba. In both cases Turkey eventually yielded; a similar question arose in 1906 with France over the boundaries of the African possessions of the two countries.

Disputes with France and Britain.

Macedonian Question.

But Macedonia was Turkey's chief source of anxiety. That country, left by the Treaty of Berlin with its status unaltered, was in a continued condition of disturbance. The Christian population, who in common with their Mussulman fellow subjects suffered from the defective methods of government of their rulers, had at least before them the example of their brethren—Greeks, Bulgarians or Servians—dwelling in independent kingdoms under Christian governments on the other side of the frontier. The hope of eventual emancipation was stimulated by sedulous propagandists from each of these countries; from time to time armed bands of insurgents were manned and equipped in the small neighbouring states, with or without the co-operation of the governments. So long as Stambolov, the energetic Bulgarian statesman, was alive he succeeded in keeping the Bulgarian element quiet, and the peace of the country was less liable to disturbance. But for some years the three rivals in Macedonia, to which a fourth, the Rumanian element, must be added, were in constant strife (see MACEDONIA). A serious Bulgarian insurrection in Macedonia in the autumn of 1903 induced Austria and Russia to combine in formulating the Mürzsteg reform programme, tardily consented to by Turkey, by which Austrian and Russian civil agents were appointed to exercise a certain degree of control and supervision over the three vilayets of Salonica, Monastir and Kossovo. It was also arranged that foreign officers should be named to reorganize the gendarmerie. An Italian officer, General De Giorgis, was appointed to the chief command in the reorganization, and the three vilayets were apportioned among the great powers into districts, in each of which was appointed a staff officer with a number of subordinate officers of his nationality under his orders. The work of reorganization was efficiently carried out, and the gendarmerie school at Salonica, under British supervision, showed excellent results. But the achievements of the two civil agents were less noteworthy; and in 1905 it was agreed that, in view of the financial necessities of the provinces, the other great powers should each appoint delegates to a financial commission with extensive powers of control in fiscal matters. The Porte opposed the project, and an international naval demonstration and the occupation of Mytilene by the powers became necessary before Turkey gave way in December 1905. Even so it proved impossible to fulfil the Mürzsteg programme, though the attempt was prolonged until 1908. The Austro-Russian *entente* had then come to an end; and after a meeting between King Edward VII. and the tsar Nicholas II. at Reval, a new scheme of reforms was announced, under the name of the "Reval programme." The enforcement of these reforms, however, was postponed *sine die* owing to the revolution which transformed the Ottoman Empire into a constitutional state; and the powers, anticipating an improvement in the administration of Macedonia by the new government, withdrew their military officers in the summer of 1908.

The Young Turks.

The Young Turkish party had long been preparing for the overthrow of the old régime. Their central organization was in Paris and their objects were known throughout Europe, but except at Yildiz Kiosk their power was almost everywhere underrated. The Porte strove by every means at its disposal to thwart their activity; but elsewhere they were regarded as a body of academic enthusiasts, more noisy than dangerous, who devoted their scanty funds to the publication of seditious matter in Paris or Geneva, and sought to achieve the impossible by importing western institutions into a country fit only to be ruled by the *sheriat* and the sword. Such was the opinion held even by experienced diplomatists and by historians. It was strengthened by the fact that the Young

Turks had deliberately abstained from violent action. They had, in fact, learned from events in Russia and Poland that sporadic outbreaks on a small scale would inevitably discredit their cause, and that a successful revolution would require the support of the army. To gain this, an extensive propaganda was carried on by secret agents, many of whom were officers. At the beginning of 1908 a favourable opportunity for action arrived. The Ottoman troops in Arabia were mutinous and unpaid; the Albanians, long the mainstay of Turkish military power in the west, had been irritated by unpopular taxes and by the repressive edicts which deprived them of schools and a printing-press; foreign interference in Crete and Macedonia was resented by patriotic Moslems throughout the empire. In these circumstances the headquarters of the Young Turks were transferred from Paris to Salonica, where a central body, known as the committee of union and progress, was established (1908) to organize the revolution. Most of its members were military officers, prominent among them being Majors Enver Bey and Niazi Bey, who directed the propaganda in Albania and Macedonia. By midsummer the Albanian leaders and the greater part of the Turkish army in Europe had sworn fidelity to the constitution.

On the 25th of May an insurrection broke out in Samos, owing to a dispute between the Samian Assembly and Kopassis Effendi, "prince," or governor of the island. After the port of Vathy had been bombarded by Ottoman war-ships the revolt was easily crushed.

The Revolution of 1908.

This affair however was of little more than local importance, and the Young Turks were not directly concerned in it. They struck their first blow on the 22nd of July 1908, when Niazi Bey and his troops raised the standard of revolt at Resna, a town on the road from Monastir to Ochrida. On the 23rd the committee of union and progress, under the presidency of Enver Bey, proclaimed the constitution in Salonica, while the second and third army corps threatened to march on Constantinople if the sultan refused to obey the proclamation. On the 24th the sultan yielded, and issued an *iradè*, restoring the constitution of 1876, and ordering the election of a chamber of deputies. Various other reforms, notably the abolition of the spy system and the censorship, were announced soon afterwards. Some of the more unpopular officials associated with the old régime were assassinated, among them Fehim Pasha, the former head of the espionage department, who had been exiled to Brusa in 1907 at the request of the British and German ambassadors. Otherwise the revolution was effected almost without bloodshed; for a time the insurgent bands disappeared in Macedonia, and the rival "nationalities"—Greek, Albanian, Turk, Armenian, Servian, Bulgarian and Jew—worked harmoniously together for the furtherance of common constitutional aims. On the 6th of August Kiamil Pasha, an advanced Liberal, became grand vizier, and a new cabinet was formed, including a Greek, Prince Mavrocordato, an Armenian, Noradounghian, and the Sheikh-ul-Islam.

Bosnia and Bulgaria.

The success of the Young Turks created a serious situation for the statesmen of Austria-Hungary and Bulgaria. A regenerated Ottoman Empire might in time be strong enough to demand the evacuation of Bosnia and Herzegovina, and to maintain or extend the nominal suzerainty over Bulgaria which the sultan had exercised since 1878. Accordingly, at the beginning of October 1908, the emperor Francis Joseph informed the powers signatory to the treaty of Berlin that the annexation of Bosnia and Herzegovina to the Dual Monarchy had become necessary, and this decision was formally announced in an imperial rescript dated the 7th of October. The independence of Bulgaria was proclaimed on the 5th. The Ottoman government protested to the powers, but it wisely limited its demands to a claim for compensation. Austria-Hungary had from the first undertaken to withdraw its garrisons from the sanjak of Novibazar—an important concession; after prolonged negotiations and a boycott of all Austrian goods exported to Turkey, it also agreed to pay £2,200,000 as compensation for the Turkish crown lands seized in Bosnia and Herzegovina. This arrangement was sanctioned by the Ottoman parliament, which assented to the annexation on the 6th of April 1909 and recognized the independence of Bulgaria on the 19th of April, the Russian government having enabled Bulgaria to pay the indemnity claimed by Turkey on account of the Eastern Rumelian tribute and railways (see BULGARIA: *History*). On the 3rd of February 1910 the Porte accepted a Bulgarian proposal for a mixed commission to delimit disputed sections of the Turco-Bulgarian frontier, and in March King Ferdinand visited Constantinople.

The Reaction in the Provinces.

Meanwhile the Young Turks were confronted with many difficulties within the empire. After the first fervour of enthusiasm had subsided the Christian nationalities in Macedonia resumed their old attitude of mutual jealousy, the insurgent bands began to reappear, and the government was in 1909–1910 forced to undertake the disarmament of the whole civil population of the three vilayets. In Albania serious discontent, resulting in an insurrection (May-September 1909), was caused by the political rivalry between Greeks and Albanians and the unwillingness of the Moslem tribesmen to pay taxes or to keep the peace with their neighbours, the Macedonian Serbs. In Asia Minor the Kurdish troops under Ibrahim Pasha revolted, and, although they were defeated with the loss of their commander, the Kurds continued to attack indiscriminately the Turks, Nestorians and Armenians; disturbances also broke out among the other reactionary Moslems of this region, culminating in a massacre of the Armenians at Adana. In Arabia Ratib Pasha, the Turkish commander-in-chief, joined the enemies of the new régime; he was defeated and captured in the autumn of 1908, but in the following year frequent raids upon the Hejaz railway were made by Bedouin tribesmen, while a Mahdist rebellion broke out and was crushed in Yemen.

The Constantinople Counter-revolution.

More serious than any of these local disturbances was the counter-revolution in Constantinople itself, which began with the revolt of Kiamil Pasha, the grand vizier, against the authority of the committee of union and progress. Kiamil Pasha was forced to resign (Feb. 14, 1909) and was succeeded by Hilmi Pasha, ex-high commissioner of Macedonia. Strife then arose between the committee and the Liberal Union, a body which mainly represented the Christian electorate, and on the 5th of April Hassan Fehmi Effendi, who edited the *Serbesti*, the official organ of the union, was assassinated. He was an Albanian, and his fellow countrymen in the Constantinople garrison at once made common cause with the opponents of the committee. Mutinous troops seized the parliament house and the telegraph offices; the grand vizier resigned and was succeeded by Tewfik Pasha (April 14); and delegates were sent by the Liberal Union, the association of Ulema and other bodies to discuss terms with the committee. But Abd-ul-Hamid had issued a free pardon to the mutineers, and the committee had now decided that the new régime would never be secure while the sovereign favoured reaction. They refused to treat with the delegates, and despatched 25,000 men under Mahmud Shevket to Constantinople.

The New Régime.

The senate and chamber met at San Stefano, and, sitting jointly as a National Assembly, issued a proclamation in favour of the committee and its army (April 22, 1909), by which Constantinople was now invested. Part of the garrison remained loyal to the sultan, but after five hours of severe fighting Shevket Pasha was able to occupy the capital (April 25). The National Assembly met in secret session two days later, voted unanimously for the deposition of Abd-ul Hamid II., and chose his younger brother Mahommed Reshad Effendi (b. Nov. 3, 1844) as his successor, with the style of Mahommed V. Abd-ul-Hamid II. was removed to Salonica on the 28th, and on the 10th of May the new sultan was formally invested with the sword of Osman. Hilmi Pasha again became grand vizier, but resigned on the 28th of December 1909, when he was succeeded by Hakki Bey. On the 5th of August 1909 the new constitution described above was promulgated by imperial *iradè*; parliament was prorogued for three months on the 27th, and during the recess the committee of union and progress met at Salonica and modified its own rules (Oct. 23), ceasing thenceforward to be a secret association. This was regarded as an expression of confidence in the reformed parliament, which had laid the foundation of the important financial and administrative reforms already described. On the 13th of September 1909 the Macedonian international commission of finance met for the last time; its members were reappointed to a higher finance board for the whole empire, under the presidency of Djavid Bey. Ch. Laurent had already been nominated financial adviser to the empire (Sept. 16, 1908), while Sir William Willcocks became head of the irrigation department; the reorganization of the army was entrusted to the German General von der Goltz, that of the navy to Admiral Sir Douglas Gamble (resigned Feb. 1, 1910).

Crete, Greece and Rumania.

The evacuation of Crete by the four protecting powers was followed in 1909 by renewed agitation. Turkey was willing to concede the fullest local autonomy, but not to abandon its sovereign rights over the island. In July 1909, however, the Greek flag was hoisted in Canea and Candia, and it was only lowered again after the war-ships of the protecting powers had been reinforced and had landed an international force. The Cretan administrative committee swore allegiance to the king of the Hellenes in August, and again, after a change of government, at the end of December 1909. This situation had already given rise to prolonged negotiations between Greece and Turkey. It also contributed towards the conclusion of an *entente* between Turkey and Rumania in the summer of 1910. Both of these powers were interested in preventing any possible accession of territory to the Bulgarian kingdom; and Rumania (*q.v.*) had for many years been a formidable opponent of Hellenism among the Macedonian Vlachs. Greece and Crete were thus confronted with what was in effect a defensive alliance between Turkey and Rumania. The Cretans had insisted upon their demand for union with Greece and had elected three representatives to sit in the Greek national assembly. Had this act been ratified by the government at Athens, a war between Greece and the Ottoman Empire could hardly have been avoided; but a royal rescript was issued by the king of the Hellenes on the 30th of September 1910, declaring vacant the three seats to which the Cretan representatives had been elected; the immediate danger was thus averted.

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3. *Official Publications and Collections of Treaties*: Sir E. Hertslet's *Treaties Regulating the Trade, &c., between Great Britain and Turkey* (London, 1875) presents a summary of all the principal treaties between Turkey and other states; see also Gabriel Effendi Noradounghian, *Recueil d'actes internationaux de l'empire ottoman, 1300–1789*, t. I. (Paris, 1897). Much valuable information is to be obtained from parliamentary papers. These are too numerous for detailed mention, but the following periods may be cited as the most interesting: 1833–1841 (Egyptian question); 1849–1859 (Crimean War and the events by which it was preceded and followed); 1868–1869 (Cretan insurrection); 1875–1881 (Bosnian and Herzegovinian insurrection, Russo-Turkish War, Berlin treaty and subsequent events); 1885–1887 (union of Eastern Rumelia with Bulgaria); 1889–1890 (Cretan disturbances); 1892–1899 (Armenian and Cretan affairs); 1902–1907 (Macedonia); 1908–1910 (revolution and reform). Some analysis of the unpublished documents in the record office, for the period 1815–1841, by W. Alison Phillips, will be found in the bibliographies to chs. vi. and xvii. of vol. x. of the *Cambridge Modern History*. (X.)

Literature.

In all literary matters the Ottoman Turks have shown themselves a singularly uninventive people, the two great schools, the old and the new, into which we may divide their literature, being closely modelled, the one after the classics of Persia, the other after those of modern Europe, and more especially of France. The old or Persian school flourished from the foundation of the empire down to about 1830, and still continues to drag on a feeble existence, though it is now out of fashion and cultivated by none of the leading men of letters. These belong to the new or European school, which, in spite of the bitter opposition of the partisans of the old Oriental system, has succeeded, partly through its own inherent superiority and partly through the talents and courage of its supporters, in expelling its rival from the position of undisputed authority which it had occupied for upwards of five hundred years.

Old School.

For the present purpose it will be convenient to divide the old school into three periods, which may be termed respectively the pre-classical, the classical and the post-classical. Of these the first extends from the early days of the empire to the accession of Suleimān I., 1301–1520 (700–926); the second from that event to the accession of Maḥmūd I., 1520–1730 (926–1143); and the third from that date to the accession of 'Abd-ul-'Azīz, 1730–1861 (1143–1277).

General Character of Ottoman Literature.

The works of the old school in all its periods are entirely Persian in tone, sentiment and form. We find in them the same beauties and the same defects that we observe in the production of the Iranian authors. The formal elegance and conventional grace, alike of thought and of expression, so characteristic of Persian classical literature, pervade the works of the best Ottoman writers, and they are likewise imbued, though in a less degree, with that spirit of mysticism which runs through so much of the poetry of Irān. But the Ottomans did not stop here: in their romantic poems they chose as subjects the favourite themes of their Persian masters, such as Leylī and Mejnūn, Khusrev and Shīrīn, Yūsuf and Zuleykhā, and so on; they constantly allude to Persian heroes whose stories occur in the *Shāh-Nāma* and other storehouses of Iranian legendary lore; and they wrote their poems in Persian metres and in Persian forms. The mesnevī, the ḳasida and the ghazel—all of them, so far at least as the Ottomans are concerned, Persian—were the favourite verse-forms of the old poets. A mesnevī is a poem written in rhyming couplets, and is usually narrative in subject. The ḳasida and the ghazel are both monorhythmic; the first as a rule celebrates the praises of some great man, while the second discourses of the joys and woes of love. Why Persian rather than Arabian or any other literature became the model of Ottoman writers is explained by the early history of the race (see TURKS). Some two centuries before the arrival of the Turks in Asia Minor the Seljūḳs, then a mere horde of savages, had overrun Persia, where they settled and adopted the civilization of the people they had subdued. Thus Persian became the language of their court and government, and when by-and-by they pushed their conquests into Asia Minor, and founded there the Seljūḳ Empire of Rūm, they carried with them their Persian culture, and diffused it among the peoples newly brought under their sway. It was the descendants of those Persianized Seljūḳs whom the early Ottomans found ruling in Asia Minor on their arrival there. What had happened to the Seljūḳs two centuries before happened to the Ottomans now: the less civilized race adopted the culture of the more civilized; and, as the Seljūḳ Empire fell to pieces and the Ottoman came gradually to occupy its place, the sons of men who had called themselves Seljūḳs began thenceforth to look upon themselves as Ottomans. Hence the vast majority of the people whom we are accustomed to think of as Ottomans are so only by adoption, being really the descendants of Seljūḳs or Seljūḳian subjects, who had derived from Persia whatever they possessed of civilization or of literary taste. An extraordinary love of precedent, the result apparently of conscious want of original power, was sufficient to keep their writers loyal to their early guide for centuries, till at length the allegiance, though not the fashion of it, has been changed in our own days, and Paris has replaced Shīrāz as the shrine towards which the Ottoman scholar turns. While conspicuously lacking in creative genius, the Ottomans have always shown themselves possessed of receptive and assimilative powers to a remarkable degree, the result being that the number of their writers both in prose and verse is enormous. Of course only a few of the most prominent, either through the intrinsic merit of their work or through the influence they have had on that of their contemporaries, can be mentioned in a brief review like the present. It ought to be premised that the poetry of the old school is greatly superior to the prose.

Pre-classical Period.

Ottoman literature may be said to open with a few mystic lines, the work of Sultān Veled, son of Maulānā Jelāl-ud-Dīn, the author of the great Persian poem the *Mathnawī*. Sultān Veled flourished during the reign of ʽOsmān I., though he did not reside in the territory under the rule of that prince. Another mystic poet of this early time was ʽĀshiḳ Pasha, who left a long poem in rhyming couplets, which is called, inappropriately enough, his *Dīwān*. The nocturnal expedition across the Hellespont by which Suleimān, the son of Orkhan, won Galipoli and therewith a foothold in Europe for his race, was shared in and celebrated in verse by a Turkish noble or chieftain named Ghāzī Fāzil. Sheikhī of Kermiyān, a contemporary of Maḥommed I. and Murād II., wrote a lengthy and still esteemed mesnevī on the ancient Persian romance of Khusrev and Shīrīn; and about the same time Yaziji-oghlu gave to the world a long versified history of the Prophet, the *Muḥammedīya*. The writers mentioned above are the most important previous to the capture of Constantinople; but there is little literature of real merit prior to that event. The most notable prose work of this period is an old collection of stories, the *History of the Forty Vesirs*, said to have been compiled by a certain Sheikh-zāda and dedicated to Murād II. A few years after Constantinople passed into the hands of the Ottomans, some ghazels, the work of the contemporary Tatar prince, Mīr ʽAlī Shīr, who under the *nom de plume* of Nevāyī wrote much that shows true talent and poetic feeling, found their way to the Ottoman capital, where they were seen and copied by Aḥmed Pasha, one of the viziers of Maḥommed II. The poems of this statesman, though possessing little merit of their own, being for the most part translations from Nevāyī, form one of the landmarks in the history of Ottoman literature. They set the fashion of ghazel-writing; and their appearance was the signal for a more regular cultivation of poetry and a greater attention to literary style and to refinement of language. In Sinān Pasha (d. 1420), another minister of Maḥommed the Conqueror, Ottoman prose found its first exponent of ability; he left a religious treatise entitled *Tasarruʽāt* (Supplications), which, notwithstanding a too lavish employment of the resources of Persian rhetoric, is as remarkable for its clear and lucid style as for the beauty of many of the thoughts it contains. The most noteworthy writers of the Conqueror's reign are, after Aḥmed and Sinān, the two lyric poets Nejātī and Zātī, whose verses show a considerable improvement upon those of Aḥmed Pasha, the romantic poets Jemālī and Hamdī, and the poetesses Zeyneb and Mihrī. Like most of his house, Maḥommed II. was fond of poetry and patronized men of letters. He himself tried versification, and some of his lines which have come down to us appear quite equal to the average work of his contemporaries. Twenty-one out of the thirty-four sovereigns who have occupied the throne of ʽOsmān have left verses, and among these Selīm I. stands out, not merely as the greatest ruler, warrior and statesman, but also as the most gifted and most original poet. His work is unhappily for the greater part in the Persian language; the excellence of what he has done in Turkish makes us regret that he did so little. The most prominent man of letters under Selīm I. was the legist Kemāl Pasha-zāda, frequently called Ibn-Kemāl, who distinguished himself in both prose and verse. He left a romantic poem on the loves of Yūsuf and Zuleykhā, and a work entitled *Nigāristān*, which is modelled both in style and matter on the *Gulistān* of Saʽdī. His contemporary, Mesīhī, whose beautiful verses on spring are perhaps better known in Europe than any other Turkish poem, deserves a passing mention.

Classical Period.

With the accession of Selīm's son, Suleimān I., the classical period begins. Hitherto all Ottoman writing, even the most highly finished, had been somewhat rude and uncouth; but now a marked improvement becomes visible alike in the manner and the matter, and authors of greater ability begin to make their appearance. Fuzūlī (d. 1563), one of the four great poets of the old school, seems to have been a native of Bagdad or its neighbourhood, and probably became an Ottoman subject when Suleimān took possession of the old capital of the caliphs. His language, which is very peculiar, seems to be a sort of mixture of the Ottoman and Āzerbaijān dialects of Turkish, and was most probably that of the Persian Turks of those days. Fuzūlī showed far more originality than any of his predecessors; for, although his work is naturally Persian in form and in general character, it is far from being a mere echo from Shīrāz or Isfahān. He struck out a new line for himself, and was indebted for his inspiration to no previous writer, whether Turk or Persian. An intense and passionate ardour breathes in his verses, and forms one of the most remarkable as well as one of the most attractive characteristics of his style; for, while few even among Turkish poets are more artificial than he, few seem to write with greater earnestness and sincerity. His influence upon his successors has scarcely been as far-reaching as might have been expected—a circumstance which is perhaps in some measure owing to the unfamiliar dialect in which he wrote. Besides his *Dīwān*, he left a beautiful mesnevī on the story of Leylī and Mejnūn, as well as some prose works little inferior to his poetry. Bāḳī (d. 1599) of Constantinople, though far from rivalling his contemporary Fuzūlī, wrote much good poetry, including one piece of great excellence, an elegy on Suleimān I. The Ottomans have as a rule been particularly successful with elegies; this one by Bāḳī has never been surpassed. Rūhī, Lāmiʽī, Nevʽī, the janissary Yahya Beg, the muftī Ebū-Suʽūd and Selīm II. all won deserved distinction as poets. During the reign of Aḥmed I. arose the second of the great poets of the old Ottoman school, Nefʽī of Erzerūm, who owes his pre-eminence to the brilliance of his ḳasīdas. But Nefʽī could revile as well as praise, and such was the bitterness of some of his satires that certain influential personages who came under his lash induced Murād IV. to permit his execution. Nefʽī, who, like Fuzūlī, formed a style of his own, had many to imitate him, of whom Ṣabrī Shākir, a contemporary, was the most successful. Nāʽili, Jevrī and Fehīm need not detain us; but Nābī (d. 1712), who flourished under Ibrāhīm and Maḥommed IV., calls for a little more attention. This prolific author copied, and so imported into Ottoman literature, a didactic style of ghazel-writing which was then being introduced in Persia by the poet Ṣāʽib; but so closely did the pupil follow in the footsteps of his master that it is not always easy to know that his lines are intended to be Turkish. A number of poets, of whom Seyyid Vehbī, Rāghib Pasha, Raḥmī of the Crimea, Kelīm and Sāmī are the most notable, took Nābī for their model. Of these, Sāmī is remarkable for the art with which he constructed his ghazels. Among the writers of this time who did not copy Nābī are Sābit, Rāsikh and Ṭālib, each of whom endeavoured, with no great success, to open up a new path for himself. We now reach the reign of Aḥmed III., during which flourished Nedīm, the greatest of all the poets of the old school. Little appears to be known about his life further than that he resided at Constantinople and was alive in the year 1727 (A.H. 1140). Nedīm stands quite alone: he copied no one, and no one has attempted to copy him. There is in his poetry a joyousness and sprightliness which at once distinguish it from the work of any other Turkish author. His ghazels, which are written with great elegance and finish, contain many graceful and original ideas, and the words he makes use of are always chosen with a view to harmony and cadence. His ḳasīdas are almost equal to his ghazels; for, while they rival those of Nefʽī in brilliancy, they surpass them in beauty of diction, and are not so artificial and dependent on fantastic and far-fetched conceits. The classical period comes to an end with Nedīm; its brightest time is that which falls between the rise of Nefʽī and the death of Nedīm, or, more roughly, that extending from the accession of Aḥmed I. 1603 (1012), to the deposition of Aḥmed III., 1730 (1143).

Classical Prose Writers.

We will now glance at the prose writers of this period. Under the name of *Humāyūn Nāma* (Imperial Book) ʽAlī Chelebi made a highly esteemed translation of the well-known Persian classic *Anvār-i Suheylī*, dedicating it to Suleimān I. Saʽd-ud-Dīn (d. 1599), the preceptor of Murād III., wrote a valuable history of the empire from the earliest times to the death of Selīm I. This work, the *Tāj-ut-Tevārīkh* (Crown of Chronicles), is reckoned, on account of its ornate yet clear style, one of the masterpieces of the old school, and forms the first of an unbroken series of annals which are written, especially the later among them, with great minuteness and detail. Of Saʽd-ud-Dīn's successors in the office of imperial historiographer the most remarkable for literary power is Naʽīmā. His work, which extends from 1591 (1000) to 1659 (1070), contrasts strongly with that of the earlier historian, being written with great directness and lucidity, combined with much vigour and picturesqueness. Evliyā, who died during the reign of Maḥommed IV., is noted for the record which he has left of his travels in different countries. About this time Ṭash-köpri-zāda began and ʽAṭā-ullāh continued a celebrated biography of the legists and sheikhs who had flourished under the Ottoman monarchs. Ḥājī Khalīfa, frequently termed Kātib Chelebi, was one of the most famous men of letters whom Turkey has produced. He died in 1658 (1068), having written a great number of learned works on history, biography, chronology, geography and other subjects. The Persianizing tendency of this school reached its highest point in the productions of Veysī, who left a *Life* of the Prophet, and of Nergisī, a miscellaneous writer of prose and verse. Such is the intentional obscurity in many of the compositions of these two authors that every sentence becomes a puzzle, over which even a scholarly Ottoman must pause before he can be sure he has found its true meaning. The first printing-press in Turkey was established by an Hungarian who had assumed the name of Ibrāhīm, and in 1728 (1141) appeared the first book printed in that country; it was Vanḳulī's Turkish translation of Jevherī's Arabic dictionary.

Coming now to the post-classical period, we find among poets worthy of mention Belīgh, Nevres, Ḥishmet and Sunbulī-zāda Vehbī, each of whom wrote in a style peculiar to himself. Three poets of note—Pertev, Neshet and Sheikh Ghālib—flourished under Selīm III. The last-named is the fourth great poet of the old

Post-classical Period.

school. *Ḥusn u 'Ashḳ* (Beauty and Love), as his great poem is called, is an allegorical romance full of tenderness and imaginative power. Ghālib's style is as original as that of Fuzūlī, Nefī or Nedim. The most distinguished prose writers of this period are perhaps Rāshid, the imperial historiographer, 'Āsim, who translated into Turkish two great lexicons, the Arabic *Kāmus* and the Persian *Burhān-i Ḳāṭi'*, and Kānī, the only humorous writer of merit belonging to the old school.

Transition Period.

When we reach the reign of Maḥmūd II., the great transition period of Ottoman history, during which the civilization of the West began to struggle in earnest with that of the East, we find the change which was coming over all things Turkish affecting literature along with the rest, and preparing the way for the appearance of the new school. The chief poets of the transition are Fāzil Bey, Wāṣif, notable for his not altogether unhappy attempt to write verses in the spoken language of the capital, 'Izzet Molla, Pertev Pasha, 'Ākif Pasha, and the poetesses Fitnet and Leylā. In the works of all of these, although we occasionally discern a hint of the new style, the old Persian manner is still supreme.

Modern School.

More intimate relations with western Europe and a pretty general study of the French language and literature, together with the steady progress of the reforming tendency fairly started under Maḥmūd II., resulted in the birth of the new or modern school, whose objects are truth and simplicity. In the political writings of Reshīd and 'Ākif Pashas we have the first clear note of change; but the man to whom more than to any other the new departure owes its success is Shināsī Effendi, who employed it (1859) for poetry as well as for prose. The European style, on its introduction, encountered the most violent opposition, but now it alone is used by living authors of repute. If any of these does write a pamphlet in the old manner, it is merely as a *tour de force*, or to prove to some faithful but clamorous partisan of the Persian style that it is not, as he supposes, lack of ability which causes the modern author to adopt the simpler and more natural fashion of the West. The whole tone, sentiment and form of Ottoman literature have been revolutionized by the new school: varieties of poetry hitherto unknown have been adopted from Europe; an altogether new branch of literature, the drama, has arisen; while the sciences are now treated and seriously studied after the system of the West. Among writers of this school who have won distinction are Ziyā Pasha, Jevdet Pasha, the statesman and historian, Ekrem Bey, the author of a beautiful series of miscellaneous poems, *Zemzema*, Ḥāmid Bey, who holds the first place among Ottoman dramatists, and Kemāl Bey (d. 1878), the leader of the modern school and one of the most illustrious men of letters whom his country has produced. He wrote with conspicuous success in almost every branch of literature—history, romance, ethics, poetry and the drama; and his influence on the Young Turk party of later days was profound. (For the Turkish language see TURKS.) (E. J. W. G.)

The *magnum opus* in English on Turkish poetry is E. J. W. Gibb's *History of Ottoman Poetry* (5 vols., 1900–8, vol. v. ed. E. G. Browne).

TURKEY, an abbreviation for Turkey-Cock or Turkey-Hen as the case may be, a well-known large domestic gallinaceous bird. How it came by this name has long been a matter of discussion, for it is certain that this valuable animal was introduced to Europe from the New World, and in its introduction had nothing to do with Turkey or with Turks, even in the old and extended sense in which that term was applied to all Mahommedans. But it is almost as unquestionable that the name was originally applied to the bird which we know as the guinea-fowl (*q.v.*), and there is no doubt that some authors in the 16th and 17th centuries curiously confounded these two species. As both birds became more common and better known, the distinction was gradually perceived, and the name "turkey" became restricted to that from the New World—possibly because of its repeated call-note—to be syllabled *turk, turk, turk*, whereby it may be almost said to have named itself (cf. *Notes and Queries*, 6th series, vol. iii. pp. 23, 369). But even Linnaeus could not clear himself of the confusion, and unhappily misapplied the name *Meleagris*, undeniably belonging to the guinea-fowl, as the generic term for what we now know as the turkey, adding thereto as its specific designation the word *gallopavo*, taken from the *Gallopavo* of C. Gesner, who, though not wholly free from error, was less mistaken than some of his contemporaries and even successors.[1]

The turkey, so far as we know, was first described by Oviedo in his *Sumario de la natural historia de las Indias*[2] (cap. xxxvi.), said to have been published in 1527. He, not unnaturally, includes both curassows and turkeys in one category, calling both "Pavos" (peafowls); but he carefully distinguishes between them, pointing out among other things that the latter make a wheel (*hacen la rueda*) of their tail, though this was not so grand or so beautiful as that of the Spanish "Pavo," and he gives a faithful though short description of the turkey. The chief point of interest in his account is that he speaks of the species having been already taken from New Spain (Mexico) to the islands and to Castilla del Oro (Darien), where it bred in a domestic state among the Christians. Much labour has been given by various naturalists to ascertain the date of its introduction to Europe, to which we can at present only make an approximate attempt;[3] but after all that has been written it is plain that evidence concurs to show that the bird was established in Europe by 1530—a very short time to have elapsed since it became known to the Spaniards, which could hardly have been before 1518, when Mexico was discovered. The possibility that it had been brought to England by Cabot or some of his successors earlier in the century is not to be overlooked, and reasons will presently be assigned for supposing that one of the breeds of English turkeys may have had a northern origin;[4] but the often-quoted distich first given in Baker's *Chronicle* (p. 298), asserting that turkeys came into England in the same year—and that year by reputation 1524—as carps, pickerels and other commodities, is wholly untrustworthy, for we know that both these fishes lived in the country long before, if indeed they were not indigenous to it. The earliest documentary evidence of its existence in England is a "constitution" set forth by Cranmer in 1541, which Hearne first printed (Leland's *Collectanea*, 2nd ed., vol. vi. p. 38). This names "Turkey-cocke" as one of the "greater fowles" of which an ecclesiastic was to have "but one in a dishe," and its association with the crane and swan precludes the likelihood of any confusion with the guinea-fowl. Moreover the comparatively low price of the two turkeys and four turkey-chicks served at a feast of the serjeants-at-law in 1555 (Dugdale, *Origines*, p. 135) points to their having become by that time abundant, and indeed by 1573 Tusser bears witness to the part they had already begun to play in "Christmas husbandlie fare." In 1555 both sexes were characteristically figured by Belon (*Oyseaux*, p. 249), as was the cock by Gesner in the same year, and these are the earliest representations of the bird known to exist.

As a denizen of the poultry-yard there are at least two distinct breeds, though crosses between them are much commoner than purely-bred examples of either (see POULTRY). That known as the Norfolk breed is the smaller of the two, and is said to be the less hardy. Its plumage is black. The chicks also are black, with occasionally white patches on the head. The other breed, called the Cambridge, is much more variegated in colour, and some parts of the plumage have a bright metallic gloss, while the chicks are generally mottled with brownish grey. This has been much crossed with the American Bronze, the largest of all, which has the beautiful metallic plumage of the wild bird, with the

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[1] The French *Coq* and *Poule d'Inde* (whence *Dindon*) involve no contradiction, looking to the general idea of what India then was. One of the earliest German names for the bird, *Kalekuttisch Hun* (whence the Scandinavian *Kalkon*), must have arisen through some mistake at present inexplicable; but this does not refer, as is generally supposed, to Calcutta, but to Calicut on the Malabar coast (cf. *Notes and Queries*, 6th series, vol. x. p. 185).

[2] Purchas (*Pilgrimes*, iii. 995) in 1625 quoted both from this and from the same author's *Hystoria general*, said to have been published a few years later.

[3] The bibliography of the turkey is so large that there is here no room to name the various works that might be cited. Recent research has failed to add anything of importance to what has been said on this point by Buffon (*Oiseaux*, ii. 132–162), Pennant (*Arctic Zoology*, pp. 291–300)—an admirable summary—and Broderip (*Zoological Recreations*, pp. 120–137)—not that all their statements can be wholly accepted. Barrington's essay (*Miscellanies*, pp. 127–151), to prove that the bird was known before the discovery of America and was transported thither, is an ingenious piece of special pleading which his friend Pennant did him the real kindness of ignoring.

[4] In 1672 Josselin (*New England's Rarities*, p. 9) speaks of the settlers bringing up "great store of the wild kind" of turkeys, "which remain about their houses as tame as ours in England." The bird was evidently plentiful down to the very seaboard of Massachusetts, and it is not likely to have been domesticated by the Indian tribes there, as, according to Hernandez, it seems to have been by the Mexicans. It was probably easy to take alive, and, as we know, capable of enduring the voyage to England.

Mexican form of which it quite agrees in colour. White, pied and buff turkeys are also often seen, and if care be taken they are commonly found to "breed true." Occasionally turkeys, the cocks especially, occur with a top-knot of feathers, and one of them was figured by Albin in 1738. It has been suggested with some appearance of probability that the Norfolk breed may be descended from the northern form, *Meleagris gallopavo* or *americana*, while the Cambridge breed may spring from the southern form, the *M. mexicana* of Gould (*Proc. Zool. Society*, 1856, p. 61), which indeed it very much resembles, especially in having its tail-coverts and quills tipped with white or light ochreous—points that recent North American ornithologists rely upon as distinctive of this form. If this supposition be true, there would be reason to believe in the double introduction of the bird into England at least, as already hinted, but positive information is almost wholly wanting.[1] The northern form of wild turkey, whose habits have been described in much detail by all the chief writers on North American birds, is now extinct in the settled parts of Canada and the eastern states of the Union, where it was once so numerous; and in Mexico the southern form, which would seem to have been never abundant since the conquest, has been for many years rare. Farther to the south, on the borders of Guatemala and British Honduras, there exists a perfectly distinct species, *M. ocellata*, whose plumage almost vies with that of a peacock in splendour, while the bare skin which covers the head is of a deep blue studded with orange caruncles (*Proc. Zool. Society*, 1861, pl. xl.).

The genus *Meleagris* is considered to enter into the family Phasianidae, in which it forms a subfamily Meleagrinae, peculiar to North and Central America. The fossil remains of three species have been described by Professor Marsh—one from the Miocene of Colorado, and two, one much taller and the other smaller than the existing species, from the post-Pliocene of New Jersey. Both the last had proportionally long and slender legs. (A. N.)

TURKI, strictly speaking an Arabic or Persian adjective formed from Turk, used by European writers in two rather different senses. (1) It is applied to tribes or languages which are Turkish as opposed to Aryan, Semitic, &c. (2) It is used as the special designation of the tribes and languages of Kashgaria and Eastern Turkestan. (See TURKS.)

TURKOMAN, a name applied to certain Turkish tribes still nomad or only recently settled in Transcaspia and northern Afghanistan and Persia. (See TURKS.)

TURKS AND CAICOS ISLANDS, a group in the British West Indies. They belong geographically to the Bahamas and lie between 21° and 22° N. and 71° and 72° 37′ W. They are of coral and sand formation, their combined area being 169 sq. m. The Turks Islands, taking their name from a species of cactus having the appearance of a turbaned head, are nine in number, but Grand Turk (10 sq. m.) and Salt Cay (5½ sq. m.) are the only two of any size. The town of Grand Turk, on the west of the island of that name, is the seat of government and a port of registry. Salt Cay has a good harbour.

The Caicos Islands lie to the north-west of Turks Islands and are seven in number. Cockburn Harbour on South Caicos, 22 m. from Grand Turk, is the principal settlement and a port of entry. The climate, though somewhat relaxing, is healthy, but there is a scarcity of drinking water, the average annual rainfall being only 27½ in. The mean temperature is 82° F., but owing to the sea breezes the climate is never oppressive. Salt raking is the staple industry. Sisal hemp is grown, sponges are found in some quantities off the coast and there are four sponge-curing factories on the Caicos Islands. Pink pearls are occasionally found. The exports, chiefly to the United States, include salt, sponges and sisal hemp. Grand Turk is in cable communication with Bermuda and with Kingston, Jamaica, some 420 m. to the S.W.

The islands were uninhabited when, about 1678, the Bermudians began to visit them to rake the salt found in the ponds. These visits became annual and permanent settlements were made. In 1710 the British were expelled by the Spaniards, but they returned and the salt trade (largely with the American colonies) continued to be carried on by the Bermudians despite attacks by Spaniards and French, and counter-claims to the islands by the British authorities at the Bahamas, who about 1765 made good their claim. In 1799 the islands were given representation in the Bahamas Assembly, and they remained part of that colony until 1848, when on the petition of the inhabitants they were made a separate colony under the supervision of the governor of Jamaica. This arrangement proving financially burdensome the islands were in 1873 definitely annexed to Jamaica. They are governed by a commissioner assisted by a nominated legislative board. The census of 1901 showed a total population of 5287, of whom 342 were whites, the rest being negroes or mulattoes; 1751 of the inhabitants lived in Grand Turk Island.

See J. N. Bellin, *Description géographique des débouquements au nord de St Dominique* (1768); the *Jamaica Handbook* (London, yearly) and Sir C. P. Lucas, *Historical Geography of the British Colonies*, vol. ii. (2nd ed., Oxford, 1905).

TURKS. The words "Turk" and "Turkish" are used in three senses, political, linguistic and ethnological. Politically, Turk means a Mahommedan subject of the sultan of Turkey. In the East at any rate it is not employed in speaking of Christians, and its application to Arabs, Albanians, Kurds, &c., living in Turkey, though not unusual, is hardly correct. The linguistic use of the name, by which it designates a well-marked division of the Ural-Altaic languages and their speakers, is the most satisfactory. The languages in question are easily identified and defined (see below), and there can be little doubt that they were spoken by the vast majority of the people called Turks since the 6th century of the Christian era. Ethnographically, the use of the word presents difficulties, for it is not easy to differentiate the Turks by physique or customs from allied tribes such as the Finno-Ugrians, Mongolians and Manchus. The Bashkirs, who are probably of Finno-Ugrian stock, speak a Turkish language, and the Magyars, who speak a Ugrian language, have many Turkish characteristics. At the present day there is no difficulty in making a practical distinction between Turks and Mongols. The former speak Turkish languages, are Moslems by religion, live almost entirely in the western half of Asia and fall within the Arabic, and to some extent the European, sphere of influence; the latter speak Mongolian languages, are Buddhists by religion, live in the eastern half of Asia and fall within the sphere of Chinese influence. Yet both Turkish and Mongol traditions represent the two nations as descended from two brothers: Jenghiz Khan, the founder of the Mongol power, must have had large numbers of Turks in his armies, for the chief traces left in Europe of the Mongol invasions are the settlements of Turkish-speaking Tatars in Russia; and the name of his son, Jagatai, is commonly used for a Turkish dialect and khanate in the regions of the Oxus. In Central Asia the distinctions between tribes, nations and races are unusually fluid: we are dealing with predatory nomads for ever fighting with one another or with the settled populations round them. The conquerors enslaved the men and married the women of the conquered. a successful leader attracted round his standard men of different tribes and languages. The corps of janissaries instituted by the Turks in Europe is no doubt an illustration of what happened during many centuries in Asia. The Turks after taking Constantinople claimed from the Christian population a certain number of male children, who were brought up as Turkish soldiers with few ties or principles except obedience to their officers. There was thus a large class, of Turkish speech and Turkish habits, who had absolutely no Turkish blood in their veins. In addition to this, intermarriage has taken place to so large an extent that the modern Turks are almost entirely European in physique. Similarly, no doubt, among the hordes of Central Asia the youths of conquered tribes were absorbed and assimilated by the conquerors and lost their original language. Such transformations were facilitated by the fact that there was no great difference in the manners and customs of these tribes. They were all nomadic, mostly horsemen, and rapacious. As they settled down from time to time they borrowed a good deal from their more civilized neighbours, but their natural manner of life was simple and untrammelled. The Turkish-speaking tribes were apparently the most mobile and adventurous. Starting from the confines of China they reached India, Algeria and the walls of Vienna. They probably formed a large contingent in the hordes of Jenghiz and of the Huns, and perhaps the Petchenegs, Avars and Comans all belonged to this group. In comparison with them the Mongol and Manchu-speaking tribes, though conquerors in the East on no mean scale, seem stationary and inactive, while the Finno-Ugrians are nomad hunters rather than warriors. To the honour of the Turks it must be said that, bad as is their administration when judged by European standards and especially when applied to Europeans, the empires of the Seljuks, Osmanlis and Moguls which they founded rise far above the ordinary standard of ephemeral Oriental dynasties.

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[1] For results of a comparison of the skulls of wild and domesticated turkeys, see Dr Shufeldt, in *Journ. of Comp. Medicine and Surgery* (July 1887).

The effect of Turkish invasions has been in the main destructive, but they have also played a considerable part in transporting both ideas and commodities from one end of the old world to the other. The achievement by which they are best known—the transplantation of Mahommedanism on to European soil—is a remarkable, though not successful, feat of this kind. But they are also largely responsible for the introduction of Mahommedanism into India, for carrying Nestorian Christianity and Persian fire-worship into China, and for the overland intercourse between China and India which fostered if it did not introduce Chinese Buddhism. They exported Chinese silk to Byzantium, and the most ancient Buddhist temple in Japan contains Persian objects which must have been brought across Asia by their caravans.

Divisions.—At the present day the name Turk is applied primarily to the people who have conquered Constantinople and the regions known as Turkey, but the following may be classed as Turkish in the sense of belonging to the same group linguistically and to some extent racially:—

1. *The Yakuts* are a Siberian tribe who inhabit the country near the banks of the middle and lower Lena, including Yakutsk and Verkhoyansk on the Yana. Their language is purely Turkish, though differing considerably from the more western Turkish idioms, but they have largely intermingled with the Tunguses. They are said to be industrious and skilful alike as artisans, traders and agriculturists. They are nominal Christians, but preserve much of their old nature worship.

2. *Tatar* (*q.v.*) or *Tartar* is a popular name which in its most correct sense is applied to Turkish-speaking Moslems in Russia, who number over three millions and are mostly remnants of the Mongol invasion which took place in the 13th century. But it is also extended rather loosely to various tribes in Siberia and elsewhere who speak Mongolian, Finnish or other languages.

The following classes of Tatars speak Turkish languages: (*a*) The Kazan Tatars, numbering perhaps a million. Their centre is in the government of Kazan, but they extend down both banks of the Volga as far as the government of Saratov. (*b*) The Astrakhan Tatars, numbering only about 10,000. (*c*) The Bashkirs, whose headquarters are in the government of Ufa. They appear to be a tribe of Finnish origin who have adopted a Turkish language. (*d*) The Tatars of the Crimea, sometimes called the Krim or Nogai Tatars, who occupied the Crimea in the 13th century and had a considerable empire from the 15th to the 17th century. There are also Nogai Tatars in the Caucasus and Kuban country. (*e*) There are considerable bodies of Tatars in Rumania and Bulgaria, who appear to be Nogais who have emigrated from the Crimea, Bessarabia and other parts of Russia. (*f*) The Tatars of the Caucasus seem to be for the most part Azerbaijan Turks mingled with Armenian, Georgian, Lesghian and other blood. But the name is often loosely applied to any Mahommedan Caucasian tribe.

3. *Kirghis* (*q.v.*), nomadic tribes amounting to about three million souls who are found chiefly in Asiatic Russia. They fall into two chief divisions. (*a*) The Kazaks, who inhabit the northern and eastern parts of the Aral-Caspian basin, including the government of Orenburg. They do not call themselves Kirghiz, and apparently the name has been given them by the Russians in order not to confuse them with the Cossacks. (*b*) The Kara-Kirghiz, who are the less numerous division, live in Dzungaria, in the Altai, about lakes Balkash and Issyk-kul, and extend southwards to the Pamirs and the sources of the Oxus. Some of them inhabit Chinese territory. Both divisions live chiefly on the produce of their herds. Their chief drink is *koumiss*, or fermented mare's milk.

4. *The Kara-Kalpaks* (*q.v.*) or Black-caps, who inhabit the south-eastern shores of the sea of Aral, are sometimes classed with the Kirghiz, but seem to be a separate branch of the Turki stock. They are a feeble race, apparently in process of extinction, and now number only about 50,000.

5. *Uzbeg* is a political and not an ethnological denomination. It is derived from Uzbeg Khan of the Golden Horde (1312–1340), and was subsequently used at the beginning of the 16th century to designate the adherents of Shaibani Khan. Finally it was employed as the name of the ruling tribes in the Central Asian khanates (much like Osmanli in Turkey), in opposition to Kirghiz and Sarts, as well as to non-Turkish tribes. The Uzbegs are accordingly a mixed race, but the elements of which they are composed are mostly Turkish. Their numbers have been estimated at about two millions. They are mostly agriculturists or dwellers in cities, not nomads.

6. *Sart* is the name commonly given to the Turkish-speaking urban population of the Central Asian khanates. It is opposed to Tajik, which denotes the agricultural, Iranian-speaking population, but both words are used very loosely and have come to mean little more than town and country people. Sart and Uzbeg are also opposed in the meanings of common people and aristocracy, but many Sarts claim Uzbeg descent. The word is hardly suitable for scientific use, but is employed by Russian writers as the name of the Turkish language spoken in Bokhara, Samarkand and Ferghana.

7. The various Turkish tribes found on the eastern slopes of the Tian Shan, in Kashgar, Yarkand, Khotan, &c., are the descendants of the ancient *Uighurs* or *Outghours*. These people were probably the most eastern branch of the Turks who remained behind when the first westward movements were made, but subsequently moved westward themselves. They ruled in Kashgaria from the 10th to the 12th centuries, and, like other branches of the Turks, adopted Mahommedanism. They continued, however, to use a variety of the Syriac alphabet introduced by Nestorian missionaries, and a book, the *Kudatku Bilik*, composed in their language about 1065, is extant. The Taranchis, an agricultural tribe of the Ili basin, seem also to belong to this group. The Turkish spoken in Kashgaria, &c., is often distinguished as Turki.

8. *Mogul*, *Moghul* or *Mughal*, appears to be the same word as Mongol, but is commonly restricted to the tribes who invaded northern India from Ferghana in 1526 under Baber (or Babar) and established the Mahommedan Empire of Delhi. Memoirs written by Baber in Jagatai Turkish are extant.

9. The *Koibals* and *Karagasses* of the upper Yenisei are perhaps of Finnish stock, but they speak languages akin to the Kashgarian Turki. They are sometimes called Tatars.

10. *Turkoman* or *Turkman* is the name usually given to the nomadic tribes who inhabit the country between the Caspian and the Oxus. They appear to be a branch of the Western Turks and not essentially different from the Osmanlis or Azerbaijanis, except that until the Russian occupation of Merv they remained in the condition of predatory horse-riding nomads, much feared by their neighbours as "man-stealing Turks."

They are divided into many tribes, of which the principal are (*a*) The *Chaudors* in the north-western part of the Ust-Urt and near the Kara-boghaz Gulf. (*b*) The *Yomuts* or *Yomuds* extending from Khiva across the Ust-Urt and along the shore of the Caspian to Persia. (*c*) The *Goklans* or *Goklens* settled in the Persian province of Astarabad. They are said to be the most civilized and friendly of all the Turkomans. (*d*) The *Tekkes*, who were the most important tribe when the Russians conquered Transcaspia. They are first heard of in the peninsula of Mangishlak, but were driven out by the Kalmuks in 1718, and subsequently occupied the Akhal and Merv oases. The Russians inflicted a crushing defeat on them at Geok-Tepe in 1881. (*e*) The *Sakars* inhabit the left bank of the Oxus near Charjui. (*f*) The *Sariks* are found in the neighbourhood of Panjdeh and Yulatan. (*g*) The *Salors*, an old and important tribe, suffered much in the course of fights with the Tekkes and in 1857 migrated to Zarabad in Persian territory near the Hari-rud. (*h*) The *Ersaris* are now chiefly found near Khoja Salih. They were once a very important tribe on the upper Oxus. (i) The *Ali-elis* live near Andkhui.

11. The Turkish nomads scattered over Persian territory are often known by the name of *Azerbaijanis* or *Adharbaijanis*, though this name is strictly applicable only to the inhabitants of the province of Azerbaijan (*q.v.*), of which Tabriz is the capital. They are the descendants of various bodies of Turks who have wandered into Persia at various times, but more particularly of the Ghuzz tribes (the Οὖζοι of the Greeks) who invaded it during the Seljuk period. They are also known as Ilāt or Iliyāt, meaning tribes, and each tribe has its own chieftain or Ilkhani appointed by the shah.

Among the tribes are (1) The *Kajars*, who dwelt in Transcaucasia until Abbas the Great (1585–1628) forced a portion of them to settle near Astarabad. The present dynasty of Persian Shahs comes from this tribe. (2) The *Afshars* or *Awshars* are a very numerous tribe in the province of Azerbaijan. Another division of them is found in the Anti-taurus. (3) The *Shekakis* and *Shah-seven*. The latter is a political name which has become hereditary, "those who love the shah," *i.e.* partisans of the Safawī dynasty (1499–1736), and of the Shiite faith. (4) The *Karakoyunlu* living near the town of Khoi. In the south of Persia are found (5) the *Abulwerdis*, (6) the *Kara-Gözlü*, (7) the *Buharlu*, (8) the *Inamlu* and (9) the *Kashkai*. These last perhaps include the Khalaches or Khalaj who were already settled near Herat before the arrival of the Seljuks, and from whom sprang the Indian dynasty known as Khalji (1290–1320).

12. The Turks now inhabiting the Turkish Empire fall into various categories and have entered it at various times.

a. The *Osmanlis* or *Ottomans*. This word is loosely used to mean any Mahommedan subject of the sultan, though even then it is not generally extended to Arabs and Albanians. Used more strictly it means the clan of Osman and their descendants as opposed to Seljuks and other Turks. The name is genealogical rather than ethnic; for though the exploits of the Osmanlis have given them an importance in modern history far exceeding that of all the other tribes, they are not distinguished from them in language or customs. According to tradition the clan came from Khorasan, supported the Seljuks and received in return the fief of Eskishehr. In the 14th century they took Brusa from the Byzantine Empire and established a kingdom there which withstood the shock of Timur's invasion (1402). In 1453 they captured Constantinople. Until recently Turkish Mahommedans always employed the words Osmanli and Osmanlija to describe themselves and their language, and avoided the expressions Türk and Türkche as signifying semi-civilized tribes, but in the last twenty years the older words have again come into use as national designations.

b. There must be many Turks in the Ottoman dominions who have no claim to be called Osmanlis in the strict sense. Byzantine authors mention a colony of 30,000 Turks on the river Vardar in Macedonia as early as the 9th century, and many Turks in Europe are still called Koniots or Konariots and claim to be descendants of the Seljuks. After the defeat of the emperor Romanus at Manzikert (1071) Turkomans and Turks of every description poured into Asia Minor. The Tatars of the Dobrudja also seem to be an ancient settlement.

c. The *Kizil-Bash*, or red-heads, who are found in the plains of Asia Minor about Angora, Tokat and Karahissar, differ somewhat from the surrounding Turkish population in both physique and customs. They appear to be immigrants from Persian territory, where some of them still remain. They are industrious agriculturists and their women enjoy unusual freedom. They call themselves *Eski-Türk* or old Turks, and have a secret religion in which Shiite tenets seem to be combined with older pagan (or possibly Christian) elements.

d. In various parts of western and southern Asia Minor, particularly the plains of Cilicia, are nomadic Turkoman tribes called by the Turks *Yürük* or *Gyŏchĕbĕ*. They are even found near Smyrna. They are a peaceful race, with fair complexions and a fine physique, and are great camel breeders. Though they do not appear to have a religion of their own like the Kizil Bash, they are only nominally Mahommedans.

Besides the peoples mentioned above, a number of extinct tribes may have been Turkish-speaking, though in the absence of linguistic records no certain conclusion is possible. Such are the Huns Ephthalites, Avars, Bulgars, Khazars, Comans and Petchenegs. The name Hun is perhaps identical with the Chinese Hiung-nu or with the Turkish word for ten, *on* or *un*, meaning the ten tribes. Of the Avars really nothing is known: they were an extremely barbarous people who made no settlements and disappeared as suddenly as they came. They have been identified with the Jwen-Jwen of the Chinese. The name of the Khazars has a Turkish sound: they were a relatively civilized people and had a kingdom in the neighbourhood of Astrakhan and the north Caspian which lasted for several centuries. The original Bulgarians were certainly not Slavs, though they acquired a Slavonic language, but it is more probable that they were Finno-Ugrians than Turks. The Petchenegs, also called Πατζινάκαι or Πατζινακῖται in Greek and Bisseni in Latin, are said to have been driven into Europe from the lower Ural by the Ghuzz (Οὖζοι) at the end of the 9th century, and wandered about the northern frontiers of the Byzantine Empire for about 300 years. Perhaps some of them settled in Hungary and Bulgaria. They were, like the Avars, very barbarous and were probably Turks, for Anna Comnena says they spoke the same language as the Comans. This dialect is known by the so-called Codex Cumanicus. Coman or Kuman is a name given by Europeans to the tribes who occupied Moldavia and the adjacent regions in the middle ages. Rubruquis speaks of the Coman Kipchaks, and it is probable that the Comans were a hybrid Turkish tribe.

History.—The invasions and conquests of the later Turkish dynasties form an important part of the history of the world and are treated in such articles as TURKEY; SELJUKS; TIMUR; MOGULS. Here it is proposed to sketch the earlier wanderings and agglomerations (for they can hardly be called kingdoms) of Turkish tribes in eastern and central Asia. Much new information on this subject has been made accessible in the last twenty years by the discovery near the river Orkhon, to the south of Lake Baikal, of Turkish inscriptions dating from the 8th century A.D., and by the publication of materials furnished by Chinese writers. But authorities are still not entirely agreed as to the chronology of the events recorded or the identity of the names which appear in Turkish, Greek and Chinese forms, so that the following summary is for many periods tentative.

From 1400 B.C. onwards, but especially about 200 B.C., Chinese history contains notices of warlike nomads called Hiung-nu or Hsiung-nu, who were a danger to the empire. Their political power broke up in the early centuries of this era before the advance of the Sien-pi and Tobas, who appear to have been Tunguses, and from whom arose the Wei dynasty of northern China. In A.D. 433 a Hiung-nu clan called Asena or A-shih-na, disliking the rule of the Wei, moved eastwards and sought the protection of a people called Jeu-Jen or Jwen-Jwen, who were also a kind of Hiung-nu. They are the Geougen of Gibbon and others, and their identity with the Avars has been affirmed and disputed with equal confidence. The Asena served the Jwen-Jwen as workers in iron and lived not far from the modern city of Shan-Tan in Kan-suh. In this neighbourhood was a hill called from its shape Türkü, Dürkü or T'u-chüeh, meaning helmet, and this is said be to the origin of the national name which has become so celebrated. The name Tu-Kiue (Tou-Kiue) or Turk is first used by the Chinese in recording the events of A.D. 545, and the following years, when the Turks, or descendants of the Asena, revolted against the Jwen-Jwen. These latter were crushed and disappear from history, at least under that name. The victorious Turks advanced across their territory, came into collision with the Hephthalites or Ephthalites, whom they defeated, and are heard of on the Oxus about A.D. 560. The period 546–582 marks the first brilliant epoch of early Turkish history. The tribes were not divided and made the most astonishing advance under Tumen (who took the title of Ili-Khan), his brother Itsāmi or She-ti-mi (perhaps the Stembis of Greek writers), his son Mokan and Istāmi's son Tardu or Ta-t'eu. Though fifty years before only a servile clan in China, they sent an embassy in 567 to the East Roman emperor Justin II., as related by Menander Protector (C. Müller: *Fragm. hist. graec.*, vol. iv.). The object of this mission was to open up commercial relations, especially in the silk trade, with the West, and to co-operate with the Greeks against the Persians, because the latter wished to make the Persian Gulf the only outlet for the silk trade, and with that object to hamper the communications of the Turks with Western powers. The ruler who sent this embassy is called in Greek

Silziboulos or Dilziboulos, corresponding to the Sinjibu of Arab chroniclers and perhaps representing Sin-jabgu in old Turkish, the latter part being a title. He has been identified with Istämi. Justin sent as envoy to him in return a certain Zemark, who visited the khan at Ektel or Ektag (? Ak-dagh), and several subsequent embassies were exchanged. In 598 the khan Tardu wrote to the emperor Maurice, and in 620–28 the Turks assisted Heraclius in his campaigns against Persia. Meanwhile the Turks had themselves split into two divisions with separate princes. A tendency towards division, very natural in so loose and extended a community, had been visible for some time, and the rupture was precipitated in 582 by the jealousy of Ta-lo-pien or Dalobian, who was angry at not being chosen khan. For a century and a half or so we hear of two khanates: the northern Turks, living near Lake Baikal and the southern tributaries of the Yenisei, and the western[1] Turks, who appear to have had two headquarters, one near Urumchi and one near Aulieata, north of Tashkent. But their conquests, or at least their successful raids, extended very much farther to the west and south. In 630 the Chinese pilgrim Yüan Chwang (Hsüan Tsang) was well received by their khan, T'ung-she-ho, who exercised some kind of authority from Turfan to Merv. The Chinese followed a consistent policy of spreading dissension among these dangerous tribes and of supporting the factions which were weak or distant against those who were strong or near. Accordingly they were friendly to the western Turks until they had conquered the northern Turks. This western branch lasted until about 750 as a political name. From about 550 till 650 they were independent, and, as mentioned, allies of the east Roman Empire against the Persians. But about 650 the politics of the Nearer East were transformed by the conquests of the Arabs following on the preaching of Mahomet. After subduing Persia in 639 they spread to Transoxiana. At the same time dissension prevailed among the western Turks themselves: the five tribes called Nu-she-pi, who lived west of Issyk-kul, quarrelled with the five tribes called Tu-lu living to the east of it. The Chinese fomented the quarrel, and in 659 were able to declare that they annexed the whole territory of the western Turks, including at least Dzungaria, Tashkent, Ferghana, Bokhara, Khulm, Badakshan, Ghazni, Bamian, Udyana, Wakhan and Karateghin. But it would seem that neither the Turkish occupation nor the Chinese annexation of most of these countries was effective. From 650 to 750 the possession of them was disputed not only by the Turks and Chinese but by the Tibetans in the east and the Arabs in the west. In the west, the campaigns of Qotaiba b. Moslim or Kutaiba (705–14) completed the Mahommedan conquest of Transoxiana (see CALIPHATE, sect. B § 6). In the east the really effective power seems to have been exercised by a new Turkish tribe called Turgäsh, who had capitals at Tokmak and in Ili.

For the history of the northern Turks our only authorities are the Orkhon inscriptions and Chinese writers. The half-century following on the division was prosperous for the northern as well as for the western Turks, and they menaced China; but in 630 the Chinese conquered them. This is the Chinese servitude mentioned in the inscriptions. In 682 Kutluk (also called Elteres, which seems to be a title) re-established a Turkish state on the Orkhon. He was succeeded by his brother Kapagan (or Me-Chuo), who subdued the Turgäsh, or perhaps merely drove them southwards, early in the 8th century, and was succeeded by Bilgä Kagan of the inscriptions.

This northern khanate was destroyed by a coalition of the Karluk, Uighur and Basmal in 744. These peoples, like the Turgäsh, appear to have been Turkish; for though Turk was originally the name of the clan whose destinies in its northern and western branches have just been sketched, yet there is no objection to the usage by which it is extended to the descendants of similar clans with similar customs and as far as is known similar languages. A succession of these pressed forwards from the east. When first heard of, the Karluk inhabited the country on the Irtysh and the Urungu, and subsequently occupied Teles and Tokmak. The Uighurs belonged to the group of tribes known as Tölös or T'ie-le and established themselves at Balasaghun (also known by the forms Kara-Balghasun, Kara-Balgassun and Balagasun: see KARAKORUM). This brings us to the middle of the 8th century. For the next two hundred years the Turkish element in Central Asia, though it must have been numerous, does not cut any figure in history, which is filled with the chronicles of Arab and Persian dynasties (see CALIPHATE; SAMANIDS), but in the 10th century we begin to hear of it again. Turkish adventurers founded the dynasty of Ghaznevids at Ghazni, and there was a Uighur kingdom in the east comprising Kashgar and Khotan. Boghra Khan, the ruler of this kingdom, was converted to Islam at the end of the 10th century, and it continued under various branches of Uighurs until 1120. An interesting memorial of this period is the book *Kudatku Bilik* (see below). More important politically is the rise of the Seljuks. They were the princely family of the Kabaks, who were a section of the group of tribes called Ghuzz (Oghuz, Οὔζοι), and are heard of in Transoxiana about 985. Their chieftains Toghrul and Chakir drove the Ghaznevids to India and established themselves as protectors of the Abbasid caliph, who formally ceded his temporal power to them. (For the history of the dynasty see SELJUKS.) Alp Arslan, the son of Chakir, defeated the Byzantines at Manzikert (1071), and prepared the way for the Ottoman conquests. His son Malik Shah ruled over nearly all the modern Turkey in Asia, and as far as the frontiers of China. On his death in 1092 his empire broke up into several pieces. Konia became the capital of the sultanate of Asia Minor and various Seljuk dynasties established themselves in Kerman, Irak and Syria. A new Turkish power was founded by the khans of Khiva, who are known as the Khwarizm-shahs. They were originally vassals of the Seljuks, with the title of tasdar or ewer-bearer, but became independent and conquered Khorasan and Irak. They had, however, to contend with yet another new arrival from the east, the Kara-Kitais. These also were probably Turks, and were pushed westwards from China by the Kins. They conquered Kashgar, Khotan, Yarkand and later Transoxiana, pushing the Ghuzz tribes before them into Persia and Afghanistan. Their prince bore the title of gur-khan, and the Khwarizm shahs did homage to him till 1208, when they unsuccessfully revolted. But all these squabbling principalities were swept away in 1219 by the extraordinary wave of invasion which surged across Asia to Europe under Jenghiz Khan (*q.v.*). After the death of Jenghiz his conquests were divided, and Transoxiana, Kashgar, Badakshan, Balkh and Ghazni were given to his second son Chagatai or Jagatai. Jenghiz and his family must have been Mongols, but the name Jagatai passed to the population and language of the countries about the Oxus. It does not appear that they ever ceased to be Turkish in speech and customs. The hordes of Jenghiz must have comprised a considerable Turkish element; the Mongols had no inclination to settle in cities, and Jagatai himself lived near Kulja in the extreme east of his dominions. Though the cities in western Central Asia suffered severely the people were not Mongolized, and Mahommedan learning even flourished. But otherwise the whole history of the Jagatai khanate, which lasted from 1234 to 1370, is a confused record of dissensions with frequent intervals of anarchy. In 1321 it split into two khanates, Transoxiana and Dzungaria, and in 1370 collapsed before Timur. This great conqueror (1333–1404), who like Jenghiz had an extraordinary power of collecting and leading the hordes of Central Asia, was a native of the district of Samarkand and a Turk by descent. He conquered successively Dzungaria (1370), Persia and the Caucasus (1390), the Kipchaks on the Volga (1395), and Northern India (1398). He then invaded Syria and Asia Minor, where he defeated but did not annihilate the Osmanlis. The house of Timur did not retain his more distant conquests, but they ruled at

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[1] No better name seems forthcoming, but western Turks is a most inconvenient designation because it is also used (and equally correctly) to signify the Osmanlis and Seljuks as opposed to the Turks of Transoxiana and Kashgar.

Samarkand until 1499 with the usual struggles between different branches of the family. Their possessions included, at least from time to time, the northern parts of Afghanistan and Persia, as well as Transoxiana and Turkestan. They were one of the most enlightened and cultivated of Turkish dynasties. They beautified the cities of Central Asia and were patrons of literature. The literary languages were as a rule Arabic or Persian; Turkish was used more rarely and chiefly for poetry.

The Timurids were overthrown and succeeded by the Shaibani dynasty, a branch of the house of Juji, Jenghiz Khan's eldest son, to whom his father had assigned dominions in the region north of the kingdom of Jagatai. About 1465 a number of this clan migrated into the Jagatai khanate. They were given territory on the Chu River and were known as Uzbegs. About 1500 their chief, Mahommed Shaibani or Shahi Beg, made himself master of Transoxiana and founded the Uzbeg power. The chief opponent of the Uzbegs in their early days was Baber, who represented the house of Timur in the fifth generation, but he ultimately led his armies in another direction and invaded India (1526), where he founded the Mogul Empire, a far more important state than the principalities of the Oxus. The Shaibanis continued to rule in these latter till 1583, and were followed by the houses of Astrakhan and Mangit; but it is not necessary to continue here the complicated chronicles of these dynasties.

The Osmanlis, or house of Osman, the founders of the present Turkish Empire, appear to have been a clan similar to the early Seljuks or the present Turkomans of Transcaspia, who migrated into Asia Minor from Khorasan and made the neighbourhood of Brusa their headquarters. Their conspicuous position in history is mainly due to the fact that they attained pre-eminence very late and in districts very near Europe. Except for the invasion of Timur they did not suffer from the attacks of other Turks and they were able to concentrate their strength on the conquest of the decrepit Byzantine Empire.

Customs, Civilization, Religion, &c.—The Turks are imitative rather than original, and, in all their branches, have assimilated to some extent the nearest civilization whenever they have settled down. Up to the 7th century their only culture consisted of some scraps of Chinese and Indian civilization. Subsequently both the eastern and western states which they founded adopted Perso-Arabic civilization and Mahommedanism. The Osmanlis have also been affected by Byzantine and west European influences.

Chinese historians and the Turkish inscriptions of the Orkhon and Yenisei give us a good deal of information respecting the earlier condition of these tribes. We are told that the Hiung-nu lived on horseback and moved about from place to place in search of fresh pasture. They possessed horses, cattle and sheep and also camels. They had no towns or villages and no agriculture and they never stayed long in one camp, but during their halts a special piece of land was assigned to each tribe and each tent. They were ignorant of writing. The children were taught to ride and shoot, and the adults were expert archers. Their food was flesh and milk and their clothing the skins of animals. They were polygamous and a son married his deceased father's wives, except his own mother. It is expressly stated that old people were despised and neglected, but this barbarous trait disappeared from the manners of the later Turks.

Of the Turks in the 6th century the Chinese writers give a rather more flattering account. They had numerous grades of rank, and when their khan was invested with the supreme power he was carried in a carpet. When troops were levied or taxes collected, the required amount was carved on a piece of wood marked with a golden arrow as a sign of authority. Their punishments were severe. Marriage was by arrangement with the parents, not capture. The dead were kept for some time after death and the mourners gashed their faces. They sacrificed to heaven and to the spirits of their ancestors. Their amusements included singing antiphonally, playing dice and drinking *koumiss* till they were drunk. They had a written alphabet (derived from India or Syria) and a duodenary cycle in which the years were designated by the names of animals. Somewhat similar accounts are given of the Kerkur or Kirghiz and of the Kankli or Kankali. These were perhaps the ancestors of the Uighurs and moved about in carts with high wheels: they are described as a barbarous undisciplined people, but capable of concerted action.

In the Orkhon inscriptions of the early part of the 8th century a somewhat more civilized branch of the Turks gives an account of itself which tallies with the Chinese descriptions. No Turkish cities are mentioned, only tribes and localities. War is the national occupation. The sovereign or kagan fights himself, and it is interesting to see that the names of the various chargers which he mounted are carefully recorded. The spirit of tribal patriotism and desire for glory which animate these compositions are very noticeable and also the implied obligation of the rulers to see to the prosperity of the people. The existence of the tombs and of inscriptions in Chinese characters as well as in an alphabet of Aramaic origin, and the mention of gold, silver, silk and precious objects show that the builders had looted, so to speak, a certain amount of fragmentary civilization from their neighbours. The chief deity is Heaven or Tängri (still used in Osmanli Turkish as the equivalent of Allah), who gives the kingdom to the kagans and cares for the name and reputation of the Turkish people. There are also spirits of the earth and waters. All this is very like the earliest Chinese religion. Funeral ceremonies were evidently elaborate and the cycle of years named after animals was used for chronology.

The Chinese pilgrim Hüsan Tsang was entertained by She-hu (perhaps a title), kagan of the Western Turks, near Tokmak about A.D. 630. He left an account of the barbaric splendour of his reception and alludes to the number of horses, the gold embroidery of the kagan's tent, the silk robes of his retinue, and the use of wine and music. He says the Turks were fire-worshippers and would not sit on wooden seats.

It is probable that before they were converted to Islam the Turks practised in a desultory manner Buddhism, fire-worship and Nestorian Christianity, though they never wholly accepted any of them. An interesting trace of Buddhism remains in the names Shaman and Shamanism. It would appear that the Indian word Śramana or Samana was applied to the wizards and exorcizers of the older Turkish superstition. Recent investigations have discovered the existence of a considerable Buddhist civilization at Khotan, but at the time when it flourished it would appear that the mass of the population was of Iranian affinities and that the Turkish element was small.

The *Kudatku Bilik* (about 1065) gives a picture of life in Eastern Turkestan after the conversion to Islam, but still showing many traces of Chinese influence. But after this period nearly all the Turks (except a few obscure tribes like the Yakuts) adopted the Perso-Arabic civilization. Some however, such as the Kirghiz, Turkomans and Yūrūks of Asia Minor, have not yet abandoned the nomadic life. The Turks seem to be everywhere characterized by their innate sense of discipline and their submissiveness to their own authorities; councils or assemblies have rarely assumed importance among them; sovereigns and even dynasties (except the house of Osman) have often been removed by violence, but the despotic form of government has never failed to secure obedience. But equally important, as explaining their military successes, is the fact, noticed alike by ancient Chinese historians and modern European officers, that the ordinary Turkish soldier has in military matters an unusual resourcefulness and power of initiative which, without impairing discipline, renders him independent of his officers.

Language.—The Turkish or Tatar-Turkish languages belong to the Ural-Altaic family. Both nominal and verbal forms are built up solely by the addition of suffixes, and the law of vowel harmony is strictly observed. Hard and soft vowels cannot occur in the same word, and there is a tendency to assimilate the vowels of the suffix to those of the root; thus *pederiniz*, your father, but *dostunuz*, your friend. From the Mongol-Manchu languages the Turkish group is distinguished by its much more developed system of inflexion, particularly in the verbs, by its free use of pronominal suffixes, and by its more thoroughly agglutinative character. The stem with its suffixes forms a single compound word, whereas in Mongol the suffixes often seem quasi-independent. In all these features Turkish resembles the Finno-Ugric languages, but it diverges from them in having a much simpler system of cases and different phonetics, in the absence of many peculiarities such as the incorporation of the pronominal object in the verb, and in the development of some special forms, such as the expression of negation by inserting a suffix after the verbal root (*yazdim*, I wrote, *yasmadim*, I did not write). The grammatical forms are more agglutinative and less inflexional than in Finnish; though they are single words, the root does not change and the elements can be easily separated, which is not always the case in Finnish. Compare the Turkish *györdünüz*, "you saw," from the root *györ*, with the equivalent Finnish *näitte* from *näke*. The fusion between the root and suffixes is much more thorough in the latter. Turkish thus stands midway between Mongol and Finnish in its development of the agglutinative principle. Also, though compounds are not unknown in Turkish (*e.g. demiryol*, railway) they are much rarer than in Finnish or Hungarian.

Despite the apparent divergence between Turkish and Mongol, due perhaps partly to the influence of Chinese on the latter, the affinity between them seems real, though not superficial. The pronouns, case suffixes, and construction of sentences all show a general similarity, and the verb in Buriat, which differs from other Mongol languages, exhibits a development parallel to Turkish.

The want of resemblance in vocabulary between the three classes of languages is remarkable. The numerals, for instance, in Turkish, Mongol and Finno-Ugric are entirely different, and considerable changes have to be assumed before the identity of words can be proved. A comparison of Turkish words with Mongol equivalents makes it probable that the former are in many instances contractions: thus *dagh*, mountain, *yol*, road, correspond to the Mongol *dabaga*, *yabudal* and perhaps represent an earlier *tavagh* and *yavol*. The best-known Turkish languages, particularly Osmanli, have borrowed an enormous number of Arabic and Persian words which disguise the characters of the native vocabulary and to some extent affect the grammar.

Compared with the Finno-Ugric group, the Turkish languages are remarkably uniform. Indeed, allowing for the lapse of time and the importation of foreign words, it is hardly an exaggeration to say that from the Lena to Constantinople, from the Orkhon inscriptions till now, we have merely one language in different dialects. The native vocabulary and grammar remain substantially the same. The linguistic type is evidently strongly individual and persistent, and its separation from Mongol, &c., is probably very ancient.

Radlov divides the Turkish languages or dialects into four groups, according to their phonetic system. (1) Eastern: Altai, Baraba, Lebed, Tuba, Abakan, Küärik, Soyon, Karagass and Uighur. (2) Western: Kirghiz, Bashkir, Irtysh and Volga dialects. (3) Central Asiatic: Jagatai, Taranji, &c. (4) Southern: Turkmani, Azerbaijani, Krimmi, Anadoli and Osmanli. But this classification does not seem entirely satisfactory. As one passes across Asia from the Yakuts, through Kashgar, Turkestan and Azerbaijan to Constantinople, the pronunciation of the Turkish languages becomes decidedly softer, the suffixes become more intimately united with the words to which they are appended (approaching though not attaining the unity of Finnish inflexions), and the verbal forms grow more numerous and more complicated. Thus in the east we find *nin*, *ni*, *ga* as suffixes for the genitive, accusative and dative, and *man* for that of the first personal pronoun (*e.g. durman*, I stand or I am) corresponding to *-in*, *-i*, *-a* and *-im* in Osmanli, which have clearly assumed the character of inseparable terminations more completely than the older forms. Osmanli possesses more copious verbal forms than the other dialects, some of which (such as the future in *-ajak*) seem to be recent formations. On the other hand, the dialects of Turkestan use in speaking, though not in writing, forms which indicate a process of composition followed by contraction, more remarkable than any change which has taken place in the west. For instance, *wopti*, a contraction of *bolup irdi*, is said to be currently used in Khokand for "has become." Yakut (which can still be best studied in Böhtlingk's excellent grammar of 1851) is the dialect which is most distinct from the others, but does not appear always to preserve the oldest forms. Thus it has lost the genitive, which is replaced by a pronominal periphrasis (*e.g. öräs bas-a*, horse head-his, *i.e.* horse's head), and has verbal forms like *bisabin*, I cut, *bispappin*, I do not cut, apparently standing for *bisarbin*, *bispatbin*. The negative suffix is *pa* not *ma*. The resemblance between the Turkish dialects is increased by the fact that they are nearly all written in a somewhat artificial and standardized form which imperfectly represents the variety existing in conversational speech.

Several alphabets have been employed to write Turkish. (1) Arabic characters are everywhere used by Mahommedan Turks, almost without exception; yet this alphabet is extremely ill suited to represent Turkish sounds. It cannot distinguish the hard and soft vowels, so that *oldu*, "he was" is written in the same way as *öldü*, "he died." In some cases the consonants indicate the character of the vowels which are to be supplied after them, hard consonants being followed by hard vowels and soft by soft. Thus the word spelt with the letters *kaf*, *re*, *he* is pronounced as *kara*, but that spelt with *kef*, *re*, *he* as *kerre*. Further the orthography often follows an antiquated pronunciation and the letters have many sounds. Thus the single letter *kef* can be used to express *k*, *ky*, *g*, *gy*, *y*, *v*, *w* and *n*. The result is that pure Turkish words written in Arabic letters are often hardly intelligible even to Turks and it is usual to employ Arabic synonyms as much as possible because there is no doubt as to how they should be read. Osmanli documents are often little more than a string of Arabic words with Turkish terminations.

2. The Uighurs and Eastern Turks used in the middle ages a short alphabet of fourteen letters derived from a Syriac source and probably introduced among them by Nestorian missionaries; similar characters may also have been employed by Manichaeans. The Mongol and Manchu alphabets represent further variations of this writing. Though very like the modern Nestorian, it is in some respects more nearly allied to the Estrangelo and Syro-Palestinian alphabets of the 6th and 7th centuries. The most important document in this alphabet is a MS. preserved at Vienna of the *Kudatku Bilik*, "The Blessed or Fortunate Knowledge," a poem composed at Kashgar about 1065. A colophon states that the MS. was written at Herat in 1465, and that it is a copy of one written in 1085. Inscriptions in a similar alphabet have also been found in China.

3. The most interesting forms of Turkish writing are those used on the inscriptions found in Siberia near the Yenisei and Orkhon rivers. For some time it has been known that stones bearing inscriptions as well as roughly carved figures and hunting scenes were to be found on the upper waters of the Yenisei, particularly near its tributary the Abakan in the district of Minusinsk. They are greatly venerated by the Soyotes inhabiting the region. They were first discovered by Messerschmidt in 1722, and some of them were represented in the plates of Strahlenberg's *Das nord. und östliche Theil von Europa und Asia* (1730). They were generally attributed to Scythians or Chudes. The knowledge of them did not much advance until the researches of Castrèn (1847) and the Finnish Society of Archaeology, which in 1889 published the text of thirty-two, chiefly from the Uibat, Ulukem, Altynkul and Tes. Even more interesting are the monuments discovered in 1889 and known as the Orkhon or Kosho-Tsaidam inscriptions, as they were found in Mongolia to the south of Lake Baikal, between the river Orkhon and Lake Kosho-Tsaidam. The most important are a mortuary inscription in Turkish and Chinese, bearing a date corresponding to 733, in honour of Kül-tegin, and another recounting the exploits of Bilgä Kagan. A third inscription at Kara-Balgassun probably dates from 800-805. The inscriptions were deciphered and translated by Thomsen and Radlov, and Donner examined the origin of the alphabet. He came to the conclusion that the Yenisei alphabet is rather older than that of the Orkhon inscriptions, and that both are derived from the Aramaic alphabet and most nearly allied to the variety of it used on the coins of the Assacid dynasty. In the 3rd century A.D. a section of the Kirghiz, who subsequently moved northwards, were in West Sogdiana and in touch with the Yüe-Chi, who had been for some time in contact with Persia. The old Turkish characters bear a superficial resemblance to runes; the Yenisei letters have the simplest shapes, those of Kara-Balgassun the most complicated. But they are mostly traceable to Aramaic prototypes and have no connexion with Scandinavia. The vowels are generally omitted, even at the beginning of words, and, as in the modern Turkish method of using the Arabic alphabet, their quality is often indicated by the consonants, many of which have two forms, one used with soft the other with hard vowels. Thus *bar* and *bär* are differentiated not by the vowels but by the consonants employed to write them.

4. Turkish-speaking Armenians and Greeks often write it in their own alphabets. Turkish newspapers printed in Armenian characters are published in Constantinople, and Greek characters are similarly employed in several parts of Asia Minor.

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b. For the study of Turkish dialects the subjoined books may be used. (1) *Osmanli*: the grammars, dictionaries and chrestomathies of Wells (1880), A. Wahrmund (1884) and Redhouse (1890). (2) *Uighur*: the works of Klaproth; Abel Rémusat, *Recherches sur les langues tatares* (Paris, 1820); Vambéry, *Uigurische Sprachmonumente und das Kudatku Bilik* (Innsbruck, 1870), and a newer edition by W. Radlov (St Petersburg, 1900). (3) *Jagatai*: the dictionary of Pavet de Courteille and Vambéry, *Jagataische Sprachstudien* (Leipzig, 1867). (4) *Eastern Turki*: Shaw's grammar and vocabulary (*Journ. Roy. As. Soc. of Bengal*, 1877). (5) *Tatar dialects*: the grammars of Kasimbeg-Zenker (Leipzig, 1848), Ilminski (Kazan, 1869) and Radlov (Leipzig, 1882); *Dictionary of Trojanski* (Kazan, 1833); the chrestomathies of Béresine (Kazan, 1857), Terentiev and specially Radlov, *Proben der Volksliteratur der türkischen Stämme Süd-Sibiriens* (St Petersburg, 1872). (6) *Yakuti*: Böhtlingk, *Die Sprache der Jakuten* (St Petersburg, 1851); Radlov, *Yakutische Sprache in ihrem Verhältniss zu den Turksprachen* (1908). (7) *Inscriptions*: Société finlandaise d'archéologie, *Inscriptions de l'Iénisei* and several works by O. Donner, W. Radlov and V. Thomsen—especially Thomsen, *Inscriptions de l'Orkhon déchiffrées* (Helsingfors, 1896); Donner, *Sur l'origine de l'alphabet turc* (Helsingfors); Radlov, *Die alt-türkische Inschriften der Mongolei* (St Petersburg, 1897); Marquardt, *Chronologie der alt-türkischen Inschriften* (1898).

(C. El.)

TURLE, JAMES (1802–1882), English organist and composer, was born at Taunton, Somerset, and started as a choir boy at Wells Cathedral. In 1817 he became a pupil in London of the organist at Westminster Abbey, and after acting as deputy for some years he succeeded to this post himself in 1831 and held it till his death. He and Sir John Goss, the organist at St Paul's, had been fellow-pupils in London as boys. Turle was a great organist in his day, and composed a good deal of church music which is still well known. His son Henry Frederic Turle (1835–1883) was editor of *Notes and Queries*.

TURMERIC (from Fr. *terre mérite*, turmeric, Lat. *terra merita*, deserved, *i.e.* excellent earth; Skeat suggests that it is a barbarous corruption, perhaps of Arabic *karkam*, *kurkum*, saffron or curcuma), the tuberous root of *Curcuma longa*, L., an herbaceous perennial plant belonging to the natural order Zingiberaceae. It is a native of southern Asia, being cultivated on a large scale both on the mainland and in the islands of the Indian Ocean. Turmeric has been used from a remote period both as a condiment and as a dyestuff, and to a more limited extent as a medicine (now obsolete). In Europe it is employed chiefly as a dye, also as an ingredient in curry powder and as a chemical test for alkalies. The root is prepared by cleaning it and drying it in an oven. There are several varieties (Madras, Bengal, Gopalpur, Java, China and Cochin turmeric), differing chiefly in size and colour and to a slight degree in flavour. Some of these consist exclusively of the ovate central tubers, known as "bulbs," or "round turmeric," and others of the somewhat cylindrical lateral tubers, which are distinguished in trade as "fingers," or "long turmeric." Both are hard and tough, but break with a short resinous or waxy fracture, which varies in tint from an orange brown to a deep reddish brown. The colour is due to *curcumin*, $C_{14}H_{16}O_7$, of which the drug contains about 0·3%. When pure it forms yellow crystals having a vanilla odour and exhibiting a fine blue colour in reflected light. It is soluble in alcohol, in chloroform and in alkaline solutions, but only sparingly in water. Paper tinged with a tincture of turmeric exhibits on the addition of an alkali a reddish brown tint, which becomes violet on drying. This peculiarity was pointed out by H. A. Vogel in 1815, and since that date turmeric has been utilized as a chemical test for detecting alkalinity. It is of no therapeutic value. In Sierra Leone a kind of turmeric is obtained from a species of *Canna*.

TURNEBUS, ADRIANUS [ADRIEN TURNÈBE] (1512–1565), French classical scholar, was born at Les Andelys in Normandy. At the age of twelve he was sent to Paris to study, and attracted great notice by his remarkable abilities. After having held the post of professor of belles-lettres in the university of Toulouse, in 1547 he returned to Paris as professor (or royal reader) of Greek at the Collège Royal. In 1552 he was entrusted with the printing of the Greek books at the royal press, in which he was assisted by his friend, Guillaume Morel (*q.v.*). He died of consumption on the 12th of June 1565. His works chiefly consist of philological dissertations, commentaries (on Aeschylus, Sophocles, Theophrastus, Philo and portions of Cicero), and translations of Greek authors into Latin and French. His son, Étienne, published his complete works, in three volumes (Strassburg, 1600), and his son Adrien his *Adversaria*, containing explanations and emendations of numerous passages in classical authors.

See *Oratio funebris* by Léger du Chesne (Leodegarius a Quercu) prefixed to the Strassburg edition; L. Clément, *De Adriani Turnebi praefationibus et poematis* (1899); J. E. Sandys, *History of Classical Scholarship* (1908) iii.

TURNER, CHARLES (1773–1857), English engraver, was born at Woodstock in 1773. He entered the schools of the Royal Academy in 1795; and, engraving in stipple in the manner of Bartolozzi, he was employed by Alderman Boydell. His finest plates, however, are in mezzotint, a method in which he engraved J.M.W. Turner's "Wreck" and twenty-four subjects of his *Liber studiorum*, Reynolds's "Marlborough Family," and many of Raeburn's best portraits, including those of Sir Walter Scott, Lord Newton, Dr Hamilton, Professors Dugald Stewart and John Robinson, and Dr Adam. He also worked after Lawrence, Shee and Owen. He was an admirable engraver, large, broad and masterly in touch; and he reproduced with great fidelity the characteristics of the various painters whose works he translated into black and white. In 1828 he was elected an associate of the Royal Academy. He died on the 1st of August 1857.

TURNER, SIR JAMES (1615–1686), Scottish soldier and military writer, was educated with a view to his entering the Church, but early showed his preference for the profession of arms by enlisting in the Swedish army, then the most famous training-school in Europe. He saw considerable service in the Thirty Years' War, and in 1640 returned to Scotland as a captain. It was not long before he secured employment, and as a major he accompanied the Scottish army in its invasion of England in the same year, successfully avoiding the imposition of the "Covenant" as a test. With Lord Sinclair's regiment Major Turner served in Ulster, and subsequently, after failing to join Montrose's army, accompanied the Scottish army until Naseby practically ended the Civil War. Turner was often with Charles I. during his detention at Leslie's headquarters, and continually urged him to escape. Up to this time he had served against the king, but always with some repugnance, and he welcomed the opportunity when in 1648 the cause of the king and the interests of the Scottish nation for the moment coincided. In the disastrous campaign which followed Turner was at Hamilton's headquarters, and it was owing to the neglect of his advice that the rout of Preston took place. Taken in the final surrender at Uttoxeter, he spent some time in captivity, but in 1649 was released and sent abroad. He was unable for want of means to reach Montrose in time to join in the final venture of the noblest of the Royalist commanders, but he landed in Scotland on the day before Dunbar, and in the grave crisis that followed was a welcome ally. As a colonel and adjutant-general of foot he was with Charles II. at Worcester. In that battle he was captured, but regained his liberty, and after many adventures escaped to the Continent, where for some years he was engaged in various Royalist intrigues, conspiracies and attempted insurrections. At the Restoration he was knighted, and in 1662 he became a major in the Royal Guards. Four years later, as a district commander in Scotland, he was called upon to deal severely with Covenanter disturbances. Though not, it appears, unjust, his dragooning methods eventually led to his being deprived of his command. The rest of his life was spent in retirement. A pension was granted to him by James II. in 1685. In 1683 he had published his *Pallas armata, Military Essayes of the Ancient Grecian, Roman and Modern Art of War*, one of the most valuable authorities for the history of military sciences.

TURNER, JOSEPH MALLORD WILLIAM (1775–1851), English painter, was born in London on the 23rd of April 1775. His father, William Turner, a native of Devonshire, kept a barber's shop at 26 Maiden Lane, in the parish of St Paul's, Covent Garden. Of the painter's mother, Mary Marshall or Turner, little is known; she is said to have been a person of ungovernable temper and towards the end of her life became insane. Apparently the home in which Turner spent his childhood was not a happy one, and this may account for much that was unsociable and eccentric in his character. The earliest known drawing by Turner, a view of Margate Church, dates from his ninth year. It was also about this time that he was sent to his first school at New Brentford. Of education, as the term is generally understood, he received but little. His father taught him to read, and this and a few months at New Brentford and afterwards at Margate were all the schooling he ever had; he never mastered his native tongue, nor was he able in after life to learn any foreign language. Notwithstanding this lack of scholarship, one of his strongest characteristics was a taste for associating his works with personages and places of legendary and historical interest, and certain stories of antiquity seem to have taken root in his mind very strongly.

By the time Turner had completed his thirteenth year his schooldays were over and his choice of an artist's career settled. In 1788–1789 he was receiving lessons from Palice, "a floral drawing master;" from T. Malton, a perspective draughtsman;

and from Hardwick, an architect. He also attended Paul Sandby's drawing school in St Martin's Lane. Part of his time was employed in making drawings at home, which he exhibited for sale in his father's shop window, two or three shillings being the usual price. He coloured prints for engravers, washed in backgrounds for architects, went out sketching with Girtin, and made drawings in the evenings for Dr Munro "for half a crown and his supper." When pitied in after life for the miscellaneous character of his early work, his reply was "Well! and what could be better practice?" In 1789 Turner became a student of the Royal Academy. He also worked for a short time in the house of Sir Joshua Reynolds, with the idea, apparently, of becoming a portrait painter; but, the death of Reynolds occurring shortly afterwards, this intention was abandoned. In 1790 Turner's name appears for the first time in the catalogue of the Royal Academy, the title of his solitary contribution being "View of the Archbishop's Palace, Lambeth." About 1792 he received a commission from Walker, the engraver, to make drawings for his *Copper-Plate Magazine*, and this topographical work took him to many interesting places. The natural vigour of his constitution enabled him to cover much of the ground on foot. He could walk from 20 to 25 m. a day with ease, his baggage at the end of a stick, making notes and memoranda as he went. He rose early, worked hard all day, wasted no time over his simple meals, and his homely way of living made him easily contented with such rude accommodation as he chanced to find on the road. A year or two after he accepted a similar commission to make drawings for the *Pocket Magazine*, and before his twentieth year he had travelled over many parts of England and Wales. None of these magazine drawings is remarkable for originality of treatment or for artistic feeling.

Up to this time Turner had worked in the back room above his father's shop. His love of secretiveness and solitude had already begun to show itself. An architect who often employed him to put in backgrounds to his drawings says, "he would never suffer me to see him draw, but concealed all that he did in his bedroom." On another occasion, a visitor entering unannounced, Turner instantly covered up his drawings, and, in reply to the intimation, "I've come to see the drawings for——," the answer was, "You shan't see 'em, and mind that next time you come through the shop, and not up the back way." Probably the increase in the number of his engagements induced Turner about this time to set up a studio for himself in Hand Court, not far from his father's shop, and there he continued to work till he was elected an associate of the Royal Academy (1799).

Until 1792 Turner's practice had been almost exclusively confined to water colours, and his early works show how much he was indebted to some of his contemporaries. There are few of any note whose style he did not copy or adopt. His first exhibited oil picture appeared in the Academy in 1793. In 1794-1795 Canterbury Cathedral, Malvern Abbey, Tintern Abbey, Lincoln and Peterborough Cathedrals, Shrewsbury, and King's College Chapel, Cambridge, were among the subjects exhibited, and during the next four years he contributed no less than thirty-nine works to the Academy. In the catalogue of 1798 he first began to add poetic quotations to the titles of his pictures; one of the very first of these—a passage from Milton's *Paradise Lost*—is in some respects curiously prophetic of one of the future characteristics of his art:—

> "Ye mists and exhalations that now rise
> From hill or steaming lake, dusky or grey
> Till the sun paints your fleecy skirts with gold,
> In honour of the world's great author rise."

This and several other quotations in the following years show that Turner's mind was now occupied with something more than the merely topographical element of landscape, Milton's *Paradise Lost* and Thomson's *Seasons* being laid under frequent contribution for descriptions of sunrise, sunset, twilight or thunderstorm. Turner's first visit to Yorkshire took place in 1797. It seems to have braced his powers and possibly helped to change the student into the painter. Until then his work had shown very little of the artist in the higher sense of the term: he was little more than a painstaking and tolerably accurate topographer; but even under these conditions he had begun to attract the notice of his brother artists and of the critics. England was, at the time, at a low point both in literature and art. Among the artists De Loutherbourg and Morland were almost the only men of note left. Hogarth, Wilson, Gainsborough and Reynolds had passed away. Beechey, Bourgeois, Garvey, Farington—names well-nigh forgotten now—were the Academicians who painted landscape. The only formidable rivals Turner had to contend with were De Loutherbourg and Girtin, and after the death of the latter in 1802 he was left undisputed master of the field.

It is not, therefore, surprising that the exhibition of his works in 1798 was followed by his election to the associateship of the Royal Academy. That he should have attained to this position before completing his twenty-fourth year says much for the wisdom and discernment of that body, which further showed its recognition of his talent by electing him an Academician four years later. Turner owed much to the Academy. Ruskin says, "It taught him nothing." Possibly it had little to teach that he had not already been able to learn for himself; at all events it was quick to see his genius and to confer its honours, and Turner, naturally generous and grateful, never forgot this. He enjoyed the dignity of Academician for nearly half a century, and during nearly the whole of that period he took an active share in the direction of the Academy's affairs. His speeches are described as "confused, tedious, obscure, and extremely difficult to follow"; but at council meetings he was ever anxious to allay anger and bitter controversy. His opinions on art were always listened to with respect; but on matters of business it was often difficult to know what he meant. His friend Chantrey used to say, "He has great thoughts, if only he could express them." When appointed professor of perspective to the Royal Academy in 1808, this painful lack of expression stood greatly in the way of his usefulness. Ruskin says, "The zealous care with which Turner endeavoured to do his duty is proved by a series of large drawings, exquisitely tinted, and often completely coloured, all by his own hand, of the most difficult perspective subjects, illustrating not only directions of line, but effects of light, with a care and completion which would put the work of any ordinary teacher to utter shame." In teaching he would neither waste time nor spare it. With his election to the associateship of the Academy in 1799 Turner's early struggles may be considered to have ended. He had emancipated himself from hack work, had given up making topographical drawings of castles and abbeys for the engravers—drawings in which mere local fidelity was the principal object—and had taken to *composing* as he drew. Local facts had become of secondary importance compared with effects of light and colour. He had reached manhood, and with it he abandoned topographical fidelity and began to paint his dreams, the visionary faculty—the true foundation of his art—asserting itself, nature being used to supply suggestions and materials.

His pictures of 1797-1799 had shown that he was a painter of no ordinary power, one having much of the poet in him, and able to give expression to the mystery, beauty and inexhaustible fullness of nature. His work at this period is described by Ruskin as "stern in manner, reserved, quiet, grave in colour, forceful in hand."

Turner's visit to Yorkshire in 1797 was followed a year or two later by a second, and it was on this occasion that he made the acquaintance, which afterwards ripened into a long and staunch friendship, of Fawkes of Farnley Hall. From 1803 till 1820 Turner was a frequent visitor at Farnley. The large number of his drawings still preserved there—English, Swiss, German and Italian, the studies of rooms, outhouses, porches, gateways, of birds shot while he was there, and of old places in the neighbourhood—prove the frequency of his visits and his affection for the place and for its hospitable master. A caricature, made by Fawkes, and "thought by old friends to be very like," shows Turner as "a little Jewish-nosed man, in an ill-cut brown tail-coat, striped waistcoat, and enormous frilled shirt, with feet and hands notably small, sketching on a small piece of paper, held down almost level with his waist." It is evident from all the accounts given that Turner's personal appearance was not of a kind to command much attention or respect. This may have pained his sensitive nature, and led him to seek refuge in the solitude of his painting room. Had he been inclined he had abundant opportunity for social and friendly intercourse with his fellow men, but he gradually came to live more and more in a state of mental isolation. Turner could never make up his mind to visit Farnley again after his old friend's death, and his voice would falter when he spoke of the shores of the Wharfe.

Turner visited Scotland in 1800, and in 1801 or 1802 he made his first tour on the Continent. In the following year, of the seven pictures he exhibited, six were of foreign subjects, among them "Bonneville," "The Festival upon the Opening of the Vintage of Mâcon," and the well-known "Calais Pier" in the National Gallery. The last-named picture, although heavily painted and somewhat opaque in colour, is magnificently composed and full of energy.

In 1802, the year in which Turner became a Royal Academician, he took his father, who still carried on the barber business in Maiden Lane, to live with him. The old man lived in his son's house for nearly thirty years, making himself useful in various ways. It is said that he used to prepare and strain his son's canvases and varnish them when finished, which may explain a saying of Turner's that "his father used to begin and finish his pictures for him." He also attended to the gallery in Queen Anne Street, showed in visitors, and took care of the dinner, if he did not himself cook it. Turner was never the same man after his father's death in 1830, living a life of almost complete isolation.

In 1804 Turner made a second tour on the Continent, and in the following year painted the "Shipwreck" and "Fishing Boats in a Squall" (in the Ellesmere collection), seemingly in direct rivalry of Vandervelde, in 1806 the "Goddess of Discord in the Garden of the Hesperides" (in rivalry of Poussin), and in 1807 the "Sun rising through Vapour" (in rivalry of Claude).[1] The last two are notable works, especially the "Sun." In after years it was one of the works he left to the nation, on the special condition of its being hung beside the Claudes in the National Gallery. In this same year (1807) Turner commenced his most serious rivalry. Possibly it arose out of a desire to break down Claude worship—the then prevailing fashion—and to show the public that there was a living artist not unworthy of taking rank beside him. That the *Liber studiorum* was suggested by the *Liber veritatis* of Claude, and was intended as a direct challenge to that master, is beyond doubt. There is, however, a certain degree of unfairness to Claude in the way in which the challenge was given. Claude made drawings in brown of his pictures as they left the easel, not for publication, but merely to serve as private memoranda. Turner's *Liber* drawings had no such purpose, but were intended as a direct appeal to the public to judge between the two artists. The first of the *Liber* drawings was made in the autumn of 1806, the others at intervals till about 1815. They are of the same size as the plates and carefully finished in sepia. He left over fifty of these to the National Gallery. The issue of the *Liber* began in 1807 and continued at irregular intervals till 1819, when it stopped at the fourteenth number. Turner had resolved to manage the publishing business himself, but in this he was not very successful. He soon quarrelled with his engraver, F. C. Lewis, on the ground that he had raised his charges from five guineas a plate to eight. He then employed Charles Turner, who agreed to do fifty plates at the latter sum, but, after finishing twenty, he too wished to raise his price, and, as a matter of course, this led to another quarrel. Reynolds, Dunkarton, Lupton, Say, Dawe and other engravers were afterwards employed—Turner himself etching and mezzotinting some of the plates. Each part of the *Liber* contained five plates, the subjects, divided into "historical," "pastoral," "marine," &c., embracing the whole range of landscape art. Seventy-one plates in all were published (including one as a gift of the artist to his subscribers); ten other plates—more or less completed—intended for the fifteenth and sixteenth numbers were never published, the work being stopped for want of encouragement. Absence of method and business habits may account for this. Turner is said to have got up the numbers in his own house with the help of a female servant. The plates, which cost the subscribers only five shillings apiece, were so little esteemed that in the early quarter of the 19th century they were sometimes used for lighting fires. So much has fashion, or public taste, changed since then that a fine proof of a single plate has sold for £210. The merit of the plates is unequal; some—for example, "Solway Moss," "Inverary Pier," "Hind Head Hill," "Ben Arthur," "Rizpah," "Junction of the Severn and Wye" and "Peat Bog"—are of great beauty, while a few are comparatively tame and uninteresting. Among the unpublished plates "Stonehenge at Daybreak," "The Stork and Aqueduct," "The Via Mala," "Crowhurst," and "Moonlight off the Needles" take a high place. The *Liber* shows strong traces of the influence of Cozens and Girtin, and, as a matter of course, of Claude. In most of the designs the predominant feeling is serious; in not a few, gloomy, or even tragic. A good deal has been written about Turner's intention, and the "lessons" of the *Liber studiorum*. Probably his only intention in the beginning was to show what he could do, to display his art, to rival Claude, perhaps to educate public taste, and at the same time make money. If lessons were intended they might have been better conveyed by words. "Silent always with a bitter silence, disdaining to tell his meaning"—such is Ruskin's explanation; but surely Turner had little reason for either silence or contempt because the public failed to see in landscape art the means of teaching it great moral lessons. The plates of the *Liber* contain an almost complete epitome of Turner's art. It is supposed that his original intention had been that the *Liber* should consist of one hundred plates, and drawings for that number exist, but there was no public demand for them. Already in this work are seen strong indications of one of his most remarkable characteristics—a knowledge of the principles of structure in natural objects; mountains and rocks are drawn, not with topographical accuracy, but with what appears like an intuitive feeling for geological formation; and trees have also the same expression of life and growth in the drawing of stems and branches. This instinctive feeling in Turner for the principles of organic structure is treated of at considerable length in the fourth volume of *Modern Painters*, and Turner is there contrasted with Claude, Poussin, and some of the Dutch masters, greatly to their disadvantage.

After 1797 Turner was little concerned with mere topographical facts: his pictures might be like the places represented or not; much depended on the mental impression produced by the scene. He preferred to deal with the spirit, rather than with the local details of places. A curious example of the *reasonableness* accompanying his exercise of the imaginative faculty is to be found in his creations of creatures he had never seen, as, for example, the dragon[2] in the "Garden of the Hesperides" and the python in the "Apollo," exhibited in 1811. Both these monsters are imagined with such vividness and reality, and the sense of power and movement is so completely expressed, that the spectator never once thinks of them as otherwise than representations of actual facts in natural history. It needs but a little comparison to discover how far Turner surpassed all his contemporaries, as well as all who preceded him, in these respects. The imaginative faculty he possessed was of the highest order, and it was further aided by a memory of the most retentive and unerring kind. A good illustration of this may be seen at Farnley Hall in a drawing of a "Man-of-War taking in Stores." Some one, who had never seen a first-rate, expressed a wish to know what it looked like. Turner took a blank sheet of paper one morning after breakfast, outlined the ship, and finished the drawing in three hours, young Fawkes, a son of the house, sitting beside him from the first stroke to the last. The size of this drawing is about 16 in. by 11 in. Ruskin thus describes it:—

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[1] This spirit of rivalry showed itself early in his career. He began by pitting himself against his contemporaries, and afterwards, when his powers were more fully developed, against some of the old masters, notably Vandervelde and Claude. During these years, while he kept up a constant rivalry with artists living and dead, he was continuing his study of nature, and, while seemingly a mere follower of the ancients, was accumulating that store of knowledge which in after years he was to use to such purpose.

[2] "The strange unity of vertebrated action and of a true bony contour, infinitely varied in every vertebra, with this glacial outline, together with the adoption of the head of the Ganges crocodile, the fish-eater, to show his sea descent (and this in the year 1806, when hardly a single fossil saurian skeleton existed within Turner's reach), renders the whole conception one of the most curious exertions of the imaginative intellect with which I am acquainted in the arts" (Ruskin, *Mod. Painters*, v. 313).

> "The hull of a first-rate occupies nearly one half of the picture to the right, her bows toward the spectator, seen in sharp perspective from stem to stern, with all her port-holes, guns, anchors and lower rigging elaborately detailed, two other ships of the line in the middle distance drawn with equal precision, a noble breezy sea, full of delicate drawing in its waves, a store ship beneath the hull of the larger vessel and several other boats, and a complicated cloudy sky, all drawn from memory, down to the smallest rope, in a drawing-room of a mansion in the middle of Yorkshire."

About the year 1811 Turner paid his first visit to Devonshire, the county to which his family belonged, and a curious glimpse of his simple manner of life is given by Redding, who accompanied him on some of his excursions. On one occasion they spent a night together in a small road-side inn, Turner having a great desire to see the country around at sunrise.

> "Turner was content with bread and cheese and beer, tolerably good, for dinner and supper in one. In the little sanded room we conversed by the light of an attenuated candle and some aid from the moon until nearly midnight, when Turner laid his head upon the table and was soon fast asleep. Three or four hours' rest was thus obtained, and we went out as soon as the sun was up to explore the surrounding neighbourhood. It was in that early morning Turner made a sketch of the picture 'Crossing the Brook.'" In another excursion to Borough Island, "the morning was squally and the sea rolled boisterously into the Sound. Off Stakes Point it became stormy; our Dutch boat rode bravely over the furrows. Two of the party were ill. Turner was all the while quiet, watching the troubled scene. Bolt Head, to seaward, against which the waves broke with fury, seemed to absorb his entire notice, and he scarcely spoke a syllable. While the fish were getting ready Turner mounted nearly to the highest point of the island rock, and *seemed writing rather than drawing*. The wind was almost too violent for either purpose."

This and similar incidents show how careless of comfort Turner was, and how devoted to his art. The tumult and discomfort by which he was surrounded could not distract his powers of observation; and some thirty years later there is still evidence of the same kind. In the catalogue of the exhibition of 1842 one of his pictures bears the following title, "Snow-Storm: steam-boat off a harbour's mouth making signals in shallow water, and going by the lead. The author was in that storm the night the 'Ariel' left Harwich."

From 1813 till 1826, in addition to his Harley Street residence, Turner had a country house at Twickenham. He kept a boat on the river, also a pony and gig, in which he used to drive about the neighbouring country on sketching expeditions. The pony, for which Turner had a great love, appears in his well-known "Frosty Morning" in the National Gallery. He appears to have had a great affection for animals, and one instance of his tenderness of heart is given by one who often joined him in the amusement of fishing, of which Turner was very fond. "I was often with him when fishing at Petworth, and also on the banks of the Thames. His success as an angler was great, although with the worst tackle in the world. Every fish he caught he showed to me, and appealed to me to decide whether the size justified him to keep it for the table or to return it to the river; his hesitation was often almost touching, and he always gave the prisoner at the bar the benefit of the doubt."

In 1813 Turner commenced the series of drawings, forty in number, for Cooke's *Southern Coast*. This work was not completed till 1826. The price he at first received for these drawings was £7, 10s. each, afterwards raised to £13, 2s. 6d.

"Crossing the Brook" appeared in the Academy of 1815. It may be regarded as a typical example of Turner's art at this period, and marks the transition from his earlier style to that of his maturity. It represents a piece of Devonshire scenery, a view on the river Tamar. On the left is a group of tall pine-trees, beautifully designed and drawn with great skill and knowledge of structure; in the foreground a couple of children, with a dog carrying a bundle in its mouth across the brook; and beyond, a vast expanse of richly-wooded country, with glimpses of a winding river, an old bridge, a mill, and other buildings, and, in the far distance, the sea. Both in design and execution this work is founded upon Claude. Some critics consider it one of Turner's greatest works; but this is open to question.[1] It can hardly be called a work in full colour: it is limited to greys and quiet greens for the earth and pale blues for the sky. It is a sober but very admirable picture, full of diffused daylight, and in the painting of its distance better than any master who had preceded him. The fascination of the remote, afterwards so distinctive an element in Turner's pictures, shows itself here. Perhaps nothing tests the powers or tries the skill of the landscape painter more severely than the representation of distant effects. They come and go so rapidly, are often in a high key of light and colour, and so full of mystery and delicacy, that anything approaching to real imitation is impossible. Only the most retentive memory and the most sensitive and tender feeling will avail. These qualities Turner possessed to a remarkable degree, and as his powers matured there was an ever-increasing tendency in his art to desert the foreground, where things were definite and clear, in order to dream in the infinite suggestiveness and space of distances. "Dido Building Carthage" also belongs to this period. It hangs beside the Claudes in the National Gallery. It pertains to the old erroneous school of historical painting. Towering masses of Claudesque architecture piled up on either side, porticoes, vestibules, and stone pines, with the sun in a yellow sky, represent the Carthage of Turner's imagination. With all its faults it is still the finest work of the class he ever painted. Carthage and its fate had a strange fascination for him. It is said that he regarded it as a moral example to England in its agricultural decline, its increase of luxury, and its blindness to the insatiable ambition of a powerful rival. He returned again to this theme in 1817, when he exhibited his "Decline of the Carthaginian Empire: Hostages Leaving Carthage for Rome"—a picture which Ruskin describes as "little more than an accumulation of academy student's outlines coloured brown."

In 1818 Turner was in Scotland making drawings for the *Provincial Antiquities*, for which Sir Walter Scott supplied the letterpress, and in 1819 he visited Italy for the first time. One of the results of this visit was a great change in his style, and from this time his works became remarkable for their colour. Hitherto he had painted in browns, greys and blues, using red and yellow sparingly. He had gradually been advancing from the sober grey colouring of Vandervelde and Ruysdael to the mellow and richer tones of Claude. His works now begin to show a heightened scale of colour, gradually increasing in richness and splendour and reaching its culminating point in such works as the "Ulysses," "Childe Harold's Pilgrimage," "The Golden Bough," and "The Fighting Téméraire." All these works belong to the middle period of Turner's art (1829–1839), when his powers were entirely developed and entirely unabated. Much of his most beautiful work at this period is to be found in his water-colour drawings: those executed for Whitaker's *History of Richmondshire* (1819–1821), for Cooke's *Southern Coast* (1814–1826), for *The Rivers of England* (1824), for *England and Wales* (1829–1838), *Provincial Antiquities* (1826), Rogers's *Italy* (1830), Scott's *Works* (1834), and *The Rivers of France* (1833–1835) are in many instances of the greatest beauty. Of the Richmondshire drawings Ruskin says, "The foliage is rich and marvellous in composition, the rock and hill drawing insuperable, the skies exquisite in complex form."

But perhaps one of the greatest services Turner rendered to the art of England was the education of a whole school of engravers. His best qualities as a teacher came from the union of strength and delicacy in his work; subtle and delicate tonality was almost a new element for the engraver to deal with, but with Turner's teaching and careful supervision his engravers by degrees mastered it more or less successfully, and something like a new development of the art of engraving was the result. No better proof can be found of the immense advance made than by comparing the work of the landscape engravers of the pre-Turnerian period with the work of Miller, Goodall, Willmore, Cooke, Wallis, Lupton, C. Turner, Brandard, Cousen, and others who worked under his guidance. The art of steel engraving reached its highest development in England at this time. Rogers's *Italy* (1830) and his *Poems* (1834) contain perhaps the most beautiful and delicate of the many engravings executed after Turner's drawings. They are vignettes,[1] a form of art which Turner understood better than any artist ever did before—perhaps, we might add, since. "The Alps at Daybreak," "Columbus Discovering Land," and "Datur Hora Quieti" may be given as examples of the finest.

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[1] "Crossing the Brook" was a great favourite with Turner. It was painted for a patron, who, dissatisfied with it, left it on the painter's hands. The price asked (£500) seems to have been part of the objection. Turner subsequently refused an offer of £1600 for it.

In 1828 Turner paid a second visit to Italy, this time of considerable duration, on the way visiting Nîmes, Avignon, Marseilles, Genoa, Spezzia and Siena, and in the following year he exhibited the "Ulysses Deriding Polyphemus," now in the National Gallery. It marks the beginning of the central and best period of Turner's power. This work is so well known that description is hardly needed. The galley of Ulysses occupies the centre of the picture; the oars are being thrust out and the sailors flocking up the masts to unfurl sail, while Ulysses waves the blazing olive tree in defiance of the giant, whose huge form is seen high on the cliffs above; and the shadowy horses of Phoebus are traced in the slanting rays of the rising sun. The impression this picture leaves is one of great power and splendour. The painting throughout is magnificent, especially in the sky. Leslie speaks of it as "a poem of matchless splendour and beauty." From this period onward till about 1840 Turner's life was one of unceasing activity. Nothing is more astonishing than his prodigious fertility; he rose early, worked from morning till night, entirely absorbed in his art, and gradually became more and more solitary and isolated. Between 1829 and 1839 he sent fifty-five pictures to the Royal Academy, painted many others on private commission, made over four hundred drawings for engravers, besides thousands of studies and sketches from nature. His industry accounts for the immense quantity of work he left behind him. There is not the slightest evidence to show that it arose from a desire to make money, which he never cared for in comparison with his art. He has been accused, perhaps not without some cause, of avarice and meanness in his business dealings, and many stories are told to his discredit. But in private he often did generous things, although owing to his reserved disposition his virtues were known only to a few. His faults on the other hand—thanks to the malice, or jealousy, of one or two individuals—were freely talked about and, as a matter of course, greatly exaggerated. "Keep it, and send your children to school and to church," were the words with which he declined repayment of a considerable loan to a poor drawing-master's widow. On another occasion, when interrupted in his work, he roughly chid and dismissed the applicant, a poor woman; but she had hardly left his door before he followed her and slipped a £5 note into her hand. His tenants in Harley Street were in arrears for years, but he would never allow his lawyer to distrain; and if further proof of his generosity were needed his great scheme for bettering the condition of the unfortunate in his own profession should suffice. On one occasion he is known to have taken down a picture of his own from the walls of the Academy to make room for that of an unknown artist.

The first of Turner's Venetian pictures ("Bridge of Sighs, Ducal Palace and Custom House, Venice, Canaletti Painting") appeared in the Academy in 1833. Compared with the sober, prosaic work of Canaletti, Turner's pictures of Venice appear like poetic dreams. Splendour of colour and carelessness of form generally characterize them. Venice appeared to him "a city of rose and white, rising out of an emerald sea against a sky of sapphire blue." Many of these Venetian pictures belong to his later manner, and some of them, "The State Procession bearing Giovanni Bellini's Pictures to the Church of the Redeemer" (exhibited in the Royal Academy, 1841), "The Sun of Venice Going to Sea" (1843), "Approach to Venice" (1844), and "Venice, Evening, Going to the Ball" (1845), to his latest. As Turner grew older his love of brilliant colour and light became more and more a characteristic. In trying to obtain these qualities he gradually fell into an unsound method of work, treating oil as if it had been water-colour, using both indiscriminately on the same canvas, utterly regardless of the result. Many of his finest pictures are already in a ruined state, mere wrecks of what they once were.

"The Fighting Téméraire Tugged to her Last Berth to be Broken Up" was exhibited in the Academy of 1839. By many it is considered one of his finest works. Turner had all his life been half a sailor at heart: he loved the sea, and shipping, and sailors and their ways; many of his best pictures are sea pieces; and the old ships of Collingwood and Nelson were dear to him. Hence the pathetic feeling he throws around "The Fighting Téméraire." The old three-decker, looking ghostly and wan in the evening light, is slowly towed along by a black, fiery little steam tug—a contrast suggesting the passing away of the old order of things and the advent of the new; and behind the sun sets red in a thick bank of smoke or mist. "The Slave Ship," another important sea picture, was exhibited in the following year, and in 1842 "Peace: Burial at Sea," commemorative of Wilkie.

Turner had now reached his sixty-seventh year, but no very marked traces of declining power are to be seen in his work. Many of the water-colour drawings belonging to this period are of great beauty, and, although a year or two later his other powers began to fail, his faculty for colour remained unimpaired almost to the end. He paid his last visit to the Continent in 1843, wandering about from one place to another, and avoiding his own countrymen, an old and solitary man. At his house in Queen Anne Street they were often ignorant of his whereabouts for months, as he seldom took the trouble to write to any one. Two years later (1845) his health gave way and with it both mind and sight began to fail. The works of his declining period exercised the wit of the critics. Turner felt these attacks keenly. He was naturally kind-hearted and acutely sensitive to censure. "A man may be weak in his age," he once remarked, "but you should not tell him so."

After 1845 all the pictures shown by Turner belong to the period of decay—mere ghosts and shadows of what once had been. In 1850 he exhibited for the last time. He had given up attending the meetings of the Academicians; none of his friends had seen him for months; and even his old housekeeper had no idea of his whereabouts. Turner's mind had evidently given way for some time, and with that love of secrecy which in later years had grown into a passion he had gone away to hide himself in a corner of London. He had settled as a lodger in a small house in Chelsea, overlooking the river, kept by his old Margate landlady, Mrs Booth. To the children in the neighbourhood he was known as "Admiral Booth." His short, sailor-like figure may account for the idea that he was an impoverished old naval officer. He had been ill for some weeks, and when his Queen Anne Street housekeeper at last discovered his hiding-place she found him sinking, and on the following day, the 19th of December 1851, he died. He was buried in St Paul's Cathedral, in deference to a wish he had himself expressed. He left the large fortune he had amassed (about £140,000) to found a charity for the "maintenance and support of male decayed artists, being born in England, and of English parents only, and of lawful issue." His pictures he bequeathed to the nation, on condition that they were exhibited in rooms of their own, and that these rooms were to be called "Turner's Gallery." The will and its codicils were so confused that after years of litigation, during which a large part of the money was wasted in legal expenses, it was found impossible to decide what Turner really wanted. A compromise was effected in which the wishes of everybody, save those of the testator, were consulted, his next-of-kin, whom he did not mean to get a single farthing, inheriting the bulk of his property. The nation got all the pictures and drawings, and the Royal Academy £20,000.

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[1] "Of all the artists who ever lived I think it is Turner who treated the vignette most exquisitely, and, if it were necessary to find some particular reason for this, I should say that it may have been because there was nothing harsh or rigid in his genius, that forms and colours melted into each other tenderly in his dream-world, and that his sense of gradation was the most delicate ever possessed by man" (Hamerton).

If Turner had died early his reputation as an artist would have been very different from what it ultimately became. He would not have been recognized as a colourist. It was only after the year 1820 that colour began to assert itself strongly in his work. He painted for many a year in greys and greens and browns, went steadily through "the subdued golden chord," and painted yellow mists and suns rising through vapour; but as time went on that was no longer enough, and he tried to paint the sun in his strength and the full glories of sunshine. The means at the painter's disposal are, however, limited, and Turner, in his efforts after brilliancy, began to indulge in reckless experiments in colour. He could not endure even the slightest restraints which technical limitations impose, but went on trying to paint the unpaintable. As a water-colour painter Turner stands pre-eminent; he is unquestionably the greatest master in that branch of art that ever lived. If his work is compared with that of Barrett, or Varley, or Cozens, or Sandby, or any of the earlier masters, so great is Turner's superiority that the art in his hands seems to be lifted altogether into a higher region.

In 1843 a champion, in the person of John Ruskin, arose to defend Turner against the unjust and ignorant attacks of the press, and what at first was intended as a "short pamphlet, reprobating the manner and style of these critics," grew into the five volumes of *Modern Painters*. Ruskin employed all his eloquence and his great critical faculty to prove how immeasurably superior Turner was to all who had ever gone before, hardly restricting his supremacy to landscape art, and placing him among the "seven supreme colourists of the world."

Like most men of note, Turner had his enemies and detractors, and it is to be regretted that so many of the stories they set in circulation against his moral character should have been repeated by one of his biographers, who candidly admits having "spared none of his faults," and excuses himself for so doing by "what he hopes" is his "undeviating love of truth." The immense quantity of work accomplished by Turner during his lifetime, work full of the utmost delicacy and refinement, proves the singularly fine condition of his nervous system, and is perhaps the best answer that can be given to the charge of being excessively addicted to sensual gratification. In his declining years he possibly had recourse to stimulants to help his failing powers, but it by no means follows that he went habitually to excess in their use. He never lost an opportunity of doing a kindness, and under a rough and cold exterior there was more good and worth hidden than the world imagined. "During the ten years I knew him," says Ruskin, "years in which he was suffering most from the evil-speaking of the world, I never heard him say one depreciating word of any living man or man's work; I never saw him look an unkind or blameful look; I never knew him let pass, without sorrowful remonstrance, or endeavour at mitigation, a blameful word spoken by another. Of no man, but Turner, whom I have ever known could I say this." Twice during his earlier days there are circumstances leading to the belief that he had the hope of marriage, but on both occasions it ended in disappointment, and his home after his father died was cheerless and solitary.

Two biographies of Turner have been written, one by Thornbury, the other by P. G. Hamerton. The work of the latter deserves the highest commendation; it gives a clear and consistent history of the great artist, and is characterized by refined thought and critical insight. An excellent little book by W. Cosmo Monkhouse may also be noticed. Books upon Turner continue to appear, although it is scarcely to be expected that they can add to the facts already known about him. *Turner and Ruskin* an exposition of the work of Turner from the writings of Ruskin, edited with a biographical note on Turner by Frederick Wedmore, in two volumes, with ninety-one illustrations, was published by George Allen in 1900. Perhaps the most important recent work upon his art is Sir Walter Armstrong's *Turner* (1901), which deals at considerable length with the events of his life, and with his pictures in oil and his drawings in water-colour. It also gives so far as possible a list of his oil pictures, and for the first time a pretty full list of his water colours, although the great painter's works in both media are so numerous that it would be impossible to say that either is complete. See also *J. M. W. Turner*, by W. L. Wyllie, A.R.A. (1905). The great authority on the *Liber Studiorum* is W. G. Rawlinson (Turner's *Liber Studiorum*, 2nd ed., 1906). (G. Rɪ.)

TURNER, NAT (1800–1831), the negro leader of a slave insurrection in Virginia, known as the "Southampton Insurrection," was born in Southampton county, Virginia, in 1800. From his childhood he claimed to see visions and hear voices, and he became a Baptist preacher of great influence among the negroes. In 1828 he confided to a few companions that a voice from heaven had announced that "the last shall be first," which was interpreted to mean that the slaves should control. An insurrection was planned, and a solar eclipse in February 1831 and peculiar atmospheric conditions on the 13th of August were accepted as the signal for beginning the work. On the night of the 21st of August 1831, with seven companions, he entered the home of his master, Joseph Travis, and murdered the inmates. After securing guns, horses and liquor they visited other houses, sparing no one. Recruits were added, in some cases by compulsion, until the band numbered about sixty. About noon on the 22nd they were scattered by a small force of whites, hastily gathered. Troops, marines and militia were hurried to the scene, and the negroes were hunted down. In all thirteen men, eighteen women, and twenty-four children had been butchered. After hiding for several weeks Nat was captured on the 30th of October and was tried and hanged, having made, meanwhile, a full confession. Nineteen of his associates were hanged and twelve were sent out of the state. The insurrection, which was attributed to the teachings of the abolitionists, led to the enactment of stricter slave codes.

See S. B. Weeks, "Slave Insurrections in Virginia," in *Magazine of American History*, vol. xxxi. (New York, 1891), and W. S. Drewry, *The Southampton Insurrection* (Washington, 1900).

TURNER, SHARON (1768–1847), English historian, was born in Pentonville, London, on the 24th of September 1768. His parents came from Yorkshire. He was educated at a private school kept by Dr Davis in Pentonville, and was articled to a solicitor in the Temple in 1783, and when his master died in 1789 he continued the business. He remained in business at first in the Temple, and later in Red Lion Square till 1829, when failing health compelled him to retire. He settled for a time at Winchmore Hill, but afterwards returned to London, and died in his son's house on the 13th of February 1847. In early boyhood he had been attracted by a translation of the "Death Song of Ragnar Lodbrok," and was led by this boyish interest to make a study of early English history in Anglo-Saxon and Icelandic sources. He devoted all the time he could spare from his business to the study of Anglo-Saxon documents in the British Museum. The material was abundant and had hitherto been neglected. When the first volume of his *History of England from the earliest times to the Norman Conquest* appeared in 1799, it was at once recognized as a work of equal novelty and value. The fourth volume appeared in 1805. He also published a continuation (*History of England during the Middle Ages*), a *Modern History of England*, a *Sacred History of the World*, and a volume on *Richard III.* (1845), and he was the author of pamphlets on the copyright laws (1813).

His son, Sydney Turner (1814–1879), educated at Trinity College, Cambridge, took orders, was known as a strong partisan of reformatory schools, and died rector of Hempstead in Gloucestershire.

TURNER, WILLIAM (d. 1568), English divine, botanist and physician, was born at Morpeth in Northumberland, and was educated at Pembroke Hall, Cambridge, where he was elected junior fellow in 1530. He learnt Greek from Nicholas Ridley, and, hearing Hugh Latimer preach, threw in his lot with the new faith. In 1538 he published his *Libellus de re herbaria*, and in 1540 set out to preach in different places. For doing this without a licence he suffered imprisonment, and on his release travelled in Holland, Germany, Italy and Switzerland, always increasing his knowledge of botany and medicine, collecting plants, and writing books on religion which were so popular in England that they were forbidden by proclamation in July 1546. On the accession of Edward VI. he became chaplain and physician to the duke of Somerset and in 1550 prebendary of York. In November 1550 he was made dean of Wells, but in 1553 was deprived, and during Queen Mary's reign lived at various places in Germany, mostly along the Rhine. Returning to England in 1558 he regained his deanery, and did all he could to disparage episcopacy and ceremonial, and to bring the Anglican Church into conformity with the Reformed Churches of Germany and Switzerland. On the complaint of his bishop, Gilbert Berkeley, he was suspended for Nonconformity in 1564. He passed his last days in Crutched Friars, London, and died on the 7th of July 1568. Turner was a sound and keen botanist, and introduced lucerne into England. He was a racy writer, a man of undoubted learning, and a vigorous controversialist.

TURNHOUT, a town of Belgium, in the province of Antwerp, 26 m. N.E. of that city. Pop. (1904), 22,162. It carries on an active industry in cloth and other manufactures. There is a breeding establishment for leeches. The hôtel de ville was formerly a palace of the dukes of Brabant. Two miles west of Turnhout is the curious penal or reformatory colony of Merxplas (pop. in 1904, 2827). The system of this establishment is to allow certain approved prisoners to follow their usual occupations within a defined area. The persons detained have complete liberty of movement, subject to the two conditions that they are under the supervision of guardians and are not allowed to cross the boundaries of the settlement. They also wear a distinct dress, and each prisoner bears a number.

TURNIP, *Brassica campestris*, var. *Rapa*, a hardy biennial, found in cornfields in various parts of England. It has been cultivated from a remote period for its fleshy roots. The tender growing tops are also used in spring as a green vegetable. The so-called "root" is formed by the thickening of the primary root of the seedling together with the base of the young stem (hypocotyl) immediately above it. The great mass of the "root" consists of soft "wood" developed internally by the cambium layer and composed mainly of thin-walled, unlignified, wood-parenchyma. The stem remains short during the first year, the leaves forming a rosette-like bunch at the top of the "bulb"; they are grass-green and bear rough hairs. In the second season the bud in the centre of the rosette forms a strong erect branched stem bearing somewhat glaucous smooth leaves. The stem and branches end in corymbose racemes of small, bright yellow flowers, which are succeeded by smooth, elongated, short-beaked pods.

The varieties of turnip are classified according to their shape as (1) long varieties, with a root three or more times as long as broad; (2) tankard or spindle-shaped varieties, with a root about twice as long as broad; (3) round or globe varieties with an almost spherical root; (4) flat varieties with a root broader than long; there are also many intermediate forms. Turnips are also grouped according to the colour of the upper part of the root which comes above ground, and according to the colour of the flesh, which is white or yellow. The yellow-fleshed varieties, many of which are probably hybrids between the turnip and swede, are more robust, of slower growth and superior feeding value to the white-fleshed turnips, and are less injured by frost.

The swede-turnip, *Brassica campestris*, var. *Napo-brassica*, differs from the turnip proper in having the first foliage-leaves glaucous, not grass-green, in colour, and the later leaves smooth and glaucous; the root bears a distinct neck with well-marked leaf-scars, the flesh is yellow or reddish-orange, firmer and more nutritious, and the roots keep much better during winter. The flowers are larger and buff-yellow or pale orange in colour and the seeds are usually larger and darker than in the turnip.

Turnips should be grown in a rich friable sandy loam, such as will produce medium-sized roots without much aid from the manure heap, and are better flavoured if grown in fresh soil. In light dry soils well decomposed hotbed or farmyard manure is the best that can be used, but in soils containing an excess of organic matter, bone dust, superphosphate of lime, wood-ashes or guano, mixed with light soil, and laid in the drills before sowing the seed, are beneficial by stimulating the young plants to get quickly into rough leaf, and thus to grow out of reach of the so-called turnip fly or turnip flea (*Phyllotreta*). To get rid of this pest, it has been found beneficial to dust the plants with quicklime, and also to draw over the young plants nets smeared with some sticky substance like treacle, by which large numbers will be caught and destroyed. It has been also recommended as a palliative to sow thick in order to allow for a percentage of loss from this and other causes, but this is inadvisable, as overcrowding is apt to render the plants weak. As a preventive, gas-lime may be scattered over the surface after the seed has been sown. Lime is also effective against the disease known as "finger and toe" (*q.v.*).

The first sowing should be made on a warm border, with the protection of a frame or matted hoops, in January or February; the second on a well-sheltered border in March, after which a sowing once a month will generally suffice. In May and June the plot should be in a cool moderately shaded position, lest the plants should suffer from drought. The principal autumn and winter sowings, which are the most important, should be made about the end of June in the northern districts, and in the beginning of July in warmer districts; a small sowing may be made at the end of August to come in before the spring-sown crops are ready. If the weather is showery at the time of sowing, the seed speedily germinates, and the young plants should be kept growing quickly by watering with rain or pond water and by surface stirrings. The drills for the earliest sorts need not be more than 15 in. apart, and the plants may be left moderately thick in the row; the late crops should have at least 2 ft. between the rows, and be thinned to 12 in. in the row, a free circulation of air about them being very important in winter. As a provision against prolonged periods of severe weather it has been recommended to lay the finest roots in rows, covering them well with soil, and leaving intact the whole of the foliage. The very latest sown crops of half-grown roots will prolong the supply until the earliest spring-sown crops are fit for use.

TURNPIKE, a pike or pointed bar or stake which turns or revolves, hence the name given to a form of barrier consisting of three or more horizontal bars, with one end sharpened, revolving on a pivot. Such barriers were used across roads, and, when tolls were exacted from passengers along highways to raise the money for the upkeep of the roads, the name, though not the form, was given both to the toll-gates set up at different places where the tolls were collected, and to the highways repaired under the system (see HIGHWAY).

A "turnstile," consisting of a vertical post with projecting, revolving arms, is another form of barrier, placed by the side of a gate across a road, or across a path to prevent the passage of all except foot passengers, or at the entrance to any building, park or other place as a means of controlling the admission of people, of collecting admission money and the like.

TURNSTONE, the name long given[1] to a shore-bird, from its habit of turning over with its bill such stones as it can to seek its food in the small crustaceans or other animals lurking beneath them. It is the *Tringa interpres*[2] of Linnaeus and *Strepsilas interpres* of most later writers, and is remarkable as being perhaps the most cosmopolitan of birds; for, though properly belonging to the northern hemisphere, there is scarcely a sea-coast in the world on which it may not occur: it has been obtained from Spitzbergen to the Strait of Magellan and from Point Barrow to the Cape of Good Hope and New Zealand—examples from the southern hemisphere being, however, almost invariably in a state of plumage that shows, if not immaturity, yet an ineptitude for reproduction. It also, though much less commonly, resorts to the margins of inland rivers and lakes; but it is very rarely seen except near water, and salt water for preference.

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[1] The name seems to appear first in F. Willughby's *Ornithologia* (p. 231) in 1676: but he gave as an *alias* that of Sea-Dottrel, under which name a drawing, figured by him (pl. 58), was sent to him by Sir Thomas Browne.

[2] Linnaeus (*Oel. och Gothländska Resa*, p. 217), who first met with this bird on the island of Gottland (July 1, 1741), was under the mistaken belief that it was there called Tolk (=*interpres*). But that name properly belongs to the REDSHANK (*q.v.*), from the cry of warning to other animals that it utters on the approach of danger.

The turnstone is about as big as an ordinary snipe; but, compared with most of its allies of the group Limicolae, to which it belongs, its form is somewhat heavy, and its legs are short. Still it is brisk in its movements, and its variegated plumage makes it a pleasing bird. Seen in front, its white face, striped with black, and broad black gorget attract attention as it sits, often motionless, on the rocks; while in flight the white of the lower part of the back and white band across the wings are no less conspicuous even at a distance. A nearer view will reveal the rich chestnut of the mantle and upper wing-coverts, and the combination of colours thus exhibited suggests the term "tortoise-shell" often applied to it—the quill-feathers being mostly of a dark brown and its lower parts pure white. The deeper tints are, however, peculiar to the nuptial plumage, or are only to be faintly traced at other times, so that in winter the adults—and the young always—have a much plainer appearance, ashy-grey and white being almost the only hues observable. From the fact that turnstones may be met with at almost any season in various parts of the world, and especially on islands as the Canaries, Azores, and many of those in the British seas, it has been inferred that these birds may breed in such places. In some cases this may prove to be true, but in most evidence to that effect is wanting. In America the breeding-range of this species has not been defined. In Europe there is good reason to suppose that it includes Shetland; but it is on the north-western coast of the Continent, from Jutland to the extreme north of Norway, that the greatest number are reared. The nest, contrary to the habits of most Limicolae, is generally placed under a ledge of rock which shelters the bird from observation,[1] and therein are laid four eggs, of a light olive-green, closely blotched with brown, and hardly to be mistaken for those of any other bird. A second species of turnstone is admitted by some authors and denied by others. This is the *S melanocephalus* of the Pacific coast of North America, which is on the average larger than *S. interpres*, and never exhibits any of the chestnut colouring.

Though the genus *Strepsilas* seems to be rightly placed among the Charadriidae (see PLOVER), it occupies a somewhat abnormal position among them, and in the form of its short pointed beak and its variegated coloration has hardly any very near relative. (A. N.)

TURNU MAGURELE, the capital of the department of Teleorman, Rumania; 2½ m. N.E. of the confluence of the Olt and Danube, at the terminus of a branch railway Pop. (1900), 8668. A ferry plies across the Danube to the Bulgarian fortress of Nicopolis. Large quantities of grain are shipped in lighters to Braila. There are some vestiges of a Roman bridge across the Danube, built (*c.* A.D. 330) by Constantine the Great.

TURNU SEVERIN, the capital of the department of Mehedintzi, Rumania, on the main Walachian railway, and on the left bank of the river Danube, below the Iron Gates cataracts. Pop. (1900), 18,628. It is a modern commercial town, having a school of arts and crafts, several churches, and large government yards for the building of river steamers, lighters and tug-boats. There is a considerable trade in livestock, preserved meat, petroleum and cereals. The town, which was originally called Drobetae by the Romans, took its later name of Turris Severi, or the "Tower of Severus," from a tower which stood on a small hill surrounded by a deep fosse. This was built to commemorate a victory over the Quadi and Marcomanni, by the Roman emperor Severus (A.D. 222–235). Near Turnu Severin are the remains of the celebrated Trajan's bridge, the largest in the Roman Empire, built in A.D. 103 by the architect Apollodorus of Damascus. The river is about 4000 ft. broad at this spot. The bridge was composed of twenty arches supported by stone pillars, several of which are still visible at low water.

TURPENTINE (in M. Eng. *turbentine*, adapted through the O. Fr. *turbentine* or *terebentine* from Lat. *terebinthina*, sc. *resina*, resin of the terebinth, Gr. *τερέβινθος* or *τέρμινθος*), the oleo-resins which exude from certain trees, especially from some conifers—such as *Pinus sylvestris*—and from the terebinth tree, *Pistacia terebinthus, L.* It was to the product of the latter, now known as Chian turpentine, that the term was first applied. The terebinth tree and its resin were well known and highly prized from the earliest times. The tree is a native of the islands and shores of the Mediterranean, passing eastward into Central Asia; but the resinous exudation found in commerce is collected in the island of Chios. Chian turpentine is a tenacious semi-fluid transparent body, yellow to dull brown in colour, with an agreeable resinous odour and little taste. On exposure to the air it becomes dry, hard and brittle. In their natural characters, turpentines are soft solids or semi-fluid bodies, consisting of resins dissolved in turpentine oil, the chief constituent of which is pinene. They are largely used in the arts, being separated by distillation into rosin or colophony (see ROSIN), and oil or spirit of turpentine.

Crude or common turpentine is the commercial name which embraces the oleo-resin yielded by several coniferous trees, both European and American. The principal European product, sometimes distinguished as Bordeaux turpentine, is obtained from the cluster pine, *Pinus Pinaster*, in the Landes department of France. Crude turpentine is further yielded by the Scotch fir, *P. sylvestris*, throughout northern Europe, and by the Corsican pine, *P. Laricio*, in Austria and Corsica. In the United States the turpentine-yielding pines are the swamp pine, *P. australis*, and the loblolly, *P. Taeda*, both inhabiting North and South Carolina, Georgia and Alabama. *Venice turpentine* is yielded by the larch tree, *Larix europaea*, from which it is collected principally in Tirol. *Strassburg turpentine* is obtained from the bark of the silver fir; but it is collected only in small quantities. Less known turpentines are obtained from the mountain pine, *P. Pumilio*, the stone pine, *P Cembra*, the Aleppo pine, *P. halepensis*, &c. The so-called *Canada balsam*, from *Abies balsamea*, is also a true turpentine.

Oil of Turpentine, or *Turps*, as a commercial product is obtained from all or any of these oleo-resins, but on a large scale only from crude or common turpentine. The essential oil is rectified by redistillation with water and alkaline carbonates, and the water which the oil carries over with it is removed by a further distillation over calcium chloride. Oil of turpentine is a colourless liquid of oily consistence, with a strong characteristic odour and a hot disagreeable taste. It begins to boil at about 155° C., and its specific gravity is between 0·860 and 0·880. It rotates the plane of polarized light both to right and left in varying degrees according to its sources, the American product being dextrorotatory and the French laevorotatory. It is almost insoluble in water, is miscible with absolute alcohol and ether, and dissolves sulphur, phosphorus, resins and caoutchouc. On exposure to the air it dries to a solid resin, and absorbing oxygen gives off ozone—a reaction utilized in the disinfectant called "Sanitas." Agitated with successive quantities of sulphuric acid and distilled in a current of steam, it yields terebene, a mixture of dipentene and terpinene mainly, which is used in medicine. Chemically, oil of turpentine is a more or less complex mixture of hydrocarbons generically named terpenes (*q.v.*). Oil of turpentine is largely used in the preparation of varnishes and as a medium by painters in their "flat" colours.

Pharmacology and Therapeutics.—Oil of turpentine (*Oleum terebinthinae*) is administered internally as an anthelmintic to kill tapeworm. Applied externally it possesses, in higher degree than any of its fellows, the properties of the volatile oils. It acts as a rubefacient, an irritant and a counter-irritant. It is also an antiseptic and, in small quantities, a feeble anaesthetic. It is absorbed by the unbroken skin. The drug is largely employed as a counter-irritant, the pharmacopoeial liniments being very useful applications. Such conditions as myalgia, bronchitis, "chronic rheumatism" and pleurisy are often relieved by its use. It may also be employed as a parasiticide in ringworm and similar conditions.

In large doses oil of turpentine causes purging and may induce much haemorrhage from the bowel; it should be combined with some trustworthy aperient, such as castor oil, when given as an anthelmintic. It is readily absorbed unchanged and has a marked contractile action upon the blood vessels. This gives it the rare and valuable property of a remote haemostatic, erroneously supposed to be possessed by so many useless drugs. It must not be used to check haemorrhage from the kidneys (haematuria) owing to its irritant action on those organs, but in haemoptysis (haemorrhage from the lungs) it is often an invaluable remedy. In large doses it has a depressant action on the nervous system, leading even to coma and total abolition of reflex action. The drug is excreted partly by the bronchi—which it tends to disinfect—and partly in the urine, which it causes to smell of violets. Glycuronic acid also appears in the urine A small portion of the drug is removed by the skin, in which it may give rise to an erythematous rash. It must not be given to the subjects of Bright's disease.

Perhaps the most valuable of all the medicinal applications of turpentine, and one which is rarely, if ever, mentioned in therapeutic textbooks—owing to the fact that gynaecology has been so extremely specialized—is in inoperable cancer of the uterus. Quite

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[1] There is little external difference between the sexes, and the brightly contrasted colours of the hen-bird seem to require some kind of concealment.

90% of these cases are seen too late for operation, and nearly all recur after operation. The exhausting pain, the serious haemorrhages, and the abdominal septicity associated with a repulsive odour and the absorption of toxic products, which are the chief and ultimately fatal symptoms of that disease, are all directly combated by the administration of oil of turpentine. So beneficial is the action that for years there prevailed the unfortunately erroneous belief that Chian turpentine is actually curative in this condition. But it undoubtedly prolongs life, lessens suffering, and by checking the growth of bacteria upon the cancer reduces the fetid odour and the symptoms of septic intoxication.

Old turpentine and French oil of turpentine are antidotes to phosphorus, forming turpentine-phosphoric acid, which is inert.

TURPIN (d. *c.* 800), archbishop of Reims, was for many years regarded as the author of the legendary *Historia de vita Caroli Magni et Rolandi*, and appears as one of the twelve peers in a number of the *chansons de geste*. He is probably identical with Tilpin, archbishop of Reims in the 8th century, who is alluded to by Hincmar, his third successor in the see. According to Flodoard, Charles Martel drove Rigobert, archbishop of Reims, from his office and replaced him by a warrior clerk named Milo, afterwards bishop of Trier. The same writer represents Milo as discharging a mission among the Vascones, or Basques, the very people to whom authentic history has ascribed the great disaster which befell the army of Charlemagne at Roncesválles. It is thus possible that the warlike legends which have gathered around the name of Turpin are due to some confusion of his identity with that of his martial predecessor. Flodoard says that Tilpin was originally a monk at St Denis, and Hincmar tells how after his appointment to Reims he occupied himself in securing the restoration of the rights and properties of his church, the revenues and prestige of which had been impaired under Milo's rule. Tilpin was elected archbishop between 752 and 768, probably in 753; he died, if the evidence of a diploma alluded to by Mabillon may be trusted, in 794, although it has been stated that this event took place on the 2nd of September 800. Hincmar, who composed his epitaph, makes him bishop for over forty years, and from this it is evident that he was elected about 753, and Flodoard says that he died in the forty-seventh year of his archbishopric. Tilpin was present at the Council of Rome in 769, and at the request of Charlemagne Pope Adrian I. sent him the pallium and confirmed the rights of his church.

The *Historia Caroli Magni* was declared authentic in 1122 by Pope Calixtus II. It is, however, entirely legendary, being rather the crystallization of earlier Roland legends than the source of later ones, and its popularity seems to date from the latter part of the 12th century. Gaston Paris, who made a special study of the *Historia*, considers that the first five chapters were written by a monk of Compostella in the 11th century and the remainder by a monk of Vienne between 1109 and 1119. The popularity of the work is attested by the fact that there are at least five French translations of the *Historia* dating from the 13th century and one into Latin verse of about the same time. According to August Potthast there are about fifty manuscripts of the story in existence. The *Historia* was first printed in 1566 at Frankfort; perhaps the best edition is the one edited by F. Castets as *Turpini historia Karoli magni et Rotholandi* (Paris, 1880). It has been translated many times into French and also into German, Danish and English. The English translation is by T. Rodd and is in the *History of Charles the Great and Orlando, ascribed to Turpin* (London, 1812). See G. Paris, *De pseudo-Turpino* (Paris, 1865), and *Histoire poétique de Charlemagne*, new ed. by P. Meyer (1905); and V. Friedel, "Études compostellanes" in *Otia Merceiana* (Liverpool, 1899).

TURPIN, FRANÇOIS HENRI (1709–1799), French man of letters, was born at Caen. He was first a professor at the university of his native town, then went to seek his fortunes in Paris, where he made some stir in philosophical circles, and especially in that of the magnificent Helvétius; but he was only enabled with difficulty to earn a livelihood by putting his pen at the service of the booksellers. He translated, or rather adapted from the English, Edward W. Montague's *Histoire du gouvernement des anciennes républiques* (1769), and wrote a continuation of Father Pierre Joseph d'Orléans, *Histoire des révolutions d'Angleterre* (1786). His *Histoire naturelle et civile du royaume de Siam* (1771) is an interesting but faulty adaptation of the observations of a vicar-apostolic who had lived for a long time in that country, and who accused Turpin of having misrepresented his ideas. His chief work, *La France illustre, ou Le Plutarque français*, contains the biographies of generals, ministers, and eminent officers of the law (5 vols., 1777–1790), in which, however, as La Harpe said, he showed himself to be "ni Plutarque ni Français." He also wrote an *Histoire des hommes publics tirés du tiers état* (1789).

TURPIN, RICHARD [DICK] (1706–1739), English robber, was born in 1706 at Hempstead, near Saffron Walden, Essex, where his father kept an alehouse. He was apprenticed to a butcher, but, having been detected at cattle-stealing, joined a notorious gang of deer-stealers and smugglers in Essex. This gang also made a practice of robbing farmhouses, terrorizing the women in the absence of their husbands and brothers, and Turpin took the lead in this class of outrage. On the gang being broken up Turpin went into partnership with Tom King, a well-known highwayman. To avoid arrest he finally left Essex for Lincolnshire and Yorkshire, where he set up under an assumed name as a horse dealer. He was convicted at York assizes of horse-stealing and hanged on the 7th of April 1739. Harrison Ainsworth, in his romance *Rookwood*, gives a spirited account of a wonderful ride by Dick Turpin on his mare, Black Bess, from London to York, and it is in this connexion that Turpin's name has been generally remembered. But as far as Turpin is concerned the incident is pure fiction. A somewhat similar story was told about a certain John Nevison, known as "Nicks," a well-known highwayman in the time of Charles II., who to establish an alibi rode from Gad's Hill to York (some 190 m.) in about 15 hours. Both stories are possibly only different versions of an old north road myth.

TURQUOISE, a mineral much used as an ornamental stone for the sake of its blue or bluish-green colour. It is generally held that the name indicates its source as a stone from Turkey, the finest kinds having come from Persia by way of Turkey, whence it was called by the Venetians who imported it *turchesa*, and by the French *turquoise*. The old form *turkis*, used by Tennyson, agrees with the German *Türkis*. Some authorities have suggested that the word may be a corruption of the Persian name of the stone *piruzeh*. Turquoise is a crypto-crystalline mineral, occurring in small reniform nodules or as an incrustation, or in thin seams and disseminated grains. Its mode of occurrence suggests its formation by deposition from solution, and indeed it is sometimes found in stalactitic masses. The typical colour is a delicate sky-blue, but the blue passes by every transition into green. In some cases the colour deteriorates as the stone becomes dry, and may be seriously affected by exposure to sunlight; whilst with age there is often a tendency to become green, as seen in examples of ancient turquoise. The mineral is always opaque in mass, but generally translucent in thin splinters. Turquoise takes a fair polish, but the lustre is feeble, and inclines to be waxy; the hardness is nearly 6, the specific gravity between 2·6 and 2·8.

Much discussion has arisen as to the chemical composition of turquoise. It is commonly regarded as a hydrous aluminium phosphate having the composition $2Al_2O_3 \cdot P_2O_5 \cdot 5H_2O$ or rather $Al_2HPO_4(OH)_4$, coloured with a variable proportion of a copper phosphate, or perhaps partly with an iron phosphate. Professor S. L. Penfield, however, has been led by careful analysis of turquoise from Nevada to propose the general formula: $[Al(OH)_2, Fe(OH)_2, Cu(OH), H]_3PO_4$. Hence turquoise may be regarded chemically as derived from orthophosphoric acid by replacement of the hydrogen by the univalent radicles $Al(OH)_2$, &c. An ingenious counterfeit of turquoise has been formed by compressing a precipitate of cupriferous aluminium phosphate.

Turquoise is usually cut as an ornamental stone in circular or elliptical form, with a low convex surface. In the East, where it is used not only for personal ornament but for the decoration of dagger-handles, horse-trappings, &c., the pieces are not unusually of irregular shape; and when worn as amulets the turquoise is often engraved with Oriental inscriptions, generally passages from the Korān, the incised characters being gilt or inlaid with gold wire. The turquoise has always been associated with curious superstitions, the most common being the notion that it changes colour with variations in the state of the owner's health or even in sympathy with his affections. It is commonly held to be a "lucky stone."

In Persia, where the finest turquoise is found, the mines have been worked for at least eight centuries. The workings have been described by General Houtum Schindler, an Austrian, who was at one time in charge of the mines. The principal locality is north-west of the village of Madan, on the southern slopes of Mt Ali-Mirsai, a peak near Nishapur, in the province of Khorasan. Here the turquoise occurs in narrow seams in a brecciated trachyte-porphyry. It is found also in some other localities in Persia and in Turkestan. Jean Baptiste Tavernier (1605–1689) states that the best turquoise, reserved for the sole use of the shah, was obtained from the Vieille Roche, whilst inferior stones were got from the Nouvelle Roche. These terms still survive, for turquoise of fine colour is sometimes said in trade to be from the "old rock," and that of pale tint or of unstable colours is described as from the "new rock." The latter is sometimes not true Oriental turquoise, but the material called "bone-turquoise" or odontolite, and known also as "occidental turquoise." This is merely fossil bone or ivory coloured by iron phosphate (vivianite) or perhaps stained in some cases by cupriferous solutions, and is readily distinguished from true turquoise by showing organic structure under the microscope. Bone-turquoise occurs in Europe; and it may be noted that mineral turquoise also is known from certain localities in Saxony and Silesia, but the quantity is very limited and the quality poor, so that it has no commercial importance. Chrysocolla has been sometimes mistaken in various parts of the world for turquoise.

In 1849 turquoise was found by Major C. Macdonald in Wadi Maghara and Wadi Sidreh in the Sinaitic Peninsula; and a large series of the specimens was shown in the Great Exhibition of 1851. According to H. Bauerman, who described the locality geologically, the turquoise occurs in a red sandstone, in the form of embedded nodules and as an incrustation lining the joint-faces. The turquoise was worked for some time by Macdonald, and many years afterwards workings were resumed on a systematic scale by an English company, but without great success. Relics of extensive ancient mining operations for turquoise show that the rock was at one time worked with flint implements. The locality was examined by Professor Flinders Petrie in 1905.

In ancient Mexico much use was made of turquoise as an inlay for mosaic work, with obsidian, malachite, shell and iron pyrites. Such work is illustrated by fine specimens in the ethnographical gallery of the British Museum and elsewhere. Relics of extensive workings are found in the mountains of Los Cerillos near Santa Fé in New Mexico, where mining for turquoise is now actively carried on. One of the hills in which old workings occur has been called Mt Chalchihuitl, since it is believed that the turquoise was known by the name chalchihuitl, which in some places was applied also to jade. Another of the Cerillos hills in which workings have been opened up is called Turquoise Hill. The matrix at Los Cerillos is described by D. W. Johnson as an altered angite-andesite, in which the turquoise occurs in thin veins and in small nodules in patches of kaolin. It appears probable that the alumina of the turquoise was derived from the alteration of felspar, and the phosphorus from apatite in the rock, whilst the copper was brought up by heated vapours which altered the andesite. Turquoise is found also at Turquoise Mountain, Cochise county, Arizona, and at Mineral Park, Mohave county, in the same state; it occurs in the Columbus district, southern Nevada; in Fresno county, California; and near Idaho, Clay county, Alabama. Mexican turquoise is known from the state of Zacatecas. Turquoise was discovered in 1894 near Bodalla, in New South Wales; and it has also been found in Victoria.

Turquoise is sometimes termed by mineralogists callaite, since it is believed to be the *callais* of Pliny—a stone which he describes as resembling lapis lazuli, but paler, and in colour more like the shallow sea. The *callaina* of Pliny was a pale green stone from beyond India, whilst his *callaica* was a kind of turbid callaina. The name callainite was suggested by Professor J. D. Dana for a bright green mineral which was found in the form of beads, with stone hatchets, in ancient graves near Mané-er-H'roek (Rock of the Fairy), near Locmariaquer in Brittany, and which A. Damour sought to identify with Pliny's *callais*. The mineral in question seems to be identical with variscite, a hydrous aluminium phosphate named by A. Breithaupt, and occurring as a beautiful green amorphous mineral, sometimes polished as an ornamental stone; fine examples occur in Utah. Somewhat allied to turquoise is the blue mineral called lazulite (to be distinguished from lazurite, see LAPIS LAZULI), which has the formula $(Fe,Mg)Al_2(OH)(PO_4)$, and has occasionally been used as an ornamental stone. (F. W. R.*)

TURRET (from O. Fr. *tourette*, diminutive of *tour*, tower, mod. Fr. *tourelle*), a small tower, especially at the angles of larger buildings, sometimes overhanging and built on corbels, when it is often called a "bartizan" (*q.v.*), and sometimes rising from the ground.

TURRETIN, or TURRETINI, the name of three Swiss divines.

BENOÎT TURRETIN (1588–1631), the son of Francesco Turretini, a native of Lucca, who settled in Geneva in 1570, was born at Zürich on the 9th of November 1588. He was ordained a pastor in Geneva in 1612, and became professor of theology in 1618. In 1620 he represented the Genevan Church at the national synod of Alais, when the decrees of the synod of Dort were introduced into France; and in 1621 he was sent on a successful mission to the states-general of Holland, and to the authorities of the Hanseatic towns, with reference to the defence of Geneva against the threatened attacks of the duke of Savoy. He published in 1618–1620 (2 vols.) a defence of the Genevan translation of the Bible, *Eine Verteidigung der genfer Bibelubersetzung* (*Défense de la fidélité des traductions de la Bible faites à Genève*), against P. Cotton's *Genève plagiaire*. He died on the 4th of March 1631.

FRANÇOIS TURRETIN (1623–1687), son of the preceding, was born at Geneva on the 17th of October 1623. After studying theology in Geneva, Leiden and France, he became pastor of the Italian congregation in Geneva in 1647; after a brief pastorate at Lyons he again returned to Geneva as professor of theology in 1653, having modestly declined a professorship of philosophy in 1650. He was one of the most influential supporters of the *Formula Consensus Helvetica*, drawn up chiefly by Johann Heinrich Heidegger (1633–1698), in 1675, and of the particular type of Calvinistic theology which that symbol embodied, and an opponent of the theology of Moses Amyraut and the school of Saumur. His *Institutio theologicae elencticae* (3 vols., Geneva 1680–1683) has passed through frequent editions, the last reprint having been made in Edinburgh in 1847–1848. He was also the author of volumes entitled *De satisfactione Christi disputationes* (Geneva, 1666) and *De necessaria secessione nostra ob ecclesia romana* (Geneva, 1687). He died on the 28th of September 1687.

JEAN ALPHONSE TURRETIN (1671–1737), son of the preceding, was born at Geneva on the 13th of August 1671. He studied theology at Geneva under L. Tronchin, and after travelling in Holland, England and France was received into the "Vénérable Compagnie des Pasteurs" of Geneva in 1693. Here he became pastor of the Italian congregation, and in 1697 professor of church history, and later (1705) of theology. During the next forty years of his life he enjoyed great influence in Geneva as the advocate of a more liberal theology than had prevailed under the preceding generation, and it was largely through his instrumentality that the rule obliging ministers to subscribe to the *Formula Consensus Helvetica* was abolished in 1706, and the *Consensus* itself renounced in 1725. He also wrote and laboured for the promotion of union between the Reformed and Lutheran Churches, his most important work in this connexion being *Nubes testium pro moderato et pacifico de rebus theologicis judicio, et instituenda inter Protestantes concordia* (Geneva, 1729). Besides this he wrote *Cogitationes et dissertationes theologicae*, on the principles of natural and revealed religion (2 vols., Geneva, 1737; in French, *Traité de la vérité de la religion chrétienne*) and commentaries on Thessalonians and Romans. He died on the 1st of May 1737.

See E. de Budé, *François et J. Alphonse Turretini* (2 vols., 1880), and *Lettres inédites à Jean Alphonse Turretini* (3 vols., 1887–1888); F. Turretini, *Notice biographique sur Bénédict Turretini* (1871); C. Borgeaud, *Histoire de l'université de Genève* (1900).

TURRIFF, a municipal and police burgh of Aberdeenshire, Scotland. Pop. (1901), 2273. It lies near the Deveron, 38½ m. N.W. of Aberdeen by the Great North of Scotland railway, via Inveramsay. In the choir of the ancient church, now in ruins, is a fresco painting of St Ninian. On the 14th of May 1639 the national struggle for civil and religious liberty was inaugurated in the county with the skirmish known as the Trot of Turriff. Some 4 m. south are the remains of the castle of Towie Barclay, the seat of the old family of the Barclays.

TURRIS LIBISONIS (mod. Porto Torres, *q.v.*), an ancient seaport town of Sardinia, situated at the north-western extremity of the island, and connected with Carales by two roads, which diverged at Othoca, one (the more important) keeping inland and the other following the west coast. It was probably of purely Roman origin, founded apparently by Julius Caesar, as it bears the title Colonia Julia; and in Pliny's time it was the only colony in the island. It is noteworthy that it apparently belonged to one of the urban tribes the Collina; Puteoli, which belonged to the Palatina is the only other exception to the rule that *municipia* and *coloniae* were not enrolled in the urban tribes. A Roman bridge of seven arches, somewhat restored in modern times, the ruins of a temple (now known as Il Palazzo del Re Barbaro), which an inscription found there shows to have been restored (A.D. 247–249) by the *praefectus* of the province, together with the basilica, an aqueduct, various buildings (S. Valero Usni in *Notizie degli scavi* (1882), 121, A. Taramelli, ibid. (1904), 145) and some rock tombs, still exist.

The inscriptions from Turris Libisonis are given by Th. Mommsen in *Corp. inscr. lat.* x. 826; V. Dessì in *Notizie degli scavi* (1898), 260; A. Taramelli, ibid. (1904), 141. One of them (*C.I.L.* No. 7954) mentions the construction of a fountain basin, another the construction of a quay (*ripa turritana*): substructions may still be seen under water when the sea is clear. (T. As.)

TURSHIZ, a district of the province of Khorasan in Persia, lying E. of the great salt desert. It has a population of nearly 20,000 and pays a yearly revenue of about £7000. It produces and exports wool, cotton, silk and much dried fruit, of the latter particularly raisins and Alû Bukhara, "Bokhara prunes." The chief place and capital of the district is Sultanabad, generally called Turshiz, like the district, situated 225 m. south-east by east from Shahrud and 100 m. south-west from Meshed, in 35° 10′ N. 58° 34′ E., at an elevation of 2200 ft. It is surrounded by a dilapidated wall and has a population of about 8000.

TURTON, an urban district in the Westhoughton parliamentary division of Lancashire, England, 4 m. N. of Bolton, on the Lancashire & Yorkshire railway. Pop. (1901), 12,355. Its modern growth is the result of the development of the cotton trade in its various branches; and there are large stone quarries in the vicinity. There remains in the township a curious building named Turton Tower, dating principally from the 16th century, and containing some fine contemporary woodwork.

TUSCALOOSA, a city and the county-seat of Tuscaloosa county, Alabama, U.S.A., in the west-central part of the state, on the Black Warrior river, about 55 m. S.W. of Birmingham and about 100 m. N.W. of Montgomery. Pop. (1900), 5094; (local census, 1908), 7140 (3551 negroes); (1910 U.S. census), 8407. It is served by the Alabama Great Southern and the Mobile & Ohio railways. The Black Warrior river, formerly not navigable beyond Tuscaloosa, has been improved by the United States government, and there are three locks in or near the city. Tuscaloosa lies between the foothills of the Appalachians to the north-east and the low alluvial valley of the Black Warrior. It has many old-fashioned residences and gardens, and a fine Federal building. It is the seat of the university of Alabama; of the Alabama Central Female College (Baptist, 1858), which occupies the old state capitol; of the Tuscaloosa Female College (Methodist Episcopal, South, 1860); of Stillman Institute (Presbyterian, 1876; originally the Tuscaloosa Institute for the Education of Coloured Ministers; named in honour of its founder, Dr Charles A. Stillman, in 1897); and of Alabama Bryce Hospital for the Insane (1861). The university of Alabama was founded by an act of the state legislature of 1820, the United States government having donated 46,080 acres of public lands for this purpose in the preceding year; in 1831 the university was opened at Tuscaloosa, then the state capital. On the 4th of April 1865 all the buildings of the university, except the observatory, were burned by a body of Federal cavalry, and the university was closed thereafter until 1869; in 1884 the United States government gave another 46,080 acres of public lands in restitution, and in 1907 the state legislature appropriated $445,000 for new buildings. The university is a part of the public school system of the state, and is governed by a board of trustees, consisting of the governor and the superintendent of education of the state, of two members from the congressional district in which the university is situated, and of one member from each of the other congressional districts of the state. The university includes, besides a college and a graduate school, departments of engineering, law, medicine (formerly the Medical College of Alabama, established in 1859) and pharmacy (the two last in Mobile), and a summer school for teachers, and in 1908-9 had 60 instructors and 887 students. In the city there are several manufacturing establishments, principally cotton and lumber mills; and in the immediate vicinity there are important coal, coke and iron interests—there is a large iron furnace, pipe foundry and coking plant at Holt, about 4 m. north-east of the city.

Tuscaloosa derives its name from an Indian chief, who, after a desperate battle with De Soto at Mauvilla (the site of which is not definitely known) in 1540, is said to have hanged himself in order to escape capture, and is commemorated by a granite monolith in the Court House Square; the name is said to mean "black warrior." The first settlement of whites was made in 1815. The city was chartered in 1819, and in 1826–1846 it was the capital of Alabama.

TUSCANA (mod. Toscanella, *q.v.*), an ancient town of Etruria, about 15 m. N.E. of Tarquinii. It is hardly mentioned in ancient literature; it was a station on the road from Blera to Saturnia, a prolongation of the Via Clodia. On the hill of S. Pietro are remains of walling of the Roman period. A number of Etruscan tombs were found by the Campanari brothers in the 19th century, and their valuable contents are in various European museums.

TUSCANY (*Toscana*), a territorial division of Italy, consisting of the western part of the centre of the peninsula, bounded N.W by Liguria and Emilia, E. by the Marches and Umbria, S.E. by the province of Rome and W. by the Mediterranean. It consists of eight provinces, Arezzo, Firenze (Florence), Grosseto, Livorno (Leghorn), Lucca, Massa-Carrara, Pisa and Siena, and has an area of 9304 sq. m. Pop. (1901), 2,566,741. The chief railway centre is Florence, whence radiate lines to Bologna (for Milan and the north), Faenza, Lucca, Pisa and Leghorn, and Arezzo for Rome. Siena stands on a branch leaving the Florence-Pisa line at Empoli and running through the centre of Tuscany to Chiusi, where it joins the Florence-Rome railway. The line from Rome to Genoa runs along the coast throughout the entire length of Tuscany, and at Montepescali throws off a branch joining the Empoli-Chiusi line at Asciano, and at Follonica another to Massa Marittima.

Except towards the coast and around Lucca, Florence and Arezzo, where the beds of prehistoric lakes form plains, the country is hilly, being intersected with sub-Apennine spurs. The most fertile country in Tuscany is in the valley of the Arno, where the plains and slopes of the hills are highly cultivated. In strong contrast with this is the coast plain known as the Maremma, 850 sq. m. in extent, where malaria has been prevalent since the depopulation of the country in the middle ages. Here in the first half of the 19th century the grand duke Leopold II. of Tuscany began an elaborate system of drainage, which was gradually extended until it covered nearly the whole of the district. The greater part of the Maremma now affords pasture to large herds of horses and half-wild cattle, but on the drier parts corn is grown, the people coming down from the hills to sow and to reap. The hill country just inland, especially near Volterra, has poor soil, largely clayey, and subject to landslips, but is rich in minerals. But for the Maremma, Tuscany is one of the most favoured regions of Italy. The climate is temperate, and the rainfall not excessive. The Apennines shelter it from the cold north winds, and the prevailing winds in the west, blowing in from the Tyrrhenian Sea, are warm and humid, though Florence is colder and more windy than Rome in the winter and hotter in summer, owing to its being shut in among the mountains. Wheat, maize, wine (especially the red wine which takes the name of Chianti from the district S.S.W. of Florence), olive oil, tobacco, chestnuts and flowers are the chief products of Tuscany. Mules, sheep and cattle are bred, and beeswax is produced in large quantities. But the real wealth of Tuscany lies in its minerals. Iron, mercury, boracic acid, copper, salt, lignite, statuary marble, alabaster and Sienese earth are all found in considerable quantities, while mineral and hot springs abound, some of which (*e.g.* Montecatini and Bagni di Lucca) are well known as health resorts. The industries of Tuscany are exceedingly varied and carried on with great activity. There are universities at Pisa and Siena. Viareggio and Leghorn are much frequented for sea-bathing, while the latter is a prosperous port.

The main art centres of Tuscany are Florence, Pisa and Siena, the headquarters of the chief schools of painting and sculpture from the 13th century onwards. While the former city, however, bore as prominent a part as any in Italy in the Renaissance, the art of Pisa ceased, owing to the political decline of the city, to make any advance at a comparatively early period, its importance being in ecclesiastical architecture in the 12th, and in sculpture in the 13th century. Siena, too, never accepted the Renaissance to the full, and its art retained an individual character without making much progress.

The language of Tuscany is remarkable for its purity of idiom, and its adoption by Dante and Petrarch probably led to its becoming the literary language of Italy. (See ITALIAN LANGUAGE, vol. xiv. p. 895.)

See E. Repetti, *Dizionario geografico fisico storico della Toscana* (6 vols., Florence, 1834–1846). See also G. Dennis, *Cities and Cemeteries of Etruria* (2 vols., London, 1883). On medieval and Renaissance architecture and art there are innumerable works. Among those on architecture may be mentioned the great work of H. von Geymüller and A. Widmann, *Die Architektur der Renaissance in Toscana*. (T. As.)

History.—Etruria (*q.v.*) was finally annexed to Rome in 351 B.C., and constituted the seventh of the eleven regions into which Italy was, for administrative purposes, divided by Augustus. Under Constantine it was united into one province with Umbria, an arrangement which subsisted until at least 400, as the *Notitia* speaks of a "consularis Tusciae et Umbriae." In Ammianus Marcellinus there is implied a distinction between "Tuscia suburbicaria" and "Tuscia annonaria," the latter being that portion which lies to the north of the Arno. After the fall of the Western empire Tuscia, with other provinces of Italy, came successively under the sway of Herulians, Ostrogoths, and Greek and Lombard dukes. Under the last-named, "Tuscia Langobardorum," comprising the districts of Viterbo, Corneto and Bolsena, was distinguished from "Tuscia Regni," which lay more to the north. Under Charlemagne the name of Tuscia or Toscana became restricted to the latter only. One of the earliest of the Frankish marquises was Boniface, either first or second of that name, who about 828 fought with success against the Saracens in Africa. Adalbert I., who succeeded him, in 878 espoused the cause of Carloman as against his brother Louis III. of France, and suffered excommunication and imprisonment in consequence. Adalbert II. (the Rich), who married the ambitious Bertha, daughter of Lothair, king of Lorraine, took a prominent part in the politics of his day. A subsequent marquis, Hugo (the Great), became also duke of Spoleto in 989. The male line of marquises ended with Boniface II. (or III.), who was murdered in 1052. His widow, Beatrice, in 1055 married Godfrey, duke of Lorraine, and governed the country till her death in 1076, when she was succeeded by Matilda (*q.v.*), her only child by her first husband. Matilda died in 1114 without issue, bequeathing all her extensive possessions to the Church. The consequent struggle between the popes, who claimed the inheritance, and the emperors, who maintained that the countess had no right to dispose of imperial fiefs, enabled the principal cities of Tuscany gradually to assert their independence. The most important of these Tuscan republics were Florence, Pisa, Siena, Arezzo, Pistoia and Lucca.

The Return of the Medici.—After the surrender of Florence to the Imperialists in August 1530 the Medici power was re-established by the emperor Charles V. and Pope Clement VII., although certain outward forms of republicanism were preserved, and Alessandro de' Medici was made duke of Florence, the dignity to be hereditary in the family. In the reign of Cosimo ~~III~~. Siena was annexed (1559); the title of grand duke of Tuscany was conferred on that ruler in ~~1567~~ by Pope Pius V. and recognized in the person of Francis I. by the emperor Maximilian II. in 1576. Under a series of degenerate Medici the history of Tuscany is certainly not a splendid record, and few events of importance occurred save court scandals. The people became more and more impoverished and degraded, a new and shoddy nobility was created and granted wide privileges, and art and letters declined. Giovan Gastone was the last Medicean grand duke; being childless, it was agreed by the treaty of Vienna that at his death Tuscany should be given to Francis, duke of Lorraine, husband of the archduchess Maria Theresa, afterwards empress. In 1737 Giovan Gastone died,[1] and Francis II., after taking possession of the grand duchy, appointed a regency under the prince of Craon and departed for Austria never to return. Tuscany was governed by a series of foreign regents and was a prey to adventurers from Lorraine and elsewhere; although the administration was not wholly inefficient and introduced some useful reforms, the people were ground by taxes to pay for the apanage of Francis in Vienna and for Austrian wars, and reduced to a state of great poverty. Francis, who had been elected emperor in 1745, died in 1765, and was succeeded on the throne of the grand duchy by his younger son, Leopold I.

The Reforms of Leopold II.

Leopold resided in Tuscany and proved one of the most capable and remarkable of the reforming princes of the 18th century. He substituted Tuscans for foreigners in government offices, introduced a system of free trade in foodstuffs (at the suggestion of the Sienese Sallustio Bandini), promoted agriculture, and reclaimed wide areas of marshland to intensive cultivation. He reorganized taxation on a basis of equality for all citizens, thereby abolishing one of the most vexatious privileges of the nobility, reformed the administration of justice and local government, suppressed torture and capital punishment, and substituted a citizen militia for the standing army. His reforms in church matters made a great stir at the time, for he curbed the power of the clergy, suppressed some religious houses, reduced the mortmain and rejected papal interference. With the aid of Scipione de' Ricci, bishop of Pistoia, he even attempted to remove abuses, reform church discipline and purify religious worship; but Ricci's action was condemned by Rome. Ricci was forced to resign, and the whole movement came to nothing. (See PISTOIA, SYNOD OF.) The grand duke also contemplated granting a form of constitution, but his Teutonic rigidity was not popular and many of his reforms were ahead of the times and not appreciated by the people. At the death of his brother, Joseph II., in 1790, Leopold became emperor, and repaired to Vienna. After a brief regency he appointed his second son, Ferdinand III., who had been born and brought up in Tuscany, grand duke.

The French Occupation.

During the French revolutionary wars Ferdinand tried to maintain neutrality so as to avoid foreign invasions, but in 1799 a French force entered Florence and was welcomed by a small number of republicans. The grand duke was forced to fly, the "tree of liberty" was set up, and a provisional government on French lines established. But the great mass of the people were horrified at the irreligious character of the new régime, and a counter-revolution, fomented by Pope Pius VII., the grand ducalists and the clergy, broke out at Arezzo. Bands of armed peasants marched through the country to the cry of "Viva Maria!" and expelled the French, not without committing many atrocities. With the assistance of the Austrians, who put an end to disorder, Florence was occupied and the grand ducalists established a government in the name of Ferdinand. But after Napoleon Bonaparte's victory at Marengo the French returned in great force, dispersed the bands, and re-entered Florence (October 1800). They too committed atrocities and sacked the churches, but they were more warmly welcomed than before by the people, who had experienced Austro-Aretine rule. Joachim Murat (afterwards king of Naples) set up a provisional government, and by the peace of Lunéville Tuscany was made a part of the Spanish dominions and erected into the kingdom of Etruria under Louis, duke of Parma (1801). The new king died in 1803, leaving an infant son, Charles Louis, under the regency of his widow, Marie Louise of Spain. Marie Louise ruled with reactionary and clerical tendencies until 1807, when the emperor Napoleon obliged Charles IV. of Spain to cede Tuscany to him, compensating Charles Louis in Portugal.

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[1] The history of Tuscany from 1530 to 1737 is given in greater detail under MEDICI.

Cos I, 1569

From 1807 to 1809, when Napoleon's sister, Elisa Baciocchi, was made grand duchess, Tuscany was ruled by a French administrator-general; the French codes were introduced, and Tuscany became a French department. French ideas had gained some adherents among the Tuscans, but to the majority the new institutions, although they produced much progress, were distasteful as subversive of cherished traditions. After Napoleon's defeats in 1814 Murat seceded from the emperor and occupied Tuscany, which he afterwards handed over to Austria, and in September Ferdinand III. returned, warmly welcomed by nearly everybody, for French rule had proved oppressive, especially on account of the heavy taxes and the drain of conscription. At the Congress of Vienna he was formally reinstated with certain additions of territory and the reversion of Lucca. On Napoleon's escape from Elba Murat turned against the Austrians, and Ferdinand had again to leave Florence temporarily; but he returned after Waterloo, and reigned until his death in 1824.

The Restoration.

The restoration in Tuscany was unaccompanied by the excesses which characterized it elsewhere, and much of the French legislation was retained. Ferdinand was succeeded by his son, Leopold II., who continued his father's policy of benevolent but somewhat enervating despotism, which produced marked effects on the Tuscan character. In 1847 Lucca was incorporated in the grand duchy. When the political excitement consequent on the election of Pius IX. spread to Tuscany, Leopold made one concession after another, and in February 1848 granted the constitution. A Tuscan contingent took part in the Piedmontese campaign against Austria, but the increase of revolutionary agitation in Tuscany, culminating in the proclamation of the republic (Feb. 9, 1849), led to Leopold's departure for Gaeta to confer with the pope and the king of Naples. Disorder continuing and a large part of the population being still loyal to him, he was invited to return, and he did so, but accepted the protection of an Austrian army, by which act he forfeited his popularity (July 1849). In 1852 he formally abrogated the constitution, and three years later the Austrians departed. When in 1859 a second war between Piedmont and Austria became imminent, the revolutionary agitation, never completely quelled, broke out once more. There was a division of opinion between the moderates, who favoured a constitutional Tuscany under Leopold, but forming part of an Italian federation, and the popular party, who aimed at the expulsion of the house of Lorraine and the unity of Italy under Victor Emmanuel. At last a compromise was arrived at and the grand duke was requested to abdicate in favour of his son, grant a constitution, and take part in the war against Austria. Leopold having rejected these demands, the Florentines rose as one man and obliged him to quit Tuscany (April 27, 1859). A provisional government, led by Ubaldino Peruzzi and afterwards by Bettino Ricasoli, was established. It declared war against Austria and then handed over its authority to Boncompagni, the Sardinian royal commissioner (May 9). A few weeks later a French force under Prince Napoleon landed in Tuscany to threaten Austria's flank, but in the meanwhile the emperor Napoleon made peace with Austria and agreed to the restoration of Leopold and other Italian princes. Victor Emmanuel was obliged to recall the royal commissioners, but together with Cavour he secretly encouraged the provisional governments to resist the return of the despots, and the constituent assemblies of Tuscany, Romagna and the duchies voted for annexation to Sardinia. A Central Italian military league and a customs union were formed, and Cavour having overcome Napoleon's opposition by ceding Nice and Savoy, the king accepted the annexations and appointed his kinsman, Prince Carignano, viceroy of Central Italy with Ricasoli as governor-general (March 22, 1860). The Sardinian parliament which met in April contained deputies from Central Italy, and after the occupation of the Neapolitan provinces and Sicily the kingdom of Italy was proclaimed (Feb. 18, 1861). In 1865, in consequence of the Franco-Italian convention of September 1864, the capital was transferred from Turin to Florence, where it remained until it was removed to Rome in 1871.

Union with the Italian Kingdom.

Since the union with Italy, Tuscany has ceased to constitute a separate political entity, although the people still preserve definite regional characteristics. It has increased in wealth and education, and owing to a good system of land tenure the peasantry are among the most prosperous in Italy.

Bibliography.—A. von Reumont, *Geschichte Toscanas* (2 vols., Gotha, 1876–1877); Zobi, *Storia civile della Toscana* (Florence, 1850); E. Robiony, *Gli ultimi dei Medici* (Florence, 1905); C. Tivaroni, *Storia critica del risorgimento italiano* (9 vols., Turin, 1888, &c.); M. Bartolommei-Gioli, *Il Rivolgimento toscano e l'azione popolare* (Florence, 1905). See also under Florence; Medici; Ferdinand III.; Leopold II.; Bartolommei; Ricasoli, &c. (L. V.*)

TUSCARORA, a tribe of North American Indians of Iroquoian stock. Their former range was on the Neuse river, North Carolina. Here in 1700 they lived in fifteen villages and were estimated at 6000. In 1711, as a protest against the encroachments on their territory, they declared war on the white settlers. After two years they were defeated and fled north to the Iroquois, in whose famous league they became the sixth nation, settling on the territory of the Oneida Indians, in New York state. In the War of American Independence some of the tribe fought for the English and some against them. The remnant of them is divided between reservations in Canada and New York, and numbers about 700.

TUSCULUM, an ancient city of Latium, situated in a commanding position on the north edge of the outer crater ring of the Alban volcano, 1½ m. N.E. of the modern Frascati. The highest point is 2198 ft. above sea-level. It has a very extensive view of the Campagna, with Rome lying 15 m. distant to the north-west. Rome was approached by the Via Latina (from which a branch road ascended to Tusculum, while the main road passed through the valley to the south of it), or by the Via Tusculana (though the antiquity of the latter road is doubtful).

According to tradition, the city was founded by Telegonus, the son of Ulysses and Circe. When Tarquinius Superbus was expelled from Rome his cause was espoused by the chief of Tusculum, Octavius Mamilius, who took a leading part in the formation of the Latin League, composed of the thirty principal cities of Latium, banded together against Rome. Mamilius commanded the Latin army at the battle of Lake Regillus (497 B.C.), but was killed, and the predominance of Rome among the Latin cities was practically established. According to some accounts Tusculum became from that time an ally of Rome, and on that account frequently incurred the hostility of the other Latin cities. In 381 B.C., after an expression of complete submission to Rome, the people of Tusculum received the Roman franchise, but without the vote, and thenceforth the city continued to hold the rank of a *municipium*. Other accounts, however, speak of Tusculum as often allied with Rome's enemies —last of all with the Samnites in 323 B.C. Several of the chief Roman families were of Tusculan origin, *e.g.* the gentes Mamilia, Fulvia, Fonteia, Juventia and Porcia; to the last-named the celebrated Catos belonged. The town council kept the name of senate, but the title of dictator gave place to that of aedile. Notwithstanding this, and the fact that a special college of Roman *equites* was formed to take charge of the cults of the gods at Tusculum, and especially of the Dioscuri, the citizens resident there were neither numerous nor men of distinction. The villas of the neighbourhood had indeed acquired greater importance than the not easily accessible town itself, and by the end of the Republic, and still more during the imperial period, the territory of Tusculum was one of the favourite places of residence of the wealthy Romans. The number and extent of the remains almost defy description, and can only be made clear by a map. Even in the time of Cicero we hear of eighteen owners of villas there. Much of the territory (including Cicero's villa), but not the town itself, which lies far too high, was supplied with water by the Aqua Crabra. On the hill of Tusculum itself are remains of a small theatre (excavated in 1839), with a reservoir behind it, and an amphitheatre. Both belong probably to the imperial period, and so does a very large villa (the substructures of which are preserved), by some attributed, but wrongly, to Cicero, by others to Tiberius, near the latter. Between the amphitheatre and the theatre is the site of the Forum, of which nothing is now visible, and to the south on a projecting spur were tombs of the Roman period. There are also many remains of houses and villas. The citadel—which stood on the highest point an abrupt rock—was approached only on one side, that towards the city, and even here by a steep ascent of 150 ft. Upon it remains of the medieval castle, which stood here until 1191, alone are visible. The city walls, of which some remains still exist below the theatre, are built of blocks of the native "lapis Albanus" or peperino. They probably belong to the republican period. Below them is a well-house, with a roof formed of a pointed arch—generally held to go back to a somewhat remote antiquity, but hardly with sufficient reason.

The most interesting associations of the city are those connected with Cicero, whose favourite residence and retreat for study and literary work was at, or rather near, Tusculum. It was here that he composed his celebrated *Tusculan Disputations* and other philosophical works. Much has been written on the position of his villa, but its true site still remains doubtful. The theory, which places it at or near Grotta Ferrata, some distance farther to the west, has most evidence to support it. Although Cicero (*Pro Sestio*, 43) speaks of his own house as being insignificant in size compared to that of his neighbour Gabinius, yet we gather from other notices in various parts of his works that it was a considerable building. It comprised two gymnasia (*Div.* i. 5), with covered *porticus* for exercise and philosophical discussion (*Tusc. Disp.* ii. 3). One of these, which stood on higher ground, was called "the Lyceum," and contained a library (*Div.* ii. 3); the other, on a lower site, shaded by rows of trees, was called "the Academy." The main building contained a covered *porticus*, or cloister, with apsidal recesses (*exedrae*) containing seats (see *Ad Fam.* vii. 23). It also had bathrooms (*Ad Fam.* xiv. 20), and contained a number of works of art, both pictures and statues in bronze and marble (*Ep. ad Att.* i. 1, 8, 9, 10). The central atrium appears to have been small, as Cicero speaks of it as an *atriolum* (*Ad Quint. Fr.* iii. 1). The cost of this and the other house which he built at Pompeii led to his being burdened with debt (*Ep. ad Att.* ii. 1). Nothing now exists which can be asserted to be part of Cicero's villa with any degree of certainty. During the imperial period little is recorded about Tusculum; but soon after the transference of the seat of empire to Constantinople it became a very important stronghold, and for some centuries its counts occupied a leading position in Rome and were specially influential in the selection of the popes. During the 12th century there were constant struggles between Rome and Tusculum, and towards the close of the century (1191) the Romans, supported by the German emperor, gained the upper hand, and the walls of Tusculum, together with the whole city, were destroyed.

See L. Canina, *Descr. dell' antico Tusculo* (Rome, 1841); A. Nibby, *Dintorni di Roma*, iii. 293 (2nd ed., Rome, 1841); H. Dessau in *Corp. inscript. lat.* pp. 252 sqq. (Berlin, 1887); F. Grossi-Gondi, *Il Tuscolano nell' età classica* (Rome, 1907); T. Ashby in *Papers of the British School at Rome*, iv. 5 (London, 1907, 1909). (T. As.)

TUSKEGEE, a town and county-seat of Macon county, Alabama, U.S.A., in the east part of the state, about 40 m. E. of Montgomery. Pop. (1900) 2170; (1910) 2803. It is served by the Tuskegee railway, which connects it with Chehaw, 5 m. distant, on the Western railway of Alabama. The city manufactures cotton seed. Tuskegee is chiefly known for its educational institutions—the Tuskegee Normal and Industrial Institute and the Alabama Conference Female College (Methodist Episcopal Church, South; opened 1856). The former was founded in 1880 by an act of the state legislature as the Tuskegee State Normal School, and was opened in July 1881 by Booker T. Washington for the purpose of giving an industrial education to negroes; in 1893 it was incorporated under its present name. In 1899 the national Congress granted to the school 25,000 acres of mineral lands, of which 20,000 acres, valued at $200,000, were unsold in 1909. Andrew Carnegie gave $600,000 to the institute in 1903, and the institute has a Carnegie library (1902), with about 15,000 volumes in 1909. In 1909 the endowment was about $1,389,600, and the school property was valued at about $1,117,660. It had in 1909 a property of 2345 acres (of which 1000 were farm lands, 1145 pasture and wood lands, and 200 school campus), and 100 buildings, many of brick, and nearly all designed and constructed, even to the making of the bricks, by the teachers and students. The state of Alabama appropriated $2000 for teachers' salaries in 1880, increased the appropriation to $3000 in 1884, and for many years gave $4500 annually; the school receives $10,000 annually from the John F. Slater Fund, and the same sum from the General Education Board. The institute comprises an academic department (in which all students are enrolled) with a seven years' course, the Phelps Hall bible training school (1892), with a three years' course, and departments of mechanical industries, industries for girls, and agriculture. The department of agriculture has an experiment station, established by the state in 1896, in which important experiments in cotton breeding have been carried on. There are a farm, a large truck garden, an orchard, and a bakery and canning factory. Forty different industries are taught. Cooking schools and night schools are carried on by the institute in the town of Tuskegee. In 1908–1909 the enrolment was 1494 students, of whom about one-quarter were women, and there were 167 teachers, all negroes. Tuition in the institute is free; board and living cost $8.50 a month; day students are allowed to "work-out" $1.50–$3.00 a month of this amount, and night students may thus pay all their expenses. At Tuskegee under the auspices of the institute are held the annual negro conferences (begun in 1891) and monthly farmers' institutes (begun in 1897); and short courses in agriculture (begun in 1904) are conducted. Farmers' institutes are held throughout the South by teachers of the school. In 1905 the institute took up the work of rural school extension. A model negro village (South Greenwood) has been built west of the institute grounds on land bought by the institute in 1901. Affiliated with the institute and having its headquarters in Tuskegee is the National Negro Business League (1900). The success of the institute is due primarily to its founder and principal, Booker T. Washington, and to the efficient board of trustees, which has included such men as Robert C. Ogden and Seth Low. Tuskegee was settled about 1800.

See Booker T. Washington, *Working With the Hands* (New York, 1904); and Thrasher, *Tuskegee, Its Story and Its Work* (Boston, 1900).

TUSSAUD, MARIE (1760–1850), founder of "Madame Tussaud's Exhibition" of wax figures in London, was born in Berne in 1760, the daughter of Joseph Grosholtz (d. 1760), an army officer. Her uncle, a doctor of Berne, John Christopher Curtius, had attracted the attention of the prince de Conti by his beautiful anatomical wax models, and had been induced to move to Paris, abandon his profession, and practise wax modelling as a fine art. His house became the resort of many of the talented men of the day, and here he brought his niece at the age of six, and taught her to model in wax. She became such an adept that she early modelled many of the great people of France, and was finally sent for to stay at the palace at Versailles to instruct the sister of Louis XVI., Mme Elizabeth, in the popular craze. It was from Curtius's exhibition that the mob obtained the busts of Necker and the duke of Orleans that were carried by the procession when on the 12th of July 1789 the first blood of the French Revolution was shed. During the terrible days that followed Marie Grosholtz was called upon to model the heads of many of the prominent leaders and victims of the Revolution, and was herself for three months a prisoner, having fallen under the suspicion of the committee of public safety. In 1794 she married a Frenchman named Tussaud, from whom she was separated in 1800. Her uncle having died in the former year, after some difficulty she secured permission from Napoleon to leave France, and she took with her to London the nucleus of her collection from the *cabinet de cire* in the Palais Royal, and the idea of her "Chamber of Horrors" from Curtius's *Caverne des Grands Voleurs*, in the Boulevard du Temple. Her wax figures were successfully shown in the Strand on the site of the Lyceum theatre, and through the provinces, and finally the exhibition was established in permanent London quarters in Baker Street in 1833. Here Mme Tussaud died on the 16th of April 1850. She was succeeded by her son Francis Tussaud, he by his son Joseph, and he again by his son John Theodore Tussaud (b. 1859). The exhibition was moved in 1884 to a large building in Marylebone Road.

TUSSER, THOMAS (*c.* 1524–1580), English poet, son of William and Isabella Tusser, was born at Rivenhall, Essex, about 1524. At a very early age he became a chorister in the collegiate chapel of the castle of Wallingford, Berkshire. He appears to have been pressed for service in the King's Chapel, the choristers of which were usually afterwards placed by the king in one of the royal foundations at Oxford or Cambridge. But Tusser entered the choir of St Paul's Cathedral, and from there went to Eton College. He has left a quaint account of his privations at Wallingford, and of the severities of Nicholas Udal at Eton. He was elected to King's College, Cambridge, in 1543, a date which has fixed the earliest limit of his birth-year, as he would have been ineligible at nineteen. From King's College he moved to Trinity Hall, and on leaving Cambridge went to court in the service of William, 1st Baron Paget of Beaudesart, as a musician. After ten years of life at court, he married and settled as a farmer at Cattiwade, Suffolk, near the river Stour, where he wrote his *Hundreth Good Pointes of Husbandrie* (1557, 1561, 1562, &c.). He never remained long in one place. For his wife's health he removed to Ipswich. After her death he married again, and farmed for some time at West Dereham. He then became a singing man in Norwich Cathedral, where he found a good patron in the dean, John Salisbury. After another experiment in farming at Fairsted, Essex, he removed to London, whence he was driven by the plague of 1572–1573 to find refuge at Trinity Hall, being matriculated as a servant of the college in 1573. At the time of his death he was in possession of a small estate at Chesterton, Cambridgeshire, and his will proves that he was not, as has sometimes been stated, in poverty of any kind, but had in some measure the thrift he preached. Thomas Fuller says he "traded at large in oxen, sheep, dairies, grain of all kinds, to no profit"; that he "spread his bread with all sorts of butter, yet none would stick thereon." He died on the 3rd of May 1580. An erroneous inscription at Manningtree, Essex, asserts that he was sixty-five years old.

The *Hundreth Good Pointes* was enlarged to *A Hundreth good pointes of husbandry, lately maried unto a hundreth good poyntes of huswifery* . . . the first extant edition of which, "newly corrected and amplified," is dated 1570. In 1573 appeared *Five hundreth pointes of good husbandry* . . . (reprinted 1577, 1580, 1585, 1586, 1590, &c.). The numerous editions of this book, which contained a metrical autobiography, prove that the homely and practical wisdom of Tusser's verse was appreciated. He gives directions of what is to be done in the farm in every month of the year, and minute instructions for the regulation of domestic affairs in general. The later editions include *A dialogue of wyvynge and thryvynge* (1562). Modern editions are by William Mavor (1812), by H. M. W. (1848), and by W. Payne and Sidney J. Herrtage for the English Dialect Society (1878).

TUTBURY, a town in the Burton parliamentary division of Staffordshire, England, 4½ m. N.W. of Burton-upon-Trent, picturesquely situated on the river Dove, a western tributary of the Trent, which forms the county boundary with Derbyshire. Pop. (1901), 1971. The station of the Great Northern and North Staffordshire railways is in Derbyshire. The fine church of St Mary has a nave of rich Norman work with a remarkable western doorway; there are Early English additions, and the apsidal chancel is a modern imitation of that style. There are ruins of a large castle standing high above the valley; these include a gateway of 14th-century work, strengthened in Caroline times, a wall enclosing the broad "Tilt Yard," and portions of dwelling rooms. Glass is the staple manufacture. Alabaster is found in the neighbourhood.

The early history of Tutbury (*Toteberie, Stutesbury, Tuttebiri, Tudbury*) is very obscure. It is said to have been a seat of the Mercian kings. After the Conquest it was granted to Hugh d'Avranches, who appears to have built the first castle there. At the time of the Domesday Survey the castle was held by Henry de Ferrers, and "in the borough round it were 42 men living by their merchandize alone." Tutbury was the centre of an honour in Norman times, but the town remained small and unimportant, the castle and town continuing in the hands of the Ferrers until 1266, when, owing to Robert de Ferrers's participation in the barons' revolt, they were forfeited to the Crown and granted to Edmund Crouchback, earl of Lancaster. They are still part of the duchy of Lancaster. Tutbury Castle was partially rebuilt by John of Gaunt, whose wife, Constance of Castile, kept her court there. Later it was, for a time, the prison of Mary Queen of Scots. During the Civil War it was held for the king but surrendered to the parliamentary forces (1646), and was reduced to ruins by order of parliament (1647). Richard III. granted to the inhabitants of Tutbury two fairs, to be held respectively on St Katharine's day and the feast of the Invention of the Cross; the fair on the 15th of August was famous until the end of the 18th century for its bull coursing, said to have been originally introduced by John of Gaunt.

In 1831 a large treasure of English silver coins of the 13th and 14th centuries was discovered in the bed of the river, and a series was placed in the British Museum. This treasure was believed to have been lost by Thomas, the rebellious earl of Lancaster, who was driven from Tutbury Castle by Edward II. in 1322.

See Mosley, *History of Castle, Priory and Town of Tutbury* (1832); *Victoria County History*: *Stafford*.

TUTICORIN, a seaport of British India in the Tinnevelly district of Madras. Pop. (1901), 28,048. It is the southern terminus of the South Indian railway, 443 m. S.W. of Madras city. In connexion with this railway a daily steamer runs to Colombo, 149 m. distant by sea. Tuticorin is an old town, long in possession of the Dutch, and has a large Roman Catholic population. It used to be famous for its pearl fisheries, which extended from Cape Comorin to the Pamban Channel between India and Ceylon; but owing to the deepening of the Pamban Channel in 1895 these banks no longer produce the pearl oysters in such remunerative quantities, though conch shells are still found and exported to Bengal. As a set-off to this, Tuticorin has advanced greatly as a port since the opening of the railway in 1875, though it has only an open roadstead, where vessels must anchor two and a half miles from the shore; it is the second port in Madras and the sixth in all India. The exports are chiefly rice and livestock to Ceylon, cotton, tea, coffee and spices. There are factories for ginning and pressing cotton and a cotton mill.

TUTOR (Lat. *tutor*, guardian, *tueri*, to watch over, protect), properly a legal term, borrowed from Roman law, for a guardian of an infant (see ROMAN LAW and INFANT). Apart from this usage, which survives particularly in Scots law, the word is chiefly current in an educational sense of a teacher or instructor. It is thus specifically applied to a fellow of a college at a university with particular functions, connected especially with the supervision of the undergraduate members of the college. These functions differ in various universities. Thus, at Oxford, a fellow, who is also a tutor, besides lecturing, or taking his share of the general teaching of the college, has the supervision and responsibility for a certain number of the undergraduates during their period of residence; at Cambridge the tutor has not necessarily any teaching functions to perform, but is more concerned with the economic and social welfare of the pupils assigned to his care. In American universities the term is applied to a teacher who is subordinate to a professor, his appointment being for a year or a term of years.

TUTTLINGEN, a town of Germany, in the kingdom of Württemberg, on the left bank of the Danube, which is here crossed by a bridge, 37 m. by rail N.E. of Schaffhausen, and at the junction of lines to Stuttgart and Ulm. Pop. (1905), 14,627. The town is overlooked by the ruins of the castle of Honberg, which was destroyed during the Thirty Years' War, and has an Evangelical and a Roman Catholic church, several schools, and a monument to Max Schneckenburger (1819–1849), the author of *Die Wacht am Rhein*. Its chief manufactures are shoes, cutlery, surgical instruments and woollen goods, and it has a trade in fruit and grain.

Tuttlingen is a very ancient place, and is chiefly memorable for the victory gained here on the 24th of November 1643 by the Austrians and Bavarians over the French. It was almost totally destroyed by fire in 1803. It has belonged to Württemberg since 1404.

TUXEDO, a town of Orange county, New York, U.S.A., about 40 m. N.N.W. of New York City, near the New Jersey state line. Pop. (1890), 1678; (1900), 2277; (1905), 2865; (1910), 2858. Tuxedo is served by the Erie railway. About 1½ m. west of the railway station is Tuxedo Lake, which with 13,000 acres of surrounding country was taken for debt in 1814 by the elder Pierre Lorillard, who built a shooting-box here and sold wood from the land. The second Pierre Lorillard (1833–1901) formed the Tuxedo Park Association for the development of the tract, and on the 1st of June 1886 the Tuxedo Club and Tuxedo Park were opened; here there has grown up a remarkable collection of private establishments for the enjoyment of country life by certain wealthy families, who form a social club to whom the privileges are restricted. The area covers a variety of wild and cultivated scenery, and is beautifully laid out and utilized; there are golf links, a tennis and racket club, and game preserves, with excellent trout and bass fishing in the lake.

TUY, a city of north-western Spain, in the province of Pontevedra, on the right bank of the river Miño (Portuguese *Minho*), opposite Valença do Minho, which stands on the left bank in Portuguese territory. Pop. (1900), 11,113. Tuy is the southern terminus of the railways to Santiago de Compostela and Corunna; Valença do Minho is the northern terminus of the Portuguese railway to Oporto. Near Tuy rises the Monte San Cristobal, whose far-spreading spurs constitute the fertile and picturesque Vega del Oro. To the east is the river Louro, a right-hand tributary of the Miño abounding in salmon, trout, lamprey, eels and other fishes; and beyond the Louro, on the railway to Corunna, are the hot mineral springs of San Martin de Caldelas. Tuy is a clean and pleasant city with well-built houses, regular streets and many gardens. The cathedral, founded in the 12th century, but largely restored between the 15th and 19th, is of a massive and fortress-like architecture. Its half-ruined cloister and noble eastern façade date from the 14th century. There are several large convents and ancient parish churches, an old episcopal palace, hospitals, good schools, a theatre, and a very handsome bridge over the Miño built in 1885. The industries of Tuy include tanning, brewing, the distillation of spirits and the manufacture of soap. The city has also a brisk agricultural trade.

During part of the 7th century Tuy was the Visigothic capital. It was taken from the Moors by Alphonso VII. in the 12th century. As a frontier fortress it played an important part in the wars between Portugal and Castile.

TVER, a government of central Russia, on the upper Volga, bounded by the governments of Pskov and Novgorod on the W. and N. respectively, Yaroslavl and Vladimir on the E. and Moscow and Smolensk on the S. It has an area of 24,067 sq. m. Lying on the southern slope of the Valdai plateau, and intersected by deep valleys, it has the aspect of a hilly region, but is in reality a plateau 800 to 1000 ft. in altitude. Its highest parts are in the west, where the Volga, Southern Dvina and Msta rise in marshes and lakes. The plateau is built up chiefly of Carboniferous limestones, Lower and Upper, underlain by Devonian and Silurian deposits, which crop out only in the denudations of the lower valleys. The whole is covered by a thick sheet of boulder-clay, the bottom-moraine of the Scandinavo-Russian ice-sheet, and by subsequent Lacustrine deposits. A number of *äsar* or eskers occur on the slopes of the plateau. Ochre, brick, and pottery clays, as also limestone for building, are obtained, and there are chalybeate springs. The soil, which is clayey for the most part, is not fertile as a rule.

Nearly the whole of Tver is drained by the upper Volga and its tributaries, several of which (Vazuza, Dubna, Sestra, Tvertsa and the tributaries of the Mologa) are navigable. The Vyshnevolotsk system of canals connects the Volga (navigable some 60 m. from its source) with the Baltic, and the Tikhvin system connects the Mologa with Lake Ladoga. The Msta, which flows into Lake Ilmen, and its tributary the Tsna drain Tver in the north-west, and the Southern Dvina rises in Ostashkov. This network of rivers highly favours navigation: corn, linseed, spirits, flax, hemp, timber, metals and manufactured wares to the annual value of £1,500,000 are shipped from, or brought to, the river ports of the government. Lakes, ponds and marshes are numerous in the west and north-west, Lake Seliger—near the source of the Volga—and Lake Mztino being the most important. The forests—coniferous in the north and deciduous in the south—are rapidly disappearing, but still cover 32% of the surface. The climate is continental; the average yearly temperature at Tver (41°·5 F.) is the same as that of Orel and Tambov (Jan. 11°, July 67°).

The population was estimated in 1906 as 2,053,000, almost entirely Great Russian, but including about 117,700 Karelians. The government is divided into twelve districts, the chief towns of which are Tver, Byezhetsk, Kalyazin, Kashin, Korsheva, Ostashkov, Rzhev, Staritsa, Torzhok, Vesyegonsk, Vyshniy Volochok and Zubtsov. Nearly 2,000,000 acres are under cereals. The principal crops are rye, wheat, oats, barley and potatoes. The sowing of grass is spreading, owing to the efforts of the *zemstvos* or local councils, and improved machinery is being introduced. Livestock breeding is also important, and dairy produce is exported. Manufactures have grown rapidly. Cotton-mills, flour-mills, tanneries, sugar-refineries, iron-foundries and distilleries are the chief establishments. The government of Tver is also the seat of important village industries, of which a remarkable variety is carried on, nearly every district and even every village having its own speciality. The principal of these are weaving, lace-making, boat-building, and the making of boots, saddlery, coarse pottery, sacks, nets, wooden wares, nails, locks, other hardware and agricultural implements and felt goods.

TVER, a town of Russia, capital of the government of the same name, 104 m. by rail N.W. of Moscow, on both banks of the Volga (here crossed by a floating bridge) at its confluence with the Tvertsa. The low right bank is protected from inundations by a dam. Pop. (1885), 39,280; (1900), 45,644. Tver is an archiepiscopal see of the Orthodox Greek Church. The oldest church dates from 1564, and the cathedral from 1689. A public garden occupies the site of the former fortress. The city possesses a good archaeological museum, housed in a former imperial palace. The industries have developed greatly, especially those in cotton, the chief works being cotton and flour mills, but there are also machinery works, glass works, sawmills, tanneries, railway carriage works and a steamer-building wharf. Among the domestic industries are nail-making and the manufacture of hosiery for export to Moscow and St Petersburg. The traffic of the town is considerable, Tver being an intermediate place for the trade of both capitals with the governments of the upper Volga.

Tver dates its origin from 1180, when a fort was erected at the mouth of the Tvertsa to protect the Suzdal principality against Novgorod. In the 13th century it became the capital of an independent principality, and remained so until the end of the 15th century. Michael, prince of Tver, was killed (1318) fighting against the Tatars, as also was Alexander his son. It long remained an open question whether Moscow or Tver would ultimately gain the supremacy in Great Russia, and it was only with the help of the Tatars that the princes of the former eventually succeeded in breaking down the independence of Tver. In 1486, when the city was almost entirely burned down by the Muscovites, the son of Ivan III. became prince of Tver; the final annexation to Moscow followed four years later. In 1570 Tver had to endure, for some reason now difficult to understand, the vengeance of Ivan the Terrible, who ordered the massacre of 90,000 inhabitants of the principality. In 1609–1612 the city was plundered both by the followers of the second false Demetrius and by the Poles.

TWAIN, MARK, the *nom de plume* of SAMUEL LANGHORNE CLEMENS (1835–1910), American author, who was born on the 30th of November 1835, at Florida, Missouri. His father was a country merchant from Tennessee, who moved soon after his son's birth to Hannibal, Missouri, a little town on the Mississippi. When the boy was only twelve his father died, and thereafter he had to get his education as best he could. Of actual schooling he had little. He learned how to set type, and as a journeyman printer he wandered widely, going even as far east as New York. At seventeen he went back to the Mississippi, determined to become a pilot on a river-steamboat. In his *Life on the Mississippi* he has recorded graphically his experiences while "learning the river." But in 1861 the war broke out, and the pilot's occupation was gone. After a brief period of uncertainty the young man started West with his brother, who had been appointed lieutenant-governor of Nevada. He went to the mines for a season, and there he began to write in the local newspapers, adopting the pen name of "Mark Twain," from a call used in taking soundings on the Mississippi steamboats. He drifted in time to San Francisco, and it was a newspaper of that city which in 1867 supplied the money for him to join a party going on a chartered steamboat to the Mediterranean ports. The letters which he wrote during this voyage were gathered in 1869 into a volume, *The Innocents Abroad*, and the book immediately won a wide and enduring popularity. This popularity was of service to him when he appeared on the platform with a lecture—or rather with an apparently informal talk, rich in admirably delivered anecdote. He edited a daily newspaper in Buffalo for a few months, and in 1870 he married Miss Olivia L. Langdon (d. 1904), removing a year later to Hartford, where he established his home. *Roughing It* was published in 1872, and in 1874 he collaborated with Charles Dudley Warner in *The Gilded Age*, from which he made a play, acted many hundred times with John T. Raymond as "Colonel Sellers." In 1875 he published *The Adventures of Tom Sawyer*, the sequel to which, *Huckleberry Finn*, did not appear until 1884. The result of a second visit to Europe was humorously recorded in *A Tramp Abroad* (1880), followed in 1882 by a more or less historical romance, *The Prince and the Pauper*; and a year later came *Life on the Mississippi*. *The Adventures of Huckleberry Finn*, the next of his books, was published (in 1884) by a New York firm in which the author was chief partner. This firm prospered for a while, and issued in 1889 Mark Twain's own comic romance, *A Connecticut Yankee at King Arthur's Court*, and in 1892 a less successful novel, *The American Claimant*. But after a severe struggle the publishing house failed, leaving the author charged with its very heavy debts. After this disaster he issued a third Mississippi Valley novel, *The Tragedy of Pudd'nhead Wilson*, in 1894, and in 1896 another historical romance, *Personal Recollections of Joan of Arc*, wherein the maid is treated with the utmost sympathy and reverence. He went on a tour round the world, partly to make money by lecturing and partly to get material for another book of travels, published in 1897, and called in America *Following the Equator*, and in England *More Tramps Abroad*. From time to time he had collected into volumes his scattered sketches; of these the first, *The Celebrated Jumping Frog of Calaveras County*, appeared in 1867, and the latest, *The Man that Corrupted Hadleyburg*, in 1900. To be recorded also is a volume of essays and literary criticisms, *How to Tell a Story* (1897). A complete edition of his works was published in twenty-two volumes in 1899–1900 by the American Publishing Company of Hartford. And in this last year, having paid off all the debts of his old firm, he returned to America. By the time he died his books had brought him a considerable fortune. In later years he published a few minor volumes of fiction, and a series of severe and also amusing criticisms of Christian Science (published as a book in 1907), and in 1906 he began an autobiography in the *North American Review*. He had a great reception in England in 1907, when he went over to receive from Oxford the degree of Doctor of Literature. He died at Redding, Connecticut, on the 21st of April 1910. Of his four daughters only one, who married the Russian pianist Gabrilowitch, survived him. Mark Twain was an outstanding figure for many years as a popular American personality in the world of letters. He is commonly considered as a humorist, and no doubt he is a humorist of a remarkable comic force and of a refreshing fertility. But the books in which his humour is broadly displayed, the travels and the sketches, are not really so significant of his power as the three novels of the Mississippi, *Tom Sawyer*, *Huckleberry Finn* and *Pudd'nhead Wilson*, wherein we have preserved a vanished civilization, peopled with typical figures, and presented with inexorable veracity. There is no lack of humour in them, and there is never a hint of affectation in the writing; indeed, the author, doing spontaneously the work nearest to his hand, was very likely unconscious that he was making a contribution to history. But such *Huckleberry Finn* is, beyond all question; it is a story of very varied interest, now comic, now almost tragic, frequently poetic, unfailingly truthful, although not always sustained at its highest level. And in these three works of fiction there are not only humour and pathos, character and truth, there is also the largeness of outlook on life such as we find only in the works of the masters. Beneath his fun-making we can discern a man who is fundamentally serious, and whose ethical standards are ever lofty. Like Cervantes at times, Mark Twain reveals a depth of melancholy beneath his playful humour, and like Molière always, he has a deep scorn and a burning detestation of all sorts of sham and pretence, a scorching hatred of humbug and hypocrisy. Like Cervantes and like Molière, he is always sincere and direct.

After Mark Twain's death, his intimate friend, W. D. Howells, published in 1910 a series of personal recollections in *Harper's Magazine*. (B. M.)

TWEED, a river in the south of Scotland. It rises in the south-west corner of Peeblesshire, not far from the Devil's Beef Tub (in Dumfriesshire) in the hill country in which the Clyde and Annan also rise. The stream flowing from Tweed's Wall, about 1500 ft. above the sea, is generally regarded as its source, though its origin has been traced to other streams at a still higher elevation. For the first 36 m. of its course the stream intersects the shire of Peebles in a north-easterly direction, and, shortly before the county town is reached, receives Lyne Water on the left and Manor Water on the right. The valley now widens, and the river, bending towards the south-east, passes Innerleithen, where it receives the Leithen (left) and the Quair (right). It then crosses Selkirkshire and, having received the Ettrick (reinforced by the Yarrow) on the right, flows northward past Abbotsford, forming for about 2 m. the boundary between the counties of Selkirk and Roxburgh. After receiving the Gala on the left, the Tweed crosses the north-western corner of Roxburghshire past Melrose and, after being joined by the Leader on the left, winds past Dryburgh Abbey round the south-western corner of Berwickshire. The remainder of its course is in a north-easterly direction through Roxburghshire past Kelso, where it receives the Teviot on the right, and then between the counties of Berwick and Northumberland, past Coldstream, to the town of Berwick, where it enters the North Sea. On the left it receives Eden Water at Edenmouth and Leet Water at Coldstream, and the Till from Northumberland between Coldstream and Norham Castle. The last 2 m. of its course before reaching Berwick are in England. The Tweed is 97 m. long and drains an area of 1870 sq. m. Its bed is pebbly and sandy, and notwithstanding discolorations from manufactures, the stream, owing to its clear and sparkling appearance, still merits the epithet of the "silver Tweed." The river, however, has no estuary, and traffic is chiefly confined to Berwick, though for a short distance above the town some navigation is carried on by barges. The Tweed is one of the best salmon streams in Scotland. From the time of Kenneth the Grim (d. 1005) to that of James VI. (1600) the Tweed uplands were the favourite hunting ground of the Scots monarchs, and, at a later date, the Covenanters found refuge in the recesses of the hills and on the banks of Talla Water, an early right-hand affluent. Close to Stobo Castle is Stobo Kirk, the mother-church of the district, founded by St Kentigern and probably the oldest ecclesiastical building in Tweeddale, a mixture of Saxon, Norman and modern Gothic.

See Sir Thomas Dick Lauder, *Scottish Rivers* (1874); Professor John Veitch, *The River Tweed* (1884); Rev. W. S. Crockett, *The Scott Country* (1892).

TWEEDDALE, MARQUESSES OF John Hay, 2nd Earl and 1st Marquess of Tweeddale (1626–1697), was the eldest son of John, 8th Lord Hay of Yester (*c.* 1599–1654), created earl of Tweeddale in 1646, who was the grandson of William Lord Hay of Yester (d. 1576), one of the partisans of Mary Queen of Scots, and thus a descendant of John Hay of Yester (Haddingtonshire) who was created a lord of the Scottish parliament in 1488 and died about 1500. Before succeeding to the peerage in 1654 the second earl fought for Charles I. during the Civil War, but he soon transferred his allegiance, and was in the Scottish ranks at Marston Moor. Changing sides again, he was with the royalists at Preston; but he was a member of Cromwell's parliament in 1656, and was imprisoned just after the restoration of Charles II. He was soon, however, in the king's favour, and in 1663 was appointed president of the Scottish council, and in 1664 an extraordinary lord of session. In Scotland he sought to mitigate the harshness shown by the English government to the Covenanters, and for this attitude he was dismissed from his offices in 1674; but he regained an official position in 1680 and held it during the reign of James II. A supporter of William of Orange, he was made lord high chancellor of Scotland in 1692, and two years later was created marquess of Tweeddale and earl of Gifford. He favoured the scheme for the expedition to Darien, and as lord high commissioner during William's absence he formally assented to the act establishing the trading company in 1695; for this action he was dismissed from office when the king returned to England in 1696. He died on the 11th of August 1697.

His son John, 2nd Marquess of Tweeddale (1645–1713), was prominent in Scottish politics during the stormy period which preceded the union with England. After acting for a time with the national party he became the leader of the *squadrone volante*, a band of men who at first took up an independent attitude on the question, but afterwards supported the union. For a very short time he was lord chancellor of Scotland, and he was one of the first of the Scottish representative peers. He died on the 20th of April 1713. His eldest son, Charles (*c.* 1670–1715), became 3rd marquess; a younger son, Lord John Hay (d. 1706), commanded the famous regiment of dragoons, afterwards called the Scots Greys, at the battle of Ramillies and elsewhere.

John, 4th Marquess of Tweeddale (*c.* 1695–1762), eldest son of the 3rd marquess, was chief secretary of state for Scotland from 1742 to 1746 and extraordinary lord of session from 1721 until his death. In six parliaments he was a representative peer for Scotland; he was for a time keeper of the king's signet, and in 1761 he was made lord-justice-general. He died on the 9th of December 1762. His brother, Lord Charles Hay (d. 1760), was the soldier who displayed great coolness when suddenly brought face to face with some French troops at Fontenoy, requesting the enemy, so Voltaire's account runs, to fire first.

The family of the 4th marquess became extinct when George, the 5th marquess, died on the 4th of October 1770; and George, a son of the 3rd marquess, succeeded to the title. When he died unmarried on the 16th of November 1787 the marquessate passed to a kinsman, George (1733–1804), a descendant of the 2nd marquess, who became 7th marquess.

George, 8th Marquess of Tweeddale (1787–1876), son of the preceding, succeeded in August 1804. He fought in the Peninsular War, being wounded at the battles of Busaco and Vittoria, and then in America; and he attained the rank of a field marshal in 1875. From 1842 to 1848 he was governor and commander-in-chief of Madras, but his later life was mainly spent at Yester, where he showed a very practical interest in agriculture. He died on the 10th of October 1876. His son, Arthur (1824–1878), who became 9th marquess, was an ornithologist of repute and a soldier who served in India and the Crimea. His ornithological works were published privately in 1881 by his nephew, Captain R. E. W. Ramsay, with a memoir by Dr W. H. Russell. His successor was his brother, William Montagu (b. 1826), who, after sitting in the House of Commons for thirteen years, was made a peer of the United Kingdom as Baron Tweeddale in 1881.

TWEEZERS, a small instrument like a pair of tongs, used for picking up minute objects, extracting thorns or splinters from the flesh, &c. Etymologically a "tweezer" is an instrument contained in a "tweeze" or a small case containing several instruments, "tweeze" being a plural form of "twee," an adaptation of French *étui*, a sheath-case or box to put things in. Why one particular instrument out of the case should be called "tweezers" is not certain; Skeat suggests a possible connexion of ideas with the obsolete "twich," "twitch" (Ger. *zwicken*, to nip, fasten, Eng. "tweak"), or reference may be made to the M. Eng. *twisel* or *twissel*, a pair of objects (*twi-*, two).

The derivation of the French *étui* (O. Fr. *estuy*) is doubtful. Cognate forms are Span. *estuche*, Port. *estojo*, Ital. *astuccio*, formerly *stuccio* or *stucchio*, all with the same meaning of a small case for instruments such as scissors, knife, &c. Skeat supports Diez in his connexion with the modern German dialect *Stauche*, cuff, that part of the sleeve where such small objects were carried. Others connect the word with Lat. *studium*, a place where one studies, hence a place where objects of study are carried, a somewhat far-fetched sense development.

TWELVE TABLES, the tables of wood on which was engraved or painted the earliest codification of the Roman law. Originally ten in number, two others were afterwards added, containing supplemental matter, and the whole code was termed the *Lex XII. Tabularum* (Law of the Twelve Tables). (See Roman Law and Rome.)

TWENTY-FOUR PARGANAS, THE, a district of British India, in the presidency division of Bengal, with an area of 4844 sq. m. It occupies part of the Gangetic delta, east of the Hugli, surrounding (but not including) the city of Calcutta. It also includes the greater part of the almost uninhabited Sundarbans (*q.v.*). The administrative headquarters are at Alipur, a southern suburb of Calcutta. The country consists for the most part of a vast alluvial plain, and is everywhere watered by numerous branches of the Ganges. In 1901 the population was 2,078,359, showing an increase of 10 % in the decade. Rice is the staple crop, followed by jute, pulses and sugar-cane. The district is traversed by three railways, two of which terminate at the ports of Diamond Harbour and Port Canning, but numerous river channels are still the chief means of communication. Apart from the suburbs of Calcutta, there is hardly a single real town. But round Calcutta all the manufactures of a great city are to be found, principally jute mills and jute presses, cotton mills and paper mills, and also government factories for rifles and ammunition.

The Twenty-four Parganas form the tract of which the *zamindari* or landlord rights were granted to the East India Company after the battle of Plassey, while the revenue arising therefrom was conferred upon Clive, upon whose death it reverted to the company.

TWICKENHAM, an urban district in the Brentford parliamentary division of Middlesex, England, 12 m. W.S.W. of St Paul's Cathedral, London, on the river Thames. Pop. (1891), 16,027; (1901), 20,991. Its situation is pleasant, and it has grown into an extensive residential district. The body of the church of St Mary was rebuilt in brick after its collapse in 1713, but the Perpendicular tower remains. Among men of eminence buried here are Alexander Pope and Sir Godfrey Kneller. The Thames in this neighbourhood forms a long deep reach in favour with fishermen, and Eel Pie Island is a resort of boating parties. There are many fine houses in the vicinity, more than one possessing historical associations. Strawberry Hill, the residence of Horace Walpole, was built to his taste in a medley of Gothic styles. Marble Hill was erected by George II. for the countess of Suffolk, and Pope, Swift and Gay took part in its equipment. Orleans House was the residence in 1800 of Louis Philippe, then duke of Orleans, and this family again acquired it in 1852, when it was occupied by the duke of Aumale. Several eminent French refugees resided at this period in the neighbourhood. In 1700 the young duke of Gloucester, son of Queen Anne, died here. York House was given to Lord Clarendon by Charles II., was probably the occasional residence of James II. when duke of York, and in 1864 was occupied by the comte de Paris, nephew of the duke of Aumale. Twickenham House was the residence of Sir John Hawkins, author of the *History of Music*, and Twickenham Park House, no longer standing, that of Lord Chancellor Bacon. Pope's Villa was replaced by another building after his death, but the tunnel which connected his garden and house beneath a road, and was ornamented by him as a grotto, remains. Other eminent residents were Turner, who occupied Sandycombe Lodge, and painted many of his famous works here, Henry Fielding the novelist, and Tennyson. Kneller Hall, the house built by Kneller (1711), was converted into a training college for masters of workhouse schools in 1847, and in 1856 became the Royal Military School of Music.

Twickenham at the Domesday survey was included in Isleworth. Anciently it was called Twittenham or Twicanham, and the first form, or a variation of it, is used by both Pope and Walpole. The manor was given in 941 by King Edmund to the monks of Christ Church, Canterbury, from whom it had been previously taken, but it was again alienated, for it was restored to the same monks by Edred in 948. In the reign of Henry VIII. it came into the possession of the Crown, and by Charles I. was assigned to Henrietta Maria as part of her jointure. It was sold during the Protectorate, but after the Restoration the queen mother resumed possession of it. In 1670 it was settled for life on Catherine of Braganza, queen of Charles II. It remains in possession of the Crown, but since the death of Catherine has been let on leases. The old manor house, now demolished, was Catherine's residence; and had been, according to tradition, the place of the retirement of Catherine of Aragon after her divorce from Henry VIII.

TWILIGHT, formerly known as Crepusculum (a Latin word meaning dusky or obscure), properly the interval during which the atmosphere is illuminated after the setting of the sun. The analogous phenomenon in the morning, *i.e.* the interval between the first appearance of light and the rising of the sun, is known as the *dawn*. These phenomena are due to the light of the sun after refraction by the atmosphere being reflected to the observer by the clouds, dust, and other adventitious matter present in the atmosphere. Even in the early infancy of astronomy, the duration of twilight was associated with the position of the sun below the horizon, and measurements were made to determine the maximum vertical depression of the sun which admitted the phenomena. This was found by Alhazen, Tycho Brahe and others, to be about 18°, and although other observers obtained somewhat different values, yet this value is now generally admitted. The duration of twilight is therefore measured by the time in which the sun traverses an arc of 18° of vertical depression, and primarily depends on the latitude of the observer and the declination of the sun. It is subject to several minor variations, occasioned by the variable amount of dust, clouds, &c. suspended in the air; and also on the temperature, which alters the altitude of the reflecting particles; thus at the same place and on the same day, the morning twilight or dawn is generally shorter than the evening twilight.

The duration and possibility of twilight may be geometrically exhibited as follows: Let O be the position of the observer (fig. 1); Z, the zenith; P, the pole of the heavens; ADB, the plane of the horizon; EDF, the path of the sun. Let the circles ADB and FDE intersect in the points D and D_1; then these points correspond to the rising and setting of the sun. Now twilight prevails from sunrise or sunset until the sun is depressed through 18°; hence if we draw arcs ZC and ZC_1 equal to 108°, and terminating on the circle FDE at C and C_1, then the arcs DC and D_1C_1 represent the distance traversed by the sun during the twilight. Also it may be observed that C_1EC represents the path of the sun during the night, and DFD_1 during the day. The arc CD is readily determined by spherical trigonometry. For, join CP by an arc of a great circle; then in the triangle ZPC we know ZP (the colatitude of O); PC (the sun's polar distance) and ZC (= 108° by construction). Hence the angle ZPC, the sun's hour angle, may be found; this gives the time before or after noon when the sun passes C. The times of sunrise and sunset being known, then the arcs DC and D_1C_1 (and the duration of dawn and twilight) are determined.

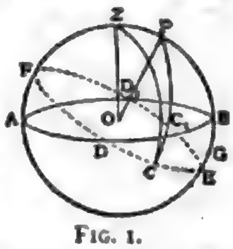

FIG. 1.

So far we have considered the case when the sun does attain a depression of 18°, but it is equally possible for this depression not to be attained. To investigate this, take ZG equal to 108°. Now if G lies beyond B and E (the maximum depression of the sun), E being also below B, then the sun will rise and set, but never descend so low as to occasion true night, and the entire interval between sunrise and sunset will be twilight.

If E be not below B but above it, the sun will never descend below the horizon, and will neither rise nor set, and we are presented with the phenomenon known as the *midnight sun*. Since $PE = 90^\circ - \text{sun's declination}$, and $PG = \text{latitude of observer} + 18^\circ$, then it follows that for there to be no night the latitude of the observer together with the declination of the sun must lie between 90° and 72°.

The maximum declination of the sun is about 23° 30′, and hence in latitude 48° 30′ there will be one day without a true night; in higher latitudes there will be an increasing number of such days; and in lower latitudes none. In England there is no real night from about the 22nd of May till the 22nd of July.

The phenomenon known as the *after-glow*, or second twilight, has been referred to a second reflection of the solar rays in the atmosphere.

TWILL (connected with "two"), a woven cloth in which the passage of the weft is arranged, not in regular succession as in plain weaving, but over one thread and under two or more according to the kind of twill. This gives a succession of diagonal lines to the cloth, and though in the normal type of twill this diagonal traverses from selvage to selvage at an angle of 45°, considerable variations may be made. Twills may be stout and serviceable cloths, though, theoretically, it would seem that the strain of wear on the threads that compose the cloth is necessarily irregular. The twill or diagonal may run either from left to right or vice versa. Twills are made in most kinds of cloths—silk, woollen, cotton, &c.

TWINING, THOMAS (1735–1804), English classical scholar, was born at Twickenham on the 8th of January 1734–1735. The son of Daniel Twining, tea merchant of London, he was originally intended for a commercial life, but his distaste for it and his fondness for study decided his father to send him to the university. He entered Sidney Sussex College, Cambridge (fellow, 1760), took orders, and after his marriage in 1764 spent the remainder of his life at Fordham (Essex) and Colchester, where he died on the 6th of August 1804. His reputation as a classical scholar was established by his translation, with notes, of Aristotle's *Poetics* (1789). Twining was also an accomplished musician, and assisted Charles Burney in his *History of Music*.

Selections from his correspondence will be found in *Recreations and Studies of a Country Clergyman of the Eighteenth Century* (1882) and *Selections from Papers of the Twining Family* (1887), edited by his grand-nephew (Richard Twining); see also *Gentleman's Magazine*, lxxiv. 490, and J. E. Sandys, *History of Classical Scholarship*, vol. iii. (1908).

TWISS, HORACE (1787–1849), English writer and politician, was born at Bath, being the son of Francis Twiss (1760–1827), a Shakespearian scholar who married Mrs Siddons's sister, Fanny Kemble, and whose brother Richard (1747–1821) made a name as a writer of travels. Horace Twiss had a pretty wit, and as a young man wrote light articles for the papers; and, going to the bar, he obtained a considerable practice and became a K.C. in 1827. In 1820 he was elected to parliament, where, with some interruptions, he sat till 1841, holding the office of under-secretary for war and the colonies in 1828–1830. In 1844 he was appointed vice-chancellor of the duchy of Lancaster, a well-paid post which enabled him to enjoy his popularity in London society. For some years he wrote for *The Times*, in which he first compiled the parliamentary summary, and his daughter married first Francis Bacon (d. 1840) and then J. T. Delane, both of them editors of that paper. He was the author of the *Life* (1844) of Lord Eldon, and other volumes. He died suddenly in London on the 4th of May 1849.

TWISS, SIR TRAVERS (1809–1897), English jurist, eldest son of the Rev. Robert Twiss, was born in London on the 19th of March 1809. At University College, Oxford, he obtained a first-class in mathematics and a second in classics in 1830, and was elected a fellow of his college, of which he was afterwards successively bursar, dean and tutor. During his connexion with Oxford he was, *inter alia*, a public examiner in classics and mathematics, Drummond professor of political economy (1842), and regius professor of civil law (1855). After he had forfeited his fellowship by marriage, he was elected to an honorary fellowship of University College. He published while at Oxford an epitome of Niebuhr's *History of Rome*, an annotated edition of Livy and other works, but his studies mainly lay in the direction of political economy, law, chiefly international law, and international politics. In 1840 he was called to the bar at Lincoln's Inn, and became an advocate at Doctors' Commons. In the ecclesiastical courts he enjoyed a large practice, and filled many of the appointments incidental thereto, such as commissary-general of the city and diocese of Canterbury (1849), vicar-general to the archbishop (1852) and chancellor of the diocese of London (1858). He was professor of international law at King's College, London (1852–1855). In 1858, when the Probate and Divorce Acts of 1857 came into force, and the ecclesiastical jurisdiction of Doctors' Commons had passed away, Twiss, like many other leading advocates of Doctors' Commons, became a Q.C., and in the same year he was also elected a bencher of his Inn. His successful career continued in the civil courts, and in addition to his large practice he was appointed in 1862 advocate-general to the admiralty, and in 1867 queen's advocate-general. In 1867 he was also knighted. He served during his legal career upon a great number of royal commissions, such as the Maynooth commission in 1854, and others dealing with marriage law, neutrality, naturalization and allegiance. His reputation abroad led to his being invited by the king of the Belgians in 1884 to draw up the constitution of the Congo Free State. In 1871 Twiss became involved in an unpleasant scandal, occasioned by allegations against the ante-nuptial conduct of his wife, whom he had married in 1862; and he threw up all his appointments and lived in retirement in London until his death on the 14th of January 1897, devoting himself to the study of international law and kindred topics. Among his more notable publications of this period were *The Law of Nations in Peace* and *The Law of Nations in War*, two works by which his reputation as a jurist will chiefly endure.

TWYSDEN, SIR ROGER (1597–1672), English antiquary and royalist pamphleteer, belonging to an ancient Kentish family. His mother, Anne, was the daughter of Sir Moule Finch, and his father, Sir William Twysden, was a courtier and scholar who shared in some of the voyages against the Spaniards in the reign of Queen Elizabeth and was well known at the court of King James I. He was one of the first baronets. Roger Twysden was educated at St Paul's School, London, and then at Emmanuel College, Cambridge. He entered Gray's Inn on the 2nd of February 1623. He succeeded to the baronetcy on his father's death in 1629. For some years he remained on his estate at Roydon, East Peckham, largely engaged in building and planting, but also in studying antiquities and the law of the constitution. The king's attempts to govern without a parliament, and the vexatious interference of his lawyers and clergy with the freedom of all classes of men, offended Sir Roger as they did most other country gentlemen. He showed his determination to stand on his rights by refusing to pay ship money, but, probably because the advisers of the Crown were frightened by the unpopularity of the impost, was not molested. He was chosen member of parliament for Kent in the Short Parliament of 1640, but was not elected to the Long Parliament. In common with most men of his class Sir Roger applauded the early measures of the parliament to restrict the king's prerogative, and then became alarmed when it went on to assail the Church. The attainder of Lord Strafford frightened him as a tyrannical use of power. He became in fact a very typical example of the men who formed the strength of the king's party when the sword was at last drawn. He considered himself too old to serve in the field, and therefore he did not join the king at Oxford. But he took the most prominent part in preparing the Kentish petition of March 1642 and in subsequent demonstrations on behalf of Charles. He incurred the wrath of the parliament, was arrested on the 1st of April 1642, but was soon let out on bail, and on his promise to keep quiet. But his respect for legality would not let him rest, and he was soon in trouble again for another demonstration known as "The Instruction to Mr Augustine Skinner." For this he was again arrested and for a time confined in a public-house, called "The Two Tobacco Pipes," near Charing Cross, London. He was released with a distinct intimation that he would be well advised not to go back to Roydon Hall, but to keep out of temptation in London. He took the advice and applied himself to reading. One plan for going abroad was given up, but at last he endeavoured to escape in disguise, was detected, and brought back to London. He was now subjected to all the vexations inflicted on Royalist partisans of good property, sequestrations of his rents, fines for "malignancy," and confinement in the Tower, where he consoled himself with his books. At last he compounded in 1650 and went home, where he lived quietly till the Restoration, when he resumed his position as magistrate. He died on the 27th of June 1672. He published *The Commons' Liberty* (London, 1648), demonstrating that finings and imprisonings by parliament were illegal; *Historiae anglicanae scriptores decem* (London, 1652), a work encouraged by Cromwell; and *Historical Vindication of the Church of England* (London, 1657).

TYBURN, a small left-bank tributary of the river Thames, England, now having its course entirely within London and below ground. The name, which also occurs as Aye-bourne, is of obscure derivation, though sometimes stated to signify Twy-burn, *i.e.* (the junction of) two burns or streams. The Tyburn rose at Hampstead and ran south, crossing Regent's Park, striking the head of the modern ornamental water there. Its course is marked by the windings of Marylebone Lane, the dip in Piccadilly where that thoroughfare borders the Green Park and at times by a line of mist across the park itself. It joined the Thames at Westminster (*q.v.*). But the name is more famous in its application to the Middlesex gallows, also called Tyburn Tree and Deadly Never Green, and also at an early period, the Elms, through confusion with the place of execution of that name at Smithfield. The Tyburn gallows stood not far from the modern Marble Arch. Connaught Square is said by several authorities to have been the exact site, but it appears that so long as the gallows was a permanent structure it stood at the junction of the present Edgware and Bayswater roads. The site, however, may have varied, for Tyburn was a place of execution as early as the end of the 12th century. In 1759, moreover, a movable gallows superseded the permanent erection. On some occasions its two uprights and cross-beam are said to have actually spanned Edgware Road. Round the gibbet were erected open galleries, the seats in which were let at high prices. Among those executed here were Perkin Warbeck (1449), the Holy Maid of Kent and confederates (1535), Haughton, last prior to the Charterhouse (1535), John Felton, murderer of Villiers, duke of Buckingham (1628), Jack Sheppard (1724), Earl Ferrers (1760).

In 1661 the skeletons of Cromwell, Ireton and other regicides were hung upon the gallows. The last execution took place in 1783, the scene being thereafter transferred to Newgate. The Tyburn Ticket was a certificate given to a prosecutor of a felon on conviction, the first assignee of which was exempted by a statute of William III. from all parish and ward duties within the district. The hangman's halter was colloquially known in the 16th century as the Tyburn Tippet.

See A. Marks, *Tyburn Tree, its History and Annals* (London, 1908).

TYDEUS, in Greek legend, son of Oeneus, king of Calydon, and Periboea. Having slain his uncle (or other relatives) he fled for refuge to Argos, where Adrastus received him hospitably and purified him from the guilt of blood. Tydeus took part in the expedition of the "Seven against Thebes," in which, although small of stature, he greatly distinguished himself. In the desperate battle under the walls of the city, he was severely wounded by Melanippus, but managed to slay his adversary. Athena, who held Tydeus in special favour, hastened to the field of battle, to heal him of his wound and bestow immortality upon him. But the sight of Tydeus, cleaving open the skull of his dead enemy and sucking out his brains, so disgusted her that she left him to his fate. Tydeus married Deïpylē, the daughter of Adrastus, by whom he had a son, the famous Diomedes, frequently called Tydides.

Homer, *Iliad*, xiv. 114–132; Apollodorus iii. 6, 8; Schol. on Pindar, *Nemea*, x. 12.

TYLDESLEY with **SHAKERLEY**, an urban district in the Leigh parliamentary division of Lancashire, England, 11 m. W.N.W. from Manchester by the London & North Western railway. Pop. (1901), 14,843. The town is of modern growth and depends upon its cotton mills and the large collieries in the neighbourhood.

TYLER, JOHN (1790–1862), tenth president of the United States, was born at Greenway, Charles City county, Virginia, on the 29th of March 1790. He was the second son of John Tyler (1747–1813), governor of Virginia in 1808–1811 and United States district judge in 1812–1813. The family was of English descent, but the claim of relationship to the famous Wat Tyler, though always stoutly maintained by President Tyler, cannot be substantiated. John Tyler the younger entered the grammar-school of the College of William and Mary, at Williamsburg, in 1802, and graduated in 1807. Two years later he was admitted to the bar. His public life began in 1811, when he was elected a member of the Virginia House of Delegates. Here he served for five years, being chosen also in 1815 a member of the council of state. In 1813 he raised a company for the defence of Richmond against the British, serving subsequently in minor operations elsewhere. From December 1816 to March 1821 he was a member of the national House of Representatives. A Republican in politics, and a firm believer in the doctrines of strict construction and state sovereignty which Thomas Jefferson had been principally instrumental in formulating, he opposed consistently the demand for internal improvements and increased tariff duties, and declined to follow Henry Clay in the proposed recognition of the independence of the Spanish colonies in South America and in the Missouri Compromise legislation. For the conduct of Jackson in Florida, in the summary execution of Arbuthnot and Ambrister, he had only strong condemnation. He declined a re-election to the House in 1821. In 1823–1825 he was again a member of the Virginia House of Delegates, and in 1825–1827 was governor of the state. In 1827 he was elected to the United States Senate to succeed John Randolph. In 1829–1830 he also served as a member of the Virginia constitutional convention. His career as senator was marked by a degree of independence which at times made his party position uncertain, notwithstanding the fact that his political ideas continued to be those of a thoroughgoing strict constructionist. Believing protective tariff duties to be unconstitutional, he voted against the "tariff of abominations" in 1828, and also against the tariff of 1832, since the latter measure, though reducing duties, showed no abandonment of the protective principle. The compromise tariff of 1833, made necessary by the hostile attitude of South Carolina, owed its inception largely to him, but he voted against the "force bill," an act for enforcing the collection of duties, being the only senator whose vote was so recorded. His hostility to a high tariff policy, however, did not prevent him from condemning the South Carolina ordinance of nullification; and in the presidential election of 1832 he supported Andrew Jackson, to whose political principles and methods, as to those of his advisers, he was invincibly opposed, as the "least objectionable" of the various candidates. The vigorous course of the president towards South Carolina, however, led him, after 1833, to act more and more with the opposition which presently became the Whig party; but he was never at heart a Whig, at least as Whig principles came later to be defined, and his place is with the Democrats of the Calhoun school. He sought to incorporate in a new code for the District of Columbia, in 1832, a prohibition of the slave trade in the district, at the same time opposing the abolition of slavery there without the consent of Maryland and Virginia, which had originally ceded the district to the United States. In the controversy over the removal of the government deposits from the Bank of the United States he sided with the bank, and voted for Clay's resolution censuring Jackson for his course in the matter. In 1833 he was again elected to the Senate, notwithstanding the criticism of his independent attitude and the wide approval of Jackson's policy in regard to the bank. In the election of 1836 he was supported as a candidate for the vice-presidency by the friends of Hugh L. White of Tennessee, the Democratic candidate opposed to Martin Van Buren, and received 47 votes, none of them from Virginia. When the legislature of Virginia voted instructions to its senators to support Senator Thomas H. Benton's resolution expunging from the journal of the Senate the resolution of censure, Tyler, though admitting the right of instruction, could not conscientiously obey the mandate, and on the 29th of February 1836 he resigned his seat. He was by this time reckoned a Whig, and his refusal to favour the Van Buren administration lent colour to that view. In 1838 he became once more a member of the Virginia House of Delegates, and in the same year was chosen president of the Virginia Colonization Society, of which he had long been a vice-president. In 1839 he made an unsuccessful contest for the United States senatorship. In December of that year the Whigs, relying upon his record in Congress as a sufficient declaration of political faith, nominated him for vice-president on the ticket with William Henry Harrison, expecting that the nomination would win support for the party in the South. Harrison and Tyler each received 234 electoral votes and were elected. On the 4th of April 1841, one month after the inauguration, Harrison died, and Tyler became president. The detailed discussion of the events of his administration, 1841–1845, belongs to the history of the United States (see United States: *History*). He retained Harrison's cabinet until his veto of the bill for a "fiscal corporation" led to the resignation of all the members except Daniel Webster, who was bringing to a close the negotiations with Lord Ashburton for the settlement of the north-eastern boundary dispute; and he not only opposed the recognition of the spoils system in appointments and removals, but kept at their posts some of the ablest of the ministers abroad. He stood, however, as it were, midway between the two great parties, without the leadership or support of either; Van Buren, whose influence in the practical working of politics was still great, refused to recognize him as a Democrat, and the Whigs repudiated him as a Whig; while with Clay leading the majority in Congress, harmony between that body and the executive was from the first impossible. The annexation of Texas, achieved just before the close of his administration, seemed to commend him for a second term on that issue, and in May 1844 he was renominated by a convention of Democrats, irregularly chosen, at Baltimore. The majority of the annexationists, however, would not support him, and he had further to meet the opposition of Van Buren, who had failed to secure the nomination in the regular Democratic convention, and of James K. Polk, the regular Democratic nominee. Tyler accepted the Baltimore nomination, but on the 20th of August withdrew from the contest. From this time until the eve of the Civil War he held no public office, but his opinions on political questions continued to be sought, and he was much in demand as a speaker on public occasions. In December 1860, when South Carolina adopted its ordinance of secession, Tyler, though sympathizing with the state, took firm ground against disunion and exerted himself in behalf of peace. The legislature of Virginia appointed him a commissioner to confer with President Buchanan and arrange, if possible, for the maintenance of the *status quo* in the matter of Fort Sumter, in Charleston harbour; but his efforts were unavailing. He did not abate his activity, however, and the Peace Congress which assembled at Washington on the 4th of February 1861, pursuant to a resolution of the Virginia legislature, and over which he presided, was largely the result of his labours. The constitutional amendment proposed by the conference, however, did not meet with his approbation, and his action in signing and transmitting the resolution to Congress was merely formal. On the 13th of February, while absent in Washington on this mission, he was elected to the Virginia convention at Richmond, and took his seat on the 1st of March. In the convention he advocated immediate secession as the only proper course under the circumstances. He continued to serve as a member of the convention until it adjourned in December, in the meantime acting as one of the commissioners to negotiate a temporary union between Virginia and the Confederate States of America. He was also a member of the provisional Confederate Congress from May 1861, when the capital of the Confederacy was removed from Montgomery, Alabama, to Richmond. He was elected a member of the House of Representatives of the permanent Congress, but died on the 18th of January 1862, in Richmond, before that body assembled.

President Tyler was twice married, first in 1813 to Miss Letitia Christian (1790–1842), and second in 1844 to Miss Julia Gardiner (1820–1889). His son, LYON GARDINER TYLER (b. 1853), graduated at the university of Virginia in 1875, and practised law at Richmond, Virginia, from 1882 to 1888, when he became president of the College of William and Mary. Among his publications, besides *Letters and Times of the Tylers*, are *Parties and Patronage in the United States* (1890); *Cradle of the Republic* (1900); *England in America* (1906) in the "American Nation" series, and *Williamsburg, the Old Colonial Capital* (1908).

The principal authority for the life of Tyler, aside from speeches, messages and other documents, is Lyon G. Tyler, *Letters and Times of the Tylers* (3 vols., Richmond, Va., 1884–1896). (W. MAC D.*)

TYLER, MOSES COIT (1835–1900), American author, was born in Griswold, Connecticut, on the 2nd of August 1835. At an early age he removed with his parents to Detroit, Michigan. He entered the university of Michigan in 1853, but in the next year went to Yale College, from which he graduated A.B. in 1857, and received the degree of A.M. in 1863. He studied for the Congregational ministry at the Yale Divinity School (1857–1858) and at the Andover Theological Seminary (1858–1859), and held a pastorate at Owego, New York, in 1859–1860 and at Poughkeepsie in 1860–1862. Owing to ill-health, however, and a change in his theological beliefs, he left the ministry. He became interested in physical training, and for some time (partly in England) wrote and lectured on the subject, besides other journalistic work. He became professor of English language and literature in the university of Michigan in 1867, and held that position until 1881, except in 1873–1874 when he was literary editor of the *Christian Union*; from 1881 until his death on the 28th of December 1900 at Ithaca, New York, he was professor of American history at Cornell University. In 1881 he was ordained deacon in the Protestant Episcopal Church and in 1883 priest, but he never undertook parochial work. Most important among his works are his valuable and original *History of American Literature during the Colonial Time, 1607–1765* (2 vols., 1878; revised in 1897), and *Literary History of the American Revolution, 1763–1783* (2 vols., 1897). Supplementary to these two is his *Three Men of Letters* (1895), containing biographical and critical chapters on George Berkeley, Timothy Dwight and Joel Barlow. In addition he published *The Brawnville Papers* (1869), a series of essays on physical culture; a revision of Henry Morley's *Manual of English Literature* (1879); *In Memoriam: Edgar Kelsey Apgar* (1886), privately printed; *Patrick Henry* (1887), an excellent biography, in the "American Statesmen" series; and *Glimpses of England: Social, Political, Literary* (1898), a selection from his sketches written while abroad.

See "Moses Coit Tyler," by Professor William P. Trent, in *The Forum* (Aug. 1901), and an article by Professor George L. Burr, in the *Annual Report of the American Historical Association* for 1901 (vol. i.).

TYLER, WAT [or WALTER] (d. 1381), English rebel, a man of obscure origin, was a native either of Kent or of Essex. Nothing definite is known of him previous to the outbreak of the peasant revolt in 1381, but Froissart says he had served as a soldier in the French War, and a Kentishman in the retinue of Richard II. professed to identify him as a notorious rogue and robber of Kent. The name Tyler, or Teghler, is a trade designation and not a surname. The discontent of the rural labourers and of the poorer class of craftsmen in the towns, caused by the economic distress that followed the Black Death and the enactment of the Statute of Labourers in 1351, was brought to a head by the imposition of a poll tax in 1379 and again in 1381, and at the end of May in the latter year riots broke out at Brentwood in Essex; on the 4th of June similar violence occurred at Dartford; and on the 6th a mob several thousands strong seized the castle of Rochester and marched up the Medway to Maidstone. Here they chose Wat Tyler to be their leader, and in the next few days the rising spread over Kent, where much pillage and damage to property occurred. On the 10th Tyler seized Canterbury, sacked the palace of Archbishop Sudbury, the chancellor, and beheaded three citizens as "traitors." Next day he led his followers, strengthened by many Kentish recruits, on the road to London, being joined at Maidstone by John Ball (*q.v.*), whom the mob had liberated from the archbishop's prison. Reaching Blackheath on the 12th, the insurgents burnt the prisons in Southwark and pillaged the archbishop's palace at Lambeth, while another body of rebels from Essex encamped at Mile End. King Richard II. was at the Tower, but neither the king's councillors nor the municipal authorities had taken any measures to cope with the rising. The drawbridge of London Bridge having been lowered by treachery, Tyler and his followers crossed the Thames; and being joined by thousands of London apprentices, artisans and criminals, they sacked and burnt John of Gaunt's splendid palace of the Savoy, the official residence of the treasurer, Sir Robert Hales, and the prisons of Newgate and the Fleet. On the 14th Richard II., a boy of fourteen, undertook the perilous enterprise of riding out to confer with the rebels beyond the city wall. At Mile End the king met Wat Tyler; a lengthy and tumultuous conference, during which several persons were slain, took place, in which Tyler demanded the immediate abolition of serfdom and all feudal services, and the removal of all restrictions on freedom of labour and trade, as well as a general amnesty for the insurgents. Richard had no choice but to concede these demands, and charters were immediately drawn up to give effect to them. While this was in progress Tyler with a small band of followers returned to the Tower, which they entered, and dragged forth Archbishop Sudbury and Sir Robert Hales from the chapel and murdered them on Tower Hill. During the following night and day London was given over to plunder and slaughter, the victims being chiefly Flemish merchants, lawyers and personal adherents of John of Gaunt, duke of Lancaster. Meantime the people of property began to organize themselves for the restoration of order. On the 15th of June, Richard, after confession and receiving the Sacrament, rode to Smithfield for a further conference with the rebels. Close to St Bartholomew's Church he met Wat Tyler, who advanced from the ranks of the insurgents and shook the king's hand, bidding him be of good cheer. Tyler then formulated a number of fresh demands, including the confiscation of ecclesiastical estates and the institution of social equality. Richard replied that the popular desire should be satisfied "saving the regalities of the Crown." Tyler thereupon grew insolent, and in the altercation that ensued the rebel leader was killed by the mayor, Sir William Walworth (*q.v.*), and John Standwick, one of the king's squires. The rebels now handled their bows in a menacing fashion, but at the critical moment the young king with great presence of mind and courage spurred his horse into the open, crying, "Sirs, will you shoot your king? I will be your chief and captain, you shall have from me all that you seek." Richard then led the mob to a neighbouring meadow, where he kept them in parley till Walworth, who had returned within the city to summon the loyal citizens to the king's aid, returned with a sufficient following to overawe and disperse the rebels. With the death of Wat Tyler the rising in London and the home counties quickly subsided, though in East Anglia it flickered a short time longer under the leadership of John Wraw and Geoffrey Litster until suppressed by the energy of Henry Despenser, bishop of Norwich. About 110 persons were executed for the rebellion in Kent and Essex, including John Ball, and Jack Straw, Tyler's chief lieutenant.[1] The enfranchisement of villeins granted by Richard at the Mile End conference was revoked by parliament in 1382, and no permanent results were obtained for the peasants by Wat Tyler's revolt.

Bibliography.—The best original account of the rebellion of Wat Tyler is the "Anonimal Chronicle of St Mary's, York," printed by G. M. Trevelyan in the *Eng. Hist. Rev.* (1898). See also Thomas Walsingham, *Chronicon Angliae* (Rolls series, 1874); Froissart, *Chronicles* (edited by G. C. Macaulay, London, 1895); André Réville, *Le Soulèvement des travailleurs d'Angleterre en 1381* (Paris, 1898); C. Oman, *The Great Revolt of 1381* (Oxford, 1906), and *The Political History of England*, vol. iv. (ed. by W. Hunt and R. L. Poole, London, 1906). (R. J. M.)

TYLER, a city and the county-seat of Smith county, Texas, U.S.A., about 115 m. E. by S. of Dallas. Pop. (1890), 6908; (1900), 8069, of whom 2693 were negroes; (1910 census), 10,400. Tyler is served by the International & Great Northern and the St Louis South-Western railways. It is the seat of the Tyler Commercial College, of the East Texas Conservatory of Music and of two institutions for negroes—Texas College (1895; Colored Methodist Episcopal) and the East Texas Normal and Industrial Academy (Baptist, 1905). The principal public buildings include the city hall, the county court-house, a Carnegie library and the post office and Federal Courts building. Sessions of the United States Circuit and District Courts, and of a state district court, as well as of the county court, are held in Tyler. Tyler is situated in a prosperous agricultural region, and has various manufactures. The St Louis South-Western railway maintains general offices and machine-shops here. Tyler, named in honour of President John Tyler, was settled in 1847, was incorporated as a town in 1870 and was chartered as a city in 1907.

TYLOPODA (Gr. for boss-footed, in reference to the cushion-like pads forming the soles of the feet), the scientific name of the section of ruminating artiodactyle ungulate mammals (see Artiodactyla) now represented by the Old World camels (see Camel) and the South American Llamas (see Llama)

Characters.—In the skull there is a sagittal crest; the tympanic bulla is filled with cancellous tissue; the condyle of the lower jaw is rounded; and the premaxillae, or anterior bones of the upper jaw, have the full number of incisor teeth in the young state, the outermost of these being persistent through life as an isolated tooth. The tusk-like canines are present in both jaws, those of the lower jaw being differentiated from the long, horizontal and spatulate incisors; in form they are sub-erect and pointed. The crowns of the molars belong to the crescentic or selenodont type, and are tall-crowned or hypsodont; but one or more of the anterior premolars is usually detached from the series, and of simple pointed form. The hinder part of the body is much contracted, and the femur long and vertically placed, so that the knee-joint is lower in position, and the thigh altogether more detached from the abdomen than in most mammals. The limbs are long, but with only two digits (the third and fourth) developed on each, no traces of any of the others being present. The trapezoid and magnum of the carpus, and the cuboid and navicular of the tarsus are distinct. The two cannon-bones of each limb are confluent for the greater part of their length, though separated for a considerable distance at the lower end. Their lower articular surfaces, instead of being pulley-like, with deep ridges and grooves, as in other Artiodactyla, are simple, rounded and smooth. The first phalanges are expanded at their lower ends, and the wide, depressed middle phalanges embedded in a broad cutaneous pad, forming the sole of the foot, on which the animal rests in walking instead of on the hoofs. The terminal phalanges are small and nodular, not flattened on their inner or opposed surfaces, and not completely encased in hoofs, but bearing nails on their upper surface only. The neck is long and curved, and its vertebrae are remarkable for the position of the canal for the transmission of the vertebral artery, which does not perforate the transverse process, but passes obliquely through the anterior part of the pedicle of the arch. There are no horns or antlers. Though these animals ruminate, the stomach differs considerably in the details of its construction from that of the Pecora. The interior of the rumen or paunch has no tags or villi on its surface, and there is no distinct psalterium or manyplies. Both first and second compartments are remarkable for the presence of a number of pouches or cells in their walls, with muscular partitions, and a sphincter-like arrangement of their orifices, by which they can be shut off from the rest of the cavity, and into which the fluid portion only of the contents of the stomach is allowed to enter. The placenta is diffuse, not cotyledonary. Finally, the Tylopoda differ not only from other ungulates, but from all other mammals, in the fact that the red corpuscles of the blood, instead of being circular in outline, are oval as in the inferior vertebrate classes.

Camels.—Of the two existing generic representatives of the Camelidae (as the family in which they are both included is named), the Old World camels (*Camelus*) are characterized by their great bodily size, and the presence of one or two fleshy humps, which diminish or increase in size according to the physical condition of the animals themselves. There is a total of 34 teeth, arranged as *i.* $\frac{1}{3}$, *c.* $\frac{1}{1}$, *p.* $\frac{3}{2}$, *m.* $\frac{3}{3}$. Of these the first upper premolar is a simple tooth placed close behind the premaxilla and separated by a long gap from the two other teeth of the same series; while the lower incisors, of which the outermost is the largest, are directed partially forwards. The skull is elongated, with an overhanging occiput, complete bony rims to the orbits, and the premaxillae separated from the arched and rather long nasals. The vertebrae are C. 7. D. 12. L. 7. S. 4 and Ca. 13 to 15. The ears are short and rounded; the toes of the broad feet very imperfectly separated; the tail is well developed, with a terminal tuft; and the straight hair is not woolly.

Llamas.—Although the name llama properly applies only to one of the domesticated breeds, zoologically it is taken to include all the South American representatives of the Camelidae, which form the genus *Lama*. In this sense, llamas are characterized as follows. The dentition in the adult is *i.* $\frac{1}{3}$, *c.* $\frac{1}{1}$, *p.* $\frac{2}{2}$, *m.* $\frac{3}{3}$; total 32. In the upper jaw there is a compressed, sharp-pointed, tusk-like incisor near the hind edge of the premaxilla, followed in the male at least by a moderate-sized, pointed, curved canine in the anterior part of the maxilla. The isolated canine-like premolar which follows in the camels is not present. The teeth of the cheek-series which are in contact with each other consist of two small premolars (the first almost rudimentary) and three broad molars, constructed generally like those of *Camelus*. In the lower jaw the three incisors are long, spatulate and horizontal, with the outer one the smallest. Next to the latter is a curved, sub-erect canine, followed after an interval by an isolated minute and often deciduous simple conical premolar; then a contiguous series of one premolar and three molars, which differ from those of recent species of *Camelus* in having a small accessory column at the anterior outer edge. The skull generally resembles that of *Camelus*, the relatively larger brain-cavity and orbits and less developed cranial ridges being due to its smaller size. The nasal bones are shorter and broader, and are joined by the premaxillae. Vertebrae: C. 7, D. 12, L. 7, S. 4, Ca. 15 to 20. Ears rather long and pointed. No hump. Feet narrow, the toes being more separated than in the camels, and each with a distinct plantar pad. Tail short. Hairy covering long and woolly. Size smaller and general form lighter than in the camels. Llamas are now confined to the western and southernmost parts of South America, though fossil remains have been found in the caves of Brazil, and in the pampas of the Argentine Republic. (See also Alpaca; Guanaco; Llama and Vicugna.)

Fossil History.—As regards the past history of the group, remains of fossil species of *Camelus* have been obtained from the superficial deposits of various parts of Russia, Rumania, and Siberia, and others from the Lower Pliocene of northern India; the molar teeth of these latter presenting the additional column referred to above as distinguishing those of the llamas from those of modern camels. In addition to these Dr M. Schlosser has described remains of a large camel-like animal from China, with apparently generalized affinities, for which the name of *Paracamelus* is proposed. Mme Pavlow, of Moscow, has brought to notice a fossil camel-skull of great interest, which was collected in the district Alexandrie, of the government of Kherson, Russia. Unfortunately, the precise age of the formation from which it was obtained is unknown, but it is considered probable that it dates from the later Tertiary. Although it has the deciduous dentition, Mme Pavlow considers herself justified in referring the Kherson skull to the genus *Procamelus* previously known only from the Lower Pliocene or Upper Miocene strata of North America, and differing from modern camels, among other features, by the retention of a fuller series of premolar teeth. Part of the cannon-bone of a camel from another district in Russia is provisionally assigned to the same species. Possibly this Russian camel (*Procamelus khersonensis*), as it is called, may form the connecting link between the typical *Procamelus* of North America and the fossil camel (*Camelus sivalensis*) of the Siwalik Hills of India. Be this as it may, the identification of a North American type of camel from the Tertiary strata of eastern Europe forms another connecting link between the extinct faunas of the northern half of the Old World and North America, and thus tends to show that the claim of America to be the exclusive birthplace of many Old World types may have to be reconsidered.

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[1] Mr F. W. D. Brie (*English Historical Review*, 1906) vol. xxi. advances the theory that Tyler and Straw are one and the same person.

Remains of camels (*C. thomasi*) have also been found in the Pleistocene strata of Oran and Ouen Seguen, in Algeria; and certain remains from the Isle of Samos have been assigned to the same genus, although the reference requires confirmation. The Algerian Pleistocene camel was doubtless the direct ancestor of the living African species, which it serves to connect with the extinct *C. sivalensis*.

In North America, apart from certain still older and more primitive mammals, with teeth of the tubercular type, the earliest known form which can definitely be included in the camel-series is *Protylopus*, of the Uinta or Upper Eocene. In this creature, which was not larger than a European hare, there was the full number of 44 teeth, which formed a regular series, without any long gaps, and with the canines but little taller than the incisors, while the hinder cheek-teeth, although of the crescentic type, were low-crowned. In both jaws the anterior front-teeth were of a cutting and compressed type. Unfortunately, the skull is incomplete, and the rest of the skeleton very imperfectly known; but sufficient of the former remains to show that the socket of the eye was open behind, and of the latter to indicate that in the hind-foot, at any rate, the upper bones of the two functional toes had not coalesced into a cannon-bone. The lateral hind-toes (that is to say the second apd fifth of the typical series) had, however, become rudimentary; although it is probable that the corresponding digits of the fore-limb were functional, so that this foot was four-toed. In old individuals the bones of the forearm (radius and ulna) became welded together about half-way down, although they remained free above. On the other hand it appears that the smaller bone of the leg (fibula) was welded to the larger one (tibia), and that its upper portion had disappeared. Nothing is known of the neck vertebrae. It is, of course, evident that there must have been an earlier form in which all the feet were four-toed, and the bones of the forearm and lower part of the leg separate.

A stage higher in the series, viz. in the Oligocene, we meet with *Pôebrotherium*, in which a distinct increase in bodily size is noticeable, as also in the relative length of the two bones which unite in the higher types to form the cannon-bone. Moreover, the crowns of the hinder cheek-teeth are taller, and more distinctly crescentic, both feet are two-toed, the ulna and radius are fused, and the fibula is represented only by its lower part. In the vertebrae of the neck the distinctive cameloid characters had already made their appearance. On the other hand, the skull was short and rabbit-like, showing none of the characteristic features of modern camels.

In the Lower Miocene occurs *Protomeryx* or *Gomphotherium*, in which there is a considerable increase in the matter of bodily size, the two metacarpal and metatarsal bones (or those which unite in the latter forms to constitute the cannon-bones) being double the length of the corresponding elements in *Protylopus*. These bones, although separate, have their adjacent surfaces more closely applied than is the case in the latter; while in this and the earlier genera the terminal toe-bones indicate that the foot was of the normal hoofed type. In the skull the socket of the eye is surrounded by bone; while the dentition begins to approximate to the camel type—notably by the circumstance that the lower canine is either separated by a gap from the outermost incisors, or that its crown assumes a backwardly curved shape. In *Protolabis* of the Middle Miocene, while no cannon-bone is formed, the first and second pairs of incisor teeth are retained, and the limbs and feet are short and disproportionately small. In the Upper Miocene we come to a distinct type—*Procamelus*—which is entitled to be regarded as a camel, and approximates in size to a small llama. Here the metacarpals and metatarsals have partially united to form cannon-bones, the skull has assumed the elongated form characteristic of modern camels, with the loss of the first and second pairs of upper incisors, and the development of gaps in front of and behind each of the next three teeth, that is to say, the third incisor, the canine and the first cheek-tooth. The approximately contemporaneous *Pliauchenia* makes another step by the loss of the second lower cheek-tooth. Both these genera have the toe-bones of the irregular nodular form distinctive of modern camels, so that we may safely infer that the feet themselves had assumed the cushion-type.

In one species of *Procamelus* the metacarpals and metatarsals coalesced into canon-bones late in life; but when we come to the Pleistocene *Camelops* such union took place at an early stage of existence, and was thoroughly complete. In the living members of the group it occurs before birth. The species of *Camelops* were probably fully as large as llamas, and some, at any rate, resembled these animals as regards the number of teeth, the incisors being reduced to one upper and three lower pairs, and the cheek-teeth to four or five in the upper and four in the lower jaw; the total number of teeth thus being 28 or 30 in place of the 44 of *Poebrotherium*. The sole difference between *Camelops* and *Llama* seems to consist in certain structural details of the lower cheek-teeth. An allied extinct genus (*Eschatius*) is also distinguished by certain features in the dentition.

Apart from *Procamelus* the foregoing genera are exclusively North American. A lower jaw from the Pleistocene deposits of that continent has, however, been referred to the Old World *Camelus*.

In addition to the above there is an extraordinary North American Miocene giraffe-necked camel (*Alticamelus*), a creature of the size of a giraffe, with similarly elongated neck and limbs, and evidently adapted for browsing on trees. The feet and number of teeth were generally similar to those of *Procamelus*. Unlike the giraffe; the length of the limbs is due to the elongation of their upper segments, and that of the neck to the lengthening of only the hinder vertebrae.

In caverns and superficial deposits of South America occur remains of extinct species more or less closely related to modern llamas; but previous to the Upper Pliocene the group is unknown in South America, which it reached from the north.

All the foregoing genera are included in the sub-family Camelidae. Parallel to this is, however, the North American family Leptomerychidae (Hypertragulidae), as represented by *Leptomeryx*, *Camelomeryx* and *Leptoreodon*, which presents remarkable resemblances, especially in the type genus, to the Tragulina (see CHEVROTAIN); camel-like features being, however, apparent in the two genera last mentioned. Generalized features are also displayed by the Oligocene *Hypisodus*, which in its short skull and large orbits presents a curious approximation to the African dik-dik antelopes of the genus *Madoqua* (see ANTELOPE). Again, the remarkable horned North American Oligocene genus *Protoceras*, while displaying resemblances to *Leptomeryx* and *Leptoreodon*, presents also points of similarity to the Tragulina and Pecora (*q.v.*).

The North American genus *Oreodon* typifies a second family included by Professor W. B. Scott in the Tylopoda and generally known as the Oreodontidae. As *Oreodon* is, however, antedated by *Merycoidodon*, the latter name is properly entitled to stand, in which case the family should be called Agriochoeridae. It is not easy to point out the characters in which the family approximates to the Camelidae, and only its general characteristics can be indicated. The family ranges in North America from the Upper Eocene to the Lower Miocene, but *Oreodon* (or *Merycoidodon*), which is typified by an animal of the size of a sheep, is Oligocene. In the Oreodontinae or typical section of the family, which includes several genera nearly allied to *Oreodon*, the skull is shorter and higher than in the camels, with a swollen brain-case, a preorbital gland-pit, the condyle of the lower jaw transversely elongated, the tympanic bulla hollow, and the orbit surrounded by bone. The dentition comprises the typical 44 teeth, of which the molars are short-crowned, with four crescentic cusps on those of the upper jaw (selenodont type). The most characteristic dental feature is, however, the assumption of the form and function of a canine by the first lower premolar; the lower canine being incisor-like. The tail is very long; and the feet have five functional toes, with complete but short metacarpals or metatarsals. In the Miocene *Agriochoerus*, which typifies a second sub-family (Agriochoerinae), there is no gland-pit in the skull, of which the orbit is open behind; while the upper incisors are wanting in the adult and the terminal toe-bones are claw-like rather than of the hoofed type. The molars are less completely selenodont than in the type genus. It is noteworthy that a molar from the Tertiary of India has been referred to *Agriochoerus*, a determination which if correct probably indicates the occurrence of Oreodonts in the unknown Tertiary deposits of Central Asia. It may be added that in the Oreodontidae the vertebral artery pierces the transverse processes of the cervical vertebrae in the normal manner.

The earliest representatives of the Tylopoda according to Professor Scott is the Middle Eocene genus *Homacodon*, typifying the family Homacodontidae, which is regarded as the common ancestor of both

Camelidae and Oreodontidae, with resemblances to the European Oligocene genus *Dichobune* (see ARTIODACTYLA). *Homacodon* was an animal of the size of a rabbit, with five toes (of which only five were functional to each foot) and 44 teeth, of which the molars are tuberculated (*bunodont*), with six columns on those of the upper jaw; the premolars being of a cutting type. It should be added that this generalized animal is not unfrequently classed among the ancestral pigs, but its cameline affinities are strongly emphasized by Professor Scott.

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(R. L.*)

TYLOR, EDWARD BURNETT (1832–   ), English anthropologist, was born at Camberwell, London, on the 2nd of October 1832, the son of Joseph Tylor, a brassfounder. Alfred Tylor, the geologist, was an elder brother. His parents were members of the Society of Friends, at one of whose schools, at Grove House, Tottenham, he was educated. In 1848 he entered his father's manufactory in London, but at about the age of twenty he was threatened with consumption and forced to abandon business. During 1855–1856 he travelled in the United States of America to recruit his health. Proceeding in 1856 to Cuba, he met Henry Christy the ethnologist, with whom he visited Mexico. Tylor's association with Christy greatly stimulated his awakening interest in anthropology, and his visit to Mexico, with its rich prehistoric remains, led him to make a systematic study of the science. While on a visit to Cannes he wrote a record of his observations, entitled *Anahuac; or, Mexico and the Mexicans, Ancient and Modern*, which was published in 1861. In 1865 appeared *Researches into the Early History of Mankind*, which made Tylor's reputation. It showed great research, original insight, and much constructive power in the formation of systematic views. The chapters on early myths and their geographical distribution are especially valuable. The work reached a third edition in 1878. This book was followed in 1871 by the more elaborate *Primitive Culture: Researches into the Development of Mythology, Philosophy, Religion, Language, Art and Custom*, which at once became the standard general treatise on anthropology. Tylor's treatment of animism (chs.xi.–xvii.) was particularly elaborate, and he first determined the limits of that province of anthropology intending it to include "the general doctrine of souls, and other spiritual beings." In 1881 Tylor published a smaller and more popular handbook on *Anthropology*. His work had already met with recognition. In 1871 he was elected F.R.S., and in 1875 received the honorary degree of D.C.L. from the university of Oxford. He was appointed keeper of the University Museum at Oxford in 1883, and reader in anthropology in 1884. In 1888 he was appointed first Gifford lecturer at Aberdeen University, and delivered a two years' course on "Natural Religion." In 1896 he became first professor of anthropology at Oxford. At the end of 1907 the Clarendon Press published a volume of *Anthropological Essays*, to which various representative scholars of a younger generation in the same field had contributed, the essays being dedicated and presented to Tylor as a mark of honour; and this collection includes not only a bibliography of his publications by Miss Freire-Marreco, but also an appreciation of Tylor's life-work by Andrew Lang.

TYMPANON, or TYMPANUM (Gr. *τύμπανον*, from *τύπτειν*, to strike), a name applied by the Romans to both kettledrum and tambourine, in the case of the latter sometimes qualified by *leve*. The *tympanum leve*, generally included among the *tympana*, described as being like a sieve, was the tambourine used in the rites of Bacchus and Cybele. Pliny doubtless described half pearls having one side round and the other flat, as *tympania*, on account of their resemblance to the tympanum or kettledrum, which, in its primitive form, innocent of screws or mechanism for tightening the head, exactly resembled the half pearl. During the middle ages the tympanum was generally a tambourine, the kettledrum being known as *nacaire*.

In architecture the term tympanum is given to the triangular space enclosed between the horizontal cornice of the entablature and the sloping cornice of the pediment. Though sometimes left plain, in the most celebrated Greek temples it was filled with sculpture of the highest standard ever attained. In Romanesque and Gothic work the term is applied to the space above the lintel or architrave of a door and the discharging arch over it, which was also enriched either with geometrical patterns or in later work with groups of figures; those in continental work are usually arranged in tiers. The upper portion of a gable when enclosed with a horizontal string-course, is also termed a tympanum.

TYNDALE (or TINDALE), **WILLIAM** (*c.* 1492–1536), translator of the New Testament and Pentateuch (see BIBLE, ENGLISH), was born on the Welsh border, probably in Gloucestershire, some time between 1490 and 1495. In Easter term 1510 he went to Oxford, where Foxe says he was entered of Magdalen Hall. He took his M.A. degree in 1515 and removed to Cambridge, where Erasmus had helped to establish a reputation for Greek and theology. Ordained to the priesthood, probably towards the close of 1521, he entered the household of Sir John Walsh, Old Sodbury, Gloucestershire, as chaplain and domestic tutor. Here he lived for two years, using his leisure in preaching in the villages and at Bristol, conduct which brought him into collision with the backward clergy of the district, and led to his being summoned before the chancellor of Worcester (William of Malvern) as a suspected heretic; but he was allowed to depart without receiving censure or giving any undertaking. But the persecution of the clergy led him to seek an antidote for what he regarded as the corruption of the Church, and he resolved to translate the New Testament into the vernacular. In this he hoped to get help from Cuthbert Tunstall, bishop of London, and so "with the good will of his master" he left Gloucester in the summer of 1523. Tunstall disappointed him, so he got employment as a preacher at St Dunstan's-in-the-West, and worked at his translation, living as chaplain in the house of Humphrey Monmouth, an alderman, and forming a firm friendship with John Frith; but finding publication impossible in England, he sailed for Hamburg in May 1524. After visiting Luther at Wittenberg, he settled with his amanuensis William Roy in Cologne, where he had made some progress in printing a 4to edition of his New Testament, when the work was discovered by John Cochlaeus, dean at Frankfurt, who not only got the senate of Cologne to interdict further printing, but warned Henry VIII. and Wolsey to watch the English ports. Tyndale and Roy escaped with their sheets to Worms, where the 8vo edition was completed in 1526. Copies were smuggled into England but were suppressed by the bishops, and William Warham, archbishop of Canterbury, even bought up copies on the Continent to destroy them. Attempts were made to seize Tyndale at Worms, but he found refuge at Marburg with Philip, landgrave of Hesse. There he probably met Patrick Hamilton, and was joined by John Frith. About this time he changed his views on the Eucharist and swung clean over from transubstantiation to the advanced Zwinglian position. His *Parable of the Wicked Mammon* (1528), *Obedience of a Christen Man* (1528), in which the two great principles of the English Reformation are set out, viz. the authority of Scripture in the Church and the supremacy of the king in the state, and *Practyse of Prelates* (1530), a strong indictment of the Roman Church and also of Henry VIII.'s divorce proceedings, were all printed at Marburg. In 1529 on his way to Hamburg he was wrecked on the Dutch coast, and lost his newly completed translation of Deuteronomy. Later in the year he went to Antwerp where he conducted his share of the classic controversy with Sir Thomas More. After Henry VIII.'s change of attitude towards Rome, Stephen Vaughan, the English envoy to the Netherlands, suggested Tyndale's return, but the reformer feared ecclesiastical hostility and declined. Henry then demanded his surrender from the emperor as one who was spreading sedition in England, and Tyndale left Antwerp for two years, returning in 1533 and busying himself with revising his translations. In May 1535 he was betrayed by Henry Phillips, to whom he had shown much kindness, as a professing student of the new faith. The imperial officers imprisoned him at Vilvorde Castle, the state prison, 6 m. from Brussels, where in spite of the great efforts of the English merchants and the appeal of Thomas Cromwell to Archbishop Carandolet, president of the council, and to the governor of the castle, he was tried for heresy and condemned. On the 6th of October 1536 he was strangled at the stake and his body afterwards burnt. Though long an exile from his native land, Tyndale was one of the greatest forces of the English Reformation. His writings show sound scholarship and high literary power, while they helped to shape the thought of the Puritan party in England. His translation of the Bible was so sure and happy that it formed the basis of subsequent renderings, especially that of the authorized version of 1611. Besides the New Testament, the Pentateuch and Jonah, it is believed that he finished in prison the section of the Old Testament extending from Joshua to Chronicles.

Beside the works already named Tyndale wrote *A Prologue on the Epistle to the Romans* (1526), *An Exposition of the 1st Epistle of John* (1531), *An Exposition of Matthew v.-vii.* (1532), a treatise on the sacraments (1533), and possibly another (no longer extant) on matrimony (1529).

The works of Tyndale were first published along with those of John Frith (*q.v.*) and Robert Barnes, "three worthy martyrs and principal teachers of the Church of England," by John Day, in 1573 (folio). A new edition of the works of Tyndale and Frith, by T. Russell, was published at London (1828–1831). *His Doctrinal Treatises and Introductions to Different Portions of the Holy Scripture* were published by the Parker Society in 1848. For biography, see Foxe's *Acts and Monuments*; R. Demaus, *William Tyndale* (London, 1871); also the Introduction to Mombert's critical reprint of Tyndale's Pentateuch (New York, 1884), where a bibliography is given.

TYNDALL, JOHN (1820–1893), British natural philosopher, was born in Co. Carlow, Ireland, on the 2nd of August 1820, his father being the son of a small landowner in poor circumstances, but a man of more than ordinary ability. With Darwin and Huxley his name is inseparably connected with the battle which began in the middle of the 19th century for making the new standpoint of modern science part of the accepted philosophy in general life. For many years, indeed, he came to represent to ordinary Englishmen the typical or ideal professor of physics. His strong, picturesque mode of seizing and expressing things gave him an immense living influence both in speech and writing, and disseminated a popular knowledge of physical science such as had not previously existed. But besides being a true educator, and perhaps the greatest popular teacher of natural philosophy in his generation, he was an earnest and original observer and explorer of nature.

Tyndall was to a large extent a self-made man; he had no early advantages, but with indomitable earnestness devoted himself to study, to which he was stimulated by the writings of Carlyle. He passed from a national school in Co. Carlow to a minor post (1839) in the Irish ordnance survey, thence (1842) to the English survey, attending mechanics' institute lectures at Preston in Lancashire. He then became for a time (1844) a railway engineer, and in 1847 a teacher at Queenwood College, Hants. Thence with much spirit, and in face of many difficulties, he betook himself, with his colleague Edward Frankland, to the university of Marburg (1848–1851), where, by intense application, he obtained his doctorate in two years. His inaugural dissertation was an essay on screw-surfaces.

Tyndall's first original work in physical science was in his experiments with regard to magnetism and diamagnetic polarity, on which he was chiefly occupied from 1850 to 1855. While he was still lecturing on natural philosophy at Queenwood College, his magnetic investigations made him known in the higher circles of the scientific world, and through the initiative of Sir E. Sabine, treasurer of the Royal Society, he was elected F.R.S. in June 1852. In 1850 he had made Faraday's acquaintance, and shortly before the Ipswich meeting of the British Association in 1851 he began a lasting friendship with T. H. Huxley. The two young men stood for chairs of physics and natural history respectively, first at Toronto, next at Sydney, but they were in each case unsuccessful. On the 11th of February 1853, however, Tyndall gave, by invitation, a Friday evening lecture (on "The Influence of Material Aggregation upon the Manifestations of Force") at the Royal Institution, and his public reputation was at once established. In the following May he was chosen professor of natural philosophy at the Royal Institution, a post which exactly suited his striking gifts and made him a colleague of Faraday, whom in 1866 he succeeded as scientific adviser to the Trinity House and Board of Trade, and in 1867 as superintendent of the Royal Institution. His reverent attachment to Faraday is beautifully manifested in his memorial volume called *Faraday as a Discoverer* (1868).

The more original contributions which Tyndall made to science are dealt with elsewhere, in the articles concerned with the various subjects (see HEAT, &c.). But his inquiries into glacier motion were notable alike for his association with Switzerland and for prolonged controversy with other men of science on the subject. In 1854, after the meeting of the British Association in Liverpool, a memorable visit occurred to the Penrhyn slate quarries, where the question of slaty cleavage arose in his mind, and ultimately led him, with Huxley, to Switzerland to study the phenomena of glaciers. Here the mountains seized him, and he became a constant visitor and one of the most intrepid and most resolute of explorers; among other feats of climbing he was the first to ascend the Weisshorn (1861). The strong, vigorous, healthfulness and enjoyment which permeate the record of his Alpine work are magnificent, and traces of his influence remain in Switzerland to this day. The problem of the flow of glaciers occupied his attention for years, and his views brought him into acute conflict with others, particularly J. D. Forbes and James Thomson. Every one knew that glaciers moved, but the questions were how they moved, for what reason and by what mechanism. Some thought they slid like solids; others that they flowed like liquids; others that they crawled by alternate expansion and contraction, or by alternate freezing and melting; others, again, that they broke and mended. Thus there arose a chaos of controversy, illuminated by definite measurements and observations. Tyndall's own summary of the course of research on the subject was as follows:—

> The *idea* of semi-fluid motion belongs entirely to Rendu; the *proof* of the quicker central flow belongs in part to Rendu, but almost wholly to Agassiz and Forbes; the proof of the retardation of the bed belongs to Forbes alone; while the discovery of the locus of the point of maximum motion belongs, I suppose, to me.

But while Forbes asserted that ice was viscous, Tyndall denied it, and insisted, as the result of his observations, on the flow being due to fracture and regelation. All agreed that ice flowed *as if* it were a viscous fluid; and of this apparent viscosity James Thomson offered an independent explanation by the application of pure thermodynamical theory, which Tyndall considered inefficient to account for the facts he observed. It is unnecessary here to rake among the ashes of this prolonged dispute, but it may be noted that Helmholtz, who, in his lecture on "Ice and Glaciers," adopted Thomson's theory, afterwards added in an appendix that he had come to the conclusion that Tyndall had "assigned the essential and principal cause of glacier motion in referring it to fracture and regelation" (1865).

Tyndall's investigations of the transparency and opacity of gases and vapours for radiant heat, which occupied him during many years (1859–1871), are frequently considered his chief scientific work. But his activities were essentially many-sided. He definitely established the absorptive power of clear aqueous vapour—a point of great meteorological significance. He made brilliant experiments elucidating the blue of the sky, and discovered the precipitation of organic vapours by means of light. He called attention to curious phenomena occurring in the track of a luminous beam. He examined the opacity of the air for sound in connexion with lighthouse and siren work, and he finally clinched the proof of what had been already substantially demonstrated by several others, viz. that germ-free air did not initiate putrefaction, and that accordingly "spontaneous generation" as ordinarily understood was a chimera (1875–1876). One practical outcome of these researches is the method now always adopted of sterilizing by a succession of gentle warmings, sufficient to kill the developed micro-organisms, instead of by one fierce heating attempting to attack the more refractory undeveloped germs of the same. This method of intermittent sterilization originated with Tyndall, and it was an important contribution to biological science and industrial practice.

For the substantial publication of these researches reference must be made to the *Transactions of the Royal Society*; but an account of many of them was incorporated in his best-known books, namely, the famous *Heat as a Mode of Motion* (1863; and later editions to 1880), the first popular exposition of the mechanical theory of heat, which in 1862 had not reached the text-books; *The Forms of Water*, &c. (1872); *Lectures on Light* (1873); *Floating Matter in the Air* (1881); *On Sound* (1867; revised 1875, 1883, 1893). The original memoirs themselves on radiant heat and on magnetism were collected and issued as two large volumes under the following titles: *Diamagnetism and Magne-crystallic Action* (1870); *Contributions to Molecular Physics in the Domain of Radiant Heat* (1872).

It was on the whole the personality, however, rather than the discoverer, that was greatest in Tyndall. In the pursuit of pure science for its own sake, undisturbed by sordid considerations, he shone as a beacon light to younger men—an exemplar of simple tastes, robust nature and lofty aspirations. His elevation above the common run of men was conspicuous in his treatment of the money which came to him in connexion with his successful lecturing tour in America (1872–1873). It amounted to several thousands of pounds, but he would touch none of it; he placed it in the hands of trustees for the benefit of American science—an act of lavishness which bespeaks a noble nature. Though not so prominent as Huxley in detailed controversy over theological problems, he played an important part in educating the public mind in the attitude which the development of natural philosophy entailed towards dogma and religious authority. His famous Belfast address (1874), delivered as president of the British Association, made a great stir among those who were then busy with the supposed conflict between science and religion; and in his occasional writings—*Fragments of Science*, as he called them, "for unscientific people"—he touched on current conceptions of prayer, miracles, &c., with characteristic straightforwardness and vigour.

As a public speaker he had an inborn Irish readiness and vehemence of expression; and, though a thorough Liberal, he split from Mr Gladstone on Irish home rule, and took an active part in politics in opposing it.

In 1876 Tyndall married Louisa, daughter of Lord Claud Hamilton. He built in 1877 a cottage on Bel Alp above the Rhône valley, and in 1885 a house on Hindhead, near Haslemere. At the latter place he spent most of his later years; his health was, however, no longer as vigorous as his brain, and he suffered frequently from sleeplessness. On the 4th of December 1893, having been accidentally given an overdose of chloral, he died at Hindhead.

TYNDARIS, an ancient city on the northern coast of Sicily, about 13 m. W.S.W. of Mylae (mod. Milazzo) and 5 m. E. of the modern town of Patti. It was founded by Dionysius the Elder in 395 B.C., who settled there 600 Peloponnesian Messenians on a site cut out of the territory of Abacaenum (1 m. north of the modern Tripi). It was thus almost the last Greek city founded in Sicily. It was one of the earliest allies of Timoleon. In the First Punic War it was dependent on Carthage, but expelled the garrison in 254 B.C. and joined the Romans, under whom it seems to have flourished. Cicero calls it "nobilissima civitas," though it seems to have suffered especially under Verres. It was one of the points occupied by Sextus Pompeius, but was later on taken by Agrippa, who used it as a base of operations. Augustus probably made it a *colonia*. Pliny mentions that half of it was swallowed up by the sea, though he does not give the date of this event (*Hist. nat.* ii. 206). It was probably, however, due to a fault in the limestone rock of which it is composed, and the action of the sea. The site is a remarkably fine one, and it is surprising that it was not occupied sooner. It is an isolated hill (920 ft.) with projecting spurs, rising abruptly on the seaward side, and connected by a comparatively narrow isthmus with the lower ground inland. It thus commands a magnificent view, including even the summit of Etna, while opposite to it on the north are the Lipari Islands. Considerable remains of the city walls, built of rectangular blocks of stone, exist on the south side; on the west their foundations are traceable. Remains of several towers may be seen, and the site of the main gate, which was in a recess on the south (the land) side, is clearly traceable, the walls defending it on each side being well preserved. Outside it are several tombs of the Roman period. The walls follow the upper edge of the plateau, and do not seem to have included the spurs to seaward. Their remains indicate that it was the north and north-east portion of the city that fell. This fact renders it doubtful whether the church of the Madonna di Tindari, at the east extremity, marks the site of the acropolis. Along parts of the north side, where the line of the wall should run, is a line of débris, which may belong to a reconstruction after the catastrophe described by Pliny. Within the walls are considerable remains of a building generally known (though not correctly) as the gymnasium, constructed of masonry, with three narrow halls, each about 90 ft. long, the central hall being 21 ft. wide, the other two 14 ft. Below it to the north are remains of a building with several mosaic pavements, and to the west is a small theatre, the internal diameter of which is 212 ft., and the length of the stage 80 ft. There are traces of many other buildings within the city area, including a considerable number of underground cisterns An important collection of objects found on the site is preserved in the Villa della Scala (1½ m. to the west), belonging to Baron Sciacca, the owner of the site itself.

See R. V. Scaffidi, *Tyndaris* (Palermo, 1895). (T. As.)

TYNE, a river in the north-east of England, flowing eastward to the North Sea, formed of two main branches, the North Tyne and South Tyne. The North Tyne rises in the Cheviot Hills, at their south-western extremity, near the Scottish border. The valley soon becomes beautifully wooded. At Bellingham it receives the Rede, whose wild valley, Redesdale, was one of the chief localities of border warfare, and contains the site of the battle of Otterburn (1388). The South Tyne rises in the south-eastern extremity of Cumberland, below Cross Fell in the Pennine Chain, and flows north past Alston as far as the small town of Haltwhistle, where it turns east. The valley receives from the south the picturesque Allendale, in which the lead mines were formerly important. The two branches of the Tyne join at Warden, a little above the town of Hexham, with its great abbey, and the united stream continues past Corbridge, where a Roman road crossed it, in a beautiful sylvan valley. The united course from the junction to the sea is about 30 m. The length from the source of the North Tyne is 80 m., and the drainage area is 1130 sq. m. In its last 15 m. the Tyne, here the boundary between Northumberland and Durham, is one of the most important commercial waterways in England. Sea-going vessels can navigate up to Blaydon, and collieries and large manufacturing towns line the banks—Newburn, Newcastle-upon-Tyne, Wallsend and North Shields on the Northumberland side; Gateshead, Jarrow and South Shields on the Durham side, with many lesser centres, forming continuous lines of factories and shipbuilding yards. The growth of the great shipbuilding and engineering companies, now amalgamated, of which the Armstrong firm at Elswick is the most famous, necessitated the dredging of the river so as to form a deep waterway. At high-water spring tides there are 40 ft. of water at Shields Harbour at the mouth, and 31 at Newcastle, 8 m. up river. Dangerous rocks outside the mouth have been partially removed and the remainder protected, and the Tyne forms a very safe harbour of refuge.

TYNEMOUTH, a municipal, county and parliamentary borough of Northumberland, England, including the townships of Chirton, Cullercoats, North Shields, Preston and Tynemouth. Pop. (1891), 46,588; (1901), 51,366. North Shields, Tynemouth and Cullercoats are successive stations on a branch of the North-Eastern railway. Tynemouth lies on the north bank of the Tyne, on a picturesque promontory, 8½ m. E. of Newcastle. North Shields (*q.v.*) adjoins it on the W.; Chirton is to the W. again, and Preston to the N. of North Shields, while Cullercoats is on the coast 1¼ m. N.N.W. of Tynemouth. Tynemouth is the principal watering-place on this part of the coast, and here and at Cullercoats are numerous private residences. On the point of the promontory there is a small battery called the Spanish battery, and near it is a monument to Lord Collingwood. Within the grounds, to which the gateway of the old castle gives entrance, are the ruins of the ancient priory of St Mary and St Oswin—the principal remains being those of the church, which was a magnificent example of Early English work engrafted upon Norman. The priory and castle serve as the headquarters of the Tyne Submarine Engineers. The municipal buildings are in North Shields, which is also an important seaport. The coast is rocky and dangerous, but a fine pier protects the harbour (see North Shields). The municipal borough is under a mayor, 6 aldermen and 18 councillors. Area, 4372 acres.

Tynemouth is supposed to have been a Roman station, from the discovery of Roman remains there, but its early history centres round the priory, supposed to have been founded by Edwin, king of Northumbria, between 617 and 633, and rebuilt by king Oswald in 634. In 651 it became famous as the burial-place of Oswin, king of Deira, afterwards patron saint of the priory. After the conquest Malcolm, king of Scotland, and Edward his son, who had been defeated and killed at Alnwick, were buried there. Earl Waltheof gave Tynemouth to the monks of Jarrow, and it became a cell to the church of Durham, but later, owing to a quarrel with the bishop, Robert de Mowbray granted it to the abbey of St Albans in Hertfordshire. The priory was probably fortified in Saxon times, and was strengthened by Robert de Mowbray so that it was able to sustain a siege of two months by William Rufus. After the Dissolution the fortifications were repaired by Henry VIII. In 1642 it was garrisoned for the king by the earl of Newcastle, but surrendered to parliament in 1644. It was converted into barracks at the end of the 18th century. Owing to their close proximity to Newcastle and to the ascendancy which the burgesses of that town had gained over the river Tyne, Tynemouth and North Shields did not become important until the 19th century; the privileges which they held before that time are contained in charters to the prior and convent, and include freedom from toll, &c., granted by King John in 1203–1204. In 1292 there were disputes between the citizens of Newcastle and the prior, who had built a quay at North Shields, but was obliged by act of parliament to destroy it. Edward IV. in 1463 confirmed the previous charters of the monks, and at the same time gave them and their tenants licence to buy necessaries from ships in the "port and river of Tyne," and to load ships with coal and salt "without hindrance from the men of Newcastle." After the Napoleonic wars the trade of North Shields rapidly increased. The borough was incorporated in 1849, and has returned one member to parliament since 1832. In 1270 the prior claimed a market at Tynemouth, but was not allowed to hold it; and in 1304 a fair, which had been granted to him in the preceding year, was withdrawn on the petition of the burgesses of Newcastle. A market and two fairs on the last Friday in April and the first Friday in November were established in 1802 by the duke of Northumberland. In the 17th century the chief industries were the salt and coal trades. The former, which has entirely disappeared, was the more important, and in 1635 the salt-makers of North and South Shields received an incorporation charter.

See *Victoria County History, Northumberland*; W. S. Gibson, *The History of the Monastery founded at Tynemouth in the Diocese of Durham* (1846–1847).

TYPEWRITER, a writing machine which produces characters resembling those of ordinary letterpress; the term is also applied to the operator who works such machines.

In 1714 a British patent was granted to Henry Mill, who claimed that he had brought his invention to perfection at great pains and expense, for "An Artificial Machine or Method for the Impressing or Transcribing Letters, Singly or Progressively one after another as in Writing, whereby all Writing whatever may be Engrossed in Paper or Parchment so Neat and Exact as not to be distinguished from Print"; but beyond the title the patent gives no indication of the nature or construction of the machine. In America a patent for a "typographer" was obtained by William A. Burt in 1829, but the records of it were destroyed by a fire at Washington in 1836. The "typographic machine or pen" patented by X. Progrin, of Marseilles, in 1833, was on the type-bar principle, and at the York meeting of the British Association in 1844 a Mr Littledale showed an apparatus for the use of the blind, by which the impression of a type selected from a series contained in a slide could be embossed on a sheet of paper. In the "chirographer," for which American patents were granted to Charles Thurber in 1843 and 1845, a horizontal wheel carried in its periphery a series of rods each bearing a letter, the wheel being rotated till the required type was over the printing point. The Great Exhibition of 1851 contained a machine patented by Pierre Foucault, of Paris, in 1840, in which a series of rods with type at their ends could be pushed down to emboss paper at the printing point to which they were arranged radially; and there was in addition the "typograph" of William Hughes, which was also intended for embossing, though it was subsequently modified to give an impression through carbon paper. Between 1847 and 1856 Alfred E. Beach in America, and between 1855 and 1860 Sir Charles Wheatstone in England, constructed several typewriters, and in 1857 Dr S. W. Francis, of New York, made one with a pianoforte keyboard and type bars arranged in a circle. In 1866 John Pratt, an American living in London, patented a machine having 36 types mounted in three rows on a type wheel, the rotation of which brought the required character opposite the printing point, when the paper with a carbon sheet intervening was pressed against it by a hammer worked by the keys. Two years later an American patent was taken out by C. L. Sholes and C. Glidden, and in 1875, after effecting various improvements, they finally placed the manufacture of their machines in the hands of Messrs E. Remington & Sons, gun-makers, of Ilion, New York. The Remington machines worked on the type-bar principle, but at first each of the 44 bars carried only a single character, so that the writing was in capitals only. But in 1878 type-bars with two types were introduced, so that a machine with 40 keys, two being change-case keys, could print 76 characters, with both capital and small letters.

The great majority of modern typewriters are worked from a keyboard; the few that are not, known as index machines, will be disregarded here, for although they are much less expensive in first cost than the others, they scarcely come into competition as practical instruments, on account of their slowness. Keyboard machines fall into two classes, according as the types which make the impressions are (*a*) carried at the end of levers or type-bars which strike the paper when the keys are depressed, or (*b*) are arranged round the circumference of a wheel, or segment, which is rotated by the action of the keys until the corresponding type is brought opposite the printing point. The former of these arrangements is the more common. Another point of difference is in the inking device; in some cases, the type is inked by means of an ink-pad before being brought down on the paper to make the impression, but more frequently an inked ribbon is drawn along by the action of the machine between the type-face and the paper. Sometimes this ribbon is inked in two colours, enabling the operator, by bringing the appropriate portion opposite the type-face, to write, say, in black and red at will. A third basis of classification may be found in the arrangement of the keyboard. In some machines there is one key for each character, in others each key does duty for two or more characters. For example, in the former class there is one key for the capital A and another for the small a, the keys being arranged in two banks corresponding to the upper and lower cases of a printer's type-case; in the latter, one key is capable of striking both the small and the capital letter, and it does one or other according as a subsidiary key is or is not brought into simultaneous use with it. In type-bar machines designed on this plan, each bar carries two or more letters (cf. fig. 1). This form of keyboard is also applied to type-wheel machines.

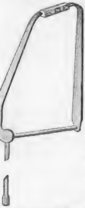
FIG. 1.—Type-bar of Oliver Machine.

Though there are numberless differences in detail, all typewriters, apart from the index machines, bear a general resemblance to each other in their mechanical arrangements. The really essential operations may be reduced to two; the machine must print a letter when a key is struck, and it must have a device by which the paper may be moved a short distance to the left with each stroke in order that the letters may be printed separately, not one on top of the other. Of the many subsidiary appliances that are fitted—a bell to warn the operator that he is approaching the end of a line, a lock to prevent the machine from working after the end of the line has been passed, attachments for facilitating insertion of fresh paper, corrections, and tabulation, &c.—some are certainly of advantage, but others are more useful to the manufacturer in drawing up his advertisements than to the expert operator, whose first care often is to disconnect them from the machine. Similarly with the "visible writing," which is sometimes put forward as a recommendation of extraordinary importance; doubtless the novice who is learning the keyboard finds a natural satisfaction in being able to see at a glance that he has struck the key he was aiming at, but to the practised operator it is not a matter of great moment whether the writing is always in view or whether it is only to be seen by moving the carriage, for he should as little need to test the accuracy of his performance by constant inspection as the piano-player needs to look at the notes to discover whether he has struck the right ones. The one important desideratum, without which no typewriter can produce work of satisfactory appearance, is accuracy of alignment. For the attainment of this the use of type-bars has given wide scope to the ingenuity of inventors, who have been confronted with the problem of making a system of levers at once strong, rigid and light, and of supporting them on bearings which are steady and adjustable for wear in conditions where space is much restricted.

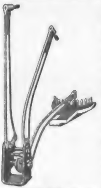
FIG. 2.—Type-bars of Bar-Lock Machine.

In the Oliver machine the type-bar is of the form shown in fig. 1, to secure stiffness and a double bearing. In the Bar-Lock, the type-bars are arranged three in one hanger, so that each has a bearing three times as wide as would be possible in the same space if each had a hanger to itself (fig. 2); in addition the wear of the pivots can be taken up by the screws seen on the right of the bearings, and as a further precaution each type-bar is locked at the printing point by falling between a pair of conical pins, which centre it exactly in the required place. In the Yost and the Empire the type-bars pass through guides. The centre guide of the former is shown at G in fig. 3, the type being just about to strike the paper. Pressure on one of the keys works the lever and pushes up the connecting-rod C, when the type leaves the ink-pad P and passes through the guide, which is slightly bevelled so as to guide it exactly to the printing point. In the Smith Premier the shafts upon which the type-bars swing are mounted tangentially on the ring (fig. 4), so that long supporting bearings are obtained, while the shortness of the type-bars themselves renders it possible to make them very stiff. The rocking-shaft mechanism (fig. 5), by which the power is transmitted from the keys to the type-bars, admits of each key having the same leverage and tends to uniformity of touch. This last quality is also aimed at by interposing an intermediate parallel bar between the key levers and the type-bar, as in the New Century Caligraph. In the Densmore the friction of the movements is minimized by the employment of ball bearings for the type-bar pivots. Electrical typewriters, in which the depression of a key does not work a type-bar directly, but merely closes a circuit that energizes an electro-magnet, have been suggested as a means of obtaining uniformity of touch combined with ease and rapidity, but have not as yet displaced the ordinary machines to any extent.

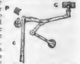

FIG. 3.—Central Guide and Type-bar of Yost Machine.

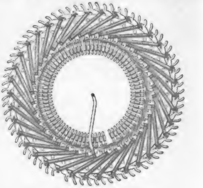
FIG. 4.—Type-bar Bearings, Smith Premier.

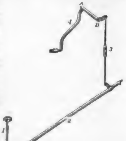

FIG. 5.—Rocking-shaft Mechanism of Smith Premier.

1. Key with stem
2. Rocking shaft.
3. Connecting-rod
4. Type-bar.

A and B, Conical bearings, 1⅜ in. apart.

One special form of typewriter, the Elliott-Fisher, is designed to write in a book such as a ledger. One leaf is clamped between the platen and an open frame which holds the paper smoothly. The operative parts slide on this frame, and move up and down the page so as to space the lines properly, the keyboard, with the type-bars, ribbon, &c., travelling step by step across the page. An adding device may be combined with this machine.

TYPHOID FEVER. Typhoid or enteric[1] (Gr. *ἔντερον*, the intestine) is a specific infectious fever characterized mainly by its insidious onset, by a peculiar course of the temperature, by marked abdominal symptoms occurring in connexion with a specific lesion of the bowels, by an eruption upon the skin, by its uncertain duration, and by a liability to relapses. This fever has received various names, such as gastric fever, abdominal typhus, infantile remittent fever, slow fever, nervous fever, "pythogenic fever," &c. The name of "typhoid" was given by Louis in 1829, as a derivative from typhus. Until a comparatively recent period typhoid was not distinguished from typhus. For, although it had been noticed that the course of the disease and its morbid anatomy were different from those of ordinary cases of typhus, it was believed that they merely represented a variety of that malady. The distinction between the two diseases appears to have been first accurately made in 1836 by Messrs Gerhard and Pennock, of Philadelphia, and valuable work was done by other American doctors, particularly Elisha Bartlett (1842). The difference between typhus and typhoid was still more fully demonstrated by Dr A. P. Stewart, of Glasgow (afterwards of London). Finally, all doubt upon the subject was removed by the careful clinical and pathological observations made by Sir William Jenner at the London fever hospital (1849-1851).

The more important phenomena of typhoid fever will be better understood by a brief reference to the principal pathological changes which take place during the disease. These relate for the most part to the intestines, in which the morbid processes are highly characteristic, both as to their nature and their locality. The changes (to be presently specified) are evidently the result of the action of the contagium on the system, and they begin to show themselves from the very commencement of the fever, passing through various stages during its continuance. The portion of the bowels in which they occur most abundantly is the lower part of the small intestine (ileum), where the "solitary glands" and "Peyer's patches" on the mucous surface of the canal become affected by diseased action of a definite and progressive character, which stands in distinct relation to the symptoms exhibited by the patient in the course of the fever. (1) These glands, which in health are comparatively indistinct, become in the commencement of the fever enlarged and prominent by infiltration due to inflammatory action in their substance, and consequent cell proliferation. This change usually affects a large extent of the ileum, but is more marked in the lower portion near the ileo-caecal valve. It is generally held that this is the condition of the parts during the first eight or ten days of the fever. (2) These enlarged glands next undergo a process of sloughing, the inflammatory products being cast off either in fragments or *en masse*. This usually takes place in the second week of the fever. (3) Ulcers are thus formed varying in size according to the gland masses which have sloughed away. They may be few or many in number, and they exhibit certain characteristic appearances. They are frequently, but not always, oblong in shape, with their long axis in that of the bowel, and they have somewhat thin and ragged edges. They may extend through the thickness of the intestine to the peritoneal coat and in their progress erode blood-vessels or perforate the bowel. This stage of ulceration exists from the second week onwards during the remaining period of the fever, and even into the stage of convalescence. (4) In most instances these ulcers heal by cicatrization, leaving, however, no contraction of the calibre of the bowel. This stage of healing occupies a considerable time, since the process does not advance at an equal rate in the case of all the ulcers, some of which have been later in forming than others. Even when convalescence has been apparently completed, some unhealed ulcers may yet remain and prove, particularly in connexion with errors in diet, a cause of relapse of some of the symptoms, and even of still more serious or fatal consequences. The mesenteric glands external to, but in functional relation with, the intestine, become enlarged during the progress of the fever, but usually subside after recovery.

Besides these changes, which are well recognized, others more or less important are often present. Among these may be mentioned marked atrophy, thinning and softness of the coats of the intestines, even after the ulcers have healed—a condition which may not improbably be the cause of that long-continued impairment of the function of the bowels so often complained of by persons who have passed through an attack of typhoid fever. Other changes common to most fevers are also to be observed, such as softening of the muscular tissues generally, and particularly of the heart, and evidences of complications affecting chest or other organs, which not infrequently arise. The swelled leg of fever sometimes follows typhoid, as does also periosteal inflammation.

The symptoms characterizing the onset of typhoid fever are very much less marked than those of most other fevers. The most marked of the early symptoms are headache, lassitude and discomfort, together with sleeplessness and feverishness, particularly at night; this last symptom is that by which the disease is most readily detected in its early stages. The peculiar course of the temperature is also one of the most important diagnostic evidences of this fever. During the first week it has a morning range of moderate febrile rise, but in the evening there is a marked ascent, with a fall again towards morning, each morning and evening, however, showing respectively a higher point than that of the previous day, until about the eighth day, when in an average case the highest point is attained. This varies according to the severity of the attack; but it is no unusual thing to register 104° or 105° F. in the evening and 103° or 104° in the morning. During the second week the daily range of temperature is comparatively small, a slight morning remission being all that is observed. In the third week the same condition continues more or less; but frequently a slight tendency to lowering may be discerned, particularly in the morning temperature, and the febrile action gradually dies down as a rule between the twenty-first and the twenty-eighth days, although it is liable to recur in the form of a relapse. Although the patient may, during the earlier days of the fever, be able to move about, he feels languid and uneasy; and usually before the first week is over he has to take to bed. He is restless, hot and uncomfortable, particularly as the day advances, and his cheeks show a red flush, especially in the evening or after taking food. The aspect, however, is different from the oppressed, stupid look which is present in typhus. The pulse in an ordinary case, although more rapid than normal, is not accelerated to an extent corresponding to the height of the temperature, and is, at least in the earlier stages of the fever, rarely above 100. In severe and protracted cases, where there is evidence of extensive intestinal ulceration, the pulse becomes rapid and weak, with a dicrotic character indicative of cardiac feebleness. The tongue has at first a thin, whitish fur and is red at the tip, edges and central line. It tends, however, to become dry, brown or glazed looking, and fissured transversely, while sordes may be present about the lips and teeth. There is much thirst and in some cases vomiting. Splenic and hepatic enlargement may be made out. From an early period in the disease abdominal symptoms show themselves and are frequently of highly diagnostic significance. The abdomen is somewhat distended or tumid, and pain accompanying some gurgling sounds may be elicited on light pressure about the lower part of the right side close to the groin—the region corresponding to that portion of the intestine in which the morbid changes already referred to are progressing. Diarrhoea is a frequent but by no means constant symptom. When present it may be slight in amount, or, on the other hand, extremely profuse, and it corresponds, as a rule, to the severity of the intestinal ulceration. The discharges are highly characteristic, being of light yellow colour resembling pea soup in appearance. Should intestinal haemorrhage occur, as is not infrequently the case during some stage of the fever, they may be dark brown or composed entirely of blood. The urine is scanty and high-coloured. About the beginning, or during the course of the second week of the fever, an eruption frequently makes its appearance on the skin. It consists of isolated spots, oval or round in shape, of a pale pink or rose colour, and of about one to one and a half lines in diameter. They are seen chiefly upon the abdomen, chest and back, and they come out in crops, which continue for four or five days and then fade away. At first they are slightly elevated, and disappear on pressure. In some cases they are very few in number, and their presence is made out with difficulty; but in others they are numerous and sometimes show themselves upon the limbs as well as upon the body. They do not appear to have any relation to the severity of the attack, and in a very considerable proportion of cases (particularly in children) they are entirely absent. Besides this eruption there are not infrequently numerous very faint bluish patches or blotches about half an inch in diameter, chiefly upon the body and thighs. When present the rose-coloured spots continue to come out in crops till nearly the end of the fever, and they may reappear should a relapse subsequently occur. These various symptoms persist throughout the third week, usually, however, increasing in intensity. The patient becomes prostrate and emaciated; the tongue is dry and brown, the pulse quickened and feeble, and the abdominal symptoms more marked; while nervous disturbance is exhibited in delirium, in tremors and jerkings of the muscles (*subsultus tendinum*), in drowsiness, and occasionally in "coma vigil." In severe cases the exhaustion reaches an extreme degree, although even in such instances the condition is not to be regarded as hopeless In favourable cases a change for the better may be anticipated between the twenty-first and twenty-eighth days, more usually the latter. It does not, however, take place as in typhus by a well-marked crisis, but rather by what is termed a "lysis" or gradual subsidence of the febrile symptoms, especially noticeable in the daily decline of both morning and evening temperature, the lessening of diarrhoea, and improvement in pulse, tongue, &c. Convalescence proceeds slowly and is apt to be interrupted by relapses. Should such relapses repeat themselves, the case may be protracted for two or three months, but this is comparatively rare.

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[1] The word "enteric" has been substituted for "typhoid" by the Royal College of Physicians in the nomenclature of diseases authorized by them, and the change was officially adopted by all departments of the British government. Its advantages are doubtful, and it has been generally ignored by those foreign countries which used the word "typhoid." "Enteric" is preferable in that it cannot be confounded with "typhus" and bears some relation to the nature of the affection, the characteristic feature of which is a specific inflammation of the small intestine; but it is not sufficiently distinctive. There are, in truth, several enteric fevers, and the appropriation of a term having a general meaning to one of them is inconvenient. Thus it is found necessary to revert to the discarded "typhoid," which has no real meaning in itself, but is convenient as a distinctive label, when speaking of the cause of the disease or some of its symptoms. We have the "typhoid bacillus," "typhoid stools," "typhoid spots", "typhoid ulcers," &c. The word "enteric" cannot well be applied to these things, because of its general meaning. Consequently both words have to be used, which is awkward and confusing.

Death in typhoid fever usually takes place from one or other of the following causes. (1) Exhaustion, in the second or third weeks, or later. Sometimes sinking is sudden, partaking of some of the characters of a collapse. (2) Haemorrhage from the intestines. The evidence of this is exhibited not only in the evacuations, but in the sudden fall of temperature and rise in pulse-rate, together with great pallor, faintness and rapid sinking. Sometimes haemorrhage, to a dangerous and even fatal extent, takes place from the nose. (3) Perforation of an intestinal ulcer. This gives rise, as a rule, to sudden and intense abdominal pain, together with vomiting and signs of collapse, viz. a rapid flickering pulse, cold clammy skin, and the marked fall of temperature. Symptoms of peritonitis quickly supervene and add to the patient's distress. Death usually takes place within 24 hours. Occasionally peritonitis, apart from perforation, is the cause of death. (4) Occasionally, but rarely, hyperpyrexia (excessive fever). (5) Complications, such as pulmonary or cerebral inflammation, bedsores, &c.

Certain sequelae are sometimes observed, the most important being the swelled leg, periostitis affecting long bones, general ill-health and anaemia, with digestive difficulties, often lasting for a long time, and sometimes issuing in pulmonary tuberculosis. Occasionally, after severe cases, mental weakness is noticed, but it is usually of comparatively short duration.

No disease has been more thoroughly studied in recent years than typhoid fever. The chief points requiring notice are (1) causation and spread, (2) prevalence, (3) treatment, (4) prevention.

Causation.—The cause is the *bacillus typhosus*, discovered by Eberth in 1880 (see PARASITIC DISEASES). This organism multiplies in the body of a person suffering from the disease, and is thrown off in the discharges. It enters by being swallowed and is conveyed into the intestine, where sets up the characteristic inflammation. It is found in the spleen, the mesenteric glands, the bile and the liver, not infrequently also in the bone marrow, and sometimes in the heart, lungs and kidneys, as well as in the faeces and the urine. It has also, though more rarely, been found in the blood. The illness is therefore regarded as a general toxaemia with special local lesions. The relation of the bacillus to the other numerous bacteria infesting the intestinal canal, some of which are undoubtedly capable of assuming a pathogenic character, has not been determined; but its natural history, outside the body, has been investigated with more positive results than that of any other micro-organism, though much still remains obscure. Certain conclusions may be stated on good evidence, but it is to be understood that they are all more or less tentative. (1) In crude sewage the bacillus does not multiply, but dies out in a few days. (2) In partly sterilized sewage (*i.e.* heated to 65° C.) it does not multiply, but dies out with a rapidity which varies directly with the number of other organisms present—the more organisms the quicker it dies. (3) It is said not to be found in sewer air, though Sir Charles Cameron, from a series of recent experiments, claims to have proved the contrary. (4) In ordinary water containing other organisms it dies in about a fortnight. (5) In sterilized water it lives for about a month. (6) In ordinary soil moistened by rain it has lived for 67 days, in sewage-polluted soil for at least 53 days, in soil completely dried to dust for 25 days, and in sterilized soil for upwards of 400 days. (7) Exposed to direct sunlight it dies in from four to eight hours. (8) It is killed by a temperature of 58 °C., but not by freezing or drying. (9) It multiplies at any temperature between 10° C. and 46° C., but most rapidly between 35° C and 42° C. These conclusions, which are derived from experiment, are to a considerable extent in agreement with certain observations on the behaviour of the disease on a large scale.

The susceptibility of individuals to the typhoid bacillus varies greatly. Some persons appear to be quite immune. The most susceptible age is adolescence and early adult life; the greatest incidence, both among males and females, is between the ages of 15 and 35. The aged rarely contract it. Men suffer considerably more than women, and they carry the period of marked susceptibility to a later age. Predisposing causes are believed to be debility, depression, the inhalation of sewer air by those unaccustomed to it, and anything tending to "lower the vitality," whatever that convenient phrase may mean. According to the latest theories, it probably means in this connexion a chemical change in the blood which diminishes its bactericidal power. The lower animals appear to be free from typhoid in nature; but it has been imparted to rabbits and other laboratory animals. There is no evidence that it is infectious in the sense in which small-pox and scarlet fever are infectious; and persons in attendance on the sick do not often contract it when sufficient care is taken. The recognition of these facts has led to a general tendency to underrate contagion, direct and indirect, from the sick to the healthy as a factor in the dissemination of typhoid fever; but it must be remembered that the sick, from whose persons the germs of the disease are discharged, are always an immediate source of danger to those about them. Such personal infection may become a very important means of dissemination. There is evidence that this is the case with armies in the field, *e.g.* the conclusions of the commission appointed to inquire into the origin and spread of enteric fever in the military encampments of the United States in the Cuban campaign of 1898. Out of 1608 cases most thoroughly investigated, more than half were found to be due to direct and indirect infection in and from the tents (Childs: Sanitary Congress, Manchester, 1902). A similar but perhaps less direct mode of infection was shown to account for a large number of cases under more ordinary conditions of life in the remarkable outbreak at Maidstone in 1897, which was also subjected to very thorough investigation. It was undoubtedly caused in the first instance by contaminated water, but 280 cases occurred after this cause had ceased to operate, and these were attributed to secondary infection, either direct or indirect, from the sick. A good deal of evidence to the same effect by medical officers of health in England has been collected by Dr Goodall, who has also pointed out that the attendants on typhoid patients in hospital are much more frequently attacked than is commonly supposed (*Trans. Epidem. Soc.* vol. xix.).

Recent discoveries as to the part played in the dissemination of typhoid fever by what are termed "typhoid carriers" have thrown light upon the subject of personal infection. The subject was first investigated by German hygienists in 1907, and it was found that a considerable number of persons who have recovered from typhoid fever continue to excrete typhoid bacilli in their faeces and urine (typhoid bacilluria). They found that after six weeks 4% to 5% of typhoid patients were still excreting bacilli; 23% of 65 typhoid patients at Boston City Hospital showed typhoid bacilli in their excretions ten days before their discharge. The liability of a patient to continue this excretion bears a direct relation to the severity of his illness, and it is probable that the bacilli multiply in the gall bladder, from which they are discharged into the intestine with the bile. The condition in a small number of persons may persist indefinitely. In 101 cases investigated, Kayser found three still excreting bacilli two years after the illness, and George Deane has recorded a case in which bacilli continued to be excreted 29 years afterwards.

Many outbreaks have in recent times been traced to typhoid carriers, one of the first being the Strassburg outbreak. The owner of a bakehouse had had typhoid fever ten years previously, and it was noticed that every fresh employé entering her service developed the disease. She prepared the meals of the men. On her exclusion from the kitchen the cases ceased. In Brentry reformatory, near Bristol, an outbreak numbering 28 cases was traced to a woman employed as cook and dairymaid who had had typhoid fever six years previously. Before entering the reformatory she had been cook to an institution for boarded-out girls, and during her year's residence there 25 cases had occurred. A case is reported by Huggenberger of Zürich (*Lancet*, October 1908) in which a woman carrier is said to have infected a series of cases lasting over 31 years, including her husband, son, daughter-in-law, and no less than nine different servants. Numerous cases of contamination of milk supplies by a "carrier" have been investigated, and in outbreaks traced to dairies it is wise to submit the blood of all employés to the agglutination test. A persistently high opsonic index to typhoid bacilli is notable among "carriers." Not only do persons who have had tyhpoid fever harbour bacilli, but also persons who come in contact with cases of the disease and who have no definite history of illness themselves.

The other means of dissemination are polluted soil, food and drink, particularly milk and water. The precise mode in which polluted soil acts is not understood. The result of experiments mentioned above shows that the bacillus lives and multiplies in such soil, and epidemiological investigation has repeatedly proved that typhoid persists in localities where the ground is polluted by the leakage of sewage or by the failure to get rid of excrementitious matter. In some instances, no doubt, drinking water thus becomes contaminated and conveys the germs, but there appears to be some other factor at work, for the disease occurs under the conditions mentioned where the drinking water is free from suspicion. Exhalation is not regarded as a channel of communication. The researches of Majors Firth and Horrocks prove that dust, flies and clothing may convey the germs. Another way in which food becomes the medium of conveyance is by the contamination of oysters and other shellfish with sewage containing typhoid bacilli. This has been abundantly proved by investigations in Great Britain, America and France. Uncooked vegetables, such as lettuces and celery, may convey the disease in a similar way. The most familiar and important medium, however, is water. It may operate directly as drinking water or indirectly by contaminating vessels used for holding other liquids, such as milk cans. Typhoid caused by milk or cream has generally been traced to the use of polluted water for washing out the cans, or possibly adulterating their contents. There is obviously no reason why this chain of causation should not hold good of other articles of food and drink. Outbreaks have been traced to ginger-beer and ice-creams. Water sources become contaminated directly by the inflow of drains or the deposit of excretal matter; indirectly, and more frequently, by the leakage of sewage into wells or by heavy rains which wash sewage matter and night-soil from ditches and the surface of the land into springs and watercourses. Water may further be contaminated in the mains by leakage, in domestic cisterns, and in supply pipes by suction. There is some reason to believe that the bacilli may multiply rapidly in water containing suitable nourishment in the absence of large numbers of their natural foes.

Prevalence.—Typhoid fever is more or less endemic and liable to epidemic outbreaks all over the world. It is more prevalent in temperate than in tropical climates. The following comparative death-rates show its relative prevalence in certain countries in 1890: Italy, 658; Austria, 470; U.S.A. 462; Prussia, 204; England, 179. It has undergone marked and progressive diminution in many countries coincidently with improved sanitation, particularly in regard to drainage and water-supply. Table I. gives annual death-rates in England and Wales after 1869, when typhoid was registered separately from typhus and "simple" fever.

TABLE I.—*Annual Mortality from Enteric Fever per Million Persons living—England and Wales.*

Year.	Mortality.	Year.	Mortality.
1869	390	1889	176
1870	388	1890	179
1871	371	1891	168
1872	377	1892	137
1873	376	1893	229
1874	374	1894	159
1875	371	1895	175
1876	309	1896	166
1877	279	1897	156
1878	306	1898	182
1879	231	1899	199
1880	261	1900	160
1881	212	1901	173
1882	229	1902	126
1883	228	1903	100
1884	236	1904	93
1885	175	1905	89
1886	184	1906	92
1887	185	1907	67
1888	172	1908	75

The diminution is more clearly shown if quinquennial periods are taken, as in Table II.

TABLE II.—*Average Annual Mortality per Million in England and Wales, and in London.*

	1871–75	1876–80	1881–85	1886–90	1891–95	1896–1900	1901–05
England and Wales . .	354	278	218	180	176	174·8	112·6
London . .	256	234	226	150	136	148	—

London shows less improvement than Great Britain as a whole, but it started with superior sanitary conditions, and though the reduction has not been maintained in the last recorded quinquennium, the mortality is still much below the mean. The disease is more prevalent in Paris, but the diminution effected has been far greater in the time, the average annual mortality per million having fallen from 1430 in 1882 and 581 in 1883–1888 to 203 in 1889–1894 and 172 in 1895–1900. Other recorded instances of diminution are Berlin, Hamburg, Munich, Copenhagen, the Netherlands, Buenos Aires (from 1060 per million in 1890 to 140 in 1899). In all these and other cases the improvement is attributed either to drainage or water-supply, or both. The case of Munich is so instructive that it deserves special mention. For many years typhoid was excessively prevalent in that city. The prevalence was continuous, but aggravated by large epidemic waves, extending over several years. These gradually decreased in magnitude, and ceased towards the end of 1880. Since then the prevalence has still further diminished, the average annual mortality per million having fallen from 2024 in 1851–1860, 1478 in 1861–1870 and 1167 in 1871–1880 to 160 in 1881–1890 and 52 in 1891–1900.

It has been forcibly argued by Dr Childs (*Trans. Epidem. Soc.* vol. xvi.) that drinking water had little, if anything, to do with the prevalence of the disease, and that its gradual reduction was due to purification of the soil by improved drainage systems and the abolition of slaughter-houses. The epidemic waves were found by von Pettenkofer to be associated with the rise and fall of the subsoil water; when the water fell the fever rose, and vice versa. He did not, however, consider that the subsoil water exercised any influence itself; he merely regarded it as an index to certain conditions of moisture which exercised a favourable or unfavourable influence on the development of the disease. His theory, which has been much misunderstood, is to some extent corroborated by some facts observed in Great Britain. One is the seasonal prevalence of typhoid, which in England is an autumnal disease. The minimum occurs in May or June; in August a marked rise begins, which continues throughout the autumn and reaches a maximum in November, after which an abrupt fall sets in. These facts are in keeping with Pettenkofer's theory, for the subsoil water reaches its maximum height at the end of spring and falls throughout the summer and a great part of the autumn. The coincidence is further emphasized by the fact that in dry years, when the subsoil water sinks lower than usual, typhoid is more prevalent, and in wet years the contrary. A glance at the mortality table for England given above will show that the progressive improvement recorded down to 1892 was suddenly interrupted in 1893, when the rate rose abruptly from 137 to 229. That was an extraordinarily dry and hot year, and it was followed by a succession of dry and hot years, culminating in 1899, with two exceptions—1894 and 1897. In both the typhoid rate fell again, but in all the others it rose. One explanation has been suggested by Mr Matthew Adams of Maidstone. He points out that organic matter deposited on or in the ground passes in normal years gradually through several layers of soil, and undergoes a process of destruction or purification before reaching the underground water; but in hot summers the ground becomes baked and cracked, and there is no such percolation; when rain comes everything is swept suddenly away without any purification, and finds its way into the sources of drinking water.

Whether this be so or not, there is no doubt that dangerous material does collect during the summer and is swept into watercourses by the autumnal rains. Perhaps this is sufficient to account for the seasonal prevalence and the annual variations noted. There is, however, a great deal of typhoid which has no connexion with water-supply. Numerous cases of persistent prevalence have been investigated by the medical officers of the local government board, in which drinking water has been exonerated and the mischief attributed to standing pollution of the soil—for instance, Mold, Middlesbrough, Southend, Swinton and Pendlebury, &c. In such places the chronic prevalence is apt to swell at times to more epidemic proportions, as at Munich; and possibly the condition of the ground may be the cause. An examination of the relative incidence of typhoid in the counties of England and Wales (Bulstrode) goes to show that its prevalence, broadly regarded, is not capricious. The areas of maximum and minimum incidence remained practically the same throughout the twenty years 1871–1890, though there was everywhere a large diminution. This fact suggests the reflection that standing conditions are more important factors than those accidental occurrences which attract public attention by causing sudden and explosive outbreaks. When these are on a small scale they may be due to milk; on a large scale they are always water-borne and caused by sudden contamination of a public supply. The classical example is Maidstone. That outbreak began towards the end of August 1897, and within six weeks some 1500 persons were attacked. The total number of cases was 1847, with 132 deaths, in a population of about 34,000. With the exception of 280 cases of secondary infection, which lingered on till the following January, they all occurred before the 18th of October, and the disease subsided almost as rapidly as it arose. A mass of evidence of different kinds left no possibility of doubt that accidental contamination of a water-supply was the cause. Perhaps the most striking point was that Maidstone is supplied with water from three different sources, known as Cossington, Boarley and Farleigh, and out of 1681 cases the respective incidence in these areas was—Cossington 29, Boarley 69, Farleigh 1583. Another great example of water-borne typhoid is furnished by Philadelphia, where 14,082 cases occurred in 1898–1899.

Treatment.—Improved knowledge of the nature and causation of typhoid fever has not led to the successful introduction of a specific treatment; nor have means been found to cut short the illness, though its fatality has been reduced. It still goes through the classical stages, which broadly coincide with first, second and third weeks. Attempts have been made to deal directly with the toxins produced by the bacilli, on the hypothesis that they are formed in the intestinal canal, by the use of internal disinfectants, such as mercury, iodine, carbolic acid, salol, &c., and these agents are sometimes beneficial; but the treatment remains essentially symptomatic, and follows the principles that were recognized before the discovery of the *bacillus typhosus*. One of the most important improvements is the regular use of sponging or bathing for the reduction of temperature. It has even been developed into a continuous bath, in which the patient is kept in water throughout the illness. Since the recent development of serum-therapy various serums have been tried in the treatment of typhoid fever, and successful reports are given of the anti-endotoxic serum devised by Dr Allen Macfadyen, while Professor Chantemesse, in the statistics of serum treatment at the Bastion Hospital, Paris, states that from July 1901 to July 1907 he so treated 1000 cases, 43 proving fatal, a mortality of 4·3%. During the same period, 5621 cases were treated in fourteen other Paris hospitals, with 960 deaths, a mortality of 17%. Chantemesse's serum was employed by Professor Brunon at Rouen in 100 cases with three deaths, and Dr Josias of Paris in 200 cases with eight deaths in typhoid fever occurring in young children. The serum is taken from a horse which has received over a long period injections of an emulsion of the *bacillus typhosus* or a soluble toxin. Sir Almroth Wright has suggested the use of an autogenous vaccine in this as in other parasitic diseases, opsonic control being exercised.

The fatality of typhoid fever varies greatly. Age exercises a marked influence, the fatality rising steadily after the period 5 to 10 years. The importance of careful and intelligent nursing is undoubtedly great, but there is a tendency, encouraged by some nurses, on the part of the public to overestimate that factor and to think that nothing more is needed. This is a grave mistake. No disease requires more vigilant attention or greater medical experience. The following table shows quinquennial figures for the London Metropolitan Asylums Board hospitals.

	Metropolitan Asylums Board Hospitals.			County of London.
	Admissions.	Deaths.	Ratio per cent. of deaths to admissions.	Mean annual mortality per 1000 living.
1874–1878	1878	379	20	0·25
1879–1883	2049	381	19	0·23
1884–1888	1937	314	16	0·17
1889–1893	2517	415	16	0·13
1894–1898	3328	578	17	0·13
1899–1903	6779	1023	15	0·13
1904–1908	3084	457	15	0·05

Prevention.—If house drainage were always perfectly carried out, sewage satisfactorily disposed of, water-supply efficiently protected or treated, patients segregated, and the typhoid material excreted by them and typhoid "carriers" effectually annihilated—if, in short, scientific cleanliness were completely attained, the disease would disappear, or be at least excessively rare. In some communities much has been done in the directions indicated; but in many others the lessons of experience are ignored, and even in the best practice lags behind theory. This is mainly due to apathy and reluctance to spend money, but there are certain real difficulties which stand in the way. To discuss them fully would involve a lengthy consideration of drainage, water-supply and other matters, which would be out of place here; but some points must be noted. The most important is undoubtedly water-supply. The substitution of public water supplies for shallow wells and small streams liable to pollution is one of the greatest factors in the diminution of typhoid and other water-borne diseases; but it may give rise to danger on a far larger scale, for a whole community may be poisoned at one blow when such a supply becomes contaminated. Unfortunately, it is extremely difficult to prevent contamination with certainty in a populous country. Theoretically, water may be pure at its source, and may be distributed in that condition. Such is water derived from deep wells and springs, or gathered from uncultivated and uninhabited uplands. In the one case it has undergone natural filtration in the ground; in the other, it escapes all risk of pollution. These waters are generally pure, but the condition cannot be relied on. A tramp or a shepherd may pollute the most remote gathering-ground unless it be fenced in; deep wells may be similarly fouled by workmen, and sewage may find its way into them from the surface or through fissures. In an outbreak of enteritis and typhoid fever at Leavesden Asylum, investigated by Dr A. Shadwell in 1890, the source of mischief was traced to contamination of the well, which was 250 ft. deep in the chalk. The contamination did not take place from the surface, but from some underground source, and there were grounds—corroborated by subsequent observation—for believing that it occurred at irregular intervals, and was probably connected with the level of the deep underground water. At the same time the similar well of a neighbouring poor-law school was found to be dangerously polluted, and it was ascertained that two others in the same locality had been condemned and closed in the past. The deep chalk in that neighbourhood was clearly unsafe, and this was thought to be due to the practice of digging holes called "dumb wells," but in reality cess-pits, as much as 40 ft. deep, in the chalk for the reception of sewage. The same practice is common in all inhabited localities on a chalk formation, as it is an extremely convenient way of disposing of sewage, which percolates away and renders it unnecessary to empty the cess-pit. Several similar cases of deep well pollution have been recorded, notably those of Houghton-le-Spring in 1889 and Worthing in 1893. To secure purity, therefore, and prevent liability to outbreaks of typhoid and other intestinal diseases, all gathering-grounds should be fenced in, and water, even from deep wells, should be regularly examined, both chemically and bacterioscopically, in order that any change in composition may be detected. In the water-supplies of great populations such examination should be made daily. Further, all supplies which are not above suspicion should be filtered through sand or sterilized by boiling. The latter can be carried out by simple means in the case of individual domestic water, and attempts have been made to apply it by means of mechanical apparatus to supplies on a larger scale. It is not, however, applicable to the water-supply of large towns, because of the liability of such apparatus to get out of order. Sand filtration is at present the best mode of dealing with these supplies. There is no purer water than that which has been properly treated by subsidence and sand filtration, even when it is taken from an impure source. So far as the prevention of typhoid and other water-borne disease is concerned, it is certainly safer than the unfiltered water which is taken from so-called pure sources. It cannot be a mere coincidence that London, Hamburg, Berlin and other towns using well-filtered but originally impure river water should be generally freer from water-borne disease than many large towns drawing their supply from purer sources but neglecting to filter it, such as Manchester, Glasgow and the American cities. Table III., prepared by Mr Caink, engineer to the city of Worcester, illustrates this fact, which has also been noted by Professor Saltet of Amsterdam as holding good of the Netherlands.

TABLE III.—*Occurrences of Typhoid according to Sources of Water-Supply.*

Source of Water.	Town.	Annual Typhoid Case-rate per 100,000.								
		1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
Deep wells in Red Sandstone	Wolverhampton	109	184	109	146	159	117	124	224	237
	Birkenhead	157	207	185	165	138	126	211	230	145
Deep wells in Chalk	Southampton	145	159	109	83	78	64	153	171	109
Upland surface water	Liverpool	152	275	267	190	168	160	129	149	115
	Manchester	120	120	90	96	92	90	118	78	78
	Plymouth	126	63	47	32	31	49	41	49	120
Rivers (filtered)	London	65	84	77	81	71	70	66	98	95
	Reading	30	35	28	53	30	67	32	48	41
	Worcester	155	145	110	36	43	45	31	50	26
Average of 219 towns		88	142	103	115	102	100	115	127	116

The amount of typhoid is dependent on other factors besides the water-supply, but the close connexion between the two and the influence of filtration are well attested by the experience of Worcester, where the great reduction recorded since 1894 coincided with new and improved filtration. The weak point about sand filtration is that it is apt to be imperfectly performed when the filters are frozen or newly cleaned, or when the process is too rapid. Filtration through porcelain is an efficient purifier, but it is not applicable to supplies on a large scale, and is liable to break down through clogging of the filters. Other portable filters are regarded as useless or worse. The best emergency treatment for suspected drinking water is boiling. Contamination of water in the mains is due to bad laying, and ought never to occur; that of supply pipes can be prevented by a constant service, and of domestic filters by providing them with covers.

Next to water-supply, and hardly less important, is drainage. The drying and cleansing of the soil by good household drainage and sewerage is essential to the prevention of typhoid. Cess-pits, leaking drains and privies, especially when there is only one to several houses, as in many industrial towns, are powerful allies of this disease. The drainage of all old houses is defective and dangerous. The ground about them is commonly honeycombed with cess-pits and saturated with sewage. The only way to discover and remedy such defects is to lay them bare with the pickaxe and shovel. Soil-pipes should always be trapped and ventilated. In short, no disease requires for its prevention more careful attention to house sanitation. The paving of yards and other spaces is also desirable in towns, on account of the liability of the unprotected soil to harbour moisture and filth.

Other modes by which the disease is spread—such as shellfish, milk and uncooked vegetables—suggest their own remedy. The dissemination by dust and flies is less easily prevented. All that can be done is to segregate the sick and promptly destroy all dangerous matters proceeding from them. It should be remembered that the urine may be an even greater source of danger than the faeces. The same observation applies to the prevention of infection from person to person. There is no doubt that sufficient care is often wanting, even in hospitals, in handling patients' soiled linen and clothes, and in dealing promptly and effectually with their excreta. For the effectual segregation and treatment of persons suffering from typhoid prompt recognition is necessary; and this, unfortunately, is a matter of much difficulty on account of variation in the type and severity of the illness. Bacteriological science has here come to the assistance of the clinical physician with what is called the Widal or serum reaction, which has a great diagnostic value when carefully performed. Professor Chantemesse has also introduced a cutaneous reaction similar to von Pirquet's reaction in tuberculosis. But obviously these remedies can only be applied to persons in the position of patients; it is of no use in the case of those who do not proclaim themselves ill, but go about their business when suffering from the disease. Such "ambulatory" cases have long been recognized as an important factor in spreading the disease. Many of the most memorable epidemics have probably been caused by them, and it is difficult to see how they can be guarded against. The "typhoid-carrier," however, when discovered should be interdicted from the preparation of food and should undergo a course of treatment with a view to lessening their excretion of typhoid bacilli.

The prevention of typhoid among armies in the field is a problem of special difficulty, not in principle but because of the conditions. The water is generally polluted, and soldiers are too thirsty to wait while it is boiled or filtered, even if the means are at hand. The sanitary arrangements are such as to ensure the saturation of the ground with excreta; flies and dust abound; personal cleanliness is impossible, and men feed and sleep together in the closest proximity. No doubt a great deal might be done by efficient sanitary organization, which has hitherto been lacking, and by educating the men. Dr Leigh Canney in 1901 suggested a scheme for dealing systematically with the water-supply of an army. Extraordinary results were obtained by the Japanese army medical department in the Russo-Japanese War of 1904–5 in the prevention of typhoid fever, which up to that period was responsible for the largest mortality of any disease affecting armies in the field. Handbooks on the avoidance of cholera, plague and typhoid fever were issued to the troops. Boiled water in quantities was provided for the soldiers, each battalion having its boiling outfit. Even foreign attachés and correspondents were requested to observe the regulations on this point. With this there was a systematic advance testing of wells, the wells being labelled "fit for drinking" or "for washing purposes only." It being impossible to suppress the presence of flies on food, care was taken to cover all latrines and cover and disinfect excreta, so that infection from flies was reduced to a minimum. Food was transferred from sterilized caldrons into sterilized lacquer boxes and served on sterilized plates. A crematory was attached to base hospitals, where all nightsoil, garbage and waste was burnt daily. Owing to these precautions the incidence of infectious disease, notably typhoid fever, was reduced to a figure unparalleled in any previous war, only 3·51% of the total sickness being due to infectious disease. Taking the number of men at the front in April 1905 to have been 599,617, the entire deaths from infectious and contagious diseases amounted to 1·24% of the entire army in the field.

In a table furnished by the Japanese war office at a still later date we note the small percentage of typhoid fever.

Percentage of patients in entire Army Corps at a certain date:—

Wounds received in action	45·53
Other wounds and injuries	3·71
Typhoid fever	1·61
Dysentery	1·95
All other diseases	47·20

In the statistics of General Oku's army, calculated to be at least 75,000 strong, Major-General Mori, chief medical officer, reports the typhoid cases to be 66 only between the dates of October 1904 and April 1905. Of this army 2142 were invalided home or died; 133 only being cases of typhoid fever.

The sickness incidence in the First Army under General Kuroki was as follows during the first six months of the campaign:—

Months	Sickness: all Diseases.	Typhoid Fever.
March	3829	3
April	3545	1
May	3154	9
June	4824	9
July	5565	4
August	6006	9

The figures are interesting when we consider that during the South African War of 1899–1902 no fewer than 31,000 men were invalided home to England on account of typhoid fever.

One other point requires mention in connexion with prevention, namely, protective inoculation. This is performed with an anti-toxic substance prepared from dead cultures of bacilli, and has been tried on a fairly large scale, particularly on the British army in India and South Africa. Sir W. B. Leishman, writing on the results of anti-typhoid inoculations in the army (*Journ. of R.A.M.C.*, February 1909), gives the total number of men inoculated up to the 1st of June 1908 as 5473, amongst whom 21 cases (3·8 per 1000) with 2 deaths occurred. The number non-inoculated, 6610 men, had an incidence of 187 cases (28·3 per 1000) with 26 deaths. The case mortality of the inoculated was 9·5%, of the non-inoculated 13·8%. Several regiments however were not exposed to enteric fever. If these be excluded the incidence in the inoculated is 6·6 per 1000 against 39·5 per 1000 in the non-inoculated. Lord Kitchener, speaking at Middlesex Hospital in October 1910, bore emphatic testimony to the value of inoculation coupled with improved sanitary methods on the health of the army in India, declaring his belief that enteric would before long join cholera in total banishment from the barracks.

TYPHON (Typhaon, Typhoeus), in Greek mythology, youngest son of Gaea and Tartarus. He is described as a grisly monster with a hundred dragons' heads, who was conquered and cast into Tartarus by Zeus. In other accounts, he is confined in the land of the Arimi in Cilicia (*Iliad*, ii. 783) or under Etna (Aeschylus, *P.V.* 370) or in other volcanic regions, where he is the cause of eruptions. Typhon is thus the personification of volcanic forces. Amongst his children by Echidna are Cerberus, the Lernaean hydra, and the Chimaera. He is also the father of dangerous winds (typhoons), and by later writers is identified with the Egyptian Seth.

See Eduard Meyer, *Set-Typhon* (1875), and M. Mayer, *Die Giganten und Titanen* (1887); Preller-Robert, *Griechische Mythologie* (1894), pp. 63–66; O. Gruppe, *Griechische Mythologie*, ii. 845, 1333, according to whom Typhon, the "snake-footed" earth-spirit, is the god of the destructive wind, perhaps originally of the sirocco, but early taken by the Phoenicians to denote the north wind, in which sense it was probably used by the Greeks of the 5th century in nautical language; and also in *Philologus*, ii. n.f. (1889), where he endeavours to prove the identity of Typhon with the Phoenician Zephon (Baal-Zephon, translated in Gesenius's *Thesaurus* by "locus Typhonis" or "Typhoni saar"), signifying "darkness," "the north wind," and perhaps "snake"; A. von Mess, "Der Typhonmythus bei Pindar und Aeschylus," in *Rhein. Mus.* lvi. (1901), 167.

TYPHOON (probably from the Arabic and Hindustani *tufán*, a tempest, which is perhaps derived from Typhon, *q.v.*: the Chinese *t'ai fung*, strong wind, is not used in application to typhoons), the name given to a heavy cyclonic storm in the seas fringing the eastern coast of Asia from Japan to the Philippine Islands. Typhoons generally occur in a series during the months of August, September and October, the season when the belt of equatorial calms in the Pacific Ocean reaches its most northerly extension.

TYPHUS FEVER (from Gr. τῦφος, smoke or mist, in allusion to the stupor of the disease), an acute infectious disease of highly contagious nature, lasting for about fourteen days, and characterized mainly by great prostration of strength, severe nervous symptoms, and a peculiar eruption on the skin. It has received numerous other names, such as pestilential, putrid, jail, hospital fever, exanthematic typhus, &c. It appears to have been known for many centuries as a destructive malady, frequently appearing in epidemic form, in all countries in Europe, under the conditions to be afterwards referred to. The best accounts of the disease are those given by old English writers, who narrate its ravages in towns and describe many "black assizes," in which it was communicated by prisoners brought into court to the judges, jurymen, court officials, &c., with fatal effect. Typhus fever would seem to have been observed in almost all parts of the world; but it has most frequently prevailed in temperate or cold climates.

The conditions concerned in its production include both the predisposing and the exciting. Of the former the most powerful are those influences which lower the health of a community, especially overcrowding and poverty. Hence this fever is most frequently found to affect the poor of large cities and towns, or to appear where large numbers of persons are living crowded together in unfavourable hygienic conditions, as has often been seen in prisons, workhouses, &c. Armies in the field are also liable to suffer from this disease; for instance, during the Crimean War it caused an enormous mortality among the French troops. Recently, however, an important change of view of the connexion of typhus fever has arisen. Professor Matthew Hay (*Journal of Public Health*, September 1907) attributes the spread of typhus fever to fleas. His observations are based on the epidemic in Aberdeen. He sums up his conclusions in the following manner: (1) Every case in hospital examined by Professor Hay and his assistants was flea bitten, and those of the staff who complained of flea bites were attacked. Care was exercised to distinguish between flea bites and petechiae. (2) Where a patient was apparently free from bites it was found he had been in contact with verminous families. (3) The disease did not spread in clean houses with clean inhabitants, even when a typhus patient remained in the dwelling during his entire illness. (4) All nurses or wards-maids who were attacked were in contact with the patients when they were first admitted. No nurse, wards-maid or doctor who had been in close contact with the cases when cleaned contracted the disease. (5) An ambulance driver who complained of being pestered by fleas contracted typhus fever, but when the ambulance staff were adequately protected from fleas no other cases developed.

Typhus is now regarded as certainly due to the action of some specific micro-organism (see Parasitic Diseases), but the bacteriology is still imperfect. In 1891 Jaroslav Hlava, of Prague, found in the blood of 20 out of 33 cases of typhus a well-defined organism which he termed the strepto-bacillus. Lewaschew in 1892 found in the blood and spleen of typhus patients small round highly refractive actively-moving bodies lying between the corpuscles. Sometimes these bodies were flagellate. Dubieff and Bruhl also found a diplococcus in the blood which they named the diplococcus exanthematicus.

The course of typhus fever is characterized by certain well-marked stages. 1. The stage of *incubation*, or the period elapsing between the reception of the fever poison into the system and the manifestation of the special evidence of the disease, is believed to vary from a week to ten days. During this time, beyond feelings of languor, no particular symptoms are exhibited.

2. The *invasion* of the fever is in general well marked and severe, in the form of a distinct rigor, or of feelings of chilliness lasting for hours, and a sense of illness and prostration, together with headache of a distressing character and sleeplessness. Feverish symptoms soon appear and the temperature of the body rises to a considerable height (103°–105° F.), at which it continues with little daily variation until about the period of the crisis. It is, however, of importance to observe certain points connected with the temperature during the progress of this fever. Thus about the seventh day the acme of the fever heat has been reached, and a slight subsidence (1° or less) of the temperature takes place in favourable cases, and no further subsequent rise beyond this lowered level occurs. When it is otherwise, the case often proves a severe one. Again, when the fever has advanced towards the end of the second week, slight falls of temperature are often observed, prior to the extensive descent which marks the attainment of the crisis. The pulse is

typhus fever is rapid (100–120 or more) and at first full, but later on feeble. Its condition as indicating the strength of the heart's action is watched with anxiety. The tongue, at first coated with a white fur, soon becomes brown and dry, while sordes (dried mucus, &c.) accumulate upon the teeth; the appetite is gone; and intense thirst prevails. The bowels are as a rule constipated, and the urine is diminished in amount and high coloured. The physician may make out distinct enlargement of the spleen.

3. The third stage is characterized by the appearance of the *eruption*, which generally shows itself about the fourth or fifth day or later, and consists of dark red (mulberry-coloured) spots or blotches varying in size from mere points to three or four lines in diameter, very slightly elevated above the skin, at first disappearing on pressure, but tending to become both darker in hue and more permanent. They appear chiefly on the abdomen, sides, back and limbs, and occasionally on the face. Besides this characteristic typhus rash, there is usually a general faint mottling all over the surface. The typhus rash is rarely absent and is a very important diagnostic of the disease. In the more severe and fatal forms of the fever the rash has all through a very dark colour, and slight subcutaneous haemorrhages (petechiae) are to be seen in abundance. After the appearance of the eruption the patient's condition seems to be easier, so far as regards the headache and discomfort which marked the outset of the symptoms; but this is also to be ascribed to the tendency to pass into the typhous stupor which supervenes about this time, and becomes more marked throughout the course of the second week. On the examination of the blood a marked leucocytosis is present. This is considered to be diagnostic in doubtful cases when the rash is badly marked. The patient now lies on his back, with a dull dusky countenance, an apathetic or stupid expression, and contracted pupils. All the febrile symptoms already mentioned are fully developed, and delirium, usually of a low muttering kind, but sometimes wild and maniacal (*delirium ferox*), is present both by night and day. The peculiar condition to which the term "coma vigil" is applied, in which the patient, though quite unconscious, lies with eyes widely open, is regarded, especially if persisting for any length of time, as an unfavourable omen. Throughout the second week the symptoms continue unabated; but there is in addition great weakness, the pulse becoming very feeble, the breathing shallow and rapid, and often accompanied with bronchial sounds.

4. A *crisis* or favourable change takes place about the end of the second or beginning of the third week (on an average the 14th day), and is marked by a more or less abrupt fall of the temperature and of the pulse, together with slight perspiration, a discharge of loaded urine, the return of moisture to the tongue, and by a change in the patient's look, which shows signs of returning intelligence. Although the sense of weakness is extreme, convalescence is in general steady and comparatively rapid.

Typhus fever may, however, prove fatal during any stage of its progress and in the early convalescence, either from sudden failure of the heart's action—a condition which is specially apt to arise—from the supervention of some nervous symptoms, such as meningitis or of deepening coma, or from some other complication, such as bronchitis. Further, a fatal result sometimes takes place before the crisis from sheer exhaustion, particularly in the case of those whose physical or nervous energies have been lowered by hard work, inadequate nourishment and sleep, or intemperance.

Occasionally troublesome sequelae remain for a greater or less length of time. Among these may be mentioned mental weakness or irritability, occasionally some form of paralysis, an inflamed condition of the lymphatic vessels of one leg (the swelled leg of fever), prolonged weakness and ill health, &c. Gradual improvement, however, may be confidently anticipated and even ultimately recovery.

The mortality from typhus fever is estimated by Charles Murchison (1830–1879) and others as averaging about 18% of the cases, but it varies much according to the severity of type (particularly in epidemics), the previous health and habits of the individual, and very specially the age—the proportion of deaths being in striking relation to the advance of life. Thus, while in children under fifteen the death-rate is only 5%, in persons over fifty it is about 46%.

Treatment.

The treatment of typhus fever includes the prophylactic measures of attention to the sanitation of the more densely populated portions of towns. Where typhus has broken out in a crowded district the prompt removal of the patients to a fever hospital and the thorough disinfection and cleansing of the infected houses are to be recommended. Where, however, a single case of accidentally caught typhus occurs in a member of a family inhabiting a well-aired house, the chance of it being communicated to others in the dwelling is small, nevertheless every precaution in the way of isolation and disinfection should be taken.

The treatment of a typhus patient is conducted upon the same general principles as in typhoid. Complete isolation should be maintained throughout the illness, and due attention given to the ventilation and cleansing of the sick chamber. Open-air treatment when practicable greatly reduces the temperature. The main element in the treatment of this fever is good nursing, and especially the regular administration of nutriment, of which the best form is milk, although light plain soup may also be given. The food should be administered at stated intervals, not, as a rule, oftener than once in one and a half or two hours, and it will frequently be necessary to rouse the patient from his stupor for this purpose. Sometimes it is impossible to administer food by the mouth, in which case recourse must be had to nutrient enemata. Alcoholic stimulants are not often required, except in the case of elderly and weakly persons who have become greatly exhausted by the attack and are threatening to collapse. When the pulse shows unsteadiness and undue rapidity, and the first sound of the heart is but indistinctly heard by the stethoscope, the prompt administration of stimulants (of which the best form is pure spirit) will often succeed in averting danger. Should their use appear to increase the restlessness or delirium they should be discontinued and the diffusible (ammoniacal or ethereal) forms tried instead.

Many other symptoms demand special treatment. The headache may be mitigated by removing the hair and applying cold to the head. The sleeplessness, with or without delirium, may be combated by quietness, by a moderately darkened room (although a distinction between day and night should be made as regards the amount of admitted light), and by soothing and gentle dealing on the part of the nurse. Opiate and sedative medicines in any form, although recommended by many high authorities, must be given with great caution, as their use is often attended with danger in this fever, where coma is apt to supervene. When resorted to, probably the safest form is a combination of the bromide of potassium or ammonium with a guarded amount of chloral. Alarming effects sometimes follow the administration of opium. Occasionally the deep stupor calls for remedies to rouse the patient, and these may be employed in the form of mustard or cantharides to the surface (calves of legs, nape of neck, over region of heart, &c.), of the cold affusion, or of enemata containing turpentine. The height of the temperature may be a serious symptom, and antipyretic remedies appear to have but a slight influence over it as compared to that which they possess in typhoid fever, acute rheumatism, &c. Hugo Wilhelm von Ziemssen (1829–1902) strongly recommends baths in hyperpyrexia, the temperature of the bath being gradually reduced by the addition of ice. Cold sponging of the hands and feet and exposed parts, or cold to the head, may often considerably lower the temperature. Throughout the progress of a case the condition of the bladder requires special attention, owing to the patient's drowsiness, and the regular use of the catheter becomes, as a rule, necessary with the advance of the symptoms.

TYPOGRAPHY (*i.e.* writing by types) is the general term for the art of printing movable (cast-metal) types on paper, vellum, &c. It is distinct from writing, and also from wood-engraving or xylography, which is the art of cutting figures, letters, words, &c., on blocks of wood and taking impressions from such blocks by means of ink, or any other fluid coloured substance, on paper or vellum.

I.—History of Typography

Although the art of writing and that of block-printing both differ widely from printing with movable metal types, yet this last process has apparently been such a gradual transition from block-printing,[1] and block-printing in its turn such a natural outcome of the many trials that were probably made to produce pictures, books, &c., in some more expeditious manner than could be done with handwriting, that a cursory glance at these two processes will not seem out of place, especially as a discussion on the origin and progress of typography could hardly be understood without knowing the state of the literary development at the time that printing appeared.

First Attempts at Printing.

The art of printing, *i.e.* of impressing (by means of certain forms and colours) figures, pictures, letters, words, lines, whole pages, &c., on other objects, as also the art of engraving, which is inseparably connected with printing, existed long before the 15th century. Not to go back to remoter essays, there is reason to suppose that medieval kings and princes (among others William the Conqueror) had their monograms cut on blocks of wood or metal in order to impress them on their charters. Such impressions from stamps are found instead of seals on charters of the 15th century. Manuscripts, even of the 12th century, show initials which, on account of their uniformity, are believed to have been impressed by means of stamps or dies.[1] Before the invention of printing, say about 1436, bookbinders are known to have impressed names or legends or other inscriptions on their bindings in two ways: (1) by means of single, insulated letters engraved reversely downwards into a stamp of brass, whereby the letters appeared en relief on the leather or parchment of the binding; (2) by letters engraved reversely en relief on the brass stamp, whereby the letters sank into the binding. For this reason the term *impressor*, applied afterwards to the "printer," was, in the first instance, applied to the binder, whereas *ligator* was the proper word for him (see F. Falk, *Der Stempeldruck*, in "Festschrift," 1900, p. 73 sqq.; Zedler, *Gutenberg-Forschungen*, 1901, p. 6). But the idea of "multiplying" representations from one engraved plate or block or stamp, or other form, was unknown to the ancients, whereas it is predominant in what we call the art of block-printing, and especially in that of typography, in which the same types can be used again and again.

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[1] We do not deal here with copperplate engraving (chalcography), nor with the question, raised by some authors, whether this art preceded that of wood-engraving (xylography), or vice versa. The earliest known date of the former is 1446 on the small engravings of "the Passion" in the Berlin Royal Print Room, whereas the earliest known date of wood-engraving is 1418 (on the Brussels Mary engraving). Both arts were naturally dependent upon MSS. for the forms of their letters, but as to the question of transition from the art of writing to that of typography, xylography alone can be regarded as the intervening and connecting link between those two arts, and there are good reasons for assuming that the inventor of printing with movable types was a xylographer (see below).

East Asiatic Printing.

Block-printing and printing with movable types seem to have been practised in China and Japan long before they were known in Europe. It is said that in the year 175 the text of the Chinese classics was cut upon tablets, and that impressions were taken of them, some of which are supposed to be still in existence. Printing from wooden blocks can be traced as far back as the 6th century, when the founder of the Suy dynasty is said to have had the remains of the classical books engraved on wood, though it was not until the 10th century that printed books became common. In Japan the earliest example of block-printing dates from the period 764–770, when the empress Shiyau-toku, in pursuance of a vow, had a million small wooden toy pagodas made for distribution among the Buddhist temples and monasteries, each of which was to contain a dhâranî out of the Buddhist Scriptures, entitled "Vimala nirbhasa Sûtra," printed on a slip of paper about 18 in. in length and 2 in. in width, which was rolled up and deposited in the body of the pagoda under the spire. In a journal of the period, under the year 987, the expression "printed book" (*suri-hon*) is applied to a copy of the Buddhist canon brought back from China by a Buddhist priest. This must have been a Chinese edition; but the use of the term implies that printed books were already known in Japan. It is said that the Chinese printed with movable types (of clay) from the middle of the 11th century. The authorities of the British Museum exhibit as the earliest instance of Korean books printed with movable types a work printed in 1337. To the Koreans is attributed the invention of copper types in the beginning of the 15th century; and an inspection of books bearing dates of that period seems to show that they used such types, even if they did not invent them.[2]

From such evidence as we have, it would seem that Europe is not indebted to the Chinese or Japanese for the art of block-printing, nor for that of printing with movable types.

MS. Period.

In Europe, as late as the second half of the 14th century, every book and every public and private document was written by hand; all figures and pictures, even playing cards and images of saints, were drawn with the pen or painted with a brush. In the 13th century there already existed a kind of book trade. The organization of universities as well as that of large ecclesiastical establishments was at that time incomplete, especially in Italy, France and Germany, without a staff of scribes and transcribers (*scriptores*), illuminators, lenders, sellers and custodians of books (*stationarii librorum*, *librarii*), and *pergamenarii*, *i.e.* persons who prepared and sold the vellum or parchment required for books and documents. The books supplied were for the most part theological, legal and educational, and are calculated to have amounted to above one hundred different works. As no book or document was approved unless it had some ornamented and illuminated initials or capital letters, there was no want of illuminators. The workmen scribes and transcribers were, perhaps without exception, calligraphers, and the illuminators for the most part artists. Beautifully written and richly illuminated manuscripts on vellum became objects of luxury which were treasured by princes and people of distinction. Burgundy of the 15th century, with its rich literature, its wealthy towns, its love for art and its school of painting, was in this respect the centre of Europe, and the libraries of its dukes at Brussels, Bruges, Antwerp, Ghent, &c., contained more than three thousand beautifully illuminated MSS.

Classes of Writing.

In speaking of the writing of the manuscripts of the 15th and preceding centuries it is essential to distinguish in each country between at least four different classes of writing, two of which must be again subdivided into two classes.

1. The *book hand*, that is, the ordinary writing of theological, legal and devotional books, used by the official transcribers of the universities and churches, who had received a more or less learned education, and consequently wrote or transcribed books with a certain pretence of understanding them and of being able to write with greater rapidity than the ordinary calligrapher. Hence they produced two kinds of writing: (*a*) the *current* or *cursive book hand*, of which several illustrations are given in Wilh. Schum *Exempla Codicum Amplon. Erfurtensium*; the volumes of the (London) Palaeogr. Society, &c. Quite distinct from this current writing, and much clearer and more distinct, is (*b*) the *upright* or *set book hand*, which was employed not only by writers who worked for universities and churches, but also by persons who may be presumed to have worked in large cities and commercial towns for schools and the people in general without university connexion. (2) In the *church hand* (Gothic or black letter) were produced transcripts of the Bible, missals, psalters and other works intended for use in churches and private places of worship and devotion. This writing we may again subdivide into two classes: (*a*) the *ornamental* or *calligraphic* writing, found exclusively in books intended for use in churches or for the private use of wealthy and distinguished persons, and (*b*) the ordinary *upright* or *set church hand*, employed for less ornamental and less expensive books. (3) The *letter hand* may be said to be intermediate between the set literary book hand and the set literary church hand, and to differ but little from either. It was employed in all public documents of the nature of a letter. (4) The *court* or *charter hand* was used for charters, title-deeds, papal bulls, &c.[3]

These different kinds of writing served again, in the first instance, as models for cutting the inscriptions and explanatory texts that were intended to illustrate and explain the figures in blockbooks, and afterwards as models for the types used in the printing of books and documents.

15th-Century Books, Written.

Dypold Läber (Lauber), a teacher and transcriber at Hágenau in Germany, is known to have carried on a busy trade in manuscripts about the time of the invention of printing. His prospectuses[4] in handwriting of the middle of the 15th century announce that whatever books people wish to have, large or small, "geistlich oder weltlich, hübsch gemolt," are all to be found at Dypold Lauber's the scribe. He had in stock *Gesta Romanorum, mit den Viguren gemolt*; poetical works (*Parcival, Tristan, Freidank*); romances of chivalry (*Der Witfarn Ritter*; *Von eime Getruwen Ritter der sin eigen Hertze gab umb einer schönen Frowen willen*; *Der Ritter unter dem Zuber*); biblical and legendary works (*A Rimed Bible*; *A Psalter, Latin and German*; *Epistein und Evangelien durch das Jor*; *Vita Christy*; *Das gantze Passional, winterteil und summerteil*; devotional books (*Bellial*; *Der Selen Trost*; *Der Rosenkrantz*; *Die zehn Gebot mit Glosen*; *Small Bette-Bücher*); and books for the people (*Gute bewehrte Artznien-Bucher*; *Gemolte Loss-Bucher*, *i.e.* fortune-telling books; *Schachtzabel gemolt*). The lower educational books consisted for the most part of the *Abecedaria*, containing the alphabet, the Lord's Prayer, the creed, and one or two prayers; the *Donatus*, a short Latin grammar extracted from the work of Aelius Donatus, a Roman grammarian of the 4th century, and distinctly mentioned in a school ordinance of Bautzen of 1418; the *Doctrinale*, a Latin grammar in *leonine* verse, compiled by Alexander Gallus (or De Villa Dei), a minorite of Brittany of the 13th century; the *Summula logica* of Petrus Hispanus (afterwards Pope John XXI.), used in the teaching of logic and dialectics; and Dionysius Cato's *Disticha de Moribus*, and its supplement called *Facetus*, with the *Floretus* of St Bernard, used in the teaching of morals. As helps to the clergy in educating the lower classes, and as a means of assisting and promoting private devotion, there were picture books accompanied with an easy explanatory text, for the most part representations of the mystic relation between the Old and New Testaments (typology). Among these books the *Biblia pauperum*[1] stands first. It represents pictorially the life and passion of Christ, and there exist MSS. of it as early as the 13th century, in some cases beautifully illuminated.[2] A richly illuminated MS. of it, executed in the Netherlands *c.* 1400, is in the British Museum (press-mark, King's 5), and also fragments of one of the 14th century (press-mark, 31,303). A remodelling and development of this work is the famous *Speculum humanae salvationis*, of which we shall speak when dealing with the blockbooks and early printed books. It was written in rhymed prose before 1324, and represents, in forty-five chapters, the Bible history of the fall and redemption of mankind interwoven with Mariolatry and legend. Of this work alone more than 200 MSS., illuminated or without pictures, are known to exist in various libraries of Europe. The National and Arsenal Libraries in Paris each possess one written some time after 1324; the British Museum has sixteen MSS. of it (eleven of which are illuminated) of the 14th and 15th centuries, written in the Netherlands, Germany, France and England, one (press-mark, 16,578) bearing the distinct date 1379 and another (press-mark, Egerton, 878) that of 1436. A work of a similar nature is the *Apocalypsis*, of which at least two recensions with illustrations may be pointed out. One gives the text as we know it, with or without commentary, for which cf. Brit. Mus. 17,333 (French), 18,633 (French, but written in England), Reg. 2 D. xiii. and 22,493 (French)—all four early 14th century. Another is more a short history or biography of St John, but the illustrations follow those of the former work very closely; cf. Brit. Mus. 19,896 (15th century, German). It is this last recension which agrees with the blockbook to be mentioned hereafter. Other devotional works are the *Ars Moriendi*, the *Antichrist* and other works which will be mentioned below among the blockbooks.

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[1] Passavant, *Le Peintre-Graveur*, i. 18 (Leipzig, 1860–1864); John Jackson, *Wood Engraving* (London, 1839); Bruno Bucher, *Gesch. der techn. Künste*, I. p. 362 seq.

[2] See Ern. Satow, "On the Early History of Printing in Japan," in *Trans. Asiat. Soc. of Japan*, x. 48 seq.; and Stan. Julien, "Documents sur l'art d'imprimer," &c., in *Journ. Asiat.*, 4me ser., vol. ix. p. 505.

[3] See further PALAEOGRAPHY.

[4] An original copy of one of them is in the British Museum (Addit. MS. 28752)

Block-printing or Xylography.—When all this writing, transcribing, illustrating, &c., had reached their period of greatest development, the art of printing from wooden blocks (block-printing, xylography) on silk, cloth, vellum, paper, &c., made its appearance in Europe. This art was already a great advance on writing, in that it enabled any one with a few simple tools to multiply impressions from any block of wood with text or pictures engraved on it, and so produce a number of single (paper) leaves or sheets with text or pictures printed on them in almost the same time that a scribe produced a single copy of them.

It seems to have been practised, so far as we have evidence, on cloth, vellum and other stuffs as early as the 12th century (Weigel, *Anfänge*, i. 10); and on paper as far back as the second half of the 14th century; while it began to be largely employed in the early part of the 15th all over Germany, Flanders and Holland in the production of (1) separate leaves (called *briefs*, from *breve*, scriptum), containing either a picture (*print*, *prent*, shortened from the Fr. *emprint*, *empreinte*, and already used by Chaucer, *C.T.* 6186, six-text, D. 604, *printe*, *prente*, *preente*, and in other early English documents; also called in colloquial German *Helge*, *Helglein*, or *Halge*), or a piece of text, or both together; and of (2) whole sheets (two leaves), a number of which, arranged like the MSS. in quires or gatherings, formed what are called "blockbooks," sometimes consisting of half picture and half text, or wholly of text, or altogether of picture.

Early dated Wood-Engravings.

The earliest dated woodcut that we know of is the Mary engraving, discovered at Malines, and now preserved in the Brussels Royal Library. It bears the date mccccxviii. Some authors have asserted that an *l* has been scratched out between the fourth *c* and the *x*; that, therefore, the date is 1468. But there is no ground for such an assertion (cf. H. Hymans, *L'Estampe de 1481*, Brussels, 1903). A slightly modified reproduction of it, on a reduced scale, which could hardly be placed later than 1460, is preserved in the St Gall Library. The next date is 1423 found on the St Christopher, preserved in the John Rylands Library (Spencer collection) at Manchester. In the third place comes the woodcut of 1437 preserved in the Imperial Library at Vienna, which was discovered in 1779 in the monastery of St Blaise in the Black Forest, and represents the martyrdom of St Sebastian, with fourteen lines of text. The date, however, is said by some to refer to a concession of indulgences. A woodcut, preserved in the same library in Vienna, which represents St Nicolas de Tolentino, has the date 1440, but written in by hand; as the saint was canonized in that year it may refer to that event. Another in the Weigel collection, representing the bearing of the cross, St Dorothea and St Alexis, has the date 1443, also written in by hand, though the woodcut is considered to belong to that period. These are the only known wood-engravings with dates ranging from 1418 to 1443. But there exist a good many woodcuts which, from the style of the engraving, are presumed to be of an earlier date, and to have been printed partly in the 14th and partly in the first half of the 15th century. J. D. Passavant (*Le Peintre-Graveur*, 1860–1864, i. 27 seq.) enumerates twenty-seven of them, all of German origin and preserved in various libraries in Germany; 154 are recorded in the *Collectio Weigeliana* (vol. i., 1866), and W. L. Schreiber (*La Gravure sur bois*, vols. i. and ii., 1891 and 1892) enumerates over 2000 of them, some of which may be ascribed to the Netherlands, *exx.g.* (1) representing the Virgin Mary, with Flemish inscriptions in the museum in Berlin; (2) representing the Virgin Mary (see above) in the library at Brussels; (3) representing St Anthony and St Sebastian, in the Weigel collection (now in the Brit. Mus.); (4) a St Hubert and St Eustatius, in the royal library at Brussels; (5) representing the Child Jesus, in the library at Berlin; (6) the Mass of St Gregory, with indulgence, in the Weigel collection (cf. i, 195), now at Nuremberg.

In these blocks, as in wood-engraving now, the lines to be printed were in relief. The block, after the picture or the text had been engraved upon it, was first thoroughly wetted with a thin, watery, pale brown material, much resembling distemper; then a sheet of damp paper was laid upon it, and the back of the paper was carefully rubbed with some kind of dabber or burnisher, usually called a *frotton*, till an impression from the ridges of the carved block had been transferred to the paper. In this fashion a leaf or sheet could only be printed on one side (anopisthographic); and in some copies of blockbooks we find the sides of the leaves on which there is no printing pasted together, so as to give the work the appearance of an ordinary book. Any one wanting to set up as a printer of briefs or books needed no apparatus but a set of woodblocks and a rubber. We know only three blockbooks which do not possess this characteristic, as the *Legend of St Servatius* in the royal library of Brussels, which may be called a xylo-chirograph (see below), in which the pictures occur on both sides of the paper (with some lines of text *written* underneath), but apparently impressed by hand from blocks without any rubbing, there being no traces of any indentures either on the rectos or the versos; *Das Zeitglocklein* in the Bamberg Library (cf. Falkenstein, p. 49); *Das geistlich und weltlich Rom*, in the John Rylands Library (Spencer collection) and at Gotha (cf. Falkenstein, p. 46); but these belong to the end of the 15th century, and therefore to a later period than the ordinary blockbooks.

Block Printers.

Formerly it was the general opinion that playing cards had been the first products of xylography; but the earliest that have been preserved are done by hand, while the printed cards date from the 15th century, therefore from a period in which woodcuts were already used for other purposes. Some of the wood engravings and blockbooks are supposed to have been printed in monasteries. In a necrology of the Franciscan monastery at Nördlingen, which comes down to the beginning of the 15th century, this entry occurs: "VII. Id. Augusti, obiit Frater h. Luger, laycus, optimus incisor lignorum"; and on some of the engravings we find the arms of certain monasteries, which may, however, merely mean that they were printed for, not in, those monasteries. The registers of Ulm mention several wood-engravers (*formschneider*)—in 1398 a certain Ulrich; in 1441 Heinrich Peter von Erolzheim, Joerg, and another Heinrich; in 1442 Ulrich and Lienhart; in 1447 Claus (Nicolas), Stoffel (Christopher) and Johann; in 1455 Wilhelm; in 1461 Meister Ulrich, &c. In a register of taxes of Nordlingen we find from 1428 to 1452 a certain Wilhelm Kegeler mentioned as *briefträcher*; in 1453 his widow is called *alt brieftruckerin*; and in 1461 his brother Wilhelm is registered for the same craft. At Mainz there was a printer, Henne Cruse, in 1440. At Nuremberg we find in 1449 Hans (Spoerer?), a *formschneider*, while his son Junghans exercised the same industry from 1472 to 1490. Hans von Pfedersheim printed at Frankfort in 1459; Lienhart Wolff, *priefdrucker*, is mentioned in the registers of Regensburg of 1463; Peter Schott at Strassburg in 1464. A certain George Glockendon exercised the same trade at Nuremberg till 1474, when he died and was succeeded by a son and afterwards by a grandson. In Flanders a Jan de Printere was established at Antwerp in 1417; and printers and wood engravers (*houte bildsnyders*) worked there in 1442 (*Privileges of the Corporation of St Luke* at Antwerp). At Bruges *printers* and *beeldemakers* (makers or engravers of images) were enumerated in 1454 among the members of the fraternity of St John the Evangelist. The printers of playing cards seem to have constituted a separate class.

All these entries show that long before the middle of the 15th century there were men who exercised the art of wood-engraving and printing as a trade or craft. It seems also certain that wealthy persons and religious institutions were wont to possess sets of blocks, and, when occasion arose, printed a set of sheets for presentation to a friend, or in the case of monasteries for sale to the passing pilgrim. A printer of briefs or blockbooks had no need to serve an apprenticeship;

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[1] This title is applied to at least three works: (1) the well-known blockbook, of which we speak below, (2) a treatise "in qua de vitiis et virtutibus agitur," and (3) a work in rhyme by Alexander Gallus.

[2] See Laib and Schwarz, *Biblia pauperum* (Zurich, 1867).

any neat-handed man could print for himself. We learn from the inventory of the possessions of Jean de Hinsberg, bishop of Liége (1419–1455), and his sister, a nun in the convent of Bethany, near Mechlin, that they possessed "unum instrumentum ad imprimendas scripturas et ymagines," and "novem printe lignee ad imprimendas ymagines cum quatuordecim aliis lapideis printis." These entries would seem to indicate that people purchased engraved blocks of wood or of stone from the wood-cutter rather than books from a printer.

Xylo-chirographs.

Concurrently with these single woodcuts, with or without written or xylographic text, arose a class of books, in some of which written texts were added to pictures printed from wooden blocks; in others the text was written first, and woodcuts pasted or printed in spaces reserved for them. These books, combining wood-engraving with handwriting, are now in technical language called *xylo-chirographs* (wood-handwritten books); they may also be called semi-blockbooks, and form an intervening stage between the manuscript book and the blockbook (*xylograph*) entirely printed from wooden blocks. They tend to show that xylography, after having been for some time confined to the production and multiplication of insulated pictures, was gradually applied to the printing of whole series of illustrations, to be added to written texts, or to have written texts added to them. It is not possible to assign definite dates to these xylo-chirographs; they could hardly be placed after, but may, for ought we know, be contemporaries of the blockbooks. We know nine of them; the years 1440 (which occurs in No. 5) and 1463 (found in No. 9) marking, for the present, the period within which they can be placed.

(1) *Biblia Pauperum*, in the Heidelberg University Library, German work, MS., Latin text added to engravings (cf. Schreiber, *Manuel*, iv. 90, *c.* 1460; photogr. pl. xlv.); (2) *Anti-christus*, one part of which is in the Paris Bibl. St Gen. (see Bernard, *Orig. de l'impr.* i. 102), another at Vienna, Alb. Bibl.; Bavarian work, MS., German text added to engravings (Schreiber iv. 231, pl. lv.); (3) *Vita et Passio Jesu Christi*, 48 leaves, in the Vienna Hofbibliothek, German work, the woodcuts printed on the versos, Latin prayers written on the rectos (Schreiber iv. 321, *c.* 1450, pl. lxxxx.); (4) *Septem planetae*, seven xylographically printed plates in the Berlin K. K. Library, German work, with German explanatory text written on separate leaves facing the engravings (Schreiber iv. 417, *c.* 1470, pl. cxi.); (5) *Pomerium spirituale*, by Henricus de Pomerio (or Henri Vanden Bogaert), in the Brussels Royal Library, bearing the date 1440 in two places; its twelve engravings seem to have originally been published as a blockbook, without any text (see below);[1] in this copy they are cut up, pasted on other (contemporary) leaves of paper, and a Latin MS. commentary added to them (see Alvin, *Documents iconogr.*; Schreiber iv. 317, pl. lxiv.; Conway, *Notes on the Exercitium super Pater Noster*; Holtrop, *Mon. typ.* p. 9). Some bibliographers unreasonably contend that the engravings cannot be earlier than *c.* 1470, and that the year 1440 is the date of the original, now lost, which the transcriber of this copy inadvertently repeated. (6) *Exercitium super Pater Noster* (ascribed for good reasons to the same Henri Vanden Bogaert); imperfect copy (8 leaves) in the Paris National Library (Invent. D. 1581); woodcuts printed on the recto of each leaf, and an explanatory text (in Flemish) written underneath them (Schreiber iv. 245, pl. lxxxvii.; Conway, *l. c.*); (7) the same *Exercitium*, with the same eleven engravings that were issued, some time before, as a complete blockbook (see below), a copy of which is preserved in the public library at Mons, in which the engravings are cut up and (after the Flemish verses of the blockbook had been cut away) pasted, with their versos, on the versos of other contemporary leaves, with an explanatory (Latin) text written on the recto of the leaf next to each engraving (Schreiber iv. 247, pl. lxxxviii.; Conway, *l. c.*; (8) a MS. of the *Speculum humanae salvationis*, with the written date 1461 (Munich Hof.-u. Staatsbibl. cod. lat. 21543), in which the 192 illustrations, usually found in the MSS. of the *Speculum*, have been impressed from small wooden blocks in the spaces reserved for them in the MS., (9) another MS. of a German version of the *Speculum* in the same Munich library (Cod. Ger. 1126), with the written date 1463, in which the 192 woodcut illustrations, impressed in No. 8, are again impressed in the spaces reserved for them.

Of blockbooks of probable German origin the following are known:—

1. *The Apocalypsis*, or *Historia S. Johannis evangelistae ejusque visiones apocalypticae* (Germ. *Das Buch der haymlichen Offenbarungen Sanct Johans*).—Of this work six or seven editions are said to exist, each containing 48 (the 2nd and 3rd edition 50) illustrations, on as many anopisthographic leaves, which seem to have been divided into three quires of eight sheets each. The first edition alone is without signatures. Cf. S. L. Sotheby, *The Blockbooks*, i. 1. A copy of the 5th edition (according to W. L. Schreiber, *Manuel*, iv. 168), 48 leaves, is in the Cambridge University Library. A copy of the supposed 4th edition in the British Museum (C. 9, c. 1), and one of the 6th edition (IB. 14); also a single leaf (with signature H) of the 5th edition (IB. 16).

Blockbooks of German Origin.

2. *Ars moriendi.*—Although the origin of this work must be ascribed to the Netherlands, some authors think that there are early German editions, among others that spoken of below as the 2nd Dutch edition. Certainly German is the edition of Hans Spörer of Nuremberg (1473), in the public library at Zwickau, and a fragment of leaf 18, in the British Museum (IB. 20); another by Ludwig zu Ulm, in the Paris National Library, and the one described in *Collectio Weigel.* (ii. 16), where also other, but opisthographic, editions are described (see Sotheby i. 70; Schreiber iv. 253). A copy of one of these in the British Museum (IA. 24). A copy of an edition printed in a press and ascribed to Augsburg, in the British Museum (IB. 23).

3. *Ars memorandi quatuor evangelia*; 30 leaves, folio, printed on one side, 15 leaves being letterpress and 15 plates (Sotheby ii. 2; Schreiber iv. 135). Copy in the British Museum (IB. 17).

4. *Salve Regina*, bears the name of its engraver, Lienhart czu Regenspurck; 16 leaves; 2 leaves (signature *a*) are wanting in the only copy known of it, which was in the Weigel collection (ii. 103) and is now in the British Museum (IB. 1); Schreiber iv. 381.

5. *Vita et Passio Christi* (German); 32 leaves, small 8vo. Two copies in the Paris Library (Sotheby ii. 143; Schreiber iv. 320, who describes other issues in German and Italian).

6. *The Ten Commandments for Unlearned People* (*Die Zehn Bott für die ungelernte Leut*).—Ten leaves in the library at Heidelberg bound up with MS. No. 438; see Joh. Geffcken, *Bildercatechismus* (Leipzig, 1855), 4to; Sotheby ii. 160; W. L. Schreiber iv. 234.

7. *The Passion of our Lord*; 16 leaves in the Weigel collection (Sotheby ii. 141; Schreiber iv. 320), now in the British Museum (IA. 25).

8. *The Antichrist* (*Der Enndchrist*); 26 leaves, small folio (Sotheby ii. 38; Weigel ii. 111; Schreiber iv. 217). Copies in the Manchester Rylands Library (Spencer collection); Coll. Weig. No. 264, leaf 6 and the upper half of 7 now in the British Museum, where also a fragment of leaf 28 is preserved; four copies at Munich.

9. *The Fifteen Signs of the Last Judgment*; 12 engravings, usually bound up with the engravings of *The Antichrist* (Sotheby ii. 42; Schreiber iv. 217). Copies as of No. 8. An edition was also published at Nuremberg in 1472 by Jung hanns Priffmaler (copy at Gotha).

10. *Symbolum Apostolicum*; small 4to, 7 leaves printed on one side only, containing 12 woodcuts. Cf. Sotheby ii. 148; also Schreiber iv. 239, who describes three editions: (1) at Vienna; (2) at Heidelberg; (3) with German inscriptions, at Munich.

11. *The Legend of St Meinrad*; 48 leaves. Copies in the libraries at Munich and Einsiedeln (Sotheby ii. 150; Schreiber iv. 385).

12. The *Acht Schalkheiten*, of which 8 leaves were in the Weigel collection (i. 112; Sotheby ii. 154).

13. The *Fable of the Sick Lion*; 12 leaves. Copies in the Berlin Museum, and in the Heidelberg Library (No. 438). Cf. Sotheby ii. 159, pl. lxxxvi.; Schreiber iv. 444.

14. *Defensorium Inviolatae Virginitatis b. Mariae Virginis*; 16 leaves, folio, with the initials of the printer F(riedrich) W(althern) and the date 1470 on the first leaf (Schreiber iv. 368; Sotheby ii. 63). Copies in the British Museum (IB. 2); two at Paris; three at Munich; one at Berlin; another at Stuttgart.

15. The same work, 27 leaves, large folio, 1471, with the imprint "Johannes eysenhüt impressor (at Regensburg) Anno ab incarnacõis dnice M° quadringentesimo septuagesimo j°" (cf. Sotheby ii. 72; Schreiber iv. 374). Copies in the British Museum (IC. 4) at Berlin, Gotha, Manchester.

16. *The Dance of Death* (*Dance Macabre*; *der Doten Dantz*); 27 leaves; two editions; one in the library at Heidelberg; another at Munich (cf. Schreiber iv. 432; Sotheby ii. 156).

17. *Die Kunst Ciromantia* of Dr Johan Hartlieb (Sotheby ii. 84; Schreiber iv. 428). Ten leaves of the edition of Jorg Schapff of Augsburg *c.* 1478 in the British Museum (IB. 8).

18. *Der Beichtspiegel* or *Confessionale*; 8 engravings (Sotheby ii. 145; Schreiber iv. 252). Copy in the royal library (Mus. Meerman) at the Hague.

19. *Exercitium super Pater Noster*, only one leaf (the first) preserved at Kremsmünster, of a German edition (Schreiber iv. 247). For two xylo-chirographic issues of this Netherlandish work, see above, and below for a xylographic edition.

20. *Biblia Pauperum*, German text; copy in the British Museum (IB. 3); and a copy of another edition (40 leaves) with the device of Hans Spoerer, and the date 1471 (IC. 5).

21. *The Apostles' Creed*; 7 leaves, folio. Copy at Wolfenbüttel.

22. The *Credo*, in German; 12 leaves, 4to. Copy in the Munich Royal Library.

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[1] Dumortier testifies to having seen a copy of the engravings unaccompanied by MS. ("Notes sur l'imprimerie," in *Bull. Acad. Roy. de Belg.*, 1841, vol. viii.).

23. *Propugnacula, seu Turris sapientiae* (Sotheby ii. 164). One sheet, plano, in the British Museum (IC. 30). It may have originated in the Netherlands.

Blockbooks of Netherlandish origin are:—

Of Netherlandish Origin.

1. *Apocalypsis S. Johannis.*—Copy in the Haarlem Town Library. A copy of the 3rd (?) edition, of 50 leaves, in the British Museum (IC. 40), the leaves 36 and 38 having been supplied from another copy. Leaf 21 of another copy in the same library.

2. *Biblia Pauperum*; 40 folio leaves (each bearing a signature: *a* to *v*; *.a.* to *.v.*). As many as seven editions have been distinguished by Sotheby (i. 43), Holtrop (*Mon. typ.* p. 3), and ten by Schreiber (iv. 1), who likewise mentions a Latin edition of 50 leaves, besides the two editions with German texts of 1470 and 1471. The British Museum Catalogue of 15th-century books enumerates copies or fragments of copies of seven editions.

3. *Speculum humanae salvationis.*—Of this work a blockbook must have existed, of which only 10 sheets (= 20 leaves) with woodcuts and texts, besides 12 isolated woodcuts (used in 1483), have come down to us. We speak of it at length below when dealing with the typographic editions known of this work.

4. *Ars moriendi*; 24 leaves, small folio, 13 containing text, 11 plates. See above (German) No. 2; Sotheby i. 69; Holtrop, p. 8; Schreiber iv. 253, who enumerates thirteen editions, some of which are German.[1] The theory, started a few years ago, that the engravings of this blockbook are imitations of the sketches by the master E. S. (see M. Lehrs, *Der Kunstler der Ars moriendi*, 1890; L. H. Cust, *The Master E. S.*, 1898) is wholly inadmissible. Copy in the British Museum (IB. 18), and an imperfect one in the Haarlem Town Library.

5. A copy of another edition of 24 leaves in the British Museum (IA. 19).

6. *Canticum Canticorum*; *Historia seu Providentia B. Virginis Mariae ex Cantico Canticorum*; 16 leaves in folio, two editions (Sotheby i. 77; Holtrop, p. 6; Schreiber iv. 151). Copies in the Haarlem Town Library (wanting the leaves 3, 4, 7, 11, 13, 15, 16); the British Museum (IB. 46), which possesses also a copy of another edition (IC. 47).

7. *Liber Regum, seu Historia Davidis*; 20 leaves, folio (Sotheby i. 120^b; Schreiber iv. 146). Some consider this to be a German work.

8. *Exercitium super Pater Noster*, by Henricus de Pomerio or Henry Vanden Bogaert; 10 leaves, small folio (Sotheby ii. 137; Holtrop p. 10; Conway, *Notes on the Exercitium*, 1887; Schreiber iv. 245). For other editions see the two preceding sections.

9. *Pomerium Spirituale*, by the same author as No. 8; 12 leaves, having 12 woodcuts. This blockbook is now only known from a xylo-chirographic issue with the MS. date 1440 (see above), preserved in the Brussels Royal Library. See Conway, *Notes on the Exercitium.*

10. *Temptationes Demonis temptantis hominem de septem peccatis mortalibus*; a single large folio leaf printed on one side (Sotheby i. 122^a; Schreiber ii. 249). One copy in the British Museum (IC. 29), another in the Wolfenbüttel Library.

11. *Vita Christi*, or *The Life and Passion of Christ*; 36 cuts, originally printed in a press on six anopisthographic leaves, in 8vo. Copy in the Erlangen Library (Campbell, *Annales*, 746).

12. *Historia Sanctae Crucis*; a fragment of one leaf (with signature *g*), formerly in the Weigel Collection (ii. 92), but now in the museum at Nuremberg; it seems to be only a proof-sheet.

13. Alphabet (grotesque) in figures (Holtrop p. 11; Sotheby i. 122; Schreiber ii. 324–327).—There is one copy in the British Museum and another in the Basel Library, the latter having the date 1464 engraved on the letter A, which is mutilated in the Museum copy. A similar alphabet preserved at Dresden seems to be a copy made in Germany.

14. *Donatus (Aelius) de octo partibus orationis.* Leaf 6 of an edition *c.* 1500 of 16 leaves in the British Museum (IA. 48). For other xylographic editions of this work cf. Holtrop, *Mon. typ.*

Besides the works of Sotheby, Holtrop, Weigel, Schreiber, Lehrs, Cust, &c., quoted above, consult Sir W. M. Conway, *The Woodcutters of the Netherlands in the 15th Century* (Cambridge, 1884); Heinecken, *Idée générale* (Leipzig, 1771); J. Ph. Berjeau's *Facsimiles of the Biblia Pauperum, Canticum Canticorum, Speculum* (London, 1859–1861), and idem, *Catal. Illustré des livres xylogr.* (London, 1865); Dodgson, *Cat. of Early German and Flemish Woodcuts in the Brit. Mus.*

Invented at Haarlem.

Early Printing with movable Metal Types.—When the art of writing, and that of printing from wooden blocks (xylography), and all the subsidiary arts of illuminating, decorating and binding manuscripts, books, pictures, &c., were at their greatest height, and had long passed out of the exclusive hands of the monasteries into the hands of students and artisans, the art of printing with movable cast-metal types (typography) was invented. As to when, where and by whom this invention came about, a dispute has been waged for more than four hundred years. It will be seen below that we must attribute it, as in our former edition, to Lourens Janszoon Coster, of Haarlem, and not to Johan Gutenberg, of Mainz.

The Claims of Germany.

In saying this, we are aware that in the year 1900 (exactly four hundred years after the *Cologne Chronicle* had publicly started the dispute by saying that Gutenberg had *improved* but not *invented* the art) Germany enthusiastically celebrated the supposed 500th anniversary of his birthday. The speeches delivered on that occasion, after making faint allusions to the doubts and opposition of former times, all declared that, after the rediscovery of the Helmasperger document of 1455, which could not be found in 1880 (Hessels, *Gutenberg*, pp. 99-101), it was impossible for any unbiased person to dispute Gutenberg's claims to the honour of the invention any longer.

In the same year a Gutenberg Museum was erected at Mainz to be a repository for anything connected with Gutenberg and printing; also a Society (*Gutenberg-Gesellschaft*) founded with the view of publishing any book that related, however remotely, to Gutenberg and his invention, to which the whole civilized world was invited to subscribe, as its object was to honour the genius who had conferred such an inestimable boon on mankind by his invention. As a first result, a "Festschrift" was published containing an historical introduction by Professor Hartwig; and articles on the first steps to typography (Schreiber); stamp-printing before Gutenberg and the Psalters of 1457, 1459, &c. (Falk); 15th-century printing in France (Labande); German printers in Spain and Portugal (Häbler); German printers in Italy (Marzi); the coloured initials in Fust and Schoeffer's Psalter (Wallau); the Turkkalendar for 1455 (Wyss); the earliest spread of typography (Velke); also an elaborate pedigree of the family Gänsfleisch (Schenk zu Schweinsberg), and an equally full account (by Schorbach) of all the documents related to Gutenberg. This "Festschrift" was followed by publications of the "Gutenberg Society": I. (1902) *Die älteste Gutenberg type* (Zedler); II. (1903) *Die Donat- und Kalendar type* (Schwenke); III. (1904) *Das Mainzer Fragment vom Weltgericht* (Schröder, Zedler, Wallau); IV. (1905) *Das Mainzer Catholicon* (Zedler); V., VI., VII. (1908) *Das Mainzer Fragment vom Weltgericht* (Schröder); Die B^{42} type *im Schöfferschen Missale Mogunt. von 1403* (Zedler); *Die Missaldrucke P. Schöffers und seines Sohnes Johann* (Tronier); *Zu den Bücheranzeigen Peter Schöffers* (Velke).

We admit the great value of these learned and painstaking publications, and those who have the time and patience to study the mass of material here brought together in a somewhat bewildering fashion, will find their knowledge enriched on various subjects connected with early printing, but no proofs that Gutenberg invented it. It is clear from these books that their authors firmly believed from the outset that Gutenberg invented printing, and printed nearly every book that appeared or can be placed before his death in 1468. Under this impression they always speak of him as the "great master," the "great genius," &c., and represent him, not as inventing printing by accident, but as conceiving, somewhere about 1436 or earlier, the idea of inventing it, and meditating from that moment over the problems which he had to solve. Consequently, our authors read a good deal between the lines of their documents, which we fail to find there, and in this way the texts of the documents always show somehow that "the great master" is making or has already made his invention. For instance, the Strassburg lawsuit of 1436–1439 is to them an unimpeachable proof that Gutenberg was secretly working there at printing and trying to solve his problems; when he is paying there, during the same time, a considerable sum in duties for large quantities of wine, we are told that he was then in good circumstances; but when he borrows money in 1442, 1448, 1450 and 1452, and is summonsed in 1455 for not repaying the two last loans, and prosecuted in 1457 for not paying the interest due on his first debt, it is all owing to his difficulties in working out the problems of his invention, though the documents themselves never allude to any "invention" and may be interpreted in quite a different way.

We proceed to examine the documents. The earliest mention and description of the new art is perhaps that in the *Donatus* issued

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[1] Heinecken enumerates six editions, of which one has German inscriptions. See also an article by Guichard, in *Bull. du Bibliophile* (Paris, 1841).

Earliest Definitions of Printing.

by Peter Schoeffer at Mainz before 1456, which, according to its colophon, was finished "Arte nova imprimendi seu caracterizandi (from *character* = letter) . . . absque calami exaratione." Fust and Schoeffer said of the Mainz Psalter of 1457 that it was formed by an "adinventio artificiosa imprimendi ac caracterizandi absque calami ulla exaratione." The colophon of the *Catholicon* of 1460 says that the book was printed "non calami, stili, aut pennae suffragio, sed mira patronarum formarumque concordia, proporcione, ac modulo." In 1462 Albrecht Pfister says that he had "gedrucket" the *Four Histories*. Fust and Schoeffer say of the *Liber Sextus Decretalium*, published in 1465, that it was completed "non atramento ("atramento communi" in the Justinianus of 1468 and 1472), plumali canna neque aerea, sed artificiosa quadam adinventione imprimendi seu caracterizandi," which phrase they slightly varied in Cicero's *Officia*, issued in the same year: "non atramento, plumali canna neque aerea, sed arte quadam perpulcra." The edition of St Jerome's *Epistles* of 1470 is said to have been completed by an "ars impressoria," the *Decretum Gratiani* of 1472 by an "ars quaedam ingeniosa imprimendi," the *Dyalogus* of 1478 by an "ars magistra." We find further—"ars sancta" or "divina," "nova ars scribendi," "novum exscribendi genus prope divinum," "sculptoria archetyporum ars," "ars mirifica formandi," "ars excusoria," "nova imprimendi ratio," "ars pressurae," "chalcotypa ars," "chalcographia" (1472 and later), "chalcographia excusoria impressoriaque," "libraria impressio," "empryntynge" (Caxton, 1482), "prenterei" (Schoeffer, 1492), "truckery" (1505), "impression des livres" (1498), and "prenten."

Printers.

The early printers called themselves, or were called by others, "librorum prothocaragmatici" (*Gramm. Rhythm.*, 1468), "impressores librorum," "exsculptor librorum" (Jenson, 1471), "chalcographus" (1473; Hain 13036), "magister artis impressoriae," "boeckprinter"; and during the 16th century we find them still frequently called "chalcotypus" and "chalcographus."

Types.

The types were at first designated more by negative than positive expressions. In 1468 they were called "caragma," later on "caracter" or "character," "archetipae notae" (1473; Hain 13036), "sculptoria archetyporum ars," "chalcotypa ars," "formae," "artificiosissimae imprimendorum librorum formae." We soon hear also of the process and material by which they were produced. The *Grammatica* of 1468, published by Schoeffer, says that it was "cast" (sum fusus libellus). In 1471 "aeneae formulae" are spoken of; and Bernardus Cenninus and his son testify that they had printed the Virgil "expressis ante calibe caracteribus et deinde fusis literis" (with letters first cut into steel and then cast). In 1473 Friedrich Creusner at Nuremberg states that he had "cut" (sculpsit) the work of Diogenes (Hain 6192). Johan Zeiner of Ulm says in 1474 that he had perfected a book, not with the pen, but with letters of metal (stagneis caracteribus). In 1474 Joh. Ph. de Lignamine speaks of "metallicae formae." In 1476 Husner of Strassburg represents the Nider as being printed with "letters cut of metal (litteris sculptis artificiali certe conatu ex aere)." Nicolas Jenson printed in 1480 with letters "cut and cast" (sculptis ac conflatis).

Word "Typography."

The word *typographus* seems to occur for the first time in 1488, in the preface of P. Stephanus Dulcinius Scalae to the *Astronomicon* of Manilius, printed in that year at Milan by Antonius Zarotus;[1] in 1498 Erasmus uses it in a letter (dated Feb. 13) to Christianus, a Lübeck merchant;[2] and in 1517 Johan Schoeffer applies the word to himself in the colophon of the Aeneas Sylvius published by him. But of the use of the word *typographia* no earlier instance is known than 1520, in which year Gerardus Noviomagus (= Geldenhaurius) in his *Lucubratiuncula de Batavorum Insula* (pref. to Nicol. Buscoducensis, dated 1520) says: "inventa Germanorum . . . bombarda videlicet, typographia, pyxis chartaque nautica"; and Johan Schott, a printer of Strassburg, in the *Geogr. Ptolem.* published by him, describes his grandfather, Johan Mentelin, as "primus typographiae inventor" Gerardus, it may be added, borrowed the whole passage from Pet. Montanus (li. 1 *Adag.*, published *an.* 1504), who has chalcographia instead of typographia. Meerman indeed[3] speaks of a use of the word typographia (or at least of typographus) earlier than 1520, and refers to the preface of Bernardinus Veronensis in the edition of Tibullus, Catullus and Propertius published at Venice in 1493 by Symon Bevilaqua, "at least," Meerman adds, "as it (the preface) is read in the *Annal. typogr.* of Maittaire, i. 560, 2nd ed." But on page 560 Maittaire quotes the first two lines of Bernardinus's preface (till *dicit*) and then adds: "Graecis characteribus destitutus, typographus necesse habuit hiatus in commentario hic illic relinquere," which is evidently Maittaire's own remark, not that of Bernardinus. The present writer at least has been unable to find such a passage in the Tibullus.

When we, for the moment, leave out of sight the question as to when, where, and by whom the art was invented, and take our stand on well-authenticated dates in such printed documents as have been preserved, we find that the first printed date, 1454, occurs in two different editions of the same letter of indulgence issued in that year by Pope Nicholas V. in behalf of the kingdom of Cyprus.

Nicholas V.'s Indulgence of 1454.

These two editions bear no printer's name, nor the place of printing, but are distinguished respectively as the 31-line and the 30-line Indulgence. The one with 31 lines claims priority,[4] from a chronological point of view, over the one with 30 lines, because one of the sold copies that has been preserved was issued at Erfurt on the 22nd of October 1454 (in the possession of Herr Ernst Fischer at Weinheim, *Centralbl.*, 1909, p. 30); a second (in the Hanover Archives; *Veroffentl.* II. tab. i.) at Fritzlar on the 12th of November 1454; a third (in the Mus. Meerman, at the Hague) at Erfurt on the 15th of November 1454, &c., whereas of the 30-line Indulgence the earliest sold copy that has as yet come down to us was issued at Cologne on the 27th of February 1455, though it has the printed date mccccliiii., which was altered with the pen to mccccliiiij. In the 31-line Indulgence occur (*a*) a large church type used for the headings and commencing words of the absolutions, for the first word in the document and for the Christian name of the pope's legate; (*b*) a smaller text or brief type for the text; (*c*) a large initial V and two large initials M, which slightly differ from each other. In the 30-line Indulgence occur (*a*) a large church type, used as in the 31-line Indulgence; (*b*) a smaller text or brief type for the text; (*c*) a large initial U, and two large initials M differing from each other.

Mainz Printing.

These two different editions are usually regarded as having been printed at Mainz; and, in the absence of any evidence to the contrary, we assume that such really was the fact. But we must at the same time conclude that about October 1454 there were at least two rival printers at work there: (1) the printer of the 31-line Indulgence, who may have been Johan Gutenberg, perhaps subsidized by Johan Fust; (2) the printer of the 30-line Indulgence, who was no doubt Peter (Schoeffer) de Gernssheym, as this Indulgence is connected with one of 1489 printed by him. Four *written* copies of this 1454 Indulgence are known to exist which respectively bear the dates: Frankfurt, 10th April 1454 (in the possession of Herr Lais, Wiesbaden); Frankfurt, 11th April 1454 (Frankfurt Archives); 11th July 1454 (place unknown; Darmstadt archives); Lübeck, 6th October 1454. As their dates precede by a few weeks only the earliest known date (Oct. 22, 1454) on a printed copy, they mark, perhaps, the exact time when printing made its appearance at Mainz, in an already advanced state of perfection.

Basing ourselves on the above Indulgences with their printed date, and four different types, we subjoin two lists of the books which the German bibliographers of the present day regard as having all been printed by Johan Gutenberg at Mainz, in the types or "developments" of them, employed for these Indulgences. They are arranged in two columns (A and B) according to types, but without regard to strict or supposed chronology. For further details cf. Hessels, *Gutenberg* (1882), p. 150 sqq.; Schwenke, *Berlin Festschr.* (and in the *Veröffentl.* of the Mainz Gutenberg-Gesellsch.); Zedler (*Gutenberg-Forsch.* and in the *Veröffentl.*), &c.

A.	B.
Types: I (large church type, also called the 36-line Bible type) and II (smaller brief type), used by an unknown printer, not later than October 1454.	Types. III (large church type, somewhat smaller than Type I, also called the 42-line Bible type) and IV (a smaller brief type), used by Peter Schoeffer de Gernssheym (1454–1455).
i. 31-line Indulgence; three different issues (A, B, C), with the printed year mccccliiii., and one issue (D) with the printed year mcccclv. All printed on vellum. Of issues A and B no sold copies have yet come to light; but three unsold copies of each are preserved at Brunswick, Wolfenbüttel and Hanover (Culemann coll.). Of issue C ten sold copies are known to exist in various libraries with dates ranging from the 22nd of October 1454 to April 1455, besides three unused copies. Of issue D ten sold copies with dates from the 7th of March 1455 to the 30th of April 1455 and four unused copies are known.	i. 30-line Indulgence; one issue (A) with the printed year mccccliiii., and two issues (B, C) with the printed year mcccclquinto. All printed on vellum. Of issue A only one copy has been discovered (now in the Rylands-Spencer Library), which was sold at Cologne on the 27th of February 1455, the printed date mccccliiii having been altered with the pen to mccccliiiij Of issue B two sold copies, with dates April 11 and 29, 1455, are in the Berlin Library and the British Museum. Of issue C a sold copy with date April 24, 1455 is at Wolfenbüttel.

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[1] Maittaire, *Annales Typogr.* i. 508, note 1.

[2] *Opp.* iii. col. 24.

[3] *Origg. Typogr.* i. 32, note *ct.*

[4] No inferences can be drawn from this priority, as it merely rests on the date of a sold copy that has come to light.

A (*contd.*).

Type I continued; for type II. (of which no further trace is found) see below.

ii. Poem on the "Weltgericht." Fragment of one leaf (paper), discovered at Mainz about 1892, preserved in the Gutenberg Museum at Mainz; presumed to have been printed *c.* 1443–1444.

iii. *Donatus*, 27 lines. Fragments of 4 vellum leaves (4, 5, 8, 9) recently discovered in the Heiligenstadt Library, and now preserved in the Berlin Royal Library.

iv. *Donatus*, 27 lines. Two rubricated vellum leaves (5 and 10) of an edition of 14 leaves, usually called the *Donatus* of 1451, preserved in the Paris National Library.

v. *Donatus*, 27 (?) lines. Two strips of vellum leaves, containing the remains of 3 lines and about 10 mutilated letters, discovered in the Heiligenstadt Library, and now in the Berlin Royal Library.

vi. *Astronomical Kalendar*, said to be for the year 1448, therefore supposed to have been printed at the end of 1447. Fragments of two large vellum rubricated sheets, printed on one side, discovered in 1901 in the binding of a MS. belonging to the monastery of Schönau, near Mainz, now preserved in the Wiesbaden Landesbibliothek.

vii. *Donatus* of 18 leaves, 26 lines, on vellum; of which 2 rubricated sheets (4 leaves, 1, 2, 9, 10) are preserved in the Berlin Royal Library; probably issued between 1447 and 1450 (*Centralbl.* xxvii. 65 sqq.).

viii. *Manung widder die Durken.* An almanac for January 1455, in 4to, 5 paper leaves, 20 and 21 uneven lines. A unique copy, discovered at Augsburg, now in the Munich Hof Library.

ix. A German translation of the bull of Pope Calixtus III, dated XII. Kal Julii (= Jun. 20) 1456. Fourteen rubricated leaves 4to, in the *Kalendar* type, except that two of the capital E's belong to the B^{36} type (13b and 14 blank), preserved in the Berlin Royal Library, not to be ascribed to P Schoeffer (*Centralbl.* xxvii 63).

x. *Conjunctiones et oppositiones solis et lunae* (now called by German bibliographers Laxier-Kalendar) A calendar for 1457, a broadside paper sheet, printed on one side, of which the upper half of the only copy known, discovered at Mainz, is in the Paris Library.

xi. *Der Cissanus* (not Cislanus) *zu Dutsche.* A broadside paper sheet, 36 lines, printed on one side, with separate headline. The Tross-copy mentioned in suppl to Brunet's *Manuel* (1878, *sub voce* "Cislanus") was bought in 1870 for the Cambridge University Library.

xii. *Donatus*, 27 lines, 14 vellum leaves, of which the British Museum possesses the leaves 4, 10 and 11 (entire) with fragments of the leaves 2, 6–9 and 13. A fragment of 6½ lines in the Bodleian Library and two small fragments discovered in the library at Heiligenstadt.

xiii. *Donatus*, 27 lines, which Schwenke calculates to have consisted of 14 vellum leaves, of which the leaves 6 to 9 are now in the Berlin Royal Library.

xiv. *Donatus*, 27 lines. Three strips of a rubricated vellum leaf 5 discovered in the Karlsruhe Hof-Bibliothek.

xv. *Donatus* 27 lines One rubricated vellum leaf (6), in the *Kalendar* type in the Berlin Library (*Centralbl.* xxvii. 62)

xvi *Donatus* 27, 28 or 30 (?) lines. Fragments of two vellum leaves of an edition of 12 (?) leaves discovered in the binding of a book (printed at Milan in 1476) which formerly belonged to the Episcopal Library at Salzburg, and is now in the Munich Hof-Bibliothek.

xvii. *Donatus*, 27 (or 30?) lines Vellum fragments of an edition of 12 (?) leaves in the British Museum (C. 18. e. 1 No. 5). Leaves 1 and 2 are in the Bodleian Library, and leaf 8 in the Mainz Town Library.

xviii *Donatus*, 27 lines. Fragment of a vellum leaf (3?) discovered in the binding of a MS. in the Munich Hof-Bibliothek.

xix. *Donatus*, 27 lines. Two vellum fragments of the leaves 6 + 9, the upper part of which is preserved in the Bodleian Library (Auct. 2 Q infra I 50 No. 6), the lower part in the Bamberg Royal Library (VI. F 1).

xx. *Donatus*, 28 (?) lines. One defective vellum leaf, showing 25 lines, formerly in the possession of Jacq. Rosenthal (*Incun typ.* ii. No. 2154), afterwards in the Amherst collection (Handlist No. 5). Another leaf in the Mainz Gutenberg Museum.

xxi. Bible of 36 lines (referred to everywhere as B^{36}), 2 vols., folio, 882 leaves, with 2 columns of 36 lines each on a page. Some bibliographers, assuming that Pfister printed it, call it the Pfister Bible. A paper copy of it is in the Paris Library, and also a separate copy of the last leaf, which bears the MS. date 1461. Other copies are preserved in the Rylands-Spencer Library, in the British Museum, at Jena, Leipzig, Antwerp, &c. (Hessels, *Gutenberg*, p. 160; Bernard, *Origine*, ii. 31).

B (*contd.*).

Type III continued (till about 1457: of Type IV no further trace is found).

ii. *Donatus*, of 35 lines, folio, printed, according to the colophon, "per Petrum de Gernssheym. in urbe Moguntina cum suis capitalibus."

iii. Bible of 42 lines (also called Mazarine Bible and referred to below as B^{42}), printed before the 15th of August 1456, as the binder of the paper copy in the Paris Library states that he finished its rubrication on that day. Two volumes folio, 641 leaves in 2 columns of 42 lines each, though in some copies the columns of pp. 1 to 9 contain 40 lines only, while the 10th page has 2 columns of 41 lines each, the difference in the number of lines making no difference in the space which they occupy. For other copies see Hessels, *Gutenberg*, p. 170; Dziatzco, *Beitr. zur Gutenbergfrage* (Berlin, 1889); Schwenke, *Festschr.*, who has drawn up a list of all the copies known to be still in existence. The copy known as the Klemm copy, which was bought by the Saxon Government in 1886, and presented to the "Deutsches Buchgewerbemuseum" at Leipzig, has the year "1453" written in small Arabic numerals of 15th-century form at the bottom of the last leaf of the second volume. But this date is highly suspicious, for Klemm, who must have known its importance and high value, never mentioned it, though he described his copy three times, in 1883 and 1884.

iv. *Donatus* of 33 lines. Vellum fragment at Oxford, without printed initials.

v. *Donatus* of 33 lines. Vellum fragment at Paris, without printed initials; also three rubricated leaves (5, 6 and 8) in the Berlin Royal Library (*Centralbl.* xxvii. 68).

vi. *Donatus* of 33 lines. Leaf 1 (defective) on vellum, mentioned in Ludw. Rosenthal's Cat. 105, No. 3, and purchased by the Berlin Royal Library, which has also acquired the leaves 1 and 11 (*Centralbl.* xxvii. 69.). The large Psalter initials are used for the initials of chapters.

vii. *Donatus* of 33 lines. Leaf 1 (vellum) discovered in the Berlin Royal Library.

viii. *Donatus* of 33 (?) lines. Small fragment, discovered in the library at Giessen, of a vellum leaf, which Schwenke thinks may be the 10th of an edition which differs from Schoeffer's 35-line edition, and also from the Paris 33-line edition.

ix. *Donatus* of 26 lines. One defective vellum leaf, discovered in a Munich private library, and now in the Mainz Gutenberg Museum.

x. *Donatus* of 26 lines. One vellum leaf at Mainz, another at Hanover, a third in the British Museum.

xi. *Donatus* of 24 (?) lines, between 1470 and 1477 (Schwenke).

xii. *Cantica ad Matutinas*; only known from one vellum leaf (the first) in the Paris Library, considered to be the remains of a Psalterium, for the printing of which Humery may have furnished (!) the type (Schwenke *Untersuch.* p. 72 seq.). Judging from the leaf preserved, the work corresponds in every respect to the 42-line Bible, having double columns 42 lines, &c.

Type V.—The "first stage" of Type VII., supposed by Otto Hupp (*Ein Missale Spec.*) and others to have served for printing (1) a *Missale speciale*, in the possession of Ludw. Rosenthal at Munich; (2) a *Missale abbreviatum* discovered in 1900 in the Benedict Church of St Paul in the Lavantthale.

Type VI.—The large type for the Psalter of 1457.

Type VII.—The small type for the same Psalter ("second stage" of Type V). Types VI and VII were also used for the "Canon Missae" of 1458, a copy of which is preserved in the Bodleian Library.

Type VIII used for (1) Joannis de Balbis *Catholicon* of 1460. Large folio, 373 leaves, with two columns of 66 lines each on a page; (2) Matth. de Cracovia, *Tractatus racionis*, 22 leaves with 30 lines to the page, 4to; (3) and (4) Thomas de Aquino, *Summa de articulis fidei*, two 4to editions, one of 13 leaves with 34 lines to the page; the second of 12 leaves with 36 lines to the page, (5) an Indulgence of 1461 of 15 lines (see Hessels, *Gutenberg*, p. 171 sqq.).

The above eight types and the books printed with them (besides a few others printed by Albrecht Pfister at Bamberg) are the only ones that bear, more or less closely, on the question regarding the introduction, or possible invention, of printing at Mainz.

Till recently the church type 1, of the 31-line Indulgence, had always been regarded as identical with that of B^{36}, and the church type 3, of the 30-line Indulgence, with that of B^{42}. But, as the capital P of Indulgence^{30} seems not to occur in B^{42}, and on examination minute differences show themselves in other respects, identity between the two types cannot be accepted. The use of the brief type 2 of Indulgence^{31} seems to have been limited to printing this one document, as its great resemblance to the type employed at Eltville in 1472 for printing a *Vocabularius ex quo*, and Thomas Aquinas' *Summa de articulis fidei*, amounts not to identity. Nor has any further trace been found of the brief type 4 of the Indulgence^{30}, so that the four types used for the two Indulgences were, perhaps, specially manufactured for them and discarded afterwards or melted down for other types.

Hence there is nothing to connect these two broadsides with any locality or any printing-office, except that one of the initial M's of the Indulgence^{30} re-occurs as the initial M of the second absolution of a 33-line Indulgence of 1489, which was unquestionably printed by Peter Schoeffer at Mainz, for "Raymundus Peyraudi archidiaconus Alniensis in ecclesia Xanton," who issued it at the order of Pope Innocent VIII., "pro tuicione orthodoxe fidei contra Turchos." For this reason types 3 and 4 and the books printed with them, including B^{42}, must all be ascribed to him, all the more as he printed, with the type of B^{42}, the 35-line Donatus, which bears his name in the colophon. As Schoeffer, in the colophon of this *Donatus* (ii.) which bears his name, says that it was printed "cum suis capitalibus," and as these capitals gradually disappear after 1459 and the type of the 42-line Bible is no longer found after 1456, we must presume that some of the twelve incunabula mentioned above (in col. B) were printed by Peter Schoeffer alone before he entered (in 1457) into partnership with Johan Fust (see Hessels, *Gutenberg*, p. 166 seq.).

During the last two decades, however, the two types (3 and 4) and most of the books mentioned above in column B, including B^{42}, together with the two types (1 and 2), and several of the books in column A, including B^{36}, have been attributed by German bibliographers to Gutenberg. This singular proceeding is chiefly owing to the late Dr Dziatzko's treatises (*Beiträge zur Gutenbergfrage*, 1889; *Gutenberg's früheste Druckerpraxis*, 1890) on Gutenberg's supposed work as a printer. This author, noticing that the two types of B^{36} and B^{42}, their signs of contraction, marks of punctuation, &c., though differing in size, closely resemble each other in form, concluded that they were manufactured in one and the same office, by one and the same printer, that is, Gutenberg. He thought his conclusion confirmed by the two Bibles being printed on the same kind of paper showing the same watermarks, and arranged in quires in the same way, and divided off into parts at the same place. Finally, from a misprint in B^{42} being rectified in the Stuttgart copy of B^{36} by a cancel (*Druckerpraxis*, p. 95), he concluded. (*a*) that B^{36} was a reprint of B^{42}; that the latter was printed by Gutenberg during his partnership (1450–1455) with Fust, who supplied the money and the material, while he himself superintended the manufacture of the type, instructed the compositor and printer, and therefore was its printer; and that the type came afterwards into Schoeffer's possession; (*b*) as B^{42} was Gutenberg's first work, and had been begun in 1450, B^{36}, a reprint of it, could not be dated before this year; but as its type already existed in 1454 (in the Indulgence^{31}), Gutenberg, foreseeing his quarrels with Fust, must have been preparing it since 1453, and have printed with it, first, some *Donatuses*, the Indulgence^{31}, &c., and finally B^{36}, with the technical and financial assistance of Albrecht Pfister who, shortly before 1458, acquired its type and printing-material (see further, Hessels, "A Bibliogr. Tour," in *The Library*, July 1908). Dr Dziatzko, noticing also a "resemblance" between the types and the workmanship of the two Indulgences, attributed both these broadsides likewise to Gutenberg.

His conclusions, and the method of research by which he reached them, the German bibliographers of the present day have adopted and amplified into a bibliographical and typographical "system," which professes to examine minutely the form and size of every letter, capital or small; the combined letters like *do* and *de* cast on one type, the signs of contraction above, or by the side of or through certain letters, the marks of punctuation, the habits and workmanship of the printer, the arrangement of the quires, the paper and its water-marks, &c.

The "system" divides the Gothic or Church types with which B^{36} and B^{42} and the other books mentioned above are printed into "chief" and "by-forms," (*Haupt- und Nebenformen*). The tops and bottoms of the former are ornamented with minute protruding tags, angles and points, while the "by-forms" miss most of these ornaments, their limbs being straight on the left or right, so as to be easily joined to the protruding tags, angles and points of the "chief forms," whenever the two come together. For instance, if a *u* or a *t* follows an *e*, the "by-form" of *u* with straight limbs was to be used, while the *t* was to be without its crossbar protruding on the left.

The bibliographers who deal with the incunabula enumerated above, in accordance with this "system," regard the books in which they find these chief and by-forms used in their proper places as the earliest, and therefore as the products of Gutenberg's "creative genius and skill," while they ascribe the books which bear evidence of the misuse of those forms to other printers, but their types to him. But this is an uncertain guide, as by errors in the distribution of the types after the printing of the first or second pages this misuse may already occur in the third and further pages of a book. In this way, however, the "system" arranges the books enumerated above in the following approximately chronological order:—

1443–1444. "*First* phase" of the Gutenberg type (= the *Donatus* type). The numbers ii., iii., iv. (with the suspicious date 1451) and v.

1447 (end of) till 1457(?). "*Second* phase" of the same type (= the *Kalendar* type). The numbers vi. to xiv.

1450–1453. B^{42} presumed to have been finished in or before 1453, taking this year, written in the Klemm copy, as genuine.

1453. "*Third* phase" of Gutenberg's type, B^{36} (xviii., of which the earliest known date is 1461).

1454. The two Indulgences with their types (1, 3; 2, 4).

1457. The two Psalter types.

1461, 1462 till (?). Pfister, who is said to have acquired the type of B^{36} from Gutenberg, is known to have issued a book with the date 14 February 1461, and another with the year 1462. Hence, Schwenke says that the 36-line Bible type, which he regards as a "continuation" of the *Donatus*, and the *Kalendar* types, had a life of nearly 20 years (*Veröffentl.* ii. 1). Type v is thought to be Gutenberg's earliest (before 1443!) by the few who regard the "Missale speciale" and the "Missale abbreviatum" as his work.

The "*Donatus* type" is so called from the Paris *Donatus*, on one of whose leaves the year 1451 is written. Zedler, somewhat unreasonably, considers this date to be a forgery of Professor Bodmann, though he is known to have forged other Gutenberg documents. This type is regarded as the same as that of the *Astronomical Kalendar*, but in an earlier, more imperfect stage. As this *Kalendar* calculates the ephemerides of the sun, moon and stars, either for the year 1429 or for 1448 or 1467, it is presumed to have been printed for 1448, that is at the end of 1447, and as its type looks new and almost perfect, the Paris *Donatus* is placed considerably earlier because its type looks old. The poem on the "Weltgericht" (No. ii.) is said to show all the forms of the *Donatus* type, but as its workmanship looks primitive, it is dated back to 1443–1444. The Heiligenstadt *Donatus* (No. iii.) is placed after the "Weltgericht" (ii.), but before the Paris *Donatus* (iv.) and the other Heiligenstadt *Donatus* (v.)

Some German bibliographers do not feel sure that Gutenberg manufactured types v., vi. and vii., though they have no doubt as to the remaining. Others are of opinion that Pfister printed some of the books in the type of B^{36}; Schwenke thinks this Bible could not have been begun before 1457, but all agree that every book in the above lists must have been printed either by Gutenberg himself, or in his office, or with his type, or under his superintendence.

Though the church type 1 cannot be said to be identical with that of B^{36}, and no further trace of the brief type 2 has been found, we see no reason for separating Indulgence^{31} from Mainz printing. And assuming that it was printed there, its printer may have been Johan Gutenberg, who was at Mainz in 1454.

A peculiarity of the above-mentioned "system" is that it ascribes two types, so different in size, shape and form, as those of B^{36} and B^{42}, to one and the same printer, merely because they "resemble" each other. This shows that the "system" takes no account of the fact that the inventor of printing, and all the early printers who came after him, in manufacturing their types necessarily imitated the forms of the written characters of their time. Hence if two printers simultaneously erected their presses in one town, their types, though cut and cast independently, were apt to resemble each other, as appears from various examples. The printers of B^{36} and B^{42} are no exception to this rule, they each took a MS. as their model, and the types which they produced are simply imitations of the Gothic or Church hand, which, from its first beginnings in the 10th century, if not earlier, can clearly be traced down to, and reached its greatest development in, the 15th century.[1]

The written characters of all ages and countries resemble and yet differ from each other in various respects, and as their resemblances and differences are closely reproduced by the metal printing types of every country, we are able to ascribe MSS. as well as incunabula to definite countries, some manuscripts even to "schools," a few even to definite scribes. But when two types differ in size and form, however slightly, and there is no evidence that they belonged to one and the same printer, some of their characteristics may justify us in ascribing both to the same country or town, but not to the same printer. It is, moreover, not safe to ascribe incunabula to one and the same printer on account of their similarity of the quires and divisions into volumes, their paper or water marks (which Dziatzko observed in the two Bibles), as these particulars are nothing but a continuance of the MSS.

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[1] The Cambridge University Library possesses two folio volumes (press-mark Dd. 7. 1, 2), the writing of which, ascribed in the catalogue to 1490, resembles the types of B^{42} with all its chief and by-forms so much, that at first sight they might be mistaken for copies of this Bible.

Nor is his evidence for saying that B^{36} is a reprint of B^{42} conclusive. The types of B^{36} and B^{42} may be ascribed to Germany, but as both are used for the printing of a Bible and editions of *Donatus*, it is improbable that the printer of B^{42} and one set of *Donatuses* should manufacture, about the same time, another type for another Bible and another set of *Donatuses*. We have shown above that B^{42} must, on bibliographical grounds, be ascribed to Peter Schoeffer at Mainz, and as he used its type for a book which actually bears his name, all the other books in the same type must be ascribed to him. It follows that B^{36} and every other book in column A must be assigned to some other printer or printers.

Type v. is a Church type and resembles those of B^{36} and B^{42}, but it can have nothing to do with Gutenberg or the invention of printing, as it is not earlier than 1480–1490. Types vi. and vii., which are nothing but imitations of the written Psalters of the time, are employed for a work, the colophon of which distinctly mentions Fust and Schoeffer as the printers; hence they cannot be claimed for Gutenberg. Of the *Catholicon* type we speak below. Therefore the books numbered i. to xxi. in column A of the above list are the only ones about which there can be any doubt or discussion.

Here we encounter another peculiarity of the above-mentioned "system," which treats the three different types detected in these twenty-one works not as different, but as "phases" or "developments" of one and the same type, while the differences between them, and the absence or presence of certain forms of letters, are taken as guides for approximately dating the books, and for subdividing the type, hitherto known as the 36-line Bible or Gutenberg type, into three or more varieties. For instance, Schwenke (*Centralbl.*, 1908, p. 74) explains that "the types *b, c, i, s, t* enable us to distinguish the earliest from the later elements in the *Donatus* type; the 'Weltgericht' shows, at least of *i* and *s*, the old forms still unmixed. But in the Paris *Donatus*, the new forms appear by the side of the old forms, though the latter are already to a great extent superseded. The new (Heiligenstadt) *Donatus* comes between these two works; it has chiefly the old *b*, which begins to a great extent to be absent in the Paris *Donatus*."

As we cannot regard types which differ in form as "developments" of one type, we must deal with three types in column A, that is (1) the so-called *Donatus* type; (2) the *Kalendar* type; (3) the 36-line Bible type, besides the two employed for the Indulgence^{31}. Gutenberg's career, and the straightened circumstances in which he appears to have lived, so far as they are known to us, make it difficult to ascribe them all to him.

More than thirty documents have come to light which enable us to trace Johan Gutenberg from 1420 to 1468. Dr Carl Schorbach has published nearly all their texts, with elaborate explanations, in the *Festschrift zum 500 jähr. Geburtstage von J. Gutenberg* (suppl. to *Centralbl. f. Biblioth.*, 1900, p. 163 sqq.), and they are further explained by Hessels (*Gutenberg, was he the Inventor of Printing?* 1886; idem, *The so-called Gutenberg Documents*, 1911).

At least six of them are known to be forgeries, among them the "relics" of a printing-press with the date "1441" which were accidentally(!) discovered in 1856 in the "Hof zum Jungen" which had always been supposed to have been Gutenberg's first printing-office at Mainz, but which we now know not to have been the case. Assuming that the Gutenberg mentioned in the remaining documents is no other than Henne (= Hans or Johan) Gensfleisch—called Gutenberg from his mother (whose maiden name was Elsa Wyrich) having lived in the "Hof zum Gutenberg" at Mainz, where he is supposed to have been born about 1400—he appears to have lived at Strassburg from 1436 (?) till the 12th of March 1444, in easy and somewhat luxurious circumstances, at least during the first three years, as he was then paying duties for large quantities of wine (about 1924 liter). But this prosperity does not seem to have continued, for on the 17th of November 1442 he borrowed 80 pounds Strassburg denarii (=about 4800 marks) from the Strassburg St Thomas Chapter, a Strassburg citizen, Martin Brechter, being his surety. From the 12th of March 1444 till the 17th of October 1448 there is no trace of him, but on the latter day he again borrowed, this time at Mainz, 150 gold guilders. Both these loans he never redeemed, nor is it known whether he ever paid any interest on his Mainz loan. But the account books of the Thomas Chapter, still preserved in the Strassburg Public Archives, show that the interest of 4 pounds per annum on his loan of 1442 was regularly paid, by him or his surety, till 1457. The interest due in the latter year was also paid, but difficulties appear to have occurred before the Chapter received it, as there is an item in their account book for 1457–1458 of two shillings for expenses, incurred by them for arresting Gutenberg and his surety. In and after 1458 no further payments were made; the Chapter had recourse to law, and made various efforts to arrest the defaulters, but in vain; and in 1474, six years after Gutenberg's death, the debt is no longer recorded in the Chapter's accounts. He can be traced at Mainz from 1450 (when he borrowed money from Fust) till the 21st of June 1457, when he is a witness at the conveyance of property in Bodenheim near Mainz. After this date we hear no more of him until the 17th of January 1465, when the archbishop of Mainz appointed him as his servant and courtier for life on account of the "grateful and willing service which he had rendered to himself and to his Stift, and will and may render in future." The nature of this "service" is not stated. It has always been supposed that he was then residing at Eltville, the residence of the archbishop, and that he died there about or before the 26th of February 1468, on which day Dr Kunr. Humery received from the archbishop some "printing apparatus which belonged to him, and which he had lent to Gutenberg." But recent researches seem to have shown that Gutenberg remained at Mainz till his death, and was buried there.

Apart from the six forgeries, about which there is no dispute, Bockenheimer, a Mainz magistrate, explains (*Gutenberg-Feier*, Mainz, 1900) as forgeries also (1) the document of the 14th of March 1434, which represents Gutenberg as having at Strassburg arrested and released the secretary of Mainz for a debt which this city owed him; (2) a document of 1437 recording a breach of promise case between Gutenberg and a Strassburg lady; (3) the records of a Strassburg lawsuit between Gutenberg and some Strassburg citizens in 1439; (4) the Helmasperger notarial instrument of the 6th of November 1455, recording a lawsuit of Joh. Fust against Joh. Gutenberg.

The last two, and a third dated the 26th of February 1468, mentioned above, are the only documents that can be said to connect Gutenberg with the art of printing. Various external and internal circumstances throw serious doubts on the genuineness of the 1439 documents; but suppose they were genuine, they only show that Gutenberg had been engaged, with other Strassburg citizens, in "polishing stones" and "manufacturing looking-glasses," and promised to give instruction in "new arts." A "press," however, is mentioned, and a clause reports that one of Gutenberg's witnesses, Hans Dünne, a goldsmith, had testified that he had earned nearly 100 guilders from Gutenberg, "merely for that which belonged to printing" (*alleine das zu dem trucken gehöret*). The document contains nothing to connect Gutenberg with the art of printing, except this line, which has clearly been added (as an afterthought) by a different hand from the one that wrote the two first lines of this witness's testimony, a circumstance which makes the whole document more than suspicious. Several theories, however, as to Gutenberg printing at Strassburg in or before 1439 have been built upon this document, and German bibliographers are even now expressing their hope of finding some day evidence of Gutenberg having printed *Donatuses* and other works in that town.

As to the notarial instrument of 1455, Bockenheimer suggests that as it contains absurdities which are contradictory to all the legal usages of the time, it may be a forgery of the Faust family, perhaps of Joh. Fr. Faust von Aschaffenburg (who pretended to descend from Joh. Fust, whom he called "Faust"), who appears to have possessed, in or about 1600, an "original" of the instrument. From this "original" are derived all the texts published before 1741. In that year, however, J. D. Köhler (*Ehren-Rettung Joh. Guttenberg's*, Leipzig) printed the text again from an "original" which is now in the Göttingen University Library (republished by Dziatzko, *Beiträge*, Berlin, 1889), and is perhaps identical with Faust von Aschaffenburg's "original." Though an analysis of the text brings out various incongruities as to the business relations between Fust and Gutenberg, it is difficult to look upon the Göttingen document as a forgery, and we deal with it here as genuine.

It is dated the 6th of November 1455, and records some of the proceedings in the lawsuit between Johan Fust (*q.v.*) and Gutenberg, which had taken place on that day in the convent of the Barefooted Friars at Mainz, whereby the former sought to recover from Gutenberg 2026 guilders in repayment of 1600 guilders which he had advanced to him (800 about August 1450, and another 800 about December 1452), with the interest thereon. The document first relates that, on some previous day (not stated), Fust had testified (1) that by a written agreement between them, Gutenberg was to "finish the work" (line 24) with the 800 guilders to be advanced to him at 6%; Fust being unconcerned whether it cost more or less. (2) Gutenberg had not been content with these 800 guilders, and Fust, wishing to please him, advanced him another 800 guilders at 6%. (3) He had himself borrowed this money, and as Gutenberg had never paid any interest, the principal sum and the interest thereon amounted to 2026 guilders (=between 15,000 and 16,000 marks), which he now demanded from him.

(4) On the same occasion Gutenberg had replied that Fust should have furnished him with 800 guilders, wherewith to make his "tools" (or apparatus; Germ. *Geczuge*), and he should be content with this money, and might devote it to his own use. (5) Such tools should be a pledge to Fust. (6) The latter should also give him (lines 37 to 40) annually 300 guilders for maintenance and furnish workmen's wages, house-rent, parchment, paper, ink, &c. (7) If they did not agree further, he should return Fust his 800 guilders, and his tools should be free; but it was to be well understood that he should finish "such work" (line 41) with the money which Fust had lent him on his pledge, and he hoped that he had not been bound to Fust to spend such 800 guilders on "the work of the books" (line 41). (8) Fust had told him that he did not desire to take interest from him; nor had these 800 guilders all, and at once, come to him in accordance with the agreement. (9) Of the additional 800 guilders he wished to render Fust an account; hence he allowed Fust no interest, nor usury, and hopes not to be legally indebted to him.

We assume, though it is nowhere stated, that these clauses relate to the "printing of books," to be executed by Gutenberg with the money which Fust advanced to him. But as he was already in debt at Strassburg since the 17th of November 1442 (and had to pay annually interest on this debt), and at Mainz since the 17th of October 1448 (also against interest), it is not surprising that when he contracted this fresh loan in 1450, at the high rate of 6%, he (by not giving any security except tools which he had still to make) practically admitted that he was penniless, and stipulated that Fust should give him also an annual sum for maintenance, and besides furnish workmen's wages, house-rent, parchment, paper, ink, &c., in fact everything required for setting up a printing-office and keeping it going. Fust seems not to have complied with these demands, otherwise he would have mentioned them in his account and at the trial. But he advanced another 800 guilders in December 1452, barely two years after his first advance, merely to please Gutenberg, who had not been satisfied with the first 800.

It is argued that Gutenberg must have been able to show Fust some specimens of his work to induce him to lend him so much money, and we have seen above that German bibliographers attribute to him a poem on the "Weltgericht," which they date *c.* 1443–1444, and the Paris *Donatus* which they date a little later, both printed, it is said, in the "first phase" of the "Gutenberg type," but showing already some traces of wear and tear; and thirdly, an *Astronomical Kalendar* (a broadside of 4 leaves) which they ascribe to the end of 1447, and regard as a "masterpiece" printed in a new type, said to be a "development" or "second phase" of the Gutenberg type, which must have been used for several years afterwards, till a fresh or "third phase" was cast of it (for B^{36}) with the alteration of some of the letters. But if Gutenberg had printed these three works in the years ascribed to them, however small they may be, he must be supposed to have had, from 1443 to 1448, types for printing them, and patrices and matrices for making his types, besides a press and various other tools for printing. Yet the notarial instrument of 1455, if it is genuine, reveals him as borrowing money, not so early as 1443, but so late as 1450, for "preparing his tools," and as having, at the time, nothing to offer his creditor as security except the tools which he still had to make(!). But, says one theory, Gutenberg, intending to print a Bible, and finding the type in his possession too large for it, manufactured a smaller one with the aid of Fust's money, while another theory would have it that he wanted to begin with the printing of a Missal, and for this purpose casted two types, one large and the other smaller. Difficulties, however, arose which induced him to use the smaller type for B^{42}, which was finished about the beginning of 1453, and Dziatzko places the type of B^{36} also in the year 1453, while Schwenke assigns a life of nearly twenty years (1443–1462) to this type.

If, however, Gutenberg had cast all these types, and printed all these books, and sold them, straight from 1443 to 1450, and from 1450 straight on to, say, 1455, he could not have done this without Fust, his money-lender, becoming aware of it, especially as Fust, for his first advance of 800 guilders, was to have received, as security, the "tools" which Gutenberg had to make before he could begin to print. Yet in 1455, fully five years after Fust had entered into such close financial relations with Gutenberg, he claimed, in spite of what he must have known of Gutenberg's supposed activity, the whole of the money which he had advanced, with interest and compound interest on it. And Gutenberg, instead of pleading on the first day of the trial that he had from 1450 to 1455 printed two large folio Bibles and a considerable number of other books, merely refers to the initial stages of his work, to "tools" to be prepared by him as a future pledge for Fust; he tells the judges that he had expected Fust to supply him with various necessaries for printing and his own existence, without saying whether Fust had complied with his demands or not, and finally declares that he had not felt called upon to devote the first 800 guilders to the "work of the books"; that he was ready to account for the second 800, but did not feel indebted to Fust either for interest or anything else, while, on the second day of the trial, he absented himself, and merely sent two of his workmen to hear what was going on (!). This does not look as if he had performed much from 1450 to 1455, but rather the reverse. Anyhow, if the Helmasperger instrument of November 1455 is not a fabrication, it shows that Gutenberg could not have begun to print before 1450; that in this year, 1450 (about August), when he borrowed money from Fust, he had no property such as a printing-office, presses, types, patrices, matrices, &c., which he must have possessed if he had been printing since 1443, to offer his creditor as security; had not a penny to maintain himself; besides being already in debt at Strassburg since 1442, and at Mainz since 1448.

The remainder of the instrument records *the verdict* given on the first day of the trial which decided (1) when Gutenberg shall have rendered his *account* of all receipts and disbursements paid out by him on the "work for the use [or profit] of them both" (l. 49), whatever less[1] money he then has received and taken in above it, that shall be reckoned in the 800 guilders; (2) but if the account should show that Gutenberg had paid out more for Fust than 800 guilders which had not come in their common good [or use] (line 60) Gutenberg shall return it to Fust; (3) and if Fust adduces by oath or by reasonable evidence that he has borrowed the above money on interest, and not lent it of his own money, then Gutenberg shall also pay such interest according to the tenor of the schedule.

The verdict is followed by Fust's *sworn declaration* regarding the amount of his claim, which he had been ordered to make in Gutenberg's presence, but which he now made in his absence, declaring (4) that he had taken up 1550 guilders which Gutenberg had received and which also had gone on "our common work" (line 60); (5) that he had annually given interest and loss, part of which he still owed; six guilders for every 100 guilders which he had thus taken up; (6) of all that Gutenberg had received of this borrowed money, which has not gone on the "work" of them both, which is found in the account, he claimed from him the interest in accordance with the verdict.

Gutenberg appears not to have produced the account which he was expected (clause 1) to render, as Fust's allusion to an account (in clause 6) must refer to his own account. Hence we know not whether he made any "disbursements." The "receipts" seem to mean nothing more than the instalments of the first 800 guilders which he acknowledged to have received from Fust, though some authors think that allusion is made to things (printed books or broadsides?) from which he might have received money by sale or otherwise.

It is to be noticed that Fust speaks here (for the sake of accuracy?) of having taken up 1550 not 1600 guilders, as in his first account. On the whole the wording of the verdict and the sworn declaration is obscure, and open to different interpretations, but it is impossible to ascribe to Gutenberg, on the strength of this document, the manufacture of the types and the printing of all the books in column A above, especially when we have regard to his own inexplicable silence at the trial, when it was incumbent on him for his own sake to show what he had done with Fust's money, and still more when we have regard to the pecuniary difficulties in which he had been placed at least eight years before he contracted these heavy new loans with Fust. Within the space of two years after the trial he was bankrupt, unable to pay either his loans or the small interest thereon, and might have ended his days in prison if the Strassburg St Thomas Stift had been able to have him arrested.

Certain circumstances point to Albrecht Pfister of Bamberg as the printer of the numbers vii., viii., ix., xviii. and perhaps those that come between them in column A. Even in former years when the church type of the Indulgence^{31} (1454) was believed to be identical with that of B^{36}, it was the general opinion that, though Pfister could not have printed the Indulgence, he had acquired its church type from Gutenberg for printing B^{36}. Now that a closer examination has shown that the type of B^{36} need not be dated so early as 1454, the known dates of Pfister (1461, 1462) harmonize with the approximate date (1460) of B^{36}. It is admitted that the types of vii., viii. and ix. differ from that of B^{36} in the form of certain capitals. But Pfister issued on the 14th of February 1401 at Bamberg, with the B^{36} type, an edition of Boner's *Edelstein* (88 leaves fol., with wood-engravings), and at least eight other works (Hessels, *Gutenberg*, p. 161, seq.), one of which bears the date 1462, the seven others none.

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[1] The instrument says: "was er dan *men* gelts dar uber enpfangen . . . hait." Senckenberg, Köhler, Van der Linde, &c., printed *nun* for the correct reading *men*. This latter word has hitherto been interpreted as meaning *more* (see Dziatzko, *Gutenbergfrage*, p. 34, note 1; Schorbach, in *Festschr.* of 1900, p. 259). Zedler (*Gutenbergforschungen*, p. 65, note) thinks that it is a dialectic by-form of the Mid. H. German *mein* found in *mein-kouf*, *mein-rât*, *mein-swern*, *mein-tât*, and still preserved in the Mod. H. German *Meineid*; he translates it therefore as "*widerrechtlich*" (unlawfully). But *men* is the same as the Mid. Dutch *min* (see Verdam's *Middel-Nederl. Woordenb. in voce*) = New Netherl. *minder*, and means *less*, the only meaning which can give sense to this clause.

Most of the copies of the 36-line Bible now known to us were at one time or another preserved in the libraries of Bavaria, and several fragments have been found in monasteries of that country, even in a register of the year 1460 of the abbey of St Michael at Bamberg. Moreover, a transfer or sale of type from Gutenberg to Pfister is contrary to all analogy in the infancy of printing, when every printer started with a type of his own making.

The Catholicon Type.

It is alleged that, in consequence of the lawsuit between Gutenberg and Fust, the former was deprived of all tools, &c., which he had made, or is supposed to have made, with the latter's money, and that afterwards a certain Dr Homery or Humery, a syndic of Mainz, lent him fresh money to enable him to set up another printing-office.

This allegation is made on the strength of a letter of obligation (dated Feb. 26, 1468) referred to above, and given by Dr Homery to Adolph, the archbishop of Mainz, by which he acknowledges to have received from the said archbishop "several forms, letters, instruments, implements and other things belonging to the work of printing, which Johan Gutenberg had left after his death, and which had belonged and still did belong to him (Dr Homery)." It is to be observed that Homery, though willing to assist or oblige Gutenberg, had been cautious enough to reserve to himself all rights to this printing apparatus, in somewhat the same way as Fust in 1450 demanded, or was promised, to receive Gutenberg's "tools" as pledge for his advances. The Homery apparatus could hardly have been of large dimensions, seeing that it was readily passed on first from him to Gutenberg, then from the latter to the archbishop and returned again to its owner. But it is presumed that with these types, which appear in the above list as type VIII., Gutenberg had printed (1) Joannis de Balbis, *Catholicon* of 1460, copies of which exist in the Cambridge University Library, three in the British Museum, two in the Paris Library, in the Spencer collection of the Rylands Library, in the Wolfenbüttel and Mainz libraries, &c.; (2) Matthaeus de Cracovia, *Tractatus rationis*, 22 leaves, of 30 lines, 4to, three copies of which are in the British Museum, one in the Rylands, one in the Cambridge, two in the Paris Library, &c.; (3 and 4), two editions of Thomas Aquinas, *Summa de articulis fidei*, in 4to., the first of 13 leaves and 34 lines (two copies of which are in the British Museum, one in the Rylands and one in the Cambridge Library, &c.); the second of 12 leaves and 36 lines (copies in the British Museum and the Paris Library); and (5) an indulgence of 1461 of 15 lines.

We have seen above that on the 17th of January 1465 Adolph II., archbishop of Mainz, had appointed "Johan Gudenberg, his servant and courtier." It has always been inferred from this that Gutenberg had quitted Mainz and gone to Eltville (Elfeld) to reside at the archbishop's court, and that, his dignity as courtier preventing him from printing himself, he passed the *Catholicon* types on to Henry Bechtermuncze at Eltville. It seems certain that in 1467 the *Catholicon* type with some additions (already found in the Indulgence of 1461) was at Eltville near Mainz, in the hands of Henry and Nicholas Bechtermuncze and Wigandus Spyes de Orthenberg, who issued on the 4th of November of that year (vi.) *Vocabularius ex quo* (a Latin-German vocabulary) in 4to, 166 leaves, 35 lines, the only known copy of which is in the Paris Library, and (vii.) *Vocabularius ex quo*, 2nd edition, with colophon dated the 5th of June 1469, 4to, 165 leaves, 35 lines, copies of which exist in the Rylands, the Blenheim, and the Paris libraries. It is therefore asked how the Bechtermunczes could have been using the *Catholicon* type in 1467, if we assume that it was this type to which Homery refers in his letter of obligation as being in his possession. Some, therefore, conclude that the *Catholicon* and the four other works in the same type were printed at Mainz by Henry Bechtermuncze, who may afterwards have transferred his printing-office to Eltville. In that case it is difficult to see what type Homery could refer to, unless it were type II, a close imitation of which, if not the actual type, was used by Nicholas Bechtermuncze at Eltville in printing (March 12, 1472) a 3rd edition of the *Vocabularius ex quo*, 166 leaves, 35 lines, copies of which are preserved in the Paris and Hamburg libraries, and an edition of Thomas Aquinas, *Summe de articulis fidei*, 12 leaves, 35 lines (Munich Library).

It would seem, however, that Fust and Schoeffer were the printers and publishers of the *Catholicon*, and the other three works mentioned above, as the latter advertised them for sale in a list which he printed and circulated in 1469–1470 (see Konr. Burger, *Buchhändleranzeigen des 15 Jahrhunderts*, Leipzig, 1907, No. 3). Schoeffer may of course have purchased the stock of these books from Gutenberg or acquired it after his death from Homery, but as nothing compels us to attribute the printing of these books to Gutenberg, there is still less reason to deny that Fust and Schoeffer printed them, as the much discussed colophon of the *Catholicon* is found, almost verbatim, in three books published by them in 1465 and 1467. Hence the numbers i. to vi. are the only ones that could be ascribed to Gutenberg.

Even this number, involving the manufacture of four different types (apart from the alterations in the forms of certain letters which involved the making of new patrices and matrices) would be large for a man who, after having lived in luxury for some years, practically subsisted from 1442 to 1455 on money which he borrowed from various parties and never repaid. But the poem on the "Weltgericht," printed on paper, could scarcely be placed at the head of a list which includes and, but for this poem, begins with vellum printed works. Moreover, as it can hardly be regarded as a specimen of primitive printing, it takes a more natural place by the side of the paper-printed *Turkkalendar*, *Cisianus* and *Conjunctiones*, which all show that printing on paper was beginning to supersede that on vellum. It is asserted that its type is the same as that of the 1451 *Donatus*, but this is doubtful.

That the *Astronomical Kalendar* calculates the ephemerides for 1448 is no evidence of its having been printed at the end of 1447, as kalendars of this kind seem to have been printed without any regard to time and circumstances. Some years ago the *Cisianus* was ascribed to Gutenberg and to the year 1444, because some of the saints and movable feasts mentioned in it were thought to relate to that year. But as the same saints and feasts occur in the same way in *Cisianus* editions printed long after 1500, this notion was abandoned. The *Astronomical Kalendar* in question lays down rules for blood-letting at certain times of the year, and was evidently intended to be hung up in houses as guides for this purpose. It is admitted that it contains mistakes if we apply its calculations to 1448, and it has not yet been proved that these rules required a special kalendar for each year in particular. Removing, therefore, Nos. ii. and vi. to somewhat later dates in the list, the *Donatus* No. iii. and that of 1451 (No. iv.) with another edition (No. v.) of the same school-book remain at the head of the column A, together with the Indulgence^{31}, as the only works that could be ascribed to Gutenberg. They bring us down to the time (*c.* 1451) when he, according to the Helmasperger document, may be supposed to have been in a position to exercise the new art of printing.

It is necessary to point out that eight books—(1) *Prognostication* or *Calendar*; (2) Hermann de Saldis, *Speculum sacerdotum*; (3) *Tractatus de celebratione missarum*; (4) a work in German treating of the necessity of councils; (5) *Dialogus inter Hugonem Cathonem et Oliverium super libertate ecclesiastica*; (6) Sifridus de Arena, *Determinatio duarum quaestionum*; (7) idem, *Responsio ad quatuor quaestiones*; (8) *Klagspiegel*, or *New geteutscht Rechtbuch*—have been ascribed to Gutenberg on the strength (*a*) of the date 1460, which was said to be found in a *Prognostication* in the Darmstadt library, and (*b*) of a so-called rubrication alleged to be in a copy of the *Tractatus de celebratione missarum*, in which "Johannes dictus a bono monte" and Johannes Numeister are represented as offering this work on the 19th of June 1463 to the Carthusians at Mainz. But the date in the *Prognostication* has been falsified from 1482 into 1460, and the rubrication in the *Tractatus* is a forgery (Hessels, *Gutenberg*, pp. 107–114). The eight books are now considered to have been printed by Erhard Reuwich.

Apart from these disputed points there is no further difficulty as regards the history of Mainz printing. Fust and Schoeffer worked together from 1457 to 1466, starting in August 1457 with an edition of the *Psalterium*, printed in large missal types, which, as far as we know, is the first printed book which bears a date, besides the place where it was printed and the name of the printers. It was reprinted with the same types in 1459 (the second printed book with date, place and name of printer), in 1490, and in 1502 (the last work of Schoeffer, who had manufactured its types). In 1459 Fust and Schoeffer also published Gul. Durantus, *Rationale divinorum officiorum*, with the small type (usually called *Durandus* type) with which they continued to print long afterwards. In 1460 they published the *Constitutiones* of Pope Clement V., the text printed in a type (Clement type) about a third larger than the *Durandus*. This type was, however, in existence in 1459, as the colophon of the *Durandus* is printed with it.[1]

The Invention Controversy.—Now that we have traced the art of printing from the moment (1454) that it made its appearance in a perfect state at Mainz, and have seen that none of the particulars known to us of the life and career of Johan Gutenberg, who is alleged to have invented it, nor any of the books said to have been printed by him, afford us any basis for ascribing that honour to him, we will examine what has been said during a period of more than four hundred years on the question of the invention. For this purpose we will gather up into a chronological sequence (*a*) a few of the most important expressions used by the earliest printers in their colophons, (*b*) whatever documentary evidence there may be on the subject, and (*c*) some accounts of the earliest authors on the question. The Roman numerals i., ii., &c., are for the sake of convenient reference.

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[1] See further Bernard, *Origine*, i. 216 seq.

Early Testimonies.

The earliest[1] testimony (i.) is the notarial instrument, dated the 6th of November 1455, of the lawsuit between Fust and Gutenberg, already mentioned above, which records transactions between the two men from August 1450 to November 1455, Fust speaking of "the work" and of "our common work"; Gutenberg of "tools" which he wanted to prepare, of "workmen's wages, house-rent, vellum, paper, ink, &c.," of "such work" and of "the work of the books," whereas the judges speak of "the work to the profit of both" and "their common use."

From Book Colophons, &c.

(ii.) In the first[2] book published with a date (the Mainz Psalter, issued the 14th of August 1457 by Fust and Peter Schoeffer) it is said that it was perfected at Mainz by an "adinventio artificiosa imprimendi ac caracterizandi absque calami ulla exaratione," repeated and varied later, by the same printers in their colophons of the years 1459 to at least 1470. (iii.) In 1460 the colophon of the *Catholicon* published at Mainz without the printer's name, after stating that "the book was printed at Mainz, the genial city of the renowned German nation, which town God's mercy had deigned to prefer and adorn above the other nations of the earth by such an exalted light of genius and spontaneous gift," adds that the book was printed and completed "non calami, stili, aut pennae suffragio, sed mira patronarum formarumque concordia, proporcione, et modulo." This work (which is to be ascribed to Peter Schoeffer) is considered to have been printed by Gutenberg, and the mention of God's mercy, &c., is regarded as an allusion to the invention of printing. The phrase is, however, also found, with some variations, in the *Liber sextus Decretalium*, in the *Summa* of Thomas Aquinas, and in the *Clementinae*, published respectively on the 17th of December 1465, the 6th of March and the 8th of October 1467, by Fust and Schoeffer. (iv.) On the 17th of January 1465 Adolph II., archbishop of Mainz, by a public decree, appointed Gutenberg as his servant in reward for "his services," but he does not say what kind of "services" he had rendered, nor does he speak of him as the inventor of printing, nor as a printer. (v.) In the *Grammatica rhythmica*, published in 1466 by Fust and Schoeffer, the third line of the colophon runs: "Hinc Nazareni sonet oda per ora Johannis," which was formerly regarded as an allusion to Johann Fust or Johann Gutenberg, but which more probably refers to Johann Brunnen or Fons, the author of the grammar. (vi.) On the 26th of February 1468 Dr Homery wrote to the archbishop of Mainz the letter quoted above, from which it may be inferred that Gutenberg had been a printer, though nothing is said as to his being the inventor of printing. (vii.) In 1468 Schoeffer reprinted Fons's *Grammatica*, in the colophon of which it is said: "At Moguntina sum fusus in urbe libellus meque (the book) domus genuit unde caragma venit." (viii.) Schoeffer published on the 24th of May 1468 the 1st edition of *Justiniani Imper. Institutionum juris libri VI., cum glossa.* To this were added by way of colophon some verses commencing: "Scema tabernaculi," &c., in which it is said that (the ornament of the church) Jesus "hos dedit eximios sculpendi in arte magistros . . . Quos genuit ambos urbs Moguntina Johannes, librorum insignes prothocaragmaticos," which is regarded as an allusion to Johann Gutenberg and Johann Fust as first or chief printers. (ix.) In the same year (1468) Johannes Andreae, bishop of Aleria, says, in the dedication of his edition of St Jerome's *Epistles*, published in that year (Dec. 13,) at Rome, to Pope Paul II., that "Germany is to be honoured for ever as having been the inventress of the greatest utilities. Cardinal Cusa wished that the sacred art of printing, which then (under Cardinal Cusa, who died on the 11th of August 1464) seemed to have arisen in Germany, were brought to Rome." (x.) In 1470 Guil. Fichet, in an octastichon inserted in the Paris edition of 1470 of the *Letters* of Gasparinus of Bergamo, exhorts Paris to take up the almost divine art of writing (printing) which Germany is acquainted with (see below No. xiii.). In the same year Erhard Windsberg writes to the same effect in an epigram inserted in the *Epistolae Phalaridis* published at Paris about 1470. (xi.) In 1471 Ludov. Carbo, in the dedication of the *Letters* of Pliny to Borso, duke of Modena, speaks of the Germans having invented printing; Nicolaus Gupalatinus (Venice, 1471) of a German being the inventor of printing, and Nicolaus Perottus of the art which had lately come from Germany. (xii.) On the 21st of May 1471 Nicolas Jenson published an edition of Quintilian, edited and revised by Ognibene de Lonigo (Omnibonus Leonicenus), who in the preface speaks of its printer as "librariae artis mirabilis inventor, non ut scribantur calamo libri, sed veluti gemma imprimantur, ac prope sigillo, primus omnium ingeniose demonstravit." (xiii.) About 1472 the first three printers of Paris published Gasparinus Pergamensis's *Orthographiae liber*, to which is prefixed (in the copy of the university library of Basel) a letter, dated the 1st of January, from Guillaume Fichet (see above No. x.), prior of the Sorbonne, to Robert Gaguin, in which he says that "it is rumoured that in Germany, 'not far from the city of Mainz,' a certain Johann Gutenberg (Johannes, cui cognomen Bonemontano) first of all invented the art of printing (impressoriam artem), by means of which books are made with letters of metal, not with a reed (as the ancients did), nor with the pen (as is done at present)." (xiv.) On the 14th of July 1474 Joh. Philippus de Lignamine published at Rome *Chronica summorum pontificum imperatorumque*, in which, between two entries, relating one to the 14th of July 1459 and the other to the 1st of October 1459, an undated paragraph is found saying that Jacobus with the surname of Gutenberg of Strassburg and a certain other one named Fustus, "imprimendarum litterarum in membranis cum metallicis formis periti, trecentas cartas quisque eorum per diem facere innotescunt apud Moguntiam Germanie civitatem." It says the same of Mentelin, and (under 1464) of Conrad Sweynheym, Arnold Pannarts, and Udalricus Gallus. (xv.) On the 23rd of May 1476 Peter Schoeffer issued the 3rd edition of the *Institutiones* of Justinian, with the same imprint as in the edition of 1468 (see testimony viii.), but with the addition that Mainz is the "impressoriae artis inventrix elimatrixque prima." (xvi.) In the *Fasciculus temporum*, issued at Cologne in 1478, it is stated under the year 1457 that the printers of books were multiplied on earth, deriving the origin of their art from Mainz. The earlier editions merely stated that the printers of books were multiplied on earth. (xvii.) In 1483 Matthias Palmer of Pisa, in the *Chron. Euseb.* published at Venice, stated under the year 1457 that students owe a great debt to Germany, where Johannes Gutenberg zum Jungen, knight of Mainz, invented the art of printing in 1440. (xviii.) In the same year, 1483, Jac. Phil. Foresta of Bergamo, in the *Supplementum chronicorum*, says under the year 1458 that the art of printing books was first discovered in Germany, according to some by Guthimberg of Strassburg, according to others by Faust (see xiv.), according to others by Nicolas Jenson (see xii.). (xix.) On the 6th of March 1492 Peter Schoeffer published the *Niedersächsische Chronik* of Conrad Botho, saying in the colophon that it was "geprent . . . in . . . Mentz, die eyn anefangk is der prentery." (xx.) At the end of 1494 two Heidelberg professors, Adam Wernher and Joh. Herbst, composed some Latin verses in honour of Johannes Gensfleisch (Gutenberg's family name turned into the Latin Ansicarus), whom they called "primus librorum impressor" and "impressoriae artis inventor primus."[3] (xxi.) In 1499 Jacob Wimpheling (born at Schlettstadt 1450, died 1528) published (at Mainz, by P. Friedberg [?]) an *Oratio in Memoriam Marsilii ab Inghen* (d. 1396), in which he, on leaf 22 a, praises Joannes Ansicarus in Latin verse for his invention at Mainz. (xxii.) These verses are preceded by a Latin epitaph on Johann Gensfleisch, "artis impressoriae inventor" and "repertor," written by Adam Gelthus, a relative of Gutenberg, adding that his remains rest in the Franciscan Church at Mainz. (xxiii.) In the same year (1499) Polydore Vergil (*De inventoribus rerum*, *Venice*, lib. ii. cap. 7) says that a certain Peter [Schoeffer ?], a German, invented in 1442 the art of printing at Mainz in Germany, as he had heard from the latter's countrymen; this statement was repeated in a Venice edition of 1503. In later editions "Peter" was altered to "Joh. Gutenberg." (xxiv.) In the same year Koelhoff, printer at Cologne, published *Cronica van der hilliger Stat van Coellen*, in which on fol. 311 b, the following statements occur: (1) The art of printing was found first of all in Germany at Mainz about the year 1440; (2) from that time till 1450 the art and what belonged to it were investigated; (3) and in 1450, when it was a golden year (jubilee), they began to print, and the first book that they printed was the Bible in Latin, in a large letter, resembling that with which at present missals are printed. (4) Although the art was found at Mainz, as aforesaid, in the manner in which it is generally employed now, yet the first prefiguration was found in Holland from out the *Donatuses* which were printed there before that time, and from and out of them was taken the beginning of the aforesaid art, and it was found much more masterly and exact (*subtilis*) than that other manner was, and has become more and more artistic. (5) Omnibonus wrote in a preface to Quintilian, and in some other books, too, that a Walloon

From Documentary Evidence.

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[1] The earliest would be the records of the Strassburg lawsuit of 1439, in which the word "trucken" is used, but we cannot accept them as genuine.

[2] Earlier is perhaps the *Donatus* issued by Peter Schoeffer, possibly before 1456, the colophon of which says that it was finished Arte nova imprimendi seu caracterizandi . . .' absque calami exaratione (by a new art of printing or making letters . . . without the writing of a pen).

[3] These verses were not published at the time, but in the 19th century by F. J. Mone, *Quellensamml. der bad. Landesgesch.* iii. 163, from the contemporary MS. of Adam Wernher, preserved in the archives of Carlsruhe.—We pass over here a few books which merely say that the invention was made at Mainz: a *Chronyk der landen van Overmaas*, written by an inhabitant of Beek, near Maastricht, in the 15th century; the *Chronycke van Hollandt* (Leiden, 1517), &c.

from France, named Nicol. Jenson (see xii.), discovered this art; but that is untrue, for there are those still alive who testify that books were printed at Venice before Nicol. Jenson came there and began to cut and make letters. (6) But the first inventor of printing was a citizen of Mainz, named Junker Johan Gudenburch. (7) From Mainz the art was introduced first of all into Cologne, then into Strassburg, and afterwards into Venice. (8) The origin and progress of the art were told to the writer verbally by Ulrich Zell of Hanau, still printer at Cologne (*anno* 1499), through whom the said art came to Cologne. (**xxv.**) In 1501 Jacob Wimpheling (see xxi.), who stated in his *Oratio querulosa contra Invasores Sacerdotum*, &c. (published at Delft, *c.* 1495) that chalcography had been invented at Mainz, says on p. 43 of his *Germania* (Strassburg, Joh. Prüss, 1501), that the invention was made at Strassburg by Johann Gutenberg of Strassburg, and that it was perfected at Mainz. (**xxvi.**) In 1503 Johann Schoeffer (the son of Peter Schoeffer and the grandson of Johann Fust) published an edition of *Hermes Trismegistus*, in which he represents himself as one of the most distinguished citizens of Mainz (nobili vrbe maguntina artis impressoriae inventrice illuminatriceque prima), descended from the most fortunate race who invented the art of printing. (**xxvii.**) In 1504 Ivo Wittig, a canon and the keeper of the seal of the St Victor Cathedral near Mainz (of which Gutenberg had been a lay member), erected in the house "Zum Gutenberg" a memorial stone and an epitaph (missing already in 1700) to Joh. Gutenberg of Mainz, "qui primus omnium litteras aere imprimendas invenit." (**xxviii.**) In 1505, in the German translation of Livy published by Johann Schoeffer (see xxxii.) the dedication to the emperor Maximilian, probably written by Ivo Wittig (see xxvii.), speaks of Johan Güttenbergk as inventor of printing (1450) and Johan Faust and Peter Schoeffer as improvers and perpetuators of the art. This work was reprinted at least eight times (in 1514, 1523, 1529, 1530, 1533, 1551, 1553, 1557) with the same dedication; but in 1509 the *Breviarium Moguntinum* says that it was printed at the expense and labour of Johann Schoeffer, whose grandfather (*i.e.* Johann Fust) was the first inventor and author of the art of printing (see xxvi.). (**xxix.**) In 1505 Jacob Wimpheling, in his *Epithoma Germanorum* (Strassburg, 1505), asserts (on leaf xxxviii. b and xxxix. a) that in 1440 Johann Gutenberg of Strassburg invented there the art of printing. And in 1507, in his *Catal. episcoporum Argent.* (Strassburg, 1507), he says that the art was invented, though in an imperfect manner, by a certain Strassburger, who afterwards went to Mainz and joined others working and trying the same art, where it was, under the guidance of Johann Gensfleisch, perfected in the house "boni montis" (Gutenberg). This he repeated in 1515. (**xxx.**) About 1506–1511 Johannes Trithemius wrote his *Chronikon* of Spanheim, published at Frankfort in 1601, in which he says (p. 366), under the year 1450, that the art of printing books was discovered afresh (*à novo*) at Mainz by a certain citizen said to be Johan Gutenberg, who, after having spent all his property in accomplishing the new invention, perfected it by the advice and assistance of Johan Fust and others. The first propagator of the new art was, after the inventor, Peter Schoeffer. (**xxxi.**) In 1515 Johann Schoeffer published Joh. Trithemius's *Compendium sive Breviarium historiae Francorum*, and said in the colophon that the book was published at Mainz (the *first* inventress of the art of printing), by him, the grandson of the late Johann Fust, the *first* author of the said art, who finally from his own genius commenced to excogitate and to investigate the art in 1450, and in 1452 perfected it and commenced printing, assisted by many necessary inventions of Peter Schoeffer von Gernsheim, his servant and adopted son. Johann Fust and Peter Schoeffer kept this art secret, binding all their servants and domestics by oath never to reveal it; but in 1462 it was spread by the same domestics into divers countries. The same statements were repeated in the *Breviar. eccles. Mindensis* of 1516. (**xxxii.**) On the 9th of December 1518 the emperor Maximilian accorded to Johann Schoeffer the privilege of printing Livy (1518–1519), saying that "he has learnt and been advised on the faith of worthy testimonies that the ingenious invention of chalcography was effected by the printer's grandfather." Erasmus, in his preface to this book, says that great praise is due to the inventors of the almost divine art of printing, the chief among whom is rumoured or said to be Joan Faust, the grandfather of Joan Scheffer; and Nicolaus Carbachius, in a final notice of the edition, speaks of "Joan Scheffer Chalcographus," whose grandfather first invented and exercised this art in Mainz. (**xxxiii.**) In 1519 Joh. Thurmayer Aventinus (1474–1534) wrote that "in 1450 Joannes Faustus, a German, a citizen of Mainz, invented a new kind of writing, called chalcography, and completed it in two years; it was kept secret by him and Peter Schoeffer, his son-in-law, but divulged in Germany ten years afterwards by Faust's servant, Johannes Guttenberger, a Strasburger." (**xxxiv.**) In a pedigree of Lourens Janssoen Coster of Haarlem and his descendants, preserved in the Haarlem Town Library, it is asserted that "he brought the first print into the world 1446." It would seem that an attempt was made, at some time or other, to alter the date 1446 of this document into 1440, otherwise its genuineness is beyond doubt; in its present state it was probably first drawn up about 1559, but its first four divisions including the above statement were evidently copied from some earlier document, as they are all written by one hand, in Roman or Karoline minuscules, and, of course, this earlier document may be assumed to have existed long before 1502–1560, the period usually assigned to this pedigree, and to go back to the time of L. J. Coster himself. There is some doubt as to whether the year 1446 refers to Coster's bringing the first print into the world, or to the marriage of his daughter. In the latter case the "first print" must be earlier. (**xxxv.**) In 1520 Johan Schott, a printer at Strassburg and grandson of Johan Mentelin, the first printer of that town, published an edition of Ptolemy, and printed at the end the arms of his grandfather with the following inscription: "insigne Schottorum Familiae ab Friderico Rom. Imp. III. Joan. Mentelio primo Typographiae Inventori ac suis concessum: Anno Christi 1466." Apart from the assertion that Mentelin was the inventor of printing, we may remark that the emperor Frederick III. raised Mentelin to the rank of a nobleman in 1466 and granted him new arms. (**xxxvi.**) In 1524 Johan Schoeffer speaks again (at the end of S. Prosperi *libellus*) of his maternal grandfather Joan "Faust" and his father Peter Schoeffer, citizens of Mainz, who first of all invented and practised metal printing. (**xxxvii.**) in 1531 Ivo Schoeffer, the son of Johan Schoeffer, speaks of his great grandfather Johan "Faust" having invented chalcography, and "Faust" continues for many years afterwards to be spoken of as the inventor, sometimes in connexion with Peter, once or twice even with Ivo Schoeffer. (**xxxviii.**) About 1533 the Neapolitan Mariangelo Accorso, who had resided at the court of Charles V., wrote on the first leaf of a vellum *Donatus* (in the possession of Aldus Manutius, jun.) that "Joh. Faust of Mainz first discovered the art of printing with metal types which afterwards he made of lead; his son Peter Schoeffer added much afterwards to polish the said art. This *Donatus* and *Confessionalia* were printed first of all in 1450. Faust derived the suggestion from a *Donatus* printed before in Holland from an engraved block." This statement is found on p. 411 of the *Biblioth. Apost. Vaticana* of Angelo Roccha (Rome, 1591), who saw the leaf. Some consider its latter part to have been derived from the *Cologne Chronicle* (xxiv.) and it seems probable that it was a mixture of some of the above testimonies. (**xxxix.**) In 1536 Johan Schott (see xxxv.) published *Historien Handt-Buchlein* (Strassburg, 1536), in which on leaf b^1 and b^2 he says that "Hans Mentlin of Strassburg invented the art, which, through infidelity, was brought to Mainz." On the strength of this and other statements (xxv., xxix., xxxv.) the bicentenary of the Strassburg invention was celebrated there in 1640. (**xl.**) In 1541 Joh. Arnold (Bergel or) Bergellanus, who had settled as press-reader at Mainz two years previously, published his *Encomium chalcographiae* (Mainz, in the St Victor Stift, Fr. Behem, 1541, 4to), in which the lawsuit between Fust and Gutenberg (i.) is alluded to for the first time. Bergel had read Tritheim's books (xxx.), in which the invention is ascribed to Johan Gutenberg with two coadjutors, Johann Faust and Peter Schoeffer, which he (Bergel) had heard confirmed in conversations with Mainz citizens; he had also seen some old tools prepared for the work by the originators which were still in existence. Gutenberg invented it in 1450. (**xli.**) About 1561 Jan van Zuren (born at Haarlem in 1517) and Dirk Volkerts Coornhert (born at Amsterdam in 1522) established a printing-office at Haarlem. Of the former it is alleged that he had compiled a work on the invention of printing, which is presumed to have been lost during the siege of Haarlem in 1573. This work was not publicly mentioned before 1628, when Peter Scriverius published his *Laurecrans voor Laurens Coster*, in which he says that he had only found the title, preface and introduction, in which Van Zuren contended that the first foundations of the art were laid at Haarlem, and that it afterwards accompanied a foreigner to Mainz. In this introduction he does not mention the name of the inventor, nor a date, but points in indefinite terms to the house of the inventor as still existing. (**xlii.**) In the same year (1561) Van Zuren and Coornhert published an edition of the *Officia Ciceronis*, in which the latter, in a dedication to the magistracy of Haarlem, refers to the rumour that the art of printing books was invented first of all at Haarlem, and was brought to Mainz by an unfaithful servant and much improved there. He adds that very old and dignified persons had often told him, not only the family of the inventor, but also his name and surname, and had explained the first crude way of printing, and pointed out to him the house of the first printer. (**xliii.**) In 1566 Luigi Guicciardini, a Florentine nobleman, who had visited the Netherlands and had resided many years at Antwerp, finished a description of the Netherlands (published in 1567), in which, alluding to Haarlem, he speaks of the invention there according to the assertions of the inhabitants, the evidence of some authors, and other remembrances; the inventor died before the perfection of his art; his servant went to Mainz, where he perfected the art, and hence the report that it was invented there. (**xliv.**) About 1568 (it is calculated) Hadrianus Junius wrote his *Batavia*, published at Leiden in 1588, with two prefaces, dated, the one from Leiden, the 6th of January 1575, the other from Delft *ad annum salutis* 1575. On p. 253 he says: (*a*) the opinion that the forms of the letters whereby books are printed were first discovered at Mainz is very inveterate, but old and eminent inhabitants of Haarlem had assured him that they had heard from their ancestors (*b*) that there lived at Haarlem, more than 128 years before, in a decent house then existing, near the market-place, opposite the royal palace, Lourens (son of) Jan, surnamed Coster, who, while walking in the wood near Haarlem, began to shape beechen bark first into figures of letters, by which, reversely impressed one by one on paper, he composed one or two lines to serve as an example for the children of his son-in-law. (*c*) When this succeeded, he began to contemplate greater things, and first of all invented, assisted by his son-in-law Thomas (son of) Peter, a more gluey and substantial kind of ink (as the ordinary ink was found to blot), with which he printed whole tablets with pictures, with the letters added. (*d*) Junius had seen books of this kind printed by Coster (the beginnings of his labours) on the rectos of the leaves only, not on both sides; the book was written (in Dutch) by an anonymous author, and entitled *Speculum nostrae salutis*, in which care was taken that the blank versos could be pasted together, so that the blank pages should not present any unsightliness. (*e*) Afterwards (Coster) changed the beechen characters into leaden, and the latter again into tin ones. Very ancient wine-pots cast of the remains of these types were still to be seen in the house of Lourens, which was afterwards inhabited by his great-grandson Gerard (son of) Thomas, who had died an old man a few years before. (*f*) When the new merchandise attracted purchasers everywhere, workmen were added to (Lourens') household, among whom was a certain John (whether, as was suspected, Faust, or another of the same name, Junius did not inquire), who was bound to the work of printing by oath. But, when he thought he knew the art of joining the letters and of casting the types, &c., he stole away, when everybody had gone to church, the whole apparatus of the types and the tools prepared by his master, and hastened to Amsterdam, thence to Cologne, until he arrived at Mainz, where he could remain in safety, and, having opened a work-office, issued within the space of one year, about 1442, the *Doctrinale* of Alexander Gallus and the *Tracts* of Petrus Hispanus, printed with the same types which Lourens had used at Haarlem. (*g*) Junius recollects that Nicolaas Gaal, his tutor, a man of firm memory and venerable old age, had told him that as a boy he had often heard a certain bookbinder, Cornelis (a man of more than eighty years of age, who had been an under-workman in the same office) narrating the story of the invention (as he had heard it from his master), the polishing and increase of the crude art, &c., and cursing those nights which he had passed, during some months, with the culprit in one bed. (*h*) The burgomaster Quirinus Talesius admitted to Junius that he had formerly heard nearly the same from the mouth of the same bookbinder.

(xlv.) Natalis Comes, in his *Universa historia sui temporis* (Venice 1581; the edition of 1572 contains only books 1 to 10), lib. xxiv. 521, says that Haarlem is memorable on account of the almost divine invention of printing books first contrived by John Cutenberg in the year 1453; who, when he had invented the rudiments of it, had a rather cunning servant, observant of his master's art, who, after the death (see xliii., xlvi., xlvii.) of Johan went to Mainz and there perfected the art, and hence the report that it was invented in that city. (xlvi.) Geo. Braunius, in the second volume of his *Civitates orbis terrarum* (Cöln, 1575?), says of Haarlem, that in this town and the whole province of Holland, there was a fixed tradition that the art of typography was first invented there. But before it was perfected and brought to light, the inventor died (see xliii., xlv.) and his servant went to Mainz, and made it known there. (xlvii.) Mich. Eyzinger on p. 75 of his *Niederländsche Beschreibung* (Cöln, 1584) says that the art of printing, as it was then done, with letters and characters on paper or otherwise, was invented by some one at Haarlem, but, on the death of his master (see xliii., xlv., xlvi.), was brought to light in perfection by his servant. (Repeated by Matthias Quadus Pictor Juliacus in *Compendium Universi, sive Geographicae narrationes*, lib. iii. c. 38, Colon. 1600.) (xlviii.) *Chronicon Sublacense*, per P. D. *Cherubinum Mirtium Trevirensem monachum Sublacensem laboratum anno . . . 1629.* A MS. in 4to, on p. 150 of which is read: Non egre ferat, quaeso lector, si inseruero ratione temporis rem non plane ab instituto nostro alienam, nempe laudabile studium monachorum Sublacensium teutonicorum . . . Nempe, quod nobilissima librorum typographia paucis ante annis in inferiori Germania enata est et in lucem producta (with a note by Mirtius: Hollandia A.D. 1453 in civitate Haarlem per Joannem Cutenbergam, quae tamen ars, postea Moguntiae per dicti inventoris famulum in meliorem redacta fuit excudendi formam). It is supposed that xlv. to xlvii. are derived from Test. xliii., but this seems impossible as regards xlviii.

(xlix.) In 1628 Scriverius in his *Laurecrans* (see xli.) placed the date of the Haarlem invention as far back as 1428, and mentioned as its inventor Lourens Janszoon, sheriff of Haarlem. He asserts that the art of printing appeared, "not in the manner as it is used now, with letters cast of lead and tin, but a book was cut leaf for leaf on wooden blocks," and the Haarlem inventor was robbed in 1440 by Johan Gutenberg. Scriverius based the date 1428 upon a Hebrew *Chronicle* compiled by Joseph ben Meir (1496–1575?), and published in 1554 at Sabionetta by Cornelius Adelkind, where, under the year of the Jewish era 5188 (=1428), the author mentions a book (without giving the title) printed at Venice and seen by him. Scriverius, being convinced that this could only refer to a book printed at Haarlem, applied the entry to a xylographic *Biblia pauperum*, of which he gave a description, together with several other blockbooks and early printed books.

(l.) In 1639 Boxhorn pushed the date of the Haarlem invention back to 1420, referring, as his authority, to the same *Chronicle* of Rabbi Joseph. Since that time the date of the Haarlem invention has been variously placed between 1420 and 1430.

Later testimonies are mere repetitions of earlier statements.[1]

We need not discuss the story of Antonio Cambruzzi, who asserted that Pamfilo Castaldi invented printing at Feltre, in Italy, in 1456, and that Fausto Comesburgo, who lived in his house in order to learn the Italian language, learnt the art from him, and brought it to Mainz; the story, however, found so much credence that in 1868 a statue was erected at Feltre in honour of Castaldi. Nor need we speak of Kuttenberg in Bohemia, where John Gutenberg is asserted to have been born and to have found the art of printing. Nor is it necessary to speak of Jean Brito, who printed at Bruges *c.* 1477–1488, and is asserted to have invented printing there. We may also pass over Johann Fust, later on called Faust (testimonies xiv., xviii., xxvi., xxviii., xxxi., xxxii., xxxiii., xxxviii.), as we know from the Mainz lawsuit of 1455 that he had simply assisted Gutenberg with loans of money. We may also pass over Johann Mentelin of Strassburg (testimonies xxxv., xxxix.), only remarking here that he had already printed a Bible in 1460, and that he is mentioned in Strassburg registers as a chrysographer or gold-writer from 1447 to 1450; but of his whereabouts between 1450 and 1460 there is no record. That he had gone, or had been called, after 1450 by Gutenberg to Mainz has been asserted but not proved, though there is no reason why he should not be one of the two Johannes alluded to as the *prothocaragmatici* of Mainz in the Justinian of 1468 (testimony viii.). That Nicolas Jenson came to be regarded in certain circles and for a time as the inventor of printing is owing to testimony xii. being misunderstood.

There remain, therefore, to be considered the testimonies which bear on the rival claims of Haarlem and Mainz. So far as we know, the controversy between Germany and Holland was publicly started as early as 1499 by the *Cologne Chronicle* (testimony xxiv.), that between the two towns mentioned not publicly before 1561 (testimony xli.); while the name of the Haarlem inventor was not mentioned publicly in print earlier than 1588 (testimony xliv.).

The claims of Germany and Mainz, as centred in the person of Johann Gutenberg, have been discussed above while treating of the early printing at Mainz. A few more words about these claims are necessary. Though some of the documents relating to him connect him with the art of printing, they say nothing of him as the inventor of it; nor do any of the books ascribed to him.

The first document that connects him with the art of printing, the notarial instrument of the 6th of November 1455 (testimony i.), says nothing of an invention or a new mode of printing. And yet the occasion was such as to make it almost imperative on Gutenberg to speak of his invention, if he had made any, for he had spent 1600 guilders of Fust's money for making "tools," apparently without printing anything,[2] and was on the point of being robbed by the latter and having taken away from him all that he is supposed to have made and done to give effect to his idea or invention. The next testimony (ii.) *i.e.* the earliest Mainz books with printed dates (1457 to 1467), shows that the art of printing was not treated as a secret at Mainz; it is openly proclaimed; its importance fully realized and appreciated, but it is distinctly advertised as a "by-invention of printing," and still more distinctly as a "*new art* of printing"; the public were informed that books were now no longer produced by means of the pen, but by a new art of forming characters and printing. Such advertisements are natural and appropriate if we assume that the new art of printing had recently (say about 1450 to 1455) become known at Mainz, but not when we assume that Gutenberg had been printing there devotional and school books and folio Bibles since 1443. But, though the new art is so distinctly described and advertised, in none of these advertisements is there one word of a "Mainz invention" or an "inventor." In testimony iii. (the *Catholicon* of 1460) there is an allusion to Mainz being favoured by God, but again not one word about an invention or an inventor. If Gutenberg had printed the *Catholicon*, it would be incredible that he, who had been wronged and robbed by his two rivals (Fust and Schoeffer), should join in with them in defining and proclaiming the new art, but never with one word assert his claim to the honour and profit of the invention, if he had made any, and should even omit his name, whereas he saw his two rivals never neglect to print their names in full on every book which they published. Those who believe that Gutenberg was the inventor of printing suggest that he kept silent, as otherwise his creditors would have seized his copies and his printing-office. But this explanation cannot be accepted, as we have seen that Gutenberg was practically bankrupt at that time, and prosecuted as a defaulter; and the verbose colophon at the end of a gigantic folio book like the *Catholicon*, published at a time when there were perhaps not more than three printing offices in the world, would be calculated to draw attention to its printer and his residence, not to conceal him. Testimony v. (1466) can no longer be regarded as having any reference to Gutenberg or the invention of printing; vii. (1468) was formerly thought to mean: "I, the book, am cast (*i.e.* its types are cast) in the Mainz city, and the house whence the type came (=where the type was invented) produced me." But of late years it has been shown that the author of the book, Johann Fons, was Peter Schoeffer's press-corrector. And, as he no doubt resided in Schoeffer's house, the two lines evidently mean: "I am a little book cast in Mainz, and I was born (=written) in the same house whence the type comes[1] (=where I am printed)." Testimony viii. (also of 1468) speaks of two Johannes (Gutenberg and Fust) as the "prothocaragmatici librorum quos genuit urbs Moguntina." But this means, not that the first printers of books were born at Mainz, but that the two Johannes (born) produced at Mainz were the chief printers of books.

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[1] Over a hundred of them have been collected by Ger. Meerman, *Origines typogr.* ii. 58 seq.

[2] In line 42 Gutenberg distinctly declares that "he hoped he was under no obligation to Fust to devote the first 800 guilders to the work of the books"; and, as Fust, by advancing the second 800 guilders in 1452, had practically become Gutenberg's partner, it seems clear that the former claimed in October or November 1455, when the trial may be said to have commenced, his money and interest because Gutenberg had as yet not printed anything.

Mainz Testimonies, 1454–1468.

When we now place together the clear documentary testimonies (i. to viii.) of the first fourteen years of printing (1454 to 1468) at Mainz, we see that they all come from Mainz itself. Everybody connected with the art when speaking of it does so in the most public and unreserved manner; its importance was as fully realized and advertised then as it is now; the German nation is even congratulated on possessing it; there is never any secrecy about it; but from the moment that it begins to be mentioned there (say about 1456) it is called a *new* art. In the midst of all this publicity, however, the *new* art which Mainz and Germany possess is never spoken of as having been *invented* at Mainz or anywhere else in Germany. The supposed Mainz inventor (Gutenberg) even speaks himself on two occasions (certainly in the lawsuit of 1455, and presumably in the *Catholicon* of 1460) but never says that he made an invention. The archbishop of Mainz, too, speaks publicly of Gutenberg in 1465 (testimony iv.), and rewards him for services, but does not speak of him as the inventor of printing, nor even as a printer. Nor does Dr Homery, in his letter to the archbishop (testimony vi. of 1468), in which he refers to Gutenberg's printing apparatus, call him the inventor of printing.

In 1468 we enter on a new phase in the history of the invention. Even if we set aside testimony viii. as being merely local, testimony ix. (1468) speaks of the art of printing as having arisen in Germany. This testimony, however, does not come from Germany, nor from Mainz, but from Italy, and is supposed to have been inspired by the two German printers who had established a printing-office at Subiaco in 1465, and in 1467 at Rome, and who most likely learned their craft at Mainz.

As the two printers are mentioned in the testimony, and as it does not speak of Gutenberg, nor of Mainz, it is far more likely that it was merely derived from the colophons of Fust and Schoeffer, or from something that Cardinal Cusa had heard during his embassies in Germany. To the Mainz colophons we must also ascribe (*a*) the two testimonies of 1470 (x.) and (*b*) the three of 1471 (xi.), all five of which come from France and Italy. At last, in 1472 (testimony xiii.), the invention of printing is ascribed to Gutenberg of Mainz, but as a rumour, and the testimony comes from France. Guil. Fichet of Paris, who gives it, is supposed to have heard the rumour from the three German printers who commenced printing at Paris in 1470. And as two of them had resided, immediately before they came to Paris, in the university of Basel, and are supposed to have learnt their art there, the rumour is traced to "Bertolff von Hanauwe," who appears in the lawsuit of 1455 as Gutenberg's servant and who was printing at Basel in 1468. But it came more likely from information which Fichet obtained from the St Victor Cathedral, near Mainz (of which Gutenberg had been a lay member), as he speaks of the art having been invented "not far from that town." Testimony xiv. (1474) again comes from Italy, from Rome, and was perhaps derived from one of the German printers settled there at that time. It merely speaks of Gutenberg, Fust and Mentelin as printers, but says not a word which even touches upon the invention of the art. In testimony xv. (1476) we have the first definite mention of Mainz as the inventress of the art; it is given as an addition to the Mainz colophon of 1468 (see viii.). In 1478 Mainz is again mentioned in a Cologne testimony (xvi.) which gives evidence of research, as it is an amplification of an earlier one in which Mainz was not mentioned. Germany, Gutenberg and Mainz are again mentioned in the Venetian testimony xvii. (1483), which gives (under the year 1457) for the first time 1440 as the date of the invention. In the same year we have two earlier testimonies (xiv. and xii.) worked into one (xviii.), to the effect that printing was invented either by Gutenberg or by Fust or by Jenson. Testimony xix. (1492), which states that printing commenced at Mainz, is practically equivalent to xv. In 1494 and 1499 we have three German testimonies (xx., xxi., xxii.) as to Gutenberg being the inventor of printing; these, however, come, not from Mainz, but from Heidelberg; xxii. is given by a relative of Gutenberg, Adam Gelthus, and, as the latter resided at Heidelberg, it is clear that he was the real source of the other two Heidelberg testimonies (xx. and xxi.). Two years later, when Wimpheling, the author of testimony xxi., had left Heidelberg, he ascribed (xxv.) the invention of printing to Strassburg, though stating that Gutenberg was the inventor. Testimony xxiii. is recorded above to show the confusion that reigned in people's minds about 1500 regarding the invention. We must add to these testimonies those of 1504 (xxvii.) and 1505 (xxviii.), which are owing to Ivo Wittig, a canon and the keeper of the seals of the St Victor Cathedral, near Mainz, of which, according to its *liber fraternitatis*, Gutenberg had been a lay member.

Thus the Helmasperger document, the two Indulgences of 1454 and the 42-line Bible tell us, that in the period from August 1450 to 1456 the art of printing had commenced and been perfected at Mainz; but not a word is heard as to how it arose, or what its nature was. In the period from 1456 (if we place Schoeffer's 35-line *Donatus* in this year) to 1468 various books were printed at Mainz with colophons in which the art of printing is proclaimed as a by-invention of printing; more especially as a *new* art; its mechanism is fully described and said to be quite different from the mode of producing books by means of the pen; but, no one says that it was *invented* at Mainz, or mentions the name of a Mainz *inventor*.

In the period from 1468 to 1505, however, we have (1) several vague statements made in Italy and France as to the art of printing being known or practised or invented in Germany, statements which arose from the books and colophons published at Mainz; (2) one item of rumour in 1472 that Gutenberg invented it *near* that town; (3) two Mainz statements, of 1476 and 1492, and one Cologne statement, of 1478, that it was invented at Mainz; (4) three German statements, of 1492, 1494 and 1499, that Gutenberg had invented it; and (5) two Mainz statements, of 1504 and 1505, to the same effect. But it is to be particularly noticed that the statements (2, 4, 5), which speak distinctly of Gutenberg being the inventor, can be clearly traced to the St Victor Cathedral, that is, to Gutenberg himself and one of his relatives.

Contradiction of Gutenberg's Claims.

Seeing then how slender the basis is for the assertion that printing was invented by Gutenberg at Mainz, that even this slender basis was not laid till fourteen years after the art had been fully established and proclaimed in that city, and that it may be traced to Gutenberg himself, we cannot be surprised to find it promptly contradicted, not in Holland, but in Germany itself.

This contradiction was made in 1499 (testimony xxiv.) in a *Chronicle* published at Cologne. To facilitate the understanding of this testimony it is divided above into eight sections. The first (taken from Hartmann Schedel's *Chronicle*, 1493), second, sixth, seventh and eighth are no doubt due to the compiler of the *Chronicle*, and must not be connected with the third, fourth and fifth, which, according to the compiler, are due to Ulrich Zell, a printer at Cologne, who had probably settled there about 1463, and had most likely learnt his art at Mainz, as he called himself "clericus moguntinus." As Zell's testimony leaves to Gutenberg nothing but the honour of having *perfected* the art, various attempts have been made to explain away this account. As long as no typographically printed *Donatus* had been found that could be fitted into Zell's account it was argued that he meant a *Donatus* printed from wooden blocks; and this argument is brought forward even at the present time. But a practical printer like Zell must have been able to express himself to that effect if he had really meant to say so; and, as block-printing was not less practised in Germany than in Holland, we could hardly assume that blockbooks printed in Holland would have inspired the German inventor rather than the same books printed in Germany. That testimony xxxviii. speaks of a *Donatus* printed from wooden blocks may be ascribed to the notion arising at that time (*c.* 1533) that block-printing had given rise to typography. It has also been remarked that unless we take Zell to refer to a *Donatus* xylographically printed in Holland, the passage in the *Chronicle* would be contradictory, as it says in its first and sixth section that the art of printing was found first of all at Mainz about 1440, by a Mainz citizen, Junker Johan Gudenburch, and then in its fourth that the art had already been found before that time in another place. But if the fourth section is read in accordance with its punctuation in the *Chronicle* itself, it says clearly that the art was found at Mainz, *as aforesaid* in the manner in which it is generally employed *now*, that is, more masterly, more artistic than in the *Donatuses* printed in Holland. It has further been asserted that Holland in the *Chronicle* means Flanders; but the *Chronicle* is usually correct in geographical matters, and is therefore not likely to have gone astray in this particular case. It has also been suggested that Zell most likely learnt his art in Fust and Schoeffer's office and invented the passage to injure the reputation of Gutenberg, who had been their enemy. Finally it has been said that Zell did not suggest or write the passage at all; but it is hard to see how this can be maintained in face of the compiler's own statement to that effect.

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[1] Venit (comes), the present not the perfect tense (has come).

Lourens Coster's Claims.

As, therefore, all these suggestions do not weaken or invalidate Zell's testimony, we must see how far it harmonizes with other circumstances and the testimonies xxxiv., xli. to xlix., which claim the honour of the invention for Haarlem in Holland

Testimony xxxiv. (the Pedigree) is sufficiently clear as to the invention of printing at Haarlem, the supposed date and the name of its inventor. Testimonies xli. and xlii., though coming from Haarlem, do not mention the name of the inventor. But xli. is a mere introduction destined for a complete book that seems to have been lost during the siege of Haarlem in 1573 before it was printed; we are, therefore, not justified in saying that Van Zuren did not know the name; xlii. may have omitted the name, because the publication of Van Zuren's work was in contemplation at the time that it was written. That Guicciardini (testimony xliii.) in 1566 did not mention the name of the reputed Haarlem inventor cannot be considered as an indication that it was not known or had not yet been "invented" when he wrote, as his accounts of the cities of the northern Netherlands are all rather meagre and for the most part derived from correspondence. He and other authors coming after him (testimonies xlv.–xlvii.) state that the Haarlem inventor had died before the art was perfected, and that thereupon his servant had brought it to perfection at Mainz. We do not find any such statement in Junius. The latter's account (xliv.), however, gives various particulars as regards the inventor and his invention. He begins by referring to the difficulty of vindicating the honour of the invention for Haarlem on account of the deep-rooted and general opinion that it took place at Mainz. He then mentions that Lourens (son of Jan) surnamed Coster resided at Haarlem "more than 128 years ago," and gives us to understand that in the year indicated by that phrase he invented the art of printing. Junius's book was not published till after his death, in 1588, but its two prefaces are dated 1575 (he died June 16, 1575), hence the number 128 is supposed to go back from the date when he actually wrote his account, which he is calculated to have done about 1568. Thus we get the year 1440 as the supposed date of the Haarlem invention, though, if we based our calculation upon the date of the preface, the year 1446 or 1447 would have to be assumed. But, as Junius adds that Coster's types were stolen by one of his servants, who fled with them to Mainz, and, establishing there a printing-office, printed within a year's time, in 1442, two books, he must, if this latter date is correct, have meant 1440. By testimonies xlix. and l. we see that in the 17th century the date of the Haarlem invention was first put back as far as 1428, then to 1420; and since then it has usually been regarded as 1420–1423, especially after it was discovered that the Haarlem wood where Coster is said to have cut his wooden letters was destroyed during a siege in 1426.

The researches regarding the reputed Haarlem inventor have hitherto been made in an inadequately scientific manner, and it appears that, after Scriverius (1628) had pushed back, in spite of Junius, the date of the invention to 1420–1428, he and later Dutch authors on the subject mixed up two Haarlem citizens (*a*) Lourens Janszoon, who never bore the surname Coster: he is proved to have been sheriff, wine merchant and innkeeper from 1404 to 1439, and to have died in the latter year; (*b*) Lourens Janszoon Coster, authenticated by official documents as a chandler and innkeeper from 1436 to 1483, leaving Haarlem in the latter year. The name of this person and some genealogical particulars known of him seemed to agree with Junius's account and the Coster pedigree.

But recent investigations at Haarlem and elsewhere tend to show that there have been two, if not three, persons of this name living at Haarlem about the same time. Though this superabundance of namesakes shows that van der Linde and those who accepted his conclusions were rather hasty in declaring L. J. Coster to be a myth, it is somewhat perplexing to the historian, and it would seem that the Dutch people prefer to make speculations and guesses on this point, rather than search in some systematic way the original documents and registers from which they draw haphazard extracts. The result of the latest inquiries (so far as they may be called inquiries) is that L. J. Coster, who would agree with Junius's account and the Haarlem Coster pedigree, was a member of a Christmas-gild in 1436, is mentioned in the Haarlem registers as a dealer in candles and oil till 1454, and seems to have died before 1460 (see Fruin, *De huidige stand van het Costervraagstuk*, 1906; Enschedé, *Laurens Jansz. Coster*, 1904); so that his business as printer was probably continued by one of his relatives, and finally broken up about 1481, when the *Speculum* cuts are in the hands of Veldener.

Junius's account of the Haarlem invention is based on three books: (1) a Dutch edition of the *Speculum humanae salvationis*; (2) the *Doctrinale* of Alexander Gallus; and (3) the *Tracts* of Petrus Hispanus (Pope John XXI.). The first work, he said, was printed by Coster as a first specimen of his art, and it would seem from his words that the tradition believed it to be printed with wooden types; the second and third books, he declares, were printed at Mainz with Coster's types, stolen from him by his workman. Of the Hispanus *Tracts* no edition answering to Junius's description has as yet come to light. Of the *Doctrinale* and the *Speculum* we possess editions which fit into his account, though, of course, it will be impossible to say whether any of the *Doctrinale* editions were printed at Haarlem or at Mainz. Various editions of the Latin grammar of Aelius Donatus, printed in the same types, link Junius's independent testimony regarding Haarlem and Coster on to that of Ulrich Zell, who declares in the *Cologne Chronicle* of 1499 that editions of this school book printed in Holland were the models (prefiguration) for the printing at Mainz, which commenced about 1450.

Costeriana.

As the evidence for Haarlem's claims has been obscured by various adverse and not always intelligent criticisms, and no less by imperfect and incorrect descriptions of the books on which they rest, we describe here, from autopsy, the types and books that have always been and still may be, on solid grounds, attributed to Coster, and which, for this reason, we continue to call Costeriana

The Costeriana. Xylographic Printing.

Of the *Speculum humanae salvationis*, a folio Latin blockbook (that is, an edition printed entirely from wooden blocks) must have been printed several years before 1471, consisting, like the later type-printed Latin editions, of at least 32 sheets = 64 leaves, all printed on one side of the leaf only, alternately on the versos or rectos (therefore 64 printed pages). The sheets were, no doubt, arranged in the same number of quires (a^3 for the preface; bcd^8, e^5 = 29 sheets for the text) as in the later editions; the first leaf was perhaps blank, the preface occupied the leaves 2 to 6, and 58 leaves remained for the 29 chapters of text, each occupying two opposite pages of two columns each. We may further assume that the upper part of each printed page of the text was occupied by one of the woodcuts, which we know from the later editions, and which are divided each into two compartments or scenes by a pillar, with a line or legend below each compartment explaining, in Latin, the subject of the engraving; and that underneath the woodcut was the text, in two columns, corresponding to the two divisions of the engraving above.

This blockbook has already been alluded to above among the Netherlandish blockbooks, but we give here further details, as various circumstances make it clear that it was the work of the same (Haarlem) printer who issued the other editions of the *Speculum*, together with the several incunabula described below, and to whom a Haarlem tradition ascribes the invention of printing.

All the *Speculum* editions which concern us contain, so far as we know, 29 chapters. But previous to the above blockbook another one of more than 29 chapters (may be 45, like most of the MSS.) must have existed, as may be inferred from Johan Veldener's 4to edition of a Dutch version of the *Speculum*, published in 1483, in which all the 58 blocks of the old folio editions reappear cut up into 116 halves to suit this smaller edition, besides twelve additional woodcuts for three additional chapters (the 25th, 28th and 29th) not found in any of the old folio editions. As these additional woodcuts appear to be also cut-up halves of six larger blocks, they point to the existence, at some earlier period, of a folio edition (xylochirographic or xylographic?) of at least 32 chapters, at present unknown to us.

Of the blockbook as is here assumed we know now only 10 sheets or 20 leaves, which, in combination with 22 sheets or 44 typographically printed leaves, make up an edition, called, on account of this mixture of xylography and typography, the *mixed* Latin edition. These twenty xylographic leaves are (counting the 6 leaves of the type-printed preface) 7+20, 8+19, 10+17, 11+16, 12+15, 13+14 (in quire *b*); 22+33, 23+32, 27+28 (in quire *c*); 52+61 (in quire *e*).

Copies of this *mixed* Latin edition still existing: (1) Bodleian Library, Oxford (Douce collection, 205), perfect; (2 and 3) Paris National Library, 2 copies, one perfect, the other wanting the first (blank) leaf; (4) John Rylands Library at Manchester (Spencer collection), wanting the first (blank) leaf; (5) Colonel Geo. Lindsay Holford, London, wanting the first (blank) leaf; (6) British Museum (Grenville collection), wanting the leaves 1 (blank) and 21 (this being supplied in facsimile); (7) Royal Public Library at Hanover, wanting the leaves 19 (xylogr.) and 24 (typ.), but having duplicates of the (xylogr.) leaves 15 and 28; (8) Museum Meerman-Westreenen, the Hague, wanting the leaves 1 to 36, and portions of the text of leaves 37 and 38; (9) Berlin Royal Library, wanting the leaves 1 (blank), 58, 59, 62, 63, 64, while in place of the (xylogr.) leaves 52 and 61 it has the same (type-printed) leaves of the second Latin edition; several of the other leaves are bound in a wrong order; (10) Pembroke library at Wilton House, wanting the leaves 1 to 7 and 64, while the leaves 9 + 18 have been supplied from the second (type-printed) Latin edition; (11) Copy, represented now by the leaves 15 + 28, which appear as duplicates in the Hanover copy (above, No. 7); (12) Ottley (*Invention of Printing*, p. 287) mentions another copy as having belonged to Mr Singer, which wanted three or four leaves, but has since been taken to pieces and dispersed. See further Holtrop, *Cat. bibl. reg. Hag.* 560; idem, *Mon. typ.* p. 22 and facs. pls. 20, 21; Bernard, *Orig.* i. 13 sqq.; Sotheby i. pl. xxxii.; Campbell, *Ann.* No. 1570 (who wrongly states that the two copies in the Paris National Library belong to the *unmixed* Latin edition).

Bernard.

Ottley.

Efforts have from time to time been made to account for the unusual mixture of xylography and typography in this one book, and to assign a date to it and the other editions, with the further view of ascertaining the date of their printer, as for him the honour of the invention of printing is claimed. Bernard (1853) was uncertain as to the chronological order to be assigned to the various editions, but, without stating his reasons, concluded that at least six or seven must have been issued, and that the *xylographic* leaves of the *mixed Latin* (his edition A), are the remains of a *first* complete, entirely *xylographic* edition. As there is a close resemblance between the letters of the xylographic and typographic texts, and both texts agree, with a few exceptions, word for word with the corresponding texts of the other Latin edition (which, being wholly typographical, is called the *unmixed Latin*), Ottley in 1816 concluded that the xylographic pages were facsimiles from those of the typographically printed *unmixed* Latin edition, which the publisher caused to be made after having lost, through some accident in his office, not only those sheets already typographically printed, but also his types. In support of this theory he pointed to some defects or breakages in the pillars, dresses, &c., of the woodcuts of the xylographic pages which he did not find in the same woodcuts in the *unmixed* Latin edition; so that he thought the latter must be the first edition. Secondly, as the scrolls in the last vignette (Daniel interpreting the handwriting on the wall) are black in the Inglis copy of the *unmixed* Latin edition, but white in all the copies of the *mixed* Latin and the other editions, he concluded that the former must have been printed before the woodcutter had cut away the piece of wood which produced the black scroll, which was to him an additional proof that the *unmixed* Latin edition was the first. These theories were adopted by Sotheby in 1858 and again by Schreiber in two treatises on xylography (in *Centralbl.*, 1895, p. 20 sqq.; in the Gutenberg-Festschrift, *Centralbl.*, 1900, p. 46 sqq.; and in his *Manuel de la gravure sur bois*, 1902, iv. 114 sqq., vii. pls. 48, 49, viii. pls. 79, 80). The latter author is of opinion that xylography was not employed for the multiplication of books till about 1468–1470, and that about that time printing with movable metal types was almost unknown in the Netherlands. Hence he thinks that the woodcut illustrations in the various editions of the *Speculum* were printed somewhere in the Netherlands, and the sheets afterwards sent to Germany, most likely to Cologne, for the purpose of having the texts added by typography. These proceedings, he fancies, were successful twice, once with what he calls the first (*unmixed*) Latin, secondly with the first Dutch edition, but on the third return journey a part of the material of the second (*mixed*) Latin edition, that is the ten sheets in question, all packed in one parcel, were lost, and the publisher, in a hurry to sell his copies, had these sheets replaced by xylography.

As a careful examination of the *mixed* Latin and other editions clearly shows their real condition and the order of their issue, we do not discuss Schreiber's improbable theories. As to those of Ottley and Sotheby, some of the lines which they regarded as broken in the copy or copies of the *mixed* Latin edition which they examined, are intact in other copies of the same edition, so that no reliance can be placed on these defects and breakages, which are clearly due to printing from wooden blocks, a process which admittedly causes more defects in the impressions than printing from types. Of the black and white scrolls we speak below.

It is to be noticed first of all that the legends underneath the woodcuts are in Latin, so that they were no doubt engraved for a *Latin edition*. But, unless we take the twenty xylographic leaves as remains of a complete xylographic edition issued (at Haarlem) before the invention of printing, there would be no Latin edition to connect the woodcuts with in the first instance, as the primitive types and workmanship of one, if not two, of the Dutch editions described below show that these must have been printed before the 44 type-printed leaves of the *mixed* Latin edition, and also before the wholly type-printed *unmixed* Latin edition, the types of which are new and far better cast.

Incidentally, this fact that the types of the *mixed* Latin edition are *later* than those of the Dutch editions disposes also of another theory favoured by some authors, viz. that during the progress of the xylographic edition its printer invented the movable type, and thereupon stopped his xylographic work to complete the book by means of type, so that in this *mixed* Latin edition we were to see the transition from xylography to typography.

The priority of the xylographic over the typographic leaves is proved by the Pembroke (No. 10) and Berlin (No. 9) copies. In the former the third sheet of quire *b* (= the leaves 9 + 18 with the figures 5, 6 and 23, 24), the only type-printed sheet in this quire in the other copies (1 to 7 and 9), is not the same as in the other copies, but belongs to the *unmixed* or second Latin edition.[1]

A somewhat similar but still more important manipulation we observe in the Berlin copy, in which the *fourth* sheet of quire *e* (= the leaves 52 and 61), the only xylographic sheet in this quire in the other copies, is replaced by the corresponding type-printed sheet of the *unmixed* or second Latin edition.

All this makes it clear that the printer of the *Speculum*, some time after having become a type-printer instead of a block-printer, replaced gradually (or by one operation), forty-four xylographically printed leaves of his first edition by type-printed leaves, for the purpose of issuing the Latin edition, now known as the *mixed* Latin edition; then, at a later stage, prepared a new Latin edition, wholly printed in movable type (now known as the *unmixed* Latin edition), and afterwards used sheets of this latest edition, not only to replace more of his old xylographic sheets (as in the Berlin copy), but even (as in the Pembroke copy) some of the forty-four sheets which he had printed (evidently for no more copies than he calculated to have left of the old xylographic stock), in the first instance, for issuing the *mixed* Latin edition. We shall see below that he proceeded in a somewhat similar way in completing copies of his Dutch editions.

Hence the sequence of the Latin editions was thus: (1) The *xylographic* edition of 64 (?) or more leaves in 29 (?) or more chapters, of which we have only 20 leaves remaining, which was issued before the invention of printing with movable types, and was probably preceded in its turn by a *xylographic* or *xylo-chirographic* edition of at least 32 or more chapters; (2) another issue of 20 leaves of the preceding edition, in combination with 44 typographic leaves (the *mixed* Latin edition) printed for the purpose of replacing the corresponding xylographic leaves of the preceding edition, considered unfit for further publication, or discarded for other reasons; (3) the wholly typographically printed edition known as the *unmixed* Latin edition.

This clear sequence of the Latin makes it easy to explain that of the other editions of the *Speculum*.

Typographic Printing.

(*Speculum* type 1).—First edition of a Dutch translation of the *Speculum*, with the title *Spieghel der menschliker behoudenisse*, hitherto called the *first*, or the *unmixed*, Dutch edition, or the Dutch edition in one fount of type. *First issue* entirely printed in type 1.

Judging by this and the third, the editions of the Dutch version of the *Speculum* must have had the same number of sheets, arranged (woodcuts and text) in the same way, as the *mixed* and *unmixed* Latin editions, with the exception of the preface, which required only 2 sheets (= 4 leaves). Hence complete copies consist of the quires a^2 (prefatory matter), bcd^7, e^8 = 31 sheets or 62 leaves.

Holtrop, who gives a facsimile of one of its pages (*Mon.* pl. 22), regarded this edition as the last of all the *Speculum* editions, because he thought the type to be identical with that employed for the other editions, only here more used up. Bernard, however, saw that it was a different fount, and there can be no doubt that it is; it differs in form and size from *Speculum* type 2 as well as from type 3, though it has all the characteristics and the family likeness of the two. Most of the letters might even be regarded as identical with those of type 3, if they were not slightly smaller. That it looks old and battered seems to be owing to bad ink having been used for the printing; it was, however, badly engraved and badly cast, for not one line in the book runs straight. For this reason alone this edition is to be placed before the next two, which are printed with a better type, especially the third. There are, however, more reasons for doing this. First of all, leaf 46 (with the figures 83: *Semey*, and 84: *Rex amon*) of Lord Pembroke's copy belongs to the 3rd edition (in *Speculum* type 3), so that the present edition, to which the Pembroke copy belongs, must have existed earlier. It appears from Holtrop's facsimile (*Mon.* pl. 22) that leaf 46 was duly printed in type 1 like the other leaves of this edition. But the leaf 46, from which he took his facsimile, is an isolated one which found its way into the Meerman Museum at the Hague, but is wanting in the copy of the Communal Library at Lille. Hence this particular leaf is, perhaps, a cancel meant to be replaced (in the Lille copy) by another one of the 3rd edition, as in the Pembroke copy. The corresponding leaf of this sheet (33, with the figures 57: *Cristus fleuit*, and 58: Jeremias) is wanting in the Pembroke copy, so that we can obtain no further information. Another reason for placing this edition before the 3rd is found in the Haarlem copy (No. 5), the leaves 24 + 27, 25 + 26 of which also belong to the (3rd) edition, and were apparently meant to replace in that copy the corresponding leaves of this edition, which may have been lost, or the stock of which had become exhausted. Similar manipulations we have noticed above, type-printed leaves having been used to replace earlier xylographic leaves, and again below in the 3rd edition leaves of another edition are found.

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[1] The Pembroke copy has this additional peculiarity that these leaves 9 + 18 consist each of two separate slips, one having the engraving, the other the text, the latter being pasted on to the bottom part of the former slip.

Hence we must distinguish between at least three issues of this edition; the *first*, with the whole text printed in *Speculum* type 1; the *second*, with sheet 46 of the 3rd Dutch edition, the *third*, with the leaves 24 to 27 of the 3rd Dutch edition. Copies of the first issue: (1) Communal Library at Lille, wanting the leaves 33 and 46 (which latter are probably now in the Meerman Museum at the Hague), and showing several peculiarities;[1] (2) Haarlem Town Library (No. 4), wanting the leaves 2 and 3, besides the woodcuts (figures 7, 8 and 21, 22) belonging to the leaves 8 and 15. The sheets of this copy have all been cut up into halves, mounted on other larger sheets, and so bound in one volume, together with a copy of the *Liber Alexandri Magni*, printed at Utrecht by Ketelaer and De Leempt, and of Pet. Scriverius' *Laurecrans*, both mounted in the same way. There is no rubrication. *Second* issue: (3) Lord Pembroke's copy, which was completed by leaf 46 of the 3rd Dutch edition. Besides wanting the original leaf 46 in type 2, this copy also wants the leaves 32, 33, 54 and 55. It shows, moreover, these peculiarities, that on the recto of leaf 7 and the verso of the corresponding leaf 16 (therefore, on the verso of the third sheet of quire *b*) are illegible sets-off of the texts of two other pages, or, perhaps, they are faulty impressions of the leaves 8 and 15, which, in the Haarlem copies, seem to be reprints. *Third* issue: (4) Haarlem Town Library (No. 5), wanting the leaves 20 + 31, 21 + 30, 22 + 29, 23 + 28, while its leaves 24 + 27, 25 + 26 belong to the *third* (formerly called *second*) Dutch edition (in *Speculum* type 3). It has, moreover, this peculiarity that the fourth sheet of quire *b* (= the leaves 8 + 15, with the figures 7, 8 and 21, 22), consists of two separate slips of paper, one containing the impression of the engravings, the other that of the text, the latter slip being pasted on the former, while underneath the figures 7 and 8 are still visible the blind impressions of the two top lines (on the corresponding leaf even 3 lines) of the old discarded letterpress. Seeing that the other copy at Haarlem has the text of these leaves, but not their engravings, it would seem that the letterpress had failed, that is, it had been impressed on the paper without its having been inked.

It is clear from all these manipulations in the copies of this edition, that its printer was inexperienced; moreover, considering its defective type, &c., it is necessary to give it precedence to all the other types and to place this edition immediately after the xylographic edition.

(*Speculum* type 2).—Second (?) edition of the Dutch version of the *Speculum*, at present only known from one sheet (the 26th) = the two leaves 49 (with the figures 89: *Xpūs crucifixus* and 90: *Inventores artis*) and 60 (with the figures 111: *Exitus ione* and 112: *Lapis reprobatus*), that is, the third sheet of quire *e*, found in all the existing copies of the Dutch edition (in the *Speculum* type 3), called the *mixed Dutch* edition, on account of its having these two leaves, printed in a different type, bound up with the others.

The type (on which see Holtrop, *Mon.* pl. 19, and Ottley, *Inquiry*, i. 249) used for these two leaves is slightly smaller than the *Speculum* type 3, and differs from it and from *Speculum* type 1 in several respects, though there is a great family likeness between all three. We place it before type 3 because the letters ba, be, ha, he, hē, ho, pe, pē, ve, &c., are cast in pairs on one body of type, which combinations appear no longer in type 3. Moreover it looks so primitive, uneven and used up that its proper place would almost seem to be before *Speculum* type 1, although the latter's uneven, wobbling condition suggests its priority. Further, its look and "ductus litterarum" bear such a singular likeness to the *Valla* type (mentioned below) that it seems reasonable to place it as near to that type as possible. Under ordinary circumstances these two leaves might be regarded as *later impressions* for completing the edition in which they occur. Ottley and others regarded them as replacing earlier leaves which, by some accident in the printing-office, had got lost or spoiled. But why should a printer use an old, quaint-looking type for printing and reprinting, with differences, one sheet for a book which he had printed entirely with a new and better type employed for many other works? We rather assume that the leaves are the remains of a complete (the second Dutch?) edition in *Speculum* type 2 and were used on this occasion as substitutes for the two corresponding leaves of the third edition, which had become defective or momentarily unavailable.

Differences in the text of the second column of leaf 60 between Meerman's copy and the Spencer Rylands and (Enschedé) Crawford copies (see Meerman, *Origg. typ.* i. 121, note cl., and facs. on pl. vi. 3rd div.; also Holtrop *Mon.* pl. 19, sec. col.) point to another edition printed in this same type. We therefore distinguish between one edition represented by the Meerman-Westreenen copy, and another represented by the two other copies, without being able to say which of the two is the earlier.

No other trace of this type has hitherto been found, but as it looks old and used up, it seems reasonable to suggest that it must have been employed not only for printing one or more editions of the *Speculum*, but for other books not yet known to us. It bears a singular likeness to the *Valla* type mentioned below, and some of the capitals seem almost identical.

(*Speculum* type 3). (1) The (*second*, or *third*, but) *first type-printed Latin* edition of the *Speculum*, or rather of 22 of its sheets (= 44 leaves), printed on one side only, in a type which is newer, and therefore later than the above types 1 and 2, and, for that reason, here called *Speculum* type 3. It has hitherto been called *the Speculum* type, as it was thought that all the editions of the *Speculum* were printed in one and the same type; type 1 being considered identical with 3, while of type 2, regarded as a stray one, no account was taken. The 22 type-printed sheets of this edition are only found in combination with the 10 sheets (20 leaves) printed entirely (figures and text) from wooden blocks, described above, and the edition so made up is, on account of this mixture of xylography and typography, called the *mixed* Latin edition. The type-printed leaves are 1 (blank) + 6, 2 + 5, 3 + 4 (quire *a*, preface); 9 + 18 (of quire *b*); 21 + 34, 24 + 31, 25 + 30, 26 + 29 (of quire *c*); the whole quire *d* (leaves 35 + 48, 36 + 47, 37 + 46, 38 + 45, 39 + 44, 40 + 43, 41 + 42); and the leaves 49 + 64, 50 + 63, 51 + 62, 53 + 60, 54 + 59, 55 + 58, 56 + 57 of quire *e*. The copies of this edition, still in existence, with all the particulars related to them, have been enumerated above.

(2) The *third* (hitherto called the *second*) *Dutch* edition; also called the *mixed Dutch* edition, or the *Dutch edition in two types*, two of its leaves (49 and 60) being printed in a different type (see above, *Speculum* type 2). This edition is arranged in the same way as the first and second, and consists therefore of 62 leaves. Copies: 1. John Rylands Library, Manchester (Spencer collection), perfect; (2) Lord Crawford's library, perfect; (3). Museum Meerman, the Hague, perfect; (4) Geneva Public Library.

(3) The (*third*, or *fourth*, but) *second type-printed Latin* edition, usually called the *unmixed* Latin edition, it being printed throughout in one type (3). It contains 64 leaves, printed on one side and arranged in the same number of quires as the *mixed* Latin edition. But under figure 100 (column 100) it has a line (5th) which is wanting in the first (*mixed*) Latin edition, and the final word of line 4 is correctly printed *corporali*, not *spirituali* as in the *mixed* Latin. Moreover, line 10 in col. 104 has the final word *egipti*, which is wanting in the mixed Latin, and line 6 in col. 62 has the correct final word *terrestris* instead of *celestis* as in the mixed Latin. (See also Holtrop, BRH. 561; Sotheby, i. 145; Bernard, i. 17; Facs. in Holtrop, *Mon.* pls. 17, 19; Sotheby, i. pls. xxix. and xxx.). Copies: (1) The Hague, Museum Meerman-Westreenen, wanting the first six leaves of the preface. A separate impression of the engraving (*Semey maledicit + Rex amon*) of leaf 48 is pasted on the lower part of the same cut, which had been printed with the text in the first instance, but defectively (Holtrop, *Mon.* p. 20, and pl. 17). (2) Florence, Royal National Library, formerly in the Pitti Palace, wanting the first (blank) leaf and having also a separate impression of the engraving of leaf 48, but here the text seems to have failed and is pasted on the engraving. (3) Stuttgart, Landesbibliothek, wanting the first (blank) leaf; (4) Munich, Hofbibliothek (pressmark Xyl. 4to No. 37) wanting the first (blank) leaf; (5) Vienna, Hofbibliothek (pressmark Inc. 2 D 19) wanting the first (blank) leaf; (6) [John B. Inglis, bought by Mr Quaritch, and now in] the Lennox library; (7) Haarlem, Town Library (No. 8), wanting the preface (leaves 1 to 6); (8) Brussels, Royal Library, wanting, besides the first (blank) leaf, the second and third sheet of quire *b* (leaves 8 + 19, 9 + 18), and the second half of the fourth sheet (leaf 31) of quire *c*; (9) Hanover, Royal Library, wanting 18 leaves, that is, the first four, and the whole quire *d* (leaves 34 to 48); (10) Munich, University Library (pressmark Xyl. 10), wanting the four leaves 1 (blank), 54, 55 and 59. In this copy Schreiber (*Centralbl.* 1895, p. 208) discovered the date 1471, in old arabic numerals in rubrics, underneath the blind impression of some line after the last line of the Prohemium. The date is repeated by a hand of the 18th century, in modern arabic numerals, underneath the old date, by way of

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[1] The fourth sheet of quire *b* (leaves 8 and 15) consists of two separate slips of paper, one containing the engravings, the other the text, the latter being pasted on the former. The fifth sheet of quire *c* (= leaves 23 and 28) is in the same condition. But these slips are not, like the former, pasted one on the other, but the pieces of leaf 23 are pasted on a small, apparently old, slip of paper, another newer piece of paper having been pasted on to the outer margin to strengthen the old piece. The slips of leaf 28 are pasted together by a slip of modern paper on the back, from which it would appear that they had been left loose when the volume was issued. Further the 7th or centre sheet of this same quire *c* (leaves 25 and 26) is bound wrongly in the place of the first sheet of quire *d* (leaves 33 and 46), which is wanting in this copy, so that leaf 25 follows after leaf 32, taking the place of the missing leaf 33, while leaf 26 follows after leaf 45, taking the place of the missing leaf 46 (now at the Hague). But on leaf 25^b, which should be blank, is an impression of the text belonging to leaf 62^a, but not of the figures (115, 116), while on leaf 26, which should also be blank, is now the text belonging to leaf 47, but without its figures (85 and 86). Hence the text of these pages (62^a and 47^b) occurs twice in this copy, first on the leaves 25^a and 26^b, and secondly in their proper place. These peculiarities seem to show that the letterpress was printed first, and that in this case a mistake was made in the first instance, but discovered when the figures were printed.

explanation; (11) Library of the Royal Gymnasium at Freiberg in Sachsen where the 14 leaves of quire *c* are said to be preserved, but which in June 1908 could not be found

In the Florence, Munich (University Library), Vienna and (Inglis) Lennox copies, all four belonging to this (*unmixed*) Latin edition, the three scrolls on the last vignette of the book (over col. 116), representing Daniel before Belshazzar, and the "handwriting on the wall," appear *black* (see Sotheby, *Principia typogr.* i. pl. xxx., xxxvii., xxxviii.), but blank in all other copies of this and the other editions. From this fact some authors have concluded that the *unmixed* Latin edition, here called the *last*, was, in reality, the *first*, as the black scrolls show that the pieces of wood which caused these black impressions had not yet been cut away when the copies were printed off. But as its type and other circumstances connected with this *unmixed* Latin edition make it impossible to regard it as the first, we have to look for another explanation of these black scrolls. First of all, scrolls, especially scrolls proceeding from the mouth of some individual, were already common in the pictures or illustrations of the manuscript- and block-printing periods, just as they are now. They were then, as they are now, intended in all cases to convey to the reader some memorable saying, quotation, inscription or motto. As black scrolls, therefore, could have had no object, we should have to assume that the practised engraver of the *Speculum* had prepared this last engraving carelessly and only saw his mistake after some copies had been printed off, which yet he allowed to pass into circulation. In some copies the Bible words *Mane thecel phares* have been written in the blank scrolls, as was to be expected; other copies vary this by adding the Latin interpretations, *numerus, appensio, divisio*. But in one of the Haarlem copies the scrolls have been coloured yellow with a brush, and it would seem that to some such operation the black scrolls are due; the colour in none of the impressions looks exactly like that of the vignette. It is, however, more than probable that, for some purpose or another, some of these scrolls were intended to be black, and that, while they were printed, something was placed in the block in the hollow of the scrolls to produce a black impression.

Sotheby, in his *Principia typogr.* p. 178 sqq., calls attention to an imitation of this *Speculum* vignette by Jacobus de Breda, who began printing at Deventer about 1483. This imitation (having one scroll which proceeds from the mouth of a figure supposed to represent Jacobus himself) he used for the first (?) time in Matthaei Bossi *Sermo*, *c.* 1491, the *scroll* being blank. But when he uses the engraving for the second (?) time, in *P. Ovidi Naso. metamor. Liber Secundus*, *c.* 1493 (copy in the Cambridge University Library), his name, "Jacob' de Breda" appears in the scroll (upside down when reading from right to left) A *third* time the vignette appears in his edition of *Pub. Ov. Nas. Metamorphoseos lib. tertius* (copy in the Cambridge Library) with his name in the ordinary way. A *fourth* time it is on the title-page of *Seneca de quattuor virtutibus*, *c.* 1495 (also in the Cambridge Library), with the name "Seneca" in the scroll. Sotheby shows that it occurs a fifth time on the title-page of a *Donatus* published by J. de Breda, again with his name in the scroll. A sixth time (says Sotheby) the engraving occurs on the title-page of a tract *Dominus que Pars*, again with his name in the scroll. And finally (says Sotheby) it is on the title-page of *Secunda Pars Doctrinalis Alexandri*, with the date 1511 and the name "Joānes Bergis" in the scroll. Seeing then the use made of this imitation till 1511, Sotheby, not unreasonably, suggests that the original scroll in the *Speculum* was from the beginning meant to contain the name of the printer (the inventor of printing). See also Dibdin, *Bibliographical Decameron*, ii. 285–296. One thing seems certain, the scrolls in the *Speculum* were not intended to be black in all cases, but to contain something or other, and not always the words *Mene*, &c., as in that case it would have been as easy for the engraver to cut them on the block as any other words or figures, pillars, &c. The printer probably wished to leave the choice to his purchasers. Incidentally the use made by Jacobus de Breda of his scroll points to his having been aware of the use for which the original scroll, which he imitated, was intended; and as the printer of the *Speculum* was undoubtedly the first printer of Holland, it is not improbable that Jacobus learnt his craft from him.

The above descriptions and explanations, based on bibliographical and typographical *facts*, deal exclusively with the editions and issues of editions of the *Speculum* now known to us. They by themselves make it clear (1) that their printer began as a *xylographer* and *block-printer*; (2) that the *six* editions which he published of this one work cannot be placed later than 1471, as this date is written in a copy of the latest of them; (3) that, for the printing of his *five* type-printed editions (Dutch and Latin), he manufactured no less than *three* different types.

When round these editions and types we now group the various other incunabula which must be ascribed to him, as being printed with the same types or others related to them by a striking family likeness and other circumstances, we obtain the following sequence for this printer's work.

A.—*The Xylographic Period.*

1. One or two folio editions of the *Speculum* in Latin, printed (pictures and text) from wooden blocks, and consisting most likely of 32 if not more chapters, but of which only ten sheets (twenty leaves), and six separate woodcuts (cut up into twelve halves, for the Veldener 4to edition of 1483) have come down to us. Of one of these xylographic editions, at least of ten sheets of it, three issues are known to have been made in combination with type-printed leaves (see below).

2. As various circumstances compel us to regard the printer of the *Speculum* as having been a xylographer before he invented printing with movable types, it is necessary to mention here a small block of wood which is known to have been preserved for nearly 300 years at Haarlem as a remnant of Coster's printing-office. On it is engraved part of an Horarium; its first lines beginning with *Servu[m] tuum in pace Quia viderunt oculi mei Salutare*, &c., of the hymn of Simeon. About 1628 it was in the possession of Adriaen Rooman, printer to the Haarlem Corporation, who had obtained it from one of Coster's descendants, a man of great age. Rooman gave it to Dr Johan Vlasveld, of Haarlem, at whose death, in 1684, it came into the hands of his children; in 1734 it was bought by Jan Maas of Haarlem, who left it at his death to his son-in-law the Rev. Jacobus Mandt, a pastor at Gorinchem; at whose death it was bought by Jacobus Koning, the well known author on the invention of printing, and after his death it was acquired by the Haarlem Town Library where it now is (see A. de Vries, *de Uitvinding der Boekdrukkunst*, 1862, p. 35).

B.—*Printing with movable Metal Types.*

Type I., also called the *Abecedarium* type, with which were printed: (1) The *Abecedarium*, 4 leaves, 16mo, on *vellum*, now preserved at Haarlem (Town Library), where M. Joh. Enschedé discovered it in 1751, in a MS. *Breviarium* of the 15th century; (2) An edition of *Donatus*, 31 lines, 4to, two *vellum* leaves, printed on one side, discovered in 1844, in the ancient binding of a Dutch Book of Hours, printed at Delft in 1484; it is now preserved in the Hague Royal Library.

Type II. (*Speculum* type 1; see p. 525; hitherto erroneously regarded as identical with *Speculum* type 3): (1) *First Dutch* edition of the *Speculum*, of 31 paper sheets (62 leaves) printed on one side, folio, hitherto known as the first or *unmixed* Dutch edition. Two issues: (*a*), printed entirely in this type, represented by copies at Lille and Haarlem (No. 4); (*b*), having some of its leaves replaced by leaves of the *third* Dutch edition, represented by the Pembroke and Haarlem (No. 5) copies. (2)[1] An edition of *Donatus*, 28 lines, 4to; two vellum leaves in the Haarlem Town Library, found pasted in the original binding of an account book of 1474 of the cathedral of that town, in which an entry testifies that this account-book was bound by Cornelis the bookbinder, whom Junius asserts to have been the servant of Lourens Janszoon Coster (Meerman, *Orig. typ.* Tab. VI.*). (3) Another *Donatus* of 28 lines, two leaves of which are in the Haarlem Town Library, and were discovered in the original bindings of account-books of the Haarlem Cathedral Church of 1476, also bound by "Cornelis the bookbinder." Fragments of this same edition are also in the Paris National Library, and in various other public and private collections. (4) *Donatus*, 28 lines, 4to, one vellum leaf, in the Hague Royal Library (BRH. 2; Ca. 612; Holtrop, *Mon.* pl. 13), discovered in the binding of a book belonging formerly to the Sion Convent at Cologne containing several treatises printed by Ulrich Zell, one being dated 1467. (5) *Donatus*, 30 lines, 4to. Two unrubricated *vellum* leaves in the Cambridge University Library (Inc. 4. E. 1.1), discovered in the binding of a copy of J. Mile's *Reportorium*, Louvain, 1475, now also in the same library. The first leaf contains the chapters xiv. 11 to xvi. 4, the second chapter xxvi. 6 to xxix. 10. The text is abridged, having *amabamus*, *batis*, *bant*, &c., where other editions have *amabamus*, *amabatis*, *amabant*, &c. (6) *Donatus*, 30 lines, abridged edition, 4to, one unrubricated vellum leaf, cut into halves. Wrongly described by Holtrop (BRH5) and Campbell (614) as part of No. 7 (below). (7) *Donatus*, 30 lines, 4to; two rubricated vellum leaves, in the Paris National Library (Van Praet, Velins, No. 8; now 1040). (8) *Donatus*, 30 uneven lines, 4to. Two rubricated vellum leaves, in the Hague Royal Library (BRH 5; Ca. 614). (9) *Donatus*, 30 lines 4to. Two vellum leaves in the Haarlem Town Library, discovered in 1750 by M. Joh. Enschedé at Haarlem in the binding of a MS. (*Handvesten* . . *van Kennemerland*, 1330 to 1477). (10) A liturgical book, containing rules for saying Mass, in 16mo (12 lines to a page [Holtrop, *Mon.* pl. 14] 2 vellum leaves, pp. 3–6), in the Brussels Royal Library. (11) Alex. Galli *Doctrinale*, on vellum, 32 lines,

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[1] The present writer is certain that *Speculum* type 1 differs from *Speculum* type 3 in size, and somewhat in form too. But he is still uncertain whether the *Donatuses* (2 to 7) here enumerated are in the same type as the first Dutch *Speculum*, though he travelled twice to the places where they are preserved to examine them. It would seem that the *Donatuses* are in a different type, more compact, regular and better cast than that used for this edition of the *Speculum*. But if there is any difference between the types it is so minute that it is well nigh impossible to detect it.

4to; one leaf and fragment of a second, in the Ghent University Library (Res. 1409). (12) Alex. Galli *Doctrinale*, on vellum, 32 lines, 4to. Two leaves (forming one sheet) in the Cologne Town Library.[1]

Type III. (*Speculum* type 2): (1) *Second Dutch* edition of the *Speculum*, which probably consisted of 31 paper sheets (62 leaves) printed on one side in folio, like the first and third. Only known from one sheet (leaves 49 and 60) which forms part of all the copies of the *mixed* or *third* Dutch edition preserved to us. (2) On account of differences in the setting up of the second column of leaf 60, another edition in this type may be supposed to have existed. There is no further trace of this type,[2] which greatly resembles type IV.

Type IV., also called the *Valla* type: (1) Laur. Vallae *Facetiae morales et Franc. Petrarcha de salibus virorum illustrium ac facetiis tractatus*, 24 paper leaves, small 4to. No other books printed in this type[2] are known to exist. But four of its capitals (B, H, L, and M) have been used in printing the edition of the *Singularia* of Ludovicus (Pontanus) de Roma, which otherwise is entirely printed in type VI

Type V. (*Speculum* type 3, hitherto wrongly called *The Speculum* type): (1) The [*second* or *third*, but] *first type-printed Latin* edition of the *Speculum*, for which only 22 paper sheets (44 leaves) seem to have been printed to replace the same sheets of the earlier *xylographic* edition A, and to make up, in combination with the ten remaining xylographic leaves, a folio Latin edition of 64 anopisthographic leaves, called, on account of this mixture of xylography and typography, the *mixed* Latin edition. Some copies (the Berlin and Pembroke) of this mixed edition were still further mixed with sheets of the *second* type-printed Latin edition. (2) *Third Dutch* edition of the *Speculum*, hitherto known as the *mixed* Dutch edition, as having two leaves, (49 and 60) printed in a different type (*Speculum* type 2); 31 paper sheets (62 leaves) printed on one side, folio. (3) A Dutch version of the *Seven Penitential Psalms*, one *vellum* sheet (= 2 leaves), 4 pages 16mo, 11 lines to the page, printed on one side; copies in the Royal Library of Brussels (where it was discovered) and the Hague. (4) An edition of *Donatus*, of 27 lines, fragments of which are in the British Museum and the Bodleian Library. (5, 6, 7) Three editions of *Donatus*, of 30 lines, all on *vellum* (Holtrop, *Mon*. pl 14b; Meerman, *Origg*. iv.). (8) A *French* translation of *Donatus*, on vellum, 29 or 30 lines to a page; four leaves, now in the Utrecht University Library, discovered by Dr Samuel Muller, the Archivist of Utrecht, in a Utrecht MS. Cartulary of the first half of the 16th century. (9, 10) Two different editions of Alexandri Galli *Doctrinale* on vellum, 32 lines to a page (Holtrop, *Mon*. pl. 15). (11) Catonis *Disticha*, imperfect copy of four vellum leaves, 8vo, 21 lines to a page (Holtrop, *Mon*. pl. 16) in the John Rylands Library (Spencer Collection). (12) The [*third* or *fourth*, but] *second* type-printed *Latin* edition of 32 sheets (64 leaves), printed entirely in this *Speculum* type (3), and therefore known as the *unmixed* Latin edition (Holtrop, *Mon*., pl. 17). For the use of sheets of this edition to complete copies of the earlier edition, see above V.1. The Munich University Library copy has the rubricator's date 1471.

Type VI., also called the *Pontanus* type: (1) Ludov. (Pontani) de Roma *Singularia juris* (in type VI.) and Pii Secundi *Tractatus de mulieribus pravis et ejusdem Epitaphia* (in type VII.), 60 paper leaves, folio, of which the Pontanus occupies the leaves 1 (blank) to 45 recto, and the Pius, the leaves 45 verso to the end. Various differences are found in the copies of the Pontanus known to us, and we may assume two if not three issues. This type VI., therefore, is linked on to type VII. by the two being used in one and the same book, while it is inseparably connected with type IV. by the capitals B, H, L and M of this latter type being employed in printing the *Singularia*. Copies in the British Museum, Cambridge University Library, John Rylands Library (Spencer Collection), Hague Royal Library. (2, 3, 4, 5) Four different editions of *Donatus*, each of 24 lines, fragments of which are preserved in the Hague Royal Library, Haarlem Town Library, Paris National Library, Cologne Town Library, &c.

Type VII., also called the *Saliceto*, or the *Pii Secundi Tractatus* type. (1) *Pii Secundi Tractatus et Epitaphia*, mentioned above under type VI. as being printed with the *Pontanus* in one volume. (2) Guil. de Saliceto *De salute corporis*. Fragments of two *vellum* leaves of this edition, discovered in the binding of a copy of the *Formulae Noviciorum*, printed at Haarlem by Joh. Andreae, in 1486, are now in the British Museum. The fragments are printed on one side only, and their texts correspond to the leaves 3 and 5 of another edition (see below) in the same type, to which treatises of Turrecremata, Pius Secundus, &c. have been added. It is not clear why these fragments were printed on one side only; the *versos* have not been scraped as was asserted by Holtrop and Campbell, nor are they printer's waste, as they are rubricated. It is not known whether the treatises added to the other edition formed also part of this one. (3) An edition of *Donatus minor*, or *abbreviatus*, 26 lines. (4, 5, 6, 7, 8) Five different editions of *Donatus* of 27 lines. (9) An edition of the *Doctrinale*, of 26 lines. (10) A *Doctrinale* of 28 lines. (11) *Doctrinale* of 29 lines. (12) *Doctrinale* of 32 lines. (13) *Catonis disticha*, 21 lines. (14) [Incerti auctoris, vulgo Pindari Thebani] *Iliados Homericae Epitome abbreviatum* (metrice), cum praefatione Pii II. in laudem Homeri, in folio, 10 leaves (first blank), 35 lines; first edition having, on fol. 9a, as last line 35: "intēcio homeri in precedēti poemate est describere," as in the copy in the Cambridge University Library (Inc. 3 E. 1. 1). (15) Guil. de Saliceto *De salute corporis*; De Turrecremata *De salute corporis*; Pii II. *Tractatus de amore*; (Pindari) *Iliados Homericae epitome* abbreviatum, cum praefatione Pii II.; added are three additional pages, the first contains "Hectoris . . . Epitaphium"; the second "Homonee . . . Epitaph."; the third is blank. In folio, 24 leaves (first blank), divided into two quires of six sheets each; 34, 35 and 36 lines (second edition of the *Saliceto*, and of the *Yliada*; but *first* of the *Turrecremata*, and the *Tract. de amore* of Pius II.). This edition is represented by the copy in the Hague Museum Meerman, in which a MS. note records that it was bought between 1471 and 1474 (Campbell *Ann*. 1493), which still has in the *Yliada*: "in precedēti poemate est describere." (16) *Second* edition of the *Yliada*, having as last line (35) on folio 9a a more correct reading: "intēcio homeri in hoc opere est describere troianā." This edition is represented by the British Museum copy (pressm. 8814) and the three additional pages (3rd blank already found in No. 15) "Hectoris . . . Epitaphium" and "Homonee . . . Epitaph." (17) Another edition of No. 15 (that is *third* edition of the *Saliceto*, second of the *Turrecremata* and *Tract. de amore* of Pius II., *third* of the *Yliada* and *third* of the additional pages), but with the line in the *Yliada* (on 22a): "intēcio . . . troianā." This edition is represented by the British Museum copy (C. 14. b 10). (18) Another issue of the *Saliceto*; *Turrecremata*; Pii *Tract. de amore* et *epitaphia*, 26 leaves, with various additions or omissions and differences in the setting up not in the former editions. Copy in the Darmstadt Hof-Bibliothek (S 4705), which has the rubricator's date *1472* written in two places. (19) Another issue of the *Yliada* with the Pii *Tract. de amore et epitaphia*, again with additions, omissions and differences in the setting up, not in the Darmstadt copy or in the earlier editions. Represented by 17 loose leaves in the Museum Meerman at the Hague (see Holtrop, *Mon. typ*., pp. 32, 33).

An *eighth* type, hitherto regarded as a Costerian, is type VI. in Hessels's List of Costeriana (*Haarlem not Mentz*, p. 31 seq.), where two editions of *Donatus* in this type are mentioned, one of 26 lines, four leaves of which are in the Catholic Gymnasium at Cologne (Campbell, 629), another of 27 lines, of which leaf 11 is in the Museum Meerman at the Hague, some fragments in the Haarlem Town Library and two leaves (formerly in the Weigel Collection) in the British Museum (IA 47028). Holtrop (*Mon. typ*. pl. 21) and Meerman (*Opp*. pl. II) give a facsimile of the type. Campbell, in his *Annales* (No. 629, 631), referring to pl. 31 of Holtrop's *Mon*. for a facsimile of both these editions, says that they are printed with the types of the Pii II. Tractatus (the *Saliceto* type), but that, by the size and form of the P, this edition is distinguished from the other books in this type. Hessels (*l. c*. p. 24) repeated this; but Campbell's assertion proves to be an error, as the two types differ, in spite of a great likeness between them (the C, F, I and V being almost identical). That of the two *Donatuses* is an early Gothic, and has some of the characteristics of the Costerian types, as the *t* with perpendicular stroke to its cross-bar, the marks of contraction connected with the letters above which they appear, but only a few pairs of letters cast on one body, and no *r* with a curl; so that it seems somewhat later than those mentioned above.

A *ninth* type (facsimile in Holtrop's *Mon*. pl. 32a), hitherto regarded as a Costerian, is No. VII. in Hessels's List (*l.c*.). It resembles much that of the *Saliceto*, and has served for a *Donatus* of 27 lines, fragments of which representing two copies, were found in the binding of a Durandi *Rationale*, printed at Strassburg, 1493, belonging to the Convent of the Holy Cross, at Uden in North Brabant. This type again bears a great likeness to the *Saliceto* and also to the above type 8, but it differs from both.

Setting aside for the moment the types viii. and ix. as doubtful Costerians, we must also point out that there is no direct evidence that type i. is connected with the other seven, or that it is the first of them. But it is a primitive one; it has all the characteristics of the *Speculum* and other Costerian types, and could hardly be placed later than the earliest of them; the *Donatus* printed with it is printed on one side of the leaf only; it shows, moreover, in other respects that it must be dated before 1470. The *Abecedarium* printed with the same type, and discovered at Haarlem in a 15th century manuscript belonging to a Haarlem family, looks as the work of an inexperienced printer. The types II., III. and V. (the *Speculum* types 1, 2 and 3) are inseparably connected with each other; they must have been in one and the same office; their workmanship shows that their founder step by step simplified and improved his work, and in what order they are to be placed; the most perfect of them (V.) was in existence not later than 1471 (see above), and the three, together with the xylographic leaves in the mixed Latin *Speculum* (from which they cannot be separated) take us back to a period which could not possibly be extended beyond 1470, but which may reasonably be said to have begun as early as, say 1440.

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[1] It may be that some of the works enumerated under type v. are really printed in the first *Speculum* type, but it is almost impossible to come to some certainty as to the difference between types 1 and 3, unless the books are together.

[2] The present writer has recently purchased from Herr Jaques Rosenthal, of Munich, two leaves of a *Donatus*, which were said (in Herr Rosenthal's catalogue) to be printed in the *Valla* type (IV.). On examination this proves not to be the case. At first sight it seemed to him to be type III (*Speculum* type 2). But this is not the case either. It has, however, the peculiarities of both these types combined, so that he does not hesitate to call these fragments a *unicum*, and its type provisionally type III.*

Therefore these three types, and the books printed with them in combination with the xylographic leaves, and various circumstances pointing to Haarlem as their birthplace, would alone suffice to support and vindicate the Haarlem claims to the honour of the invention of printing. It could, however, serve no useful purpose to separate the types I., IV., VI. and VII. from those of the *Speculum*, as they have all a great family likeness and three distinctive peculiarities common among them: (1) a perpendicular stroke to the cross-bar of the *t*; (2) a small curl attached to the top of the *r* found in no other Netherlandish type; it goes backward in types 1 and 3; and in type 2 another curl is added to the first, bending to the right again; (3) a minute perpendicular link connecting the marks of contraction with the letters above which they appear (a peculiarity common also in the Dutch MSS. of the time). A copy of the latest issue of the *Saliceto*, preserved at Darmstadt, printed in type VII., has the rubricator's date 1472 in two places; another book in the same type (in the Meerman Museum) was bought between 1471–1474, and as this type is used for a tract printed together with the Pontanus treatise printed in type VI., and the Pontanus type is supplemented with capitals of type IV. (the *Valla* type), it follows that these three types (IV., VI. and VII.) must have been in use in one and the same office, and that the latest of them (VII.) cannot be placed later than 1472. Again, it must be said that there is no direct evidence that these three types were used by the printer of the *Speculum*, but as fragments of *Donatuses* in the Saliceto type have been found in account-books of the Great Church at Haarlem, all presumably bound by the same Cornelis the bookbinder (the reputed servant of the Haarlem inventor), who also used fragments of *Donatuses* in the *Speculum* types, Haarlem may be regarded as their common birthplace.[1] Hence these seven types may be grouped thus: (*a*) the *Abecedarium* type; (*b*) the three *Speculum* types; (*c*) the *Valla*, *Pontanus* and *Saliceto* or *Pius* types; the (*a*) group cannot be dated later than 1470; (*b*) (three types) not later than 1471; (*c*) (three types) not later than 1472 and perhaps not before 1458.

Here then we have a printer who, before 1472, had manufactured and extensively used at least seven (if not eight or nine) different and primitive looking types; three of the seven must have existed long before 1471, as with them he had printed before that year no less than five folio editions of one book (the *Speculum*), besides several editions of *Donatus* and the *Doctrinale* of Alex. Gallus and other smaller books. This work may be supposed to have extended over a number of years, and before he printed any of these type-printed books he had already engraved, printed and issued at least one large folio blockbook (the *Speculum*).

And yet the catalogues of the present day, which profess to arrange the incunabula *chronologically*, under their respective countries, towns, printers, types and dates—according to some "historical" or "natural history method" suggested in 1870 by an eminent bibliographer, and intended to show the "development of printing"—assign this primitive Dutch printer, and his primitive types and books, to what is presumed to be their "chronological" place, *after* the productions of Germany, Italy, Switzerland and France; that is, they are placed in a period when printing presses had been established in nearly every large town of Europe, and the art of printing was already so fully developed and vulgarized, that the books of that period show, on comparison with the Costeriana, that the latter must have preceded them by at least two or three decades.

Apart from this anachronism, the same catalogues assign this printer and his books no longer to Haarlem in North Holland, to which they had always been attributed in conformity with the tradition that printing had been invented in that town and the *Speculum* and other books printed there; but they locate them at Utrecht, the capital of the province of the same name, although the types of the Costeriana show that they are imitations of the handwritings indigenous to the province of Holland, not to those of Utrecht.

This bibliographical calamity dates from the year 1870, when Dr Anton Van der Linde published his book *The Haarlem Coster Legend*. After it had become known to him that for years past the "Lourens Janszoon Coster" mentioned by Junius as the inventor of printing had been confused by some authors with another inhabitant of Haarlem, whose name was "Lourens Janszoon," but who had never borne the surname "Coster," he, after an inadequate investigation in the Haarlem archives and elsewhere, professed to prove from documents (1) that the Haarlem tradition was nothing but a "legend," the kernel of which was "Jacob Bellaert," who published in 1483 the first Haarlem book with a date; (2) Lourens Janszoon Coster was a "myth"; (3) Cornelis the bookbinder, Junius's chief witness for the Haarlem tradition, had been Bellaert's servant, and, telling his story in his second childhood, magnified the first Haarlem printer of 1483 into the first printer of the world; (4) the "Spiegel" and the Donatuses could not have been printed before 1470–1474, &c. As Van der Linde's book was apparently based on documents, it was generally thought to have put an end to the Haarlem claims. It seems to have struck nobody at the time that this Haarlem tradition or legend, if it had originated in or after 1483, could not have been so strangely distorted and altered that, within a few decades, "Jacob Bellaert" its hero, according to Van der Linde, was forgotten, while his "servant," in his second childhood, substituted for him another person of an entirely different name and of a much earlier period; whose descendants all appear in Haarlem's history, and one of whom records him in a genealogy; who is himself mentioned again and again in the Haarlem registers of the time, but who is finally, in 1870, declared to be a "myth." Nor did it strike anybody at the time that if Cornelis the bookbinder had been Bellaert's servant or binder, and his story of the inventor related to him, and to no other printer, this bookbinder must have used fragments of Bellaert's productions for strengthening his bindings, instead of which he employed fragments of the Costeriana, which are admittedly not printed by Bellaert.

These are two of the many points which might have arrested Van der Linde in his sweeping denunciation of the Haarlem tradition if he had given more attention to the subject. As no reply invalidating the main part of his criticism emanated from Haarlem, Henry Bradshaw, the librarian at Cambridge, who had been studying the Dutch incunabula for some years, accepted Van der Linde's conclusions, and published, in 1871, his *List of the founts of type used by printers in Holland in the 15th century*, in which he explained that he was compelled to place the printer of the *Speculum* at Utrecht because "it is there that the cuts of the old folio editions first appear cut up into pieces in a book (*Epistelen ende Evangelien*) printed by Veldener at that place in 1481. Without further information he would have found it necessary to place the printer of the *Speculum* last among the Utrecht presses and to affix as his date (before 1481). But as the types of the *Yliada* (VII.) and of the Ludovicus de Roma (VI.) bear a close resemblance to those of the *Speculum*, they could not be separated from the latter, and a note in the Hague copy of the *Tractatus de salute corporis* in the same type VII. makes it clear that it was bought between 1471 and 1474, this was the only date which he could accept, and it compelled him to place the printer of the *Speculum* at the head of the Dutch printers, just as the *Speculum* compelled him to place him at Utrecht."

It is clear that Bradshaw's system of classifying the incunabula, so inflexible as regards dates and places of printing, that he would admit any stray statement on these points if it be found in the books themselves, rather than go outside the books for further information, is yet elastic enough to ascribe the *Yliada* and the *Pontanus* to the printer of the *Speculum*, merely on account of a close resemblance between the types of these books. As he knew that the early printers shaped their types according to the handwritings indigenous to the places where they settled, it must have escaped him that in locating the printer of the *Speculum* at Utrecht, he placed him among printers whose types bore no resemblance to those of the Costeriana. This system, therefore, so rigorous on the one hand and so flexible on the other, can only be applied with safety to books whose country, printer and date are known, not to such as the *Costeriana*, which have neither date nor printer's name, nor place of printing, and might, therefore, be ascribed to France, Italy, Germany or any other European country, if it were not that some of them were printed in the Dutch vernacular.

As to the *Speculum* cuts being in Veldener's hands in 1481 (and 1483), various circumstances show (see Holtrop, *Mon.* p. 110 sqq.) that he could not have possessed them, nor acquired them from other printers at Utrecht, until he used them cut up into halves and already considerably worn out. It is also known that ten years at least before he employed them, the cuts had been used intact as illustrations in a book which could not be ascribed to him. In such cases bibliography is bound to inquire where they could have been so used before ascribing them to the place where they are used in 1481. The statements of the *Cologne Chronicle* (1499) and of Junius (1568) when examined together with the types and workmanship of the *Costeriana* give satisfactory answers on this point. The fact that fragments of a French translation of *Donatus*, printed in *Speculum* type 3, and of a treatise of Ludov. Pontanus on Canonical Law in the *Pontanus* type, were discovered at Utrecht, cannot be set against the finding of many more fragments of Donatuses, &c. at Haarlem.

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[1] The Cambridge University Library possesses two sheets of two different editions of *Donatus*, one (unrubricated) printed in *Speculum* type 1, the other (rubricated) in the *Saliceto* type, both found pasted by the binder on the wooden boards of a copy of J. Mile's *Repertorium*, printed at Louvain in 1475, which is also in the same library.

Bradshaw lived to see some result of his system in Campbell's *Annales*, published in 1874, where all the Costeriana are ascribed to a *Prototypographie neerlandaise à Utrecht*, and he regretted it. Unhappily, his untimely death prevented him from testing his system more closely; those who adopted it were unable, or considered it unnecessary, to repeat his explanations and reservations, so that the Costeriana are now, in almost every catalogue, placed at Utrecht,[1] without any sign of doubt or hesitation, though all the particulars connected with them prove that they could not have originated there.

Date of Haarlem Invention.

To ascertain the probable date of the Haarlem invention, we have at our disposal: (A) some historic statements and documents, namely (*a*) two entries of 1446 and 1451 in the Diary of Jean Le Robert (Abbat of Cambray); (*b*) the Helmasperger Instrument of 1455; (*c*) Ulrich Zell's account of the invention of printing in the *Cologne Chronicle* of 1499; (*d*) the Coster pedigree; and (*e*) Junius's narrative of the Haarlem tradition; (B) a collection of nearly, if not more than, fifty incunabula, known as Costeriana, the printing of which must have involved the manufacture of *seven* types, four of which (the *Abecedarium*, and three *Speculum* types) cannot be placed later than 1471, the other three (the *Valla*, *Pontanus* and *Saliceto* types) not later than 1472. With these types were printed five folio editions of the *Speculum*, twenty-three of *Donatus*, eight of the *Doctrinale*, besides several other important books.

Mainz date, 1450.

A. Historic Statements.—Junius, saying that Coster invented printing in 1440, and that Johan, who stole his types, printed with them at Mainz in 1442, probably knew, or had heard, nothing more definite about a date than that Coster's types were used at Mainz within a year after the theft. The year 1440 as that of the invention was first mentioned, it seems, in 1483, in testimony xvii.; a second time by the *Cologne Chronicle* in 1499 (but only as the year in which the art began to be "investigated," whatever that may mean), and again in 1505 and later (testimonies xxix., xxxix.). Junius, therefore, may have derived 1440 not from the Haarlem tradition, nor from the Coster pedigree (which gives 1446, and may imply a still earlier date), but from other sources, and hence fixed the commencement of printing at Mainz in 1442 (first mentioned, it seems, in 1499 by Polyd. Vergil, testimony xxiii.). Be this as it may, the Helmasperger instrument of 1455, if it is genuine, shows that Gutenberg could not have begun printing before the end of 1450, if so early, as in that year, about the middle of August, he borrowed money for "making his tools," and was then, moreover, destitute of everything necessary for printing, as parchment, paper, even ink. This year 1450 agrees with the date (1451) written in the Paris *Donatus*, which, on insufficient grounds is considered to be a forgery. It also agrees with Ulr. Zell's statement in the *Cologne Chronicle* that printing and all that belonged to it were "investigated" from 1440 to 1450, and that in the latter year they began to print. And it likewise agrees with the testimonies xxviii., xxx., xxxi., xxxiii., xxxviii. and xl. quoted above, which all come from persons who may be supposed to have known something about the date of early Mainz printing, namely, Johan Schoeffer, the son of Peter Schoeffer, Joh. Trithemius (who was personally acquainted with both Peter and Johan Schoeffer), Joh. Thurmayer Aventinus (who lived from 1474 to 1534), Mariangelo Accorso (who wrote *c.* 1533), while No. xl. is that of Joh. Bergellanus, the first author, so far as we know, who mentioned the lawsuit of 1455, in his *Encomium*, printed and published in the very St Victor Stift of which Gutenberg had been for some years a lay-brother till his death, so that this testimony points to Gutenberg's own version of the "beginning" of Mainz printing.

Therefore the Mainz date 1450, derived from documents and testimonies which cannot be lightly set aside, is much later than the latest date (1446) of the Haarlem claims, and those who accept the Haarlem tradition, as we do, may reasonably conclude that Fust was induced to advance money to Gutenberg about August 1450, not by seeing anything printed by the latter, but by having some of Coster's types and tools, and a type-printed *Donatus*, shown and explained to him.

We are, however, now asked to disregard this date 1450 and all documents that indicate, and have hitherto always been relied on as fixing, the beginning of printing at Mainz in that year, and to believe that the *Astronomical Kalendar*, said to be for 1448, was printed at Mainz in 1447. If this year could be accepted for the printing of this Kalendar, its value would of course be greater than any written or printed statement. It is, however, far from certain, and its assumed date, though not interfering with the Haarlem dates, as it falls after 1446 of the Coster pedigree, is incompatible with the Helmasperger instrument, which shows that so late as August 1450 Gutenberg had not printed anything, and had not even made his apparatus for printing. There remains the Poem on the "Weltgericht," also ascribed to Gutenberg and said to be printed in the same type as the *Donatus* of 1451, with the exception of certain letters the form of which represents, it is thought, a still earlier stage. Hence the Poem is dated back, apparently for no tangible reason, to 1443–1444, and the *Donatus* placed between it and the *Kalendar*, the type of which is said to be a "development" of the *Donatus* type. This date, which is even more speculative than that assigned to the *Kalendar*, militates entirely against the Helmasperger instrument; it can hardly be said to go against the Coster pedigree, while it does not interfere with, but rather favours, Junius' dates.

Among the historic statements also come the two entries of the Abbot of Cambray, on folio 161^{a} of his *Diary*, preserved in the Archives at Lille, in which he records having bought in January (1445, o.s. =) 1446 and in 1451, at Bruges and Valenciennes, printed[2] *Doctrinalia* (on vellum[3] and on paper). Even if printing could be said to have begun at Mainz in 1450 or earlier, no *Doctrinalia* printed there have ever come to light, unless we accept the Haarlem tradition, that those printed with Coster's types were printed there. Hence these entries can only be applied to the *Doctrinalia* printed in Holland in the same types as the *Speculum* (on which Junius based the tradition of the Haarlem invention) and the *Donatuses* which fit into Zell's historic statement (in the *Cologne Chronicle* of 1499), that the *Donatuses* printed in Holland were the models for the Mainz printing. Therefore there is no certainty as to any Mainz printing having been done before 1450, and, if the Helmasperger instrument has any value, it is certain that it could not have begun there before that year; Ulrich Zell unreservedly places the printing done in Holland before that of Mainz; Jean Le Robert's statements make it certain that printing was exercised before January 1446; the Coster pedigree fixes no later date than 1446 for the invention at Haarlem; Junius' years (1440–1442) are, perhaps, his own guess. Anyhow, if historic statements and documents have any value, the invention must have been accomplished within the six years from 1440 to 1446 (also indicated by Zell).

B. *The Costeriana.*—It has been pointed out above that we have nearly 50 Costeriana, for which *seven* types have been employed, four of which cannot be placed later than 1471, the remaining three not later than 1472; and that with these types five folio editions of the *Speculum* were printed, 23 of *Donatus*, 8 of the *Doctrinale*, besides several other important books. With such an abundance of material, for the greatest part of which we have the year 1471–1472 as an undoubted *terminus ad quem*, we need not inquire too anxiously whether Junius placed the invention in 1440, or whether the Haarlem Coster pedigree fixes it at 1446 or earlier. For, by placing intervals either between the seven types or between the several editions of the *Speculum*, *Donatus*, *Doctrinale*, &c., we can easily reach any *terminus a quo* which may be found to agree with the historic statements explained above. Such intervals, however natural and necessary they may be to arrange the Costeriana in some chronological order, must always be more or less arbitrary, as it is impossible to say whether the editions followed each other within two months or within two or more years, or whether the types became used up within six months or within six, seven or more years. Therefore, only such intervals need be suggested as may show that the Costeriana, or some of them, may reasonably be placed before Mainz dates which are certain (that is *c.* 1450, derived from the Helmasperger instrument, and 1454, the date of the Indulgences), or speculative (as 1443–1444 for the "Weltgericht," and 1447 for the *Astronomical Kalendar*). The first products of the art of printing were intended to be faithful imitations of the manuscripts, and no material deviations from the general plan become observable till about 1473–1477. Nowhere are the features of the MSS. of the 15th century so faithfully imitated as in the productions of the three earliest printing-offices of Coster, Gutenberg (?) and Schoeffer. They are all without signatures, without printed initial directors,[1] without printed catchwords; in short, without any of those characteristics which we see gradually, one after the other, come into almost general use when printing becomes more developed, that is from 1473 (if not earlier) to 1480. Hence a comparison of the *Speculum*, *Donatus* and *Doctrinale* editions, printed in the *Speculum* and other types, with the Gutenberg and Schoeffer *Donatuses* and their other books enumerated above, shows that the types, mode of printing and workmanship of all these books stand on nearly the same primitive stage. Yet there is a considerable difference between the productions of the three offices, those of the Haarlem office being more primitive than any of the other two. First of all the types of the Costeriana (which have nothing in common with any of those used in the Netherlands after 1471), show by their *t* with the perpendicular stroke attached to its cross-bar, the *r* with a curl, and the signs of contraction connected by a fine link to the tops of the letters over which they stand, that they were manufactured during the MS. and block-printing periods of Holland. Secondly, none of the Costeriana have any hyphens, which, in the Gutenberg and Schoeffer incunabula appear already from the beginning. Thirdly, the five editions of the *Speculum* are all printed anopisthographically (that is, on one side), the woodcuts at the top of the pages as well as the explanatory text underneath, which would hardly be the case if they had been printed after 1471, when the printing of woodcuts, together with text in movable types, on both sides of the leaf, was no longer a novelty. None of them have any colophon (except such a word as *explicit*), which would, for a collection of nearly 50 books, be incompatible with a period after 1471, but not with the earlier period of the blockbooks and MSS. Moreover, of the 50 no less than 38 are printed on vellum, which is incompatible with a period after 1471 and even earlier, when printing on paper had become universal, but not with the earlier period of the MSS. Therefore, those who wish to date the *Donatuses*, ascribed to Gutenberg, before 1450, or before 1447, must not forget that the more primitive editions of the *Speculum*, *Donatus* and *Doctrinale* printed in types I. and II. &c. can also be dated before 1450 or 1447; and when once so much is admitted, there is no reason to reject Zell's statement that the *Donatuses* printed in Holland served as models to Mainz printing.

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[1] It is pleasant to be able to record some exceptions. Voulliéme and Günther in their *Catalogues* still mention Haarlem.

[2] The abbot speaks of *Doctrinalia* "gette" or "jettez en molle," and the phrase is, as Bernard (*Origine*, i. 97 seq.) shows by eight examples from 1474 (the year when printing is first officially spoken of in France) to 1593, and down to the present day, applied to typographically printed books only; see also Fred. Godefroy, *Dictionaire*, in voce *mole* (which he interprets as *caractère d'imprimerie*, where he gives six quotations showing the same meaning.

[3] The abbot does not mention the word *vellum*, but states that the *Doctrinale* which he had bought at Valenciennes was full of mistakes wherefore he had bought one *on paper*.

In addition to the above considerations, there is the remarkable fact that the chief productions of the three earliest printing-offices are editions of *Donatus*, all printed on vellum. This fact has become more conspicuous by the discovery in recent years, in various parts of Holland and Germany, of a multitude of fragments of different editions of this schoolbook. Of the Haarlem office we know 23 editions; 13 are ascribed to Gutenberg; 9 we have in the Schoeffer or B^42^ type. The production of so many editions, all about the same time in the infancy of printing and in two different places, so widely apart from each other as Haarlem and Mainz, cannot have been an accident or coincidence, but suggests some connexion, some links[2] between the three or more offices that produced them. One link we find in Ulrich Zell's statement that the *Donatuses* printed in Holland were the models for Mainz printing, another in the Haarlem tradition, as narrated by Junius, that one of Coster's workmen, taking his master's types and tools, went with them to Mainz and settled there as a printer. These two statements go far to explain not only how the art of printing was transferred from Haarlem to Mainz, but how, at the latter place, it was thought expedient to continue the printing of *Donatuses* begun at Haarlem. Bearing this obvious connexion between the three earliest offices in mind, and also that the books of the printer of the *Speculum* show that he could not have learnt his art at Mainz or any other place, the only question really is: Can the Costeriana, or some of them, by placing an interval between them, be dated so far back that they may be placed before the certain or speculative dates now attributed to books or broadsides printed at, or ascribed to Mainz. In our former edition, when only 20 Costerian editions of *Donatus* were known, and no earlier final date than 1474, we suggested an interval of 18 months between each of them, giving about 30 years, from 1474 back to 1445, for the issue of all the *Donatuses*. We now know 23 editions, and 1472 as final date for the existence of all the types, though, of course, some of the editions may have appeared after this year. Therefore, our interval need not be longer than about 15 months, which makes a stretch of nearly 29 years from 1472 back to 1443. As to an interval between the types, an eminent type-founder, Dr Ch. Enschedé of Haarlem, when dealing with Coster's types (in his treatise *Laurens Jansz. Coster de uitvinder van de boekdrukkunst*, Haarlem, 1904, p. 28), reminds us of three printers (Eckert van Homberch of Delft, Govaert Bac and Willem Vorsterman, of Antwerp), who used one type all the time that they were printing (which means 23 years for the first and 19 for the second), and declares that we could not possibly put a shorter interval than 6 years between each type. As there are seven Costerian types, such an interval would mean a period of 42 years, from 1472 back to 1430, hence only four and a half years (=31½ years) between each type would suffice to reach the year 1440.

These calculations, however, include the *Abecedarium* (i.), *Valla* (v.), *Pontanus* (vi.) and *Saliceto* (vii.) types, and, as has been pointed out above there is no absolute proof that these four also belonged to the printer of the *Speculum*. Types v., vi., and vii. cannot be separated, and two circumstances, mentioned above, make it more than probable that they did belong to him. But the *Abecedarium* type can be ascribed to the *Speculum* printer on no other grounds than that it has all the characteristics of the Costerian types; that it is too primitive to be attributed to any later Dutch printer, so far as we know them, and that the *Abecedarium* printed with it, was discovered at Haarlem in a Dutch MS. which belonged to a Haarlem family.

Hence a computation based on the five *Speculum* editions (all printed and issued at least before 1471), the 12 editions of *Donatus* and four editions of the *Doctrinale* printed in the same types might be more convincing to the opponents of Haarlem's claims. Apart from the final date (1471) for them there is also evidence that the *Speculum* type 1 existed a considerable time before 1474, as in that year the bookbinder Cornelis used fragments of a *Donatus* printed in that type in the binding of an account book of the cathedral church at Haarlem. Their types and workmanship, moreover, compel us to place them before the *Valla*, *Pontanus* and *Saliceto* (or *Pius*) types. The last two, employed together in one book, cannot have been used for this book before 1458, as it bears the name of Pope Pius II., who was not elected till that year, but it is certain that it cannot have been printed after 1472. The *Valla* type, however, existed before the *Pontanus* and *Saliceto* types, as four capitals of the former were used to supply the want of such capitals in the *Pontanus* type.

If then, as suggested by Enschedé, the type-founder, an interval of six years is placed between the three *Speculum* types, it would mean 18 years, or a period from 1471 back to 1453. A similar number of years we obtain by intervals of 18 months between each of the 12 editions of *Donatus* printed in type 1. Even this moderate calculation makes it plain that the printer of the *Speculum* must have begun printing at least about the same time that printing began at Mainz. But we have seen above that this printer did not hesitate to make up complete copies of his books by mixing sheets of a later edition, printed in a different type, with those of an earlier edition, and even mixed type-printed with xylographically printed sheets. A printer so carefully and economically husbanding his stock of sheets is not likely to have printed new editions of his books before the old ones were fully sold off, or to have manufactured new types till his old ones were used up. Moreover, Haarlem, a quiet provincial town, could not have been a favourable market for a rapid sale of books, especially not for books in the vernacular, like the Dutch versions of the *Speculum*. Hence we should not put too short an interval either between his editions or his types.

As (*e.g.*) Gerard Leeu[3] printed at Gouda, during the six years 1477 to 1482, 17, mostly bulky, volumes, together consisting of 2968 leaves, or nearly 6000 folio pages, all in *one* type, we need not hesitate to place at least eight or nine years between each of the three *Speculum* types, that is together 24 or 27 years from 1471 back to 1447 or 1444. It is true, the types manufactured after, say 1477, may have been more enduring than the earlier types, as being, perhaps, cast of better material and by a more perfect process than those of Coster, but the number of pages printed by the latter with the three *Speculum* types, barely amounts, so far as we know, to a tenth part (600 pages) of Gerard Leeu's work. Our calculations are, of course, liable to modification or alteration; earlier dates may yet be discovered in the Costeriana or in other documents; more editions of *Donatus* in the same types may be found, which would shorten the intervals. But we have shown that, without straining chronology, bibliography or typology, the Costeriana can be dated back so as to harmonize with any historical date, Dutch (1440, 1446) or German (1450), known at the present time, or so as to precede even the speculative dates (1447 or 1444) assigned to some Gutenberg products.

Necessity of an Earlier Printer before Mainz.

There is therefore no reason to discredit Zell's statement in the *Cologne Chronicle* of 1499, that the *Donatuses* printed in Holland were anterior to, and the models for, the art of printing at Mainz, or that of Hadrianus Junius in his *Batavia*, that printing was invented at Haarlem by Lourens Janszoon Coster, and that the *Speculum* was one of his first productions. The two statements were made independently of each other. But even without them, the existence of a group of nearly fifty primitively printed books of undoubtedly Dutch origin, the printing of which must have taken a number of years before 1471, would suggest serious doubts as to the priority of Mainz printing. Zell's statement is all the more weighty, as it is not one made at random but meant to be a direct *contradiction* of the vague rumours and statements about an invention of printing at Mainz by Gutenberg, which had gradually crept into print since 1468 in Italy and France, and had found their way back into Germany about 1476, after Mainz and Germany had given the greatest publicity, during twenty-two years, to the existence of the new art in their midst; while all those who might, and would and could, have told the public that the invention had been made at Mainz, if it had come about there, preserved a profound silence on this particular point, even the supposed inventor himself. And, though Zell accords to Mainz and Gutenberg the honour of having "improved" the art and having made it more artistic, he denies to them the honour of having "invented" or "begun" it, and this latter honour was never claimed by that town before 1476. Junius's account, on the other hand, is the embodiment of a local tradition at Haarlem, the first written traces of which we have in a pedigree (testimony xxxiv) of the family of the reputed Haarlem inventor, which, as regards its central part, may have existed at least as early as 1520, whereas its first part may be dated much earlier. His account is indirectly confirmed by the finding of several fragments at Haarlem, all belonging to the groups of books mentioned above, but still more by the discovery of several fragments of the *Donatuses* printed in the *Speculum* type 1 and 3, some of which had been used as binder's waste by Cornelis, the bookbinder, the very man whom Junius alleges to have been the servant of Coster.

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[1] An exception is to be noticed in the Costerian *Ylada* (see above type VII., no. 14-17) in which on the recto of the second leaf the initial director *i* is printed.

[2] Schwenke has, to some extent, observed this connexion, and suggested that the texts of the *Donatuses* should be studied, as the differences between them might show whether those of Mainz were printed from the Haarlem editions or vice versa. Such a study may be useful, but could hardly lead to a definite result, as the types of these schoolbooks, like those of other incunabula, were imitations of the respective handwritings of the places where they were printed, and the texts were no doubt taken from the same MSS. in the first instance, though it is possible that the types were cast for other books and used afterwards for the *Donatuses*.

[3] These examples might easily be multiplied. Ulr. Zell, for instance, printed more than 80 books in his first type.

As the case stands at present, therefore, we have, after careful and impartial examination, no choice but to repeat that the invention of printing with movable metal types took place at Haarlem between the years 1440 and 1446 by Lourens Janszoon Coster.

That the Haarlem inventor of printing was, as we have shown, a block-printer before he printed with movable types, helps us to understand what the tradition, as chronicled by Junius, says of him (Testimony xliv. *b*): that he, while walking in the wood near Haarlem, cut some letters in the bark of a tree, and with them, reversely impressed one by one on paper, he composed one or two lines as an example for the children of his son-in-law. Junius does not say it, but clearly implies that, in this way, Coster came to the idea of the movability (the first step in the invention of typography) of the characters which, hitherto, he had been cutting together on one block. He perceived the advantage and utility of such insulated characters, and so the invention of printing with movable types was made. The questions as to whether he continued to print with movable "wooden" types, or even printed books with them, cannot be answered, because no such books or fragments of them have come down to us. Junius's words (Test. xliv. § *d*) on this point are ambiguous, and no Dutch edition of the *Speculum* printed, figures and text, from wooden blocks or movable wooden types, is known.

By the middle of the 19th century the claims of Coster and Haarlem had steadily gained ground, owing to the researches of Joh. Enschedé (1751), Meerman (1765), Koning (1815), Young Ottley (1816), Bernard (1853), Sotheby (1858) and others. But in 1870 they were wellnigh destroyed by a criticism which afterwards proved to be partly groundless, partly a distortion of facts. At the time, however, it was, without further research, accepted as decisive; the claims were regarded to be a fiction, and a system of classifying the incunabula started with the unfortunate result that Utrecht came to be adopted as the birthplace of the Costeriana and Coster and Haarlem almost obliterated from all our catalogues. Since then many things have come to light, all tending to confirm Haarlem's claims, and showing how unjustifiably they were attacked in 1870. An examination of the incunabula on which they rest is far from easy or inexpensive, as the books are scattered not only over Europe but now also over America, and therefore not easy of access. We have, however, made it, sufficiently to be able to prove that the claims are based on good grounds. Our evidence, though still circumstantial, is not based on guesses; we assert nothing except on bibliographical or historical grounds; nor do we accept one statement unless it is corroborated by other statements, or by the rules of bibliography and history. Hence we should not accept Zell's evidence or that of Junius, or of any one else, if the books to which they refer did not corroborate them to the fullest extent, or if the claims of Mainz to the honour of the invention could be said to have any substance of fact. The great efforts made in Germany since 1882 to strengthen the case for Gutenberg, which culminated in the celebrations of 1900 and the publication of valuable and learned books, have enriched our knowledge of early Mainz and German printing, but at the same time conclusively shown that it requires great courage to maintain that Gutenberg was the inventor of printing.

How long Coster or his successors continued the first printing-office at Haarlem we cannot say; it seems to have come to an end in or before 1481, as the cuts of the *Speculum* had evidently then passed into John Veldener's hands, and the Haarlem tradition says that wine-pots had been cast of the remains of the types. In 1483 Jacob Bellaert was printing at Haarlem, and Jan Andrieszn in 1485; their types are imitations of the writing of their time, but already differ from those of the *Speculum* and the other Costeriana in various respects, and show many features of a later period. The question as to whether they learnt their craft from the first Haarlem printer, or from other masters, has been asked but not yet answered.

Spread of Typography.—Having explained the early printing of Haarlem and Mainz, in so far as it bears upon the controversy as to where and by whom the art of printing was invented, and shown that the testimony of Ulrich Zell (in the *Cologne Chronicle* of 1499) as to Mainz having learnt the art of printing from Holland through the *Donatuses* printed there, and that of Hadrianus Junius, as to the tradition of its Haarlem origin, are confirmed by bibliographical and historical facts, we can follow its spread from Haarlem to Mainz, and from the latter place to other towns and countries.

1460; Strassburg.—First printers: Johann Mentelin, who completed a Latin Bible in that year, according to a rubrication in a copy at Freiburg in the Breisgau; Adolph Rusch de Inguilen, who is presumed to be the printer of the undated books with a singularly shaped R,[1] *c.* 1464; Henricus Eggestein, 1471; George Husner, &c.

1461; Bamberg.—First printers: Albrecht Pfister, who in 1461 published Boner's *Edelstein*, though it is still doubtful whether he did not print earlier, while he has always been regarded as the printer of B^{36} (see above); Joh. Sensenschmidt, *c.* 1480.

1465; Subiaco.—First and only printers: Conrad Sweynheym and Arnold Pannarts, who completed in that year an edition of Cicero, *De Oratore*, and Lactantius, and removed to Rome in 1467.

1466; Cologne.—Earliest printers: (1) Ulrich Zell, who published in that year Chrysostom, *Super Psalmo quinquagesimo liber primus*, though it is presumed that he printed already in 1463; (2) Arnold Ther Hoernen, 1470; (3) Johannes Koelhoff of Lübeck, 1470, who printed the *Cologne Chronicle* in 1499; (4) Nicolaus Götz, 1474; (5) Goiswinus Gops, 1475; (6) Petrus de Olpe, 1476 (not 1470); (7) Conradus Winter of Homburg, 1476; (8) Joh. Guldenschaaf, 1477; (9) Henricus Quentel, 1479, &c.[2]

1467; Eltville.—First printers: Nicolas and Henry Bechtermuncze and Wygandus Spyes de Orthenberg, who completed in that year a *Vocabularius ex quo*.

1467; Rome.—First printers: Conrad Sweynheym and Arnold Pannarts from Subiaco, who published an edition of Cicero's *Epistolae ad familiares*; Ulrich Hahn or Udalricus Gallus, who issued on the 31st of December 1467 Turrecremata's *Meditationes*.

1468; Augsburg.—First printer: Günther Zainer or Zeyner. Same year at Basel (first printer Berthold Rot of Hanau) and at Marienthal (Brothers of the Common Life).

1469; Venice.—Printers: (1) Johannes of Spires; (2) his brother Vindelinus of Spires; (3) Christopher Valdarfer; (4) Nicolas Jenson, &c.

The further spread of typography is indicated by the following dates: 1470 at Nüremberg (Johan Sensenschmidt, Friedr. Creusner, Anton Koberger, &c.), Berona or Beromünster in Switzerland (Helyas Helye *alias* De Llouffen), Foligno (Emilianus de Orfinis and Johannes Numeister), Trevi (Johann Reynard), Paris (first printers the three partners Ulrich Gering, Michael Friburger, Martin Krantz); 1471 at Spires, Bologna, Ferrara, Florence, Milan, Naples, Pavia, Treviso, Savigliano (Hans Glim?); 1472 at Esslingen, Cremona, Mantua, Padua, Brescia, Parma, Monreale (Mondovi), Fivizzano, Verona, Iesi, St Ursino (?); 1473 at Lauingen, Ulm (perhaps as early as 1469), Merseburg, Alost, Utrecht, Lyons, Messina, Buda-Pest, Santorso; 1474 at Louvain, Genoa, Como, Savona, Turin, Vicenza, Modena, Valencia; 1475 at Lübeck, Breslau, Blaubeuren, Burgdorf, Trent, Cracow (?), Reggio (in Calabria), Cagli,

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[1] M. Philippe, *Origine de l'imprimerie à Paris*, p. 219, mentions two books printed in this type, which contain manuscript notes, to the effect that they were purchased in 1464 and 1467, so that Inguilen is to be placed before Eggestein.

[2] Johann Veldener, who is said to have printed at Cologne, was never established there, but at Louvain (1473–1477), Utrecht (1478–1481), and Culenborg or Kuilenburg (1483–1484); see Holtrop, *Mon. typ.*, pp. 42, 47, 109.

Caselle or Casale, Pieve (Piove) di Sacco, Perugia, Piacenza, Saragossa; 1476 at Rostock, Bruges, Brussels, Angers, Toulouse, Polliano (Pogliano), Pilsen; 1477 at Reichenstein, Deventer, Gouda, Delft, Westminster, Lucca, Ascoli, Bergamo, Tortosa, Palermo, Seville; 1478 at Oxford, St Maartensdijk, Colle, Schussenried (in Würtemberg), Eichstadt, Geneva, Vienne, Trogen (?), Chablis, Cosenza, Prague, Barcelona; 1479 at Erfurt, Würzburg, Nijmegen, Zwolle, Poitiers, Toscolano, Pinerolo, Novi, Lerida, Segorbe, Saluzzo; 1480 at London, St Albans (or in 1479), Oudenarde, Hasselt, Reggio (in Modena), Salamanca, Toledo, Nonantola, Friuli (?), Caen; 1481 at Passau, Leipzig, Magdeburg, Treves, Urach, Casale di San Vaso, Saluzzo, Albi, Antwerp, Rougemont; 1482 at Reutlingen, Memmingen, Metz, Pisa, Aquila, Promentoux, Zamora, Odense, Chartres, Wien, Guadalajara, Munchen, Erfurt; 1483 at Leiden Kuilenburg (Culenborg), Ghent, Chalons-sur-Marne (?), Gerona, Stockholm, Siena, Soncino, Salins; 1484 at Bois-le-Duc, Eichstatt, Novi, Sangermano, Chambéry, Udine, Winterberg, Klosterneuburg, Rennes, Loudéac, Tarragona; 1485 at Heidelberg, Ratisbon, Pescia, Vercelli, Tréguier or Lantreguet, Brünn, Salins, Burgos, Mallorca, Hijar, Palma, Xeres; 1486 at Münster, Stuttgart, Chiavasco, Voghera, Casal Maggiore, Abbeville, Schleswig, Toledo; 1487 at Ingolstadt, Gaeta, Rouen, Murcia, Besançon; 1488 at Stendal, Viterbo, Gradisca, Faro, Constantinople, Lantenac; 1489 at Hagenau, Kuttenberg, San Cucufat (near Barcelona), Portesio, Coria, Pamplona, Tolosa, Lisbon, 1490 at Embrun, Orleans, Grenoble, Döle; 1491 at Hamburg, Kirchheim, Norzano, Goupillières, Angoulême, Dijon, Narbonne; 1492 at Marienburg, Cluni, Zinna, Valladolid, Leiria; 1493 at Lüneburg, Freiburg (in Breisgau), Urbino, Cagliari, Lausanne, Nantes, Copenhagen, Ricka; 1494 at Oppenheim, Tours, Mâcon, Monterey, Braga, 1495 at Freisingen, Freiberg (near Leipzig), Scandiano, Forli, Limoges, Schoonhoven (monastery Den Hem), Pamplona, Wadstena, Cettinje; 1496 at Offenburg, Provins, Barco, Valence, Granada, 1497 at Carmagnola, Avignon; 1498 at Tubingen, Périgueux, Schiedam, Gripsholm; 1499 at Danzig, Olmütz, Montserrat, Madrid; 1500 at Pforzheim, Sursee, Perpignan, Valenciennes, Jaen.

Printing seems to have begun in Scotland after September 1507, when King James IV. granted a patent to Walter Chepman and Andrew Myllar (also printed Millar) for the establishment of a printing press at Edinburgh Their first book (*The Maying or disport of Chaucer*) appeared on the 4th of April 1508. Myllar, however, appeared to have been established there as a bookseller already in 1503 and to have published there his first book, Joh. de Garlandia *Interpr vocabulorum equivocorum* (printed for him abroad) in 1505, his second *Expositio Sequentiarum* (also printed abroad) in 1506. (See Rob. Dickson and John Ph. Edmond, *Annals of Scottish Printing from 1507 to the 17th century*, Cambridge, 1890; Harry G. Aldis, *List of Books printed in Scotland before 1700*, Edinburgh 1904). Printing was introduced into Ireland at Dublin in 1551 by Humfrey Powell, who published in that year a verbal reprint of Whitchurch's edition of the Common Prayerbook of 1549. Printing in *Irish types* was brought into the kingdom in 1571 by N. Walsh and John Kearney, the first book printed in that type being *A Catechism*, written by Kearney.

Above we have stated that printing was established at Avignon in the year 1497. But during the last two decades various treatises have been published endeavouring to show that printing had already been exercised there more than half a century earlier.

Question of Date at Avignon.

In 1890 the Abbat Requin discovered at Avignon, in three notarial registers, five Latin notarial Protocols of the years 1444 and 1446, which, though they mention only the arts of "writing artistically," and painting different colours on stuffs, he and others interpreted as showing that, during those years, certain artisans had exercised the art of printing with movable types at Avignon; so that, if the art was not invented there, one of those artisans must have learnt the secret from Gutenberg, said to have been engaged in printing at Strassburg from 1436 to 1439. And hence Avignon, hitherto regarded as the 60th town where printing was introduced, was to take the second place, if not the first, in the history of the invention of printing, between Strassburg and Mainz (Requin, *L'Imprimerie à Avignon en* 1444, Paris, 1890; id., *Origines de l'imprimerie en France, Avignon*, 1444, Paris, 1891).

From Requin's first document (dated July 4, 1444) it appears that a silversmith, Procopius Waldfoghel, of Prague, residing at Avignon, had received from a magister Manaudus (also called Menaldus Vitalis, born at Dax, in the Département des Landes, *baccalaureus in decretis*, and student at Avignon) two alphabets of steel, two iron forms (frames?), one steel screw, 48 forms of tin, and divers other forms belonging to the art of *writing* (*duo abecedaria calibis et duas formas ferreas, unum instrumentum calibis vocatum vitis, quadraginta octo formas stangni necnon diversas alias formas ad artem* scribendi *pertinentes*), and promised to return these instruments (*ad usum* scribendi *pertinencia*) the moment Manaudus asked for them. The second document (dated August 27, 1444) makes no mention of tools or instruments, but is Procopius's bond for two sums of money (10 to 27 florins) which he had borrowed from Georgius de la Jardina, for the first he promised to instruct the said George in the art of *writing* well and seemly, and to do the necessary and suitable things for one month (*pro quibus promisit instruere dictum Georgium in arte* scribendi *bene et condecenter, et administrare necessaria et opportuna, hinc ad unum mensem*), on condition that neither of them should instruct anyone else in the said art of *writing*, without the consent of the other (*fuit tamen de pacto quod nullus non debeat instruere aliquem in dicta arte* scribendi, *nisi de licentia alterius*). The third document (March 10, 1446) is an agreement between Procopius and a Jew of Avignon named Davinus de Codarossia, who had advanced money to him and held property from him as security. The Jew had promised to teach Procopius to paint stuffs in different colours, and the latter had promised the Jew to make for him and to deliver to him "twenty-seven prepared Hebrew letters, well and properly cut in iron according to the science and practice of *writing*, which, two years ago, the said Procopius had shown and taught the Jew, together with instruments of wood, tin and iron (*Procopius promisit . . . judeo facere et factas reddere et restituere viginti septem litteras ebreaycas formatas, scisas in ferro bene et debite juxta scientiam et practicam* scribendi, *sunt duo anni elapsi ipsi judeo per dictum Procopium ostensam et doctam, ut dixit, una cum ingeniis de fuste, de stagno et de ferro*). It was also agreed that the Jew should pay for the tin and wood for the instruments of the Hebrew writing (*fuit de pacto quod idem judeus solvet stagnum et fustes artificiorum sive ingeniorum scripture ebrayce*). And Procopius further promised to give the Jew, the following week, ten florins to recover certain pledges or utensils which the Jew had in pawn from him, the latter binding himself not to reveal the science or teach the art to any one as long as Procopius should remain at Avignon or in the neighbourhood (*promisit eidem judeo dare decem florenos per totam hebdomadam proxime futuram et restituere sibi certa pignora sive ustensilia que ipse judeus habet in pignora a dicto Procopio*) The fourth document (April 5, 1446) shows that Procopius had made for the above-named Menaldus Vitalis and Arnaldus de Coselhaco (and Girardus Ferrosis?) and delivered to them several instruments or tools of iron, steel, copper, latten, lead, tin and wood for writing artistically; he had instructed them in the said art of *writing* artistically, and all the tools belonged to them in common. But Menaldus, wishing to sell his share in the said tools to the others and to retire from the association, twelve florins were paid to him in two instalments, but at the request of Procopius he testifies under oath that the said art of writing, taught him artistically by the said Procopius, was real and most proper, and also easy, practicable and useful to any one wishing and choosing to work it (*Cum dictus Procopius super* arte scribendi artificialiter *fecerit venerabilibus viris . . . Menaldo Vitalis et Arnaldo de Coselhaco . . . nonnulla instrumenta sive artificia causa* artificialiter scribendi *tam ferro de callibe, de cupro, de lethono, de plumbo, de stagno, et de fuste . . . dictamque artem scribendi artificialiter eos docuerit, instrumentaque ipsa omnia et singula sint . . . communia inter eosdem studentes . . . Cumque dictus . . . Vitalis cupiat . . . partem suam dictorum instrumentorum sive artificiorum . . . vendere et a communione eorum recedere . . . vendidit dicto Procopio et Girardo presentibus . . . partem suam . . . precio duodecim florenorum . . . Ibidem Vitalis . . . medio suo juramento . . . dixit . . . dictam artem scribendi per dictum Procopium artificialiter eidem doctam, esse veram et verissimam, esseque facilem, possibilem et utilem laborare volenti et diligenti eam*). The fifth document (April 26, 1446) shows that Procopius had recovered from Davinus all the pledges which he had pawned with him, except one mantle and 48 letters engraved in iron, that Davinus had not yet carried out his part of the agreement as to teaching Procopius the painting of different colours on stuffs, whereas Procopius had delivered to the Jew all the arts, tools and instruments pertaining to writing artistically in Latin letters, as he had promised to do on the 10th of March last. (*Procopius confessus fuit se ab eodem judeo recepisse . . . omnia pignora sua per eum penes dictum judeum impignorata, excepto uno mantello et quadraginta octo litteris gravatis in ferro. Et . . . dictus judeus confessus fuit . . . recepisse a dicto Procopio . . . omnia artificia, ingenia et instrumenta ad scribendum artificialiter in litera latina*, &c.) Again the compact is that Davinus shall not reveal the science to anyone, at least so long as Procopius should reside at Avignon or within 30 m. in the neighbourhood. (*nemini mundi dicere, notificare nec quovismodo revelare, per se nec per alium ullomodo, presentem scientiam in teorica nec pratica, et nulli mundi eam docere neque revelare eam fuisse ostensam per quemvis*).

It is difficult to find the art of printing with movable types, or the art of casting types in these documents. The Abbat, however, says they prove the establishment of a printing-office at Avignon in 1444, and he reads "*matrices*," "*caractères d'imprimerie*," *une* "*imprimerie*," and "*tout un matériel d'imprimerie*" in them, although the documents themselves do not mention such things; they only allude to the "art of *writing*," the "practice" or "exercise of *writing*", the "art of *writing* well and seemly"; the "science and practice of *writing*"; the "art of *writing* artistically." And there is, apparently, no reason to think that these precise documents, while speaking exclusively of this art, should always mean another art which they do not mention. Procopius, indeed, seemed to have known an art of *writing*, in which he instructed others (second document) and which he and his associates wished to keep secret, while the "letters," tools, &c of which they speak were no doubt "movable."

But Procopius himself appears to have possessed neither letters nor tools nor instruments or forms at the beginning of these proceedings, it was Menaldus Vitalis, a bachelor of law and student at Avignon, who entrusted to him the "two steel alphabets, two iron forms, one steel screw, and forty-eight tin and other forms," mentioned in the first document of 1444. Procopius, however, appears to have seen no permanent value in these letters, forms, &c. as he, of his own accord, promised to return them at the first request of Menaldus, who had handed them to Procopius without asking for a receipt. The third document, however, makes it plain that Procopius engraved for Davinus the Jew, not for himself, twenty-seven Hebrew letters (therefore a complete alphabet, including the five final letters) in iron, in accordance with the art of writing which he had taught Davinus two years ago, together with tools of wood, tin and iron, in return for which the Jew would teach Procopius the art of painting stuffs. The fourth document shows that Procopius had made tools of iron, steel and other metals for *writing* artistically, but again not for himself but for two other men one of whom was Menaldus who, two years ago, had entrusted him with two alphabets and some tools; Procopius, however, had this time reserved to himself a share in these tools, and Menaldus sold his share in the tools for twelve florins to the other associates, so that the value of all these tools cannot have amounted to more than about 36 florins of Avignon currency.

Therefore, the precise descriptions in the documents of the letters, tools and instruments required for Procopius's art of *writing* artistically, and the absence of all allusions to paper, ink and other things necessary for *printing* with movable types, show that there is no reference to this art, even in its infancy. That art means the multiplication of books or documents by means of an adequate quantity of single types for composing a whole page of text, and capable of being taken asunder and used again for a second, a third and a multitude of other pages, and so produce a number of copies of a book in the same or a shorter time than a scribe with his pen could produce one copy. But two Latin alphabets (of steel) and one Hebrew alphabet (of iron) would not suffice for composing and printing more than two or three words on any one page at a time, so that a person with such a small quantity of letters at his command would, in several respects, be worse off than a scribe. Hence the documents which only refer to the art of writing, mean nothing more serious than an art of taking impressions of certain letters (perhaps initials or capitals) in a more regular and steady fashion than even trained scribes could produce them by hand. For pressing in such (ornamental) initials or capitals here and there in MSS., after the scribes had done their ordinary work of writing, the insulated alphabets of Menaldus and Davinus would be a great help and save a deal of time and labour, but useless for the art of printing with movable types. If the two steel alphabets, and the one Hebrew alphabet of iron, and the 48 letters engraved in iron had been *patrices*, and the 48 forms of tin had been *matrices*, the documents, no doubt, would contain some expressions to show this, in spite of the endeavour not to divulge this art of writing. What the nature of this writing was, and why all these forms and instruments, even a screw, were required, we cannot say. It has been pointed out that the art of *printing* was also described as an art of *writing*, which is true; but when it is so described we learn at the same time that typography is meant. But we must bear in mind that Davinus the Jew was engaged on the painting of colours on stuffs and that Procopius desired to become acquainted with this industry. No doubt tools were much more required for this work than for writing. However, this writing association seems to have come to an end in 1446, and the parties departed from Avignon, without leaving there or anywhere else any trace of themselves and their interesting operations. See also Zedler, *Gutenberg-Forsch.*, p. 10 sqq.

As for non-European countries and towns, printing was established in Mexico in 1544, at Goa about 1550, at Tranquebar in 1569, Terceira in the Azores 1583, Lima 1585, Manila and Macao (China) 1590, in Haiti in the beginning of the 17th century, at Puebla in 1612, Cambridge (Mass.) 1638, Batavia 1668, Tiflis 1701, German-town 1735, Ceylon 1737, Halifax (Nova Scotia) 1766, Madras 1772, Calcutta 1778, Buenos Aires 1789, Bombay 1702, in Egypt (at Alexandria, Cairo, and Gizeh) in 1708, at Sydney 1802, Cape Town 1806, Montevideo 1807, Sarepta 1808, Valparaiso 1810, Astrakhan 1815, in Sumatra and at Hobart Town and Santiago (in Chile) in 1818, in Persia (at Teheran) in 1820, and at Chios about 1821.[1]

Customs of Early Printers.

Till the moment (say 1477) that printing was practised in almost all the chief towns of the Netherlands, Germany, Italy, Switzerland, France, Spain, England, not a single printer carried away with him a set of types or a set of punches or moulds from the master who had taught him, but, in setting up his printing office, each man cast a set of types for his own use, always imitating as closely as possible the handwriting indigenous to his locality, or of some particular manuscript which he or his patron desired to publish. When we compare Schoeffer's 30-line Indulgence of 1454 with a manuscript copy of the same Indulgence dated the 10th of April 1454, now in the hands of a private collector at Wiesbaden, we see that the types used in printing that document were specially cast for the purpose after the model of the handwriting employed for the written copies. We know also that the types of the 36-line and 42-line Bibles and those of the Psalter of 1457 are the closest possible imitations of the ornamental church handwriting customary at the time of their production. Also, when we compare the 31-line Indulgence of 1454 with the German blockbook called the *Enndickrist*, and both in their turn with the German MSS. of that period (especially the manuscript portions in the printed copies of the Indulgences), we see that the cutter of the text type of the Indulgence, as well as the engraver of the blockbook, formed his characters according to some German handwriting (book hand) of the period. This imitation extended, not only to the shape of the individual letters of the alphabet, but likewise to all those combinations of letters (double *p*, double *f*, double *s*, *st*, *ts*, *tu*, *re*, *cu*, *cl*, *ss*, *de*, *co*, *ci*, *le*, *ce*, *or*, *ve*, *po*, *fa*, *he*, *be*, &c.) and contractions (for *pro*, *-um*, *-em*, *-en*, *the-*, *uer*, *-bus*, *-bis*, *sed*, *am*, *tur*, *qui*, *quae*, *quod*, *secundum*, &c.) which were then, and had been for many centuries, in use by scribes. In most, if not all cases, the MSS. which the printers imitated were, as has been remarked above, indigenous to the place where they settled. Thus the first printers of Subiaco, though they were Germans and had most probably learnt the art of casting types and printing at Mainz, yet cut their types after the model of some Italian MS. which was free from any Gothic influence, but written in a pure Caroline minuscule hand, differing but slightly from the Caroline minuscules which the same printers adopted two years afterwards at Rome. The first Paris printers started in 1470 with a type cast entirely on the model of the Caroline minuscule handwriting then in vogue at Paris. John de Westphalia, who introduced printing into Belgium, used from the beginning a type which he calls Venetian. Therefore a great similarity (without absolute identity) between the types of two printers (*e.g.* Schoeffer and Ulr. Zell), should be attributed to the similarity of the handwritings which the printers followed, not to any attempt on their part to imitate each other's types. To this universal system (clearly discernible in the first twenty-five years of printing) of each printer setting up business with a new type cast by himself, there would be, according to the conjectures of some bibliographers, only two exceptions; one is Albrecht Pfister (see above); the other is the Bechtermunczes of Eltville (see above).[2]

Unevenness of Lines.

Another important feature in the earliest books is that the printers imitated, not only the handwriting, with all its contractions, combined letters, &c., but all the other peculiarities of the MSS. they copied. There is in the first place the unevenness of the lines, which often serves as a guide to the approximate date of an early printed book, especially when we deal with the works of the same printer, since each commenced with uneven lines, and gradually made them less uneven, and finally even. The unevenness was unavoidable in manuscripts as well as in blockbooks; but in the earliest printed books it is regarded as evidence of the inability of the printers to space out their lines. If this theory be correct, this inability was perhaps owing to the types being perforated and connected with each other by a thread, or to some other cause which has not yet been clearly ascertained. In some incunabula we find some pages with uneven lines, and others quite straight in the same book. It is not impossible, however, that the unevenness was simply part and parcel of the system of imitating MSS., and that only gradually about 1473 or 1474, but in some cases later) printers began to see that even lines looked better than uneven. This seems clear when we observe that the imitation of MSS. was carried so far that sometimes things which deviated from the work of the scribe, but had accidentally been printed in, were afterwards erased and altered in conformity with the MS. The Paris Library, for instance, possesses two copies of the *Liber Epistolarum* of Gasparinus Pergamensis (printed at Paris in 1470), in both of which the initial G of the first line and the initial M of the fourth line were printed in, and, whilst they have been allowed to remain in one of the copies, in the other they were regarded as a fault and replaced by a rubricated L and M.

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[1] On the introduction of printing in various towns, consult Henry Cotton, *A Typog. Gazet.*, 8vo, Oxford, 1831 and (second series, 8vo, Oxford, 1866); (P. Deschamps) *Dict. de géogr. à l'usage du libraire*, (8vo, Paris, 1870); R. C. Hawkins, *Titles of the First Books from the Earliest Presses Established in Different Cities in Europe*, (4to, New York, 1884); Rob. Proctor, *Early Printed Books in the British Museum*, (1898), &c.

[2] In recent years Dr Dziatzko, overlooking the relation between MSS. and typography in its infancy, has attempted to show that the types of the 36-line Bible were imitations of those of the 42-line Bible.

Initials.

Hyphens.

In the second place the initials of books or the chapters of books in MSS., and again in blockbooks and the earliest products of printing, were always, or at least in most cases (they are printed in the Indulgences of 1454), omitted by the scribe and the printer and afterwards filled in by the rubricator. As the latter artists were sometimes illiterate and very often filled up the gap by a wrong initial, we find in many MSS. as well as early printed books small letters written either in the margin or in the blank left for the initial, to guide the rubricator. In most cases where these letters (now called initial directors) were written in the margin, they were placed as much as possible on the edges of the pages in order that they might be cut away by the binder as unsightly; but in many incunabula they have remained till the present day.[1] Later on these initial directors were in many books printed in (in lower-case type) with the text. In all cases, whether written or printed, they were meant to be covered by the illuminated initial; but, as a matter of fact, the latter very seldom covers the initial director so completely as to make it invisible, and in various cases the intended illumination was never carried into effect. With respect to the hyphens, which were used in the 1454 Indulgences and the 36-line and 42-line Bibles, always outside the printed margin, some of the earliest printers did not employ them at the moment that they started their presses, and in the case of some printers the non-use or use of hyphens, and their position outside or inside the printed margin, serve as a guide to the dating of their products. After about 1472 they become more uniform in their shape and more generally used.

Signatures.

The use of signatures was confined in MSS. mostly to mark the quires (with a numeral or a letter of the alphabet), sometimes also the leaves; in many cases they were written close to the bottom of the leaf, so that they might be cut off by the binder, which has happened in many cases, wholly or in part, as may be seen in many MSS.; in blockbooks they are usually printed with the picture on each sheet or page; they are not printed in incunabula close to the bottom line of the page before 1472 (at least in no earlier book with a date), when they appear in Joh. Nider's *Praeceptorium Divinae Legis*, published by Johan Koelhoff at Cologne. Caxton did not adopt them till 1480. In the books printed before 1472 they were written by the rubricator or the binder, in the same way as in the MSS.

Catchwords.

Catchwords (custodes) were used for the first time about 1469 by Johannes of Spires, at Venice, in the first edition of Tacitus.

Pagination.

Pagination or rather foliation was first used by Arn. Ther Hoernen, at Cologne in 1471, in Adrianus's *Liber de remediis fortuitorum casuum*, having each leaf (not page) numbered by figures placed in the end of the line on the middle of each right-hand page.

Slowness of Progress at First.

The practice among early printers of imitating and reproducing MSS. was not abandoned till many years after the first dated document (1454) made its appearance; and, looking at the books printed, say from 1454 to 1477, from our present standpoint, the printing of that period may be said to have been almost wholly stagnant, without any improvement or modification. If some printers (for instance, Sweynheym and Pannartz at Subiaco and Rome, and Nicolas Jenson at Venice) produced handsomer books than others, this is to be attributed to the beauty of the MSS. imitated and the paper used rather than to any superior skill. Generally speaking, therefore, we shall not be far wrong in saying that the workmanship of Ketelaer and De Leempt's first book, published at Utrecht c. 1473, and that of Caxton's first book issued at Westminster in 1477, exhibit almost the same stage of the art of printing as the 1454 Indulgences. If, therefore, any evidence were found that Ketelaer and De Leempt and Caxton had really printed their first books in 1454, there would hardly be anything in the workmanship of these books to prevent us from placing them in that year. And conversely, if the Indulgences of 1454 had been issued without a date or without any names to indicate their approximate date, their workmanship might induce bibliographers to ascribe them to c. 1470, if not somewhat later. Even after 1477 alterations in the mode of printing books came about slowly and almost imperceptibly. It was no longer a universal system for printers to begin business by casting a type for themselves, but some received their types from one of their colleagues. And, though there were still many varieties of types, one sort began to make its appearance in two or three different places. The combinations of letters were the first to disappear, but the contractions remain in a good many books even of the 17th century.

Some theories have been based on, and others have been considered to be upset by, the supposition that the early printers always required as much type as printers of the present day, or at any rate so much as would enable them to set up, not only a whole quire of 4 or 5 sheets (=8 or 10 leaves=16 or 20 pages), but even two quires (=40 pages). Consequently calculations have been made that, for instance, the printer of the 42-line Bible required a fount of at least 120,000 characters. See Bernard, *Orig. de l'impr.* i. 164, who was a printer himself and speaks very strongly on this point. But there are numerous proofs that many early books were printed page by page, even when in small 4to. For instance, in some books it has been observed that portions of the types with which the text of the first, second or third pages of a quire had been printed, were used to "lock up" the types employed for the later pages of the same quire, as is evident from the blank impressions of such portions being found on these later pages. Again, in some small books, two, three or four blank leaves are found at the end, showing a miscalculation of the printer at the commencement. Moreover, numerous itinerant printers of the 15th century established a press for a short time wherever they went, which proves that the furniture of the earliest printing-offices cannot have been of any great extent.

Early Types and their Fabrication.—We must now take notice of two theories or traditions which have been current for a long time as to some intervening stage between the art of block-printing and the art of printing with movable cast metal types.[2] One theory or tradition would have it that the inventor of printing, after the idea of single, individual, movable types had arisen in his mind, practised his new invention for some time with wooden types, and that he came only gradually to the idea of movable types cast of metal.

Wooden Types.

Junius gives us to understand that the Dutch *Speculum* was printed with such wooden types. Of Johann Gutenberg it was asserted that he printed his first Bible with wooden types. The Mainz psalter, printed in 1457 by Joh. Fust and Peter Schoeffer, was alleged to have been printed with wooden types, in which case the 4th edition, published in 1502, and even the 5th edition of 1516, would be printed with wooden types, the same being used for them as for the editions of 1457 and 1459. Theod. Bibliander was the first to speak (in 1548) of such types and to describe them: first they cut their letters, he says, on wood blocks the size of an entire page; but, because the labour and cost of that way was so great, they devised movable wooden types, perforated and joined one to the other by a thread.[3] Bibliander does not say that he had ever seen such types himself, but Dan. Speckle or Specklin (d. 1589), who ascribed the invention to Mentelin, asserts that he saw some of these wooden types at Strassburg.[4] Angelo Roccha asserted in 1591 that he had seen at Venice types perforated and joined one to the other by a thread, but he does not say whether they were of wood or of metal.[5] In 1710 Paulus Pater asserted that he had seen wooden types made of the trunk of a box-tree, and perforated in the centre to enable them to be joined together by a thread, originating from the office of Fust at Mainz.[6] Bodman, as late as 1781, saw the same types in a worm-eaten condition at Mainz; and Fischer stated in 1802 that these relics were used as a sort of token of honour to be bestowed on worthy apprentices on the occasion of their finishing their term.

Besides those who believed in these wooden types from the fact that the letters (especially in the *Speculum*) vary among themselves in a manner which would not be the case had they been cast from a matrix in a mould, there were authors and practical printers who attempted to cut themselves, or to have cut for them, some such wooden types as were alleged to have been used by the early printers. Some of them came to the conclusion that such a process would be quite practicable; others found by experiment that it would, in the case of small types, be wholly impossible. Nearly all the experiments, however, were made with the idea that the inventor of printing, or the earliest printers, started, or had to start, with as large a supply of type as a modern printer. This idea is erroneous, as it is known that, for a good many years after the first appearance of the art, printers printed their books (large or small) not by quires (quaternions or quinternions) but page by page.[7] Therefore, all considerations of the experimenters as to the impracticability of such wooden types, on account of the trouble and length of time required for the cutting of thousands of types, fall to the ground in face of the fact that the earliest printers required only a very small quantity of type, in spite of the peculiar forms (combined letters, letters with contractions, &c.) which were then in vogue. Up to the present time no book or document has come to light which can be asserted to have been printed from single, movable, wooden types. But we have seen above that the Haarlem tradition, as told by Junius, distinctly points to such types having been used for, among other things, the first edition of the Dutch Spiegel, and no one examining this edition (of which two copies are preserved at Haarlem) would deny that there are grounds for this belief; the dancing condition of the lines and letters making it almost impossible to think that they are metal types. For how long and to what extent such types were employed, if at all, we cannot say.

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[1] The university library of Basel possesses a collection of the earliest Paris books still bound in their original binding, in which these initial directors are written not only on the outer edges, but on the inner sides of the pages, and so close to the back that they can only be seen by stretching the books wide open.

[2] We do not allude to Tritheim's assertion that the *Catholicon* of 1460 was printed from wooden blocks; for this story, which he declares he had heard from Peter Schoeffer, if it were true, would belong to the history of block-printing. Nor need we speak of Bergellanus's verses (1541), in which he distinctly alludes to carved blocks.

[3] *Commentatio de ratione communi omnium linguarum et literarum*, p. 80 (Zurich, 1548).

[4] *Chron. Argent.* MS. ed. Jo. Schilterus, p. 442.

[5] *De Bibliotheca Vaticana*, p. 412 (Rome, 1591).

[6] *De Germaniae miraculo*, p. 10 (Leipzig, 1710).

[7] See, for instance, W. Blades, *Life of Caxton*, i. 39.

Sculpto-fusi Types.

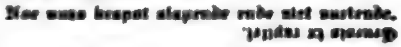
The other theory would have it that between block-printing and printing with movable cast types there was an intermediate stage of printing with "sculpto-fusi" types, that is, types of which the shanks had been cast in a quadrilateral mould, and the "faces," *i.e.* the characters or letters engraved by hand afterwards. This theory was suggested by some who could not believe in wooden types and yet wished to account for the marked irregularities in the types of the earliest printed books.

Gerardus Meerman, the chief champion of this theory, based it, not only on the words of Celtes (*Amores*, iii. 3), who in 1502 described Mainz as the city "quae prima sculpsit solidos aere characteres," but on the frequent recurrence of the word *sculptus* in the colophons of the early printers (for Jenson and Husner of Strassburg, see p. 514 above). Sensenschmid in 1475 said that the *Codex Justinianus* was "cut" (*insculptus*), and that he had "cut" (*sculpsit*) the work of Lombardus, *In Psalterium*. Meerman also interpreted the account of the invention of printing by Trithemius[1] as meaning that, after the rejection of the first wooden types, the inventors discovered a method of casting the bodies only of all the letters of the Latin alphabet from what they called matrices, on which they cut the face of each letter; and from the same kind of matrices a method was in time discovered of casting the complete letters of sufficient hardness for the pressure they had to bear, which letters they were before—that is, when the bodies only were cast—obliged to cut.[2] In this way Meerman explained that the *Speculum* was printed in sculpto-fusi types, although in the one page of which he gives a facsimile there are nearly 1700 separate types, of which 250 alone are e's. Schoepflin claimed the same invention for Strassburg, and believed that all the earliest books printed there were produced by this means. Meerman and Schoepflin agreed that engraved metal types (*literae in aere sculptae*) were in use for many years after the invention of the punch and matrix, mentioning among others so printed the Mainz psalter, the *Catholicon* of 1460, the Eggestein *Bible* of 1468, and even the *Praeceptorium* of Nider, printed at Strassburg in 1476. But the difficulty connected with the process of first casting the shanks and afterwards engraving the faces of the types has become apparent to those who have made experiments; and it seems more probable that the terms *sculpere*, *exsculpere*, *insculpere*, are only a figurative allusion to the first process towards producing the types, namely, the cutting of the punch, which is artistically more important to the fabrication of types than the mechanical casting—all the more as Schoeffer in 1468 makes his *Grammatica vetus rhythmica* say, "I am cast at Mainz," an expression which could hardly be anything but a figurative allusion to the casting of the types.

Types Cast in Sand.

Granting that all the earlier works of typography preserved to us are impressions of cast-metal types, there are still differences of opinion, especially among practical printers and type-founders, as to the probable methods employed to cast them. It is considered unlikely that the inventor of printing passed all at once to the perfect typography of the punch, the matrix and the mould. Bernard[3] thought that the types of the *Speculum* were cast in sand, as that art was certainly known to the silversmiths and trinket-makers of the 15th century; and he accounts for the varieties observable in the shapes of various letters on the ground that several models would probably be made of each letter, and that the types, when cast by this imperfect mode, would require some touching up or finishing by hand. He exhibits a specimen of a word cast for him by this process which not only proves the possibility of casting types in this manner, but also shows the same kind of irregularities as those observable in the types of the *Speculum*.

But here again it is argued that in types cast by this or any other primitive method there would be an absence of uniformity in what founders term "height to paper." Some types would stand higher than others, and the low ones, unless raised, would miss the ink and not appear in the impression. The comparative rarity of faults of this kind in the *Speculum* leads one to suppose that, if a process of sand-casting had been adopted, the difficulty of uneven heights had been surmounted either by locking up the forme face downwards, or by perforating the types, either at the time of casting or afterwards, and holding them in their places by means of a thread or wire. To this cause Ottley attributed the numerous misprints in the *Speculum*, to correct which would have involved the unthreading of every line in which an error occurred. And, as a still more striking proof that the lines were put into the forme one by one, in a piece, he shows a printer's blunder at the end of page 42 in the unmixed Dutch edition, where the whole of the last reference-line is put in upside down, thus:—



A "turn" of this magnitude could hardly have occurred if the letters had been set in the forme type by type.

A second suggested mode is that of casting in clay moulds, by a method very similar to that used in the sand process, and resulting in similar peculiarities and variations in the types.

Types Cast in Clay Moulds.

Ottley, who was the chief exponent of this theory, suggested that the types were made by pouring melted lead or other soft metal into moulds of earth or plaster, after the ordinary manner used from time immemorial in casting statues of bronze and other articles of metal. But the mould thus formed could hardly avail for a second casting, as it would be scarcely possible to extract the type after casting without breaking the clay, and, even if that could be done, the shrinking of the metal in cooling would be apt to warp the mould beyond the possibility of further use. Ottley therefore suggests that the constant renewal of the moulds could be effected by using old types cast out of them, after being touched up by the graver, as models—a process which he thinks will account for the varieties observable in the different letters, but which would really cause such a gradual deterioration and attenuation in the type, as the work of casting progressed, that in the end it would leave the face of the letter unrecognizable as that with which it began. It would, therefore, be more reasonable to suppose that one set of models would be used for the preparation of all the moulds necessary for the casting of a sufficient number of types to compose a page, and for the periodical renewal of the moulds all through the work, and that the variations in the types would be due, not to the gradual paring of the faces of the models, but to the different skill and exactness with which the successive moulds would be taken.

It is evident that the sand and clay methods of casting types above described would be slow. The time occupied after the first engraving of the models in forming, drying and clearing the moulds, in casting, extracting, touching up and possibly perforating the types required for one page, would exceed the time required by a practised xylographer for the cutting of a page of text upon a block. But he that has gone through the trouble of casting separate movable types has a clear gain over the wood-block printer in having a fount of movable types, which, even if the metal in which they were cast were only soft lead or pewter, might be used again and again in the production of any other page of text, while the wood block can only produce the one page which it contains. Moreover, only one hand could labour on the xylographic block; but many hands could be employed in the moulding and casting of types, however rude they might be. Bernard states that the artist who produced for him the few sand-cast types shown in his work assured him that a workman could easily produce a thousand such letters a day. He also states that, though each letter required squaring after casting, there was no need to touch up the faces.

Polytype.

A third suggestion was made as to the method in which the types of the rude school may have been produced. This may be described as a system of what the founders of about 1800 called polytype, which is a cast or facsimile copy of an engraved block, matter in type, &c.

Lambinet,[4] who is responsible for the suggestion, based upon a new translation of Trithemius's narrative, explains that this process really means an early adoption of stereotype. He thinks that the first printers may have discovered a way of moulding a page of some work—an *Abecedarium*—in cooling metal, so as to get a matrix-plate impression of the whole page. Upon this matrix they would pour a liquid metal, and by the aid of a roller or cylinder press the fused matter evenly, so as to make it penetrate into all the hollows and corners of the letters. This tablet of tin or lead, being easily lifted and detached from the matrix, would then appear as a surface of metal in which the letters of the alphabet stood out reversed and in relief. These letters could easily be detached and rendered mobile by a knife or other sharp instrument, and the operation could be repeated a hundred times a day. The metal faces so produced would be fixed on wooden shanks, type high, and the fount would then be complete. Lambinet's hypothesis was endorsed by Firmin-Didot, the renowned type-founder and printer of Lambinet's day. But it is impossible to suppose that the Mainz psalter of 1457, which these writers point to as a specimen of this mode of execution, is the impression, not of type at all, but of a collection of "casts" mounted on wood

Yet another theory has been proposed by Dr Ch. Enschedé, head of the celebrated type foundry of the same name at Haarlem, who says (pp. 15 sqq. of his *Technisch onderzoek naar de uitvinding van de Boekdrukkunst*, 1901), that the principle of a printing surface composed of separate pieces was known to the block-printer, but he would have found it impossible to use small insulated blocks of wood for printing, or to manufacture them for that purpose with the necessary mathematical precision. Hence the idea of separate movable characters was not the invention of printing, but the art of casting them, and this was a work not for the block-printer, but for another industry, for a foundry.

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[1] *Annales Hirsaugienses*, ii. 421: "Post haec inventis successerunt subtiliora, inveneruntque modum fundendi formas omnium Latini alphabeti literarum, quas ipsi matrices nominabant, ex quibus rursum aeneos sive stanneos characteres fundebant, ad omnem pressuram sufficientes, quos prius manibus sculpebant."

[2] *Origines typographicae*, app. p. 47 (The Hague, 1765).

[3] *Origine de l'imprimerie*, i. 40.

[4] *Orig. de l'imprimerie* i. 97 (2 vols. 8vo., Paris, 1810).

Enschedé Theory.

From the types of B^{36} and B^{42} Enschedé concludes that Gutenberg's punches (patrices) were made, like the bookbinders' stamps, of yellow copper (brass, Germ. *Messing*). With such patrices only leaden matrices could be made, but the latter could be produced in two ways: the lead can be poured over the patrix, or the patrix be pressed into cold lead. The first mode is somewhat complex, but the matrix would have a smooth surface, and need no further adjustment. The second mode is more simple, but requires great force, although lead is a soft metal. Moreover, the surface of the matrix has to be trimmed, as the impression forces the lead downwards and sidewards, which makes the surface uneven, though by this pressure the lead becomes firmer and more compact, to the advantage of the type-founder. Enschedé thinks that Gutenberg's letters must have been sharp, and that he obtained his matrices by the second mode; he had each letter engraved on a brass plate, 2mm. thick, therefore a mere letter without anything underneath it. This letter (patrix) was pressed, by means of a small flat plate, so far into the metal that its back formed one surface with the top part of the lead, and then removed. After the patrix and matrix had been made in this way, the letter was to be cast, and Enschedé believes that for this work Gutenberg used what in Germany is called the *Abklatsch*-method, which, after having been gradually improved, was at last superseded by more perfect machinery. By this method the letter was cast in two tempos. First the letter itself on a small plate; then the plate placed underneath a casting-form, to fix it to a small shank, which was to be cast into the form and would make, with the plate, the exact height of the letter. The letter on the plate was made not by pouring the metal into the matrix, but by beating the latter into the molten metal. When lead is heated so as to be a soft mass it easily assumes the form of any object which falls on or in it, therefore also of the matrix, which is the image of the engraved type. When the metal is not overheated it will immediately cool down by contact with the cold matrix, so that the latter will not be injured, although it consists of the same substance as the molten metal. In this way a great many letters can be cast from one matrix. Enschedé describes various difficulties connected with this method, and tells us that only large letters, like those of B^{36} and B^{42}, could be made by it, as the operation of adding the shank to the letter becomes impossible in the case of smaller letters. Hence Gutenberg, having conceived the idea of printing from seeing (!) the Dutch *Donatuses*, chose this large size of type for his work; for the smaller types of the 1454 Indulgences a copper matrix was required, which, in its turn, necessitated the use of a steel patrix, the introduction of which he ascribes, as others have done before him (*e.g.* Bergellanus), to Peter Schoeffer.

As to the Costerian types, their bad and irregular condition shows, he thinks, that they were produced from leaden matrices, and the latter from brass patrices, though wooden patrices are also possible, but not probable. All the tools, however, were imperfect, and the workmen inexperienced, and therefore bound to produce such imperfections as he finds in the *Abecedarium* and *Donatus* types. But the types were cast in one tempo; the *Abklatsch*-method would have been out of the question for them on account of their small size. In this way Enschedé thinks Coster, not having learnt his art from anybody, invented the type cast with the staff, in one tempo, while Gutenberg, having had a Costerian *Donatus* as his model, cast his large types in two tempos by the *Abklatsch* system till Peter Schoeffer, by means of his steel patrices, was able to cast smaller types such as those of the 1454 Indulgences, with staff and all.

Enschedé warns us that he is merely making suggestions as a type-founder, that he is not a bibliographer, and leaves the interpretation of documents to others. We quote his theories as coming from such a qualified type-founder, and because they have made some impression in certain quarters, but they lead us away from the real points connected with the invention of printing. First of all the "casting of metal types" is not, as he thinks, the *first* stage in the invention; its beginning, its essence is, and has always been thought to be, the *movability* of the characters. This movability, and the accidental way in which it was discovered, form together the pith of the Haarlem tradition as told by Junius. He indicates it, without using the word "movable," by saying that Coster, while walking in the Haarlem wood, cut some letters in the bark of a tree, and with them, "reversely impressed *one by one* on paper," composed one or two lines. Nothing seems more natural than that a block-printer (as the printer of the xylographically printed *Speculum* must have been) should cut such separate letters, and thereupon perceive that they could be used over and over again for a variety of words, on different pages, while those which he used to cut in a block only served him for one page and for one purpose. It is equally clear from the Haarlem tradition that the art of *casting metal* types was the *second* stage in the invention, a development or outcome of the primary idea of "movable letters," and the realization of their advantage, for Junius says that Coster "afterwards changed the beechen characters into leaden, and the latter again into tin ones." This also shows that the discoverer of the insulated movable wooden letters—after realizing, perhaps, that they could not endure much pressure, or missed (as Enschedé says) the mathematical precision necessary for his purpose—transformed himself from a woodcutter into a letter-founder, and had no recourse (as Enschedé would have it) for casting his types to a foundry apart from his own. As this transformation is possible and probable there seems to be no reason for departing from the simple but clear Haarlem tradition as we read it in Junius.

In the infancy of printing every printer, in different countries and different towns, starts with his own types; hence we may conclude that he had learnt the art of engraving and casting them himself, and so combined the art of type-founding with that of printing. This points back to a combination of the two or three arts in the first printing-office. It would be strange if the inventor of the movable letters, whom we have shown to have been a block-printer, and therefore acquainted with the art of engraving letters, and other mechanical contrivances connected with printing, had lacked the ability, which his immediate followers possessed, of imparting to his movable characters, by some means or another, that firmness and precision which he required for the realization of his invention. How long Coster had been a block-printer before he invented, and how long and to what extent he continued to use, the movable wooden letters, we cannot tell.

That Enschedé ascribes to Coster the invention of casting metal types with a shank (as they have been manufactured for centuries afterwards), and that of another mode of manufacturing types (the *Abklatsch*-method) to Gutenberg, suggested to the latter by *seeing* (!) the *Donatuses* printed at Haarlem, looks like an amiable attempt to get over the unpleasant tradition of the theft of Coster's types, but his theories are irreconcilable with the Haarlem tradition, with Zell's account of the relation between Dutch and Mainz printing and with bibliography in general.

It is not surprising that Enschedé's theories called forth others from Zedler (*Veröffentl.* i. 34), who argues as follows: Enschedé says rightly that the type of the Hague Dutch *Donatus* is more defective than that of any other 15th-century book, more than even that of the Paris *Donatus*. Such types could not have been cast from a copper matrix. But a printer who had derived his art of casting types from Gutenberg or one of his pupils, would hardly, after the introduction of the steel stamp and the copper matrix (necessary for manufacturing the small types of the 1454 Indulgences), have returned to the casting of a small type from a leaden matrix, and used, moreover, a process which remained, in its consequences, behind that of Gutenberg. Zedler then points to a peculiarity of the earliest Dutch incunabula already mentioned above, namely, the sign of contraction connected with some letters by a fine stroke, which he says is not (!) found in the Dutch block-books, or in the Dutch MSS. He thinks, therefore, that this stroke was required by the method of casting this type. The stamp for making the matrix cannot have been *a staff*, on the lower end of which the *reversed* letter was cut, but a mere letter without any footing. Consequently, it must have consisted of lead not wood, and have been manufactured in the same way as Gutenberg's type was made, according to Enschedé. Every sign of contraction had to be one whole with the letters to which they belonged to prevent their being shifted during the process of printing. The letters cast from the matrix made in this way had as foot a thin square plate which enclosed the letter but no staff, owing to the mode of making the stamp and the matrix. If the Dutch printer had intended to cast a type with a staff by means of a casting tool, however primitive, he would not have required the thin plate. But his letters, with a thin plate as their foot, required to be pasted on a sheet of strong paper, so as to be firmly connected in words and sentences for the purpose of printing. Hence the printer could regulate the spaces between the words, without using, like Gutenberg, spaces of a definite width for this purpose, so that he had no trouble in making the lines end evenly. From such a printing-surface with a firm footing, it was possible, after the ground had become hard, to obtain impressions just as from movable types enclosed in the forme. Zedler was told by an expert that, technically, there was nothing against such an explanation, but, he says, if it were correct, it would not solve the question, not yet satisfactorily answered, as to what we have to understand by the printed Dutch *Donatuses*. The "doctrinal jetté en molle" of Jean le Robert and the *libri impressi*, mentioned under the year 1450 in the *Memorial* of the monastery Weidenbach in Cologne would then be books printed from such printing plates with separately cast letters. In this way Zells' account in the *Cologne Chronicle* would be confirmed (!). We should also understand why the Dutch, though knowing the art of casting types, only printed *Donatuses* and similar small schoolbooks, for which there was much demand, for in the present day, stereotype-printing is likewise used for books which, when editions follow each other rapidly, have to be printed unaltered. In this case Gutenberg would not be the inventor of the cast letter. But the Dutch could not claim, with Enschedé, the honour of the invention of movable metal types. They invented the casting of letters, but it would be Gutenberg's merit to have invented the *movable* cast types. At any rate he would be the inventor of the casting instrument whereby the letter with the staff became independent, that is movable. The early Dutch printing letter, which could only be used by being firmly footed on a plate, would have missed its real value for printing, its free movability.

Zedler, for want of data, cannot say where and when Gutenberg learnt the technics of early Dutch printing, though the *Cologne Chronicle* tells us that from this printing his work began. But he thinks that the secret arts which occupied Gutenberg at Strassburg, and which, when the documents are impartially (!) considered, can be regarded as nothing but experiments in the printing of books, are earlier than 1440. He will not decide whether Gutenberg has been in Holland, or whether this historical kernel is the foundation of the Coster legend (!) of Adrianus Junius which is independent of the *Cologne Chronicle*. Anyhow, Gutenberg still required ten years of hard work and troublesome experiments, before he, basing himself on the early Dutch printing, whatever this may have been, could become the inventor of the present mode of printing books.

We here see how Enschedé's theories give rise to Zedler's structure of theories. When the former says that Gutenberg chose for his first work the large letters of B^{36} and B^{42}, because the Abklatsch-method (invented [?] by him) was only fit for large letters, he forgets that the printers of these Bibles, wishing to apply their new art to the production of copies of the Bible in a speedier way than the scribes of their time were able to do, had, of necessity, to design their types from the large ornamental church-hand then in vogue for Bibles, Psalters, Missals, &c. For the same reason they prepared different, much smaller, types for the Indulgences of 1454, as the manuscript copies of these Indulgences, handed to them as "copy," were written in the bastard Roman book-hand, used for such documents. When the arts of casting types and of printing with them found their way to Mainz they were new in that city, but they came there already well-developed, and the printers, whoever they were, knew how to prepare themselves for any book or document which it was thought desirable to print. But of these questions Enschedé takes no account. He ascribes the two Bibles to Gutenberg, because Dziatzko has done so, without inquiring whether Gutenberg (not Pfister) had, after all, anything to do with B^{36}.

Zedler's theories, partly developments, partly corrections of those of Enschedé's, are based on the misapprehension that a peculiarity in the Costerian types, *i.e.* the connexion of the signs of contractions by a fine stroke with the letters over which they stand, does not occur either in the Dutch blockbooks or in the Dutch MSS. This connexion, however, far from being not found, is a conspicuous feature, in the Dutch blockbooks and MSS., and being faithfully reproduced in the Costerian types, shows how near these types stand to the block-printing and MS. periods. Zedler does not explain how he would print with the plate-footed types, pasted on strong paper, which he ascribes to Coster. Nor does he say whether he ever examined the Costerian editions of the *Speculum*, *Donatuses*, &c., to see whether they showed any traces of such awkward contrivances.

After having done justice, we hope, to these latest theories, which, in spite of their great length, leave many things unexplained, it is a pleasure to read once more Junius's unvarnished account of the Haarlem tradition, which contains no intricate theories, but a simple explanation of the rise and progress of printing with movable (metal) types in that city. The reading of it shows that real facts can be explained in a few words, while theories require long explanations, first for explaining away the real facts, and then for explaining the theories, which after all lead us astray.

Shape of Earliest Type.

The shape and manufacture of the types used as early as *c.* 1470 do not seem to have differed materially from those of the present types. This is evident (1) from the shape of the old types which were discovered in 1878 in the bed of the river Saône, near Lyons, opposite the site of one of the 15th-century printing-houses of that city, and which there is reason to believe belonged once to one of those presses, and were used by the early printers of Lyons; (2) from a page in Joh. Nider's *Lepra moralis*, printed by Conrad Homburch at Cologne in 1476, which shows the accidental impression of a type, pulled up from its place in the course of printing by the ink-ball, and laid at length upon the face of the forme, thus leaving its exact profile indented upon the page; (3) from an entirely similar page (fol. 4^b) in *Liber de laudibus ac festis gloriosae Virginis* (Cologne, *c.* 1468). From the small circle appearing in the two last-mentioned types, it is presumed that the letters were pierced laterally by a circular hole, which did not penetrate the whole thickness of the letter, and served, like the nick of modern types, to enable the compositor to tell by touch which way to set the letter in his stick. The fact that in these two cases the letter was pulled up from the forme seems to show that the line could not have been threaded.

Vinc. Fineschi, *Notizie Storiche sopra la stamperia di Ripoli*, p. 49 (Florence, 1781), gives an extract from the cost-book of the Ripoli press, about 1480, which shows that steel, brass, copper, tin, lead and iron wire were all used in the manufacture of types at that period.[1]

History of the Earliest Types.—The history and nomenclature of the earliest types are practically a continuation of the history and nomenclature of the characters figured in the earliest blockbooks, wood-engravings and MSS. For instance, Gothic type was first used, say, about the year 1445, but Gothic writing, of which that type was an imitation, was already known and used about the second half of the 12th century and can be traced still farther back (see above). Again, the pure Roman type, which appeared about 1464, is nothing but an imitation of what in palaeography is called the Caroline minuscule, a handwriting which was already fully developed towards the end of the 8th century (see PALAEOGRAPHY).

The broad outlines of the history of the earliest types are as follows:—

Gothic.

Gothic type, of the angular or pointed kind, was first used by the Haarlem printer of the *Speculum*, *Donatus*, &c. (see specimen No. 1, taken from the British Museum copy of the *Speculum humanae salvationis*, mixed Latin edition), presumably *c.* 1445. An entirely similar but larger type (No. 2, taken from the British Museum copy of Ludovicus [Pontanus] de Roma, *Singularia*) was used, presumably by the same printer, *c.* 1465–1470. Gothic type appeared in Germany as a church type in 1454, in the 31-line Indulgence, presumably printed by Johan Gutenberg at Mainz (No. 3, from the Göttingen copy), and in the 30-line Indulgence (No. 4, taken from the British Museum copy), printed by Peter Schoeffer at Mainz. Type No. 3 was also used about the same time for the 36-line Bible, and type No 4 for the 42-line Bible. Two much larger Gothic types appeared in the Psalter of 1457, published by Fust and Schoeffer (see Bernard, *Origine*, pl. vii.). In Italy Gothic type appears in 1468 (No. 5, taken from the British Museum copy of Cicero, *De oratore*, published at Rome by Ulr. Hahn, the 15th of December 1468, in small Roman type, with imprint in Gothic), but in a more rounded form: it is practically the ordinary Italian writing influenced by the Gothic. In France Gothic began to be used in 1473; in England it appears first in Caxton's type about the year 1480.[2] It was employed extensively in a great many of the earliest presses all over Europe, and continued to be used largely at all times, especially for Bibles, law books, royal proclamations, &c., and even to this day it is the national character of Germany. It is now usually called *lettre de forme*, *black letter* or *English* in English-speaking countries, *lettre flamand* in Holland, and *fractur* in Germany.

Bastard Italian or Roman.

Bastard Italian or bastard Roman was introduced in 1454 at Mainz in the 31-line (No. 6) and 30-line (No. 7) Indulgences. It is also called *lettre de somme*, some think from the *Summa* of Thomas Aquinas, printed in the type of the Bible of 1462 by Fust and Schoeffer. Varieties of this kind of type were, like the Gothic, much used by the earliest printers, as, for instance, the printer of the 1460 *Catholicon*, Mentelin of Strassburg, *c.* 1460, and Ulrich Zell at Cologne, *c.* 1466, &c. In England it appeared in the first three books printed (1478, 1479) at Oxford (No. 8, taken from the British Museum copy of Jerome's *Expositio in Simbolum Apostolorum* wrongly dated 1468 for 1478).

Roman.

Roman type, the Caroline minuscule of palaeography, was first used in Germany about 1464, Strassburg, by the printer whose fount of type is known by a peculiarly shaped R, and who on that account is usually called "the R printer" (No. 9, taken from the British Museum copy of Durandus, *Rationale*, of which the Basel library possesses a copy which was bought in 1464).[3] In Italy it appears in 1465 at Subiaco (see Bernard pl. xii. No. 19), at Rome in 1467 (*op. cit.* pl. xii. No. 20), but in all its purity at Venice in 1469, used by Johannes of Spires (*op. cit.* pl. xii. No. 25), and at Paris in 1470 (*op. cit.* pl. xiii. No. 25). In England it was not used before 1518, when Richard Pynson printed Pace's *Oratio in Pace nuperrima* (see facsimile in Reed's *Type Foundries*, p. 92).

Burgundian.

Burgundian type, or *gros batarde* or *secretary*, was first used about 1470–1472 by Colard Mansion at Bruges (No. 10, taken from the British Museum copy of *La Controversie de Noblesse*, *c.* 1471–1472). With a somewhat similar type (No. 11, taken from the British Museum copy of the *Recuyell*) William Caxton is presumed to have printed, likewise at Bruges, a set of five books, of which the *Recuyell of the History of Troye*, a translation of a work by Raoul le Fèvre, is the best known and was probably printed *c.* 1471.[4] To this same class belong the first type (No. 12, from the British Museum copy of the *Dictes*) used in England by William Caxton for the printing of *Dictes and Sayings of the Philosophers* (Nov. 18, 1477), and that used by the printer of St Albans (No. 13, taken from the Cambridge University Library copy of Aug. Dactus, *Elegancie*). It was an imitation of the manuscript hand of the English and Burgundian scribes of the 15th century, and, after having figured for a long time in several of the early London and provincial presses, was about 1534 entirely superseded by the English black letter. To this class of type belong also the later *lettre de civilité* (*c.* 1570), the *script* (*lettre coulée, lettre de finance*, Dutch, *geschreven schrift*), *set court, base secretary*, and *running secretary* types.

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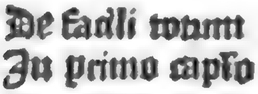
[1] On the above theories and types consult T. B. Reed, *Old English Letter Foundries*, pp. 3–26.

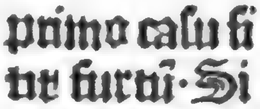
[2] See Blades, *Life of Caxton*, pl. xvii.

[3] See Jules Philippe, *L'Imprimerie à Paris*, p. 219.

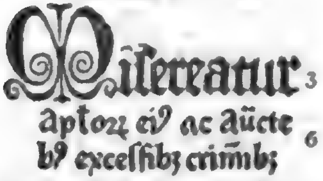
[4] Cf. Blades, *Life of Caxton*.

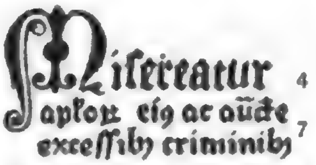


No. 1.—*Speculum* type *c.* 1445 (?).



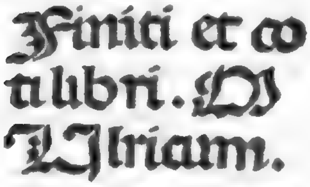
No. 2.—Pontanus type, *c.* 1470 (?).



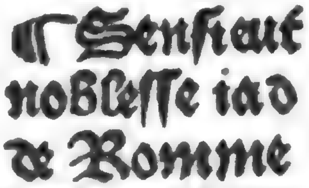


Nos. 3 and 6.—Mainz 31-line Indulgence, 1454.

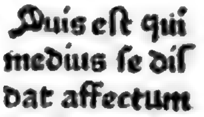
Nos. 4 and 7.—Mainz 30-line Indulgence, 1454.



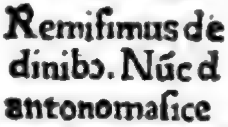
No. 5.—Cicero, *De oratore*, 1468.



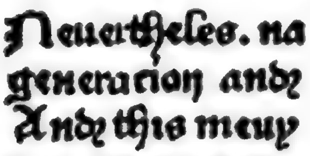
No. 10.—*Controversie de Noblesse*, *c.* 1471–1472.



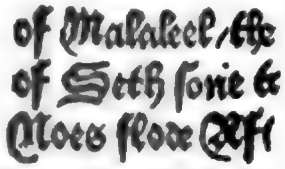
No. 8.—Jerome's *Expositio* (1468), 1478.



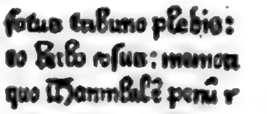
No. 9.—Durandus, *c.* 1464.



No. 11.—*Recuyell of the Hist. of Troye*, *c.* 1471.



No. 12.—*Dictes and Sayings*, 1477.



No. 13.—Aug. Dactus, *Elegancis*, 1479.

On the types, illustrations, initials, &c., before 1500, consult also the facsimiles in Holtrop's *Mon. typ. des Pays-Bas* (the Hague, 1868); R. C. Hawkins, *First Books and Printers of the Fifteenth Century* (New York, 1884); William Blades, *The Life of Caxton* (London, 1861–1863); Bernard, *Origine de l'imprimerie*, vol. i. pls. iii.–xiii. (Paris, 1853); Placidus Braun, *Notitia de libris ab artis typogr. inventione usque ad annum 1479 impressis* (Augsburg, 1788); H. Noel Humphreys, *Hist. of the Art of Printing*, fol. (London, 1867); *Veröffentlichungen der Gesellsch. für Typenkunde des 15. Jahrhunderts.* Edd. Isak Collyn, Rud. Haupt, H. O. Lange, K. Haebler, V. Madsen, E. Voulliéme, vol. i, &c. (220 facs. published, Leipzig, 1907–); *The Woolley* [Geo. Dunn], *Photographs of Early Types* (400), designed to supplement published examples with references to the British Museum Index 1899–1904, 5 pts., folio; K. Burger, *Deutsche und italienische Inkunabeln, in getreuen Nachbildungen herausgeg.*, pts. 1–8 (200 pls.), folio (Berlin, 1892–); E. Gordon Duff, *Early English Printing*, a series of facs., folio (London, 1896); Ch. Enschedé, *Fonderies de caractères et leur matériel dans les Pays-Bas du 15me au 19me siècle*, fol. (Haarlem, 1908); Horace Hart, *Notes on a Century of Typography at the University Press, Oxford, 1693–1794*, folio (Oxford, 1900); Olgar Thierry-Poux, *Premiers monuments de l'imprimerie en France au 15me siècle*, fol. (Paris, 1890); *British Museum* (*Facsimiles from early printed books in the*), (1897), 32 pls. folio; *Type Facsimile Society*, folio (Oxford, 1900–).

The types after 1500 can best be learned from the catalogues of type-founders, among which those of Messrs Enschedé of Haarlem occupy a foremost place. Of others we may mention: *Indice dei caratteri nella stampa Vaticana*, 4to (Rome, 1628); *Épreuves des caractères qui se trouvent chez Claude Lamesle*, 4to (Paris, 1742); *Épreuves des car. de la fonderie de Claude Mozet*, 8vo (Nantes, 1754); *Les Car. de l'imprimerie par Fournier le Jeune*, 8vo (Paris, 1764); *Proef van Letteren, Bloemen, &c., van Ploos van Amstel*, 8vo (Amsterdam, 1767); *Épreuve de car. de Jacques François Rosart*, 8vo (Brussels, 1771); *Schriften . . . bey J. H. Prentzler*, 4to (Frankfort-on-Main, 1774); *Épreuves des car. de la fond. de J. L. Joannis*, 8vo (Paris, 1776); *Épreuves des car. de la fond. de J. L. de Boubers*, 8vo (Brussels, 1777); *Proeve van Letteren welke gegooten worden door J. de Groot*, 8vo (the Hague, 1787); *Pantographie*, by Edmund Fry, 8vo (London, 1799); and *Manuale typographico*, by G. Bodoni, 4to (Parma, 1818).

Printers after 1500.—Though the *Cologne Chronicle* of 1499 denies to Mainz the honour of the invention of the art of printing, it was right in asserting that, after it had been brought there from Holland, it became more masterly and exact, and more and more artistic. During the first half-century of printing a good many printers distinguished themselves by the beauty, excellence and literary value of their productions. We may mention as such: Johan Fust and Peter Schoeffer at Mainz; Johan Mentelin and Heinrich Eggestein at Strassburg; Ulrich Zell at Cologne; Sweynheym and Pannarts at Subiaco and at Rome; Nicolas Jenson at Venice; Anton Koberger at Nuremberg; Ketelaer and De Leempt at Utrecht; Johan Veldener at Louvain, Utrecht and Kuilenburg; Gerard Leeu at Gouda; Johan of Westphalia at Louvain; and William Caxton (*q.v.*) at Westminster.

Very soon the demand for books increased, and with it came a reduction in their prices. This caused a decline in the execution of printing, which begins to be appreciable about 1480 in some localities, and may be said to have become general towards the end of the 15th century. At all times, however, we find some printers raise their art to a great height by the beauty of their types and the literary excellence of their productions. Among the later printers we may mention the Aldi of Venice (1490 to 1597); G. B. Bodoni of Parma (1768–1813); John Amerbach at Basel (1492–1516); John Froben at Basel (1496–1527); John Baskerville at Birmingham (1750–1775); the house of Weichel, first at Paris (*c.* 1530–1572), afterwards at Frankfort; Christopher Plantin at Antwerp (1554–1589); the Elzevirs, first at Leiden, afterwards at Amsterdam (1580–1680); Antoine Verard at Paris (1485–1513); Josse Bade or Badius at Paris (1495–1535); and the Estiennes at Paris (1502–1598).

Italic.

The Italic type[1] is said to be an imitation of the handwriting of Petrarch, and was introduced by Aldus Manutius of Venice for the purpose of printing his projected small editions of the classics. The cutting of it was entrusted to Francesco da Bologna, an artist who is presumed to be identical with the painter Francesco Francia or Raibolini. The fount is a "lower case" only, the capitals being Roman in form. It contains a large number of tied letters, to imitate handwriting, but is quite free from contractions and ligatures. It was first used in the *Virgil* of 1500. Aldus produced six different sizes between 1501 and 1558. It was counterfeited almost immediately in Italy, at Lyons and elsewhere, Originally it was called Venetian or Aldine, but subsequently Italic type, except in Germany and Holland, where it is called "cursive." The Italians also adopted the Latin name "characteres cursivi seu cancellarii." In England it was first used by Wynkyn de Worde in Wakefield's *Oratio* in 1524. The character was at first intended and used for the entire text of classical works. When it became more general, it was employed to distinguish portions of a book not properly belonging to the work, such as introductions, prefaces, indexes, notes, the text itself being in Roman. Later it was used in the text for quotations, and finally served the double part of emphasizing certain words in some works, and in others, chiefly translations of the Bible, of marking words not rightly forming a part of the text.

Greek.

Greek type (*minuscules*) first occurs in Cicero, *De officiis* printed at Mainz in 1465 by Fust and Schoeffer. The fount used is rude and imperfect, many of the letters being ordinary Latin. In the same year Sweynheym and Pannarts used a good Greek letter for some of the quotations in their edition of *Lactantius* (see, for instance, leaves 11a, 19a, 36a, 139, 140); but the supply was evidently short at first, as some of the larger quotations in the first part of the book were left blank to be filled in by hand. The first book wholly printed in Greek minuscules was the *Grammar* of Lascaris, by Paravisinus, at Milan in 1476, in types stated to have been cut and cast by Demetrius of Crete. The fount contains breathings, accents and some ligatures. The headings to the chapters are wholly in capitals. The *Anthologia graeca* of Lascaris was printed at Florence in 1494 wholly in Greek capitals (*litterae majusculae*), and it is stated in the preface that they were designed after the genuine models of antiquity to be found in the inscriptions on medals, marbles, &c. But as late as 1493 Greek type was not common, for in that year the Venice printer Symon Bevilaqua issued *Tibullus*, *Catullus* and *Propertius* with blanks left in the commentary for the Greek quotations. In England Greek letters appeared for the first time in 1519 in W. de Worde's edition of Rob. Whittington's *Grammatica*, where a few words are introduced cut in wood. Cast types were used at Cambridge in Galen's *De temperamentis*, translated by Linacre, and printed by Siberch in 1521, who styles himself the first Greek printer in England; but the quotations in the Galen are very sparse, and Siberch is not known to have printed any entire book in Greek. The first printer who possessed Greek types in any quantity was Reginald Wolfe, who held a royal patent as printer in Greek, Latin and Hebrew, and printed in 1543 two *Homilies* of Chrysostom, edited by Sir John Cheke, the first Greek lecturer at Cambridge. In Edinburgh, in 1563, and as late as 1579, the space for Greek words was left blank in printing, to be filled in by hand.

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[1] These paragraphs on the various types are for the most part taken from T. B. Reed's *History of the Old English Letter Foundries*, p. 50 seq. (London, 1887).

The Oxford University Press, re-established in 1585, was well supplied with Greek types, which were used in the Chrysostom of 1586. About 1607 Sir Henry Savile introduced Greek types (vulgarly called on account of their beauty "the silver letter") into Eton College, for printing his edition of St Chrysostom (8 vols., 1610–1613, John Norton), and other Greek authors. He afterwards presented this type to the university of Oxford. In 1632 Cambridge applied to Oxford for the loan of a Greek fount to print a Greek Testament, and the same university made an offer in 1700 for the purchase of a fount of the king's Greek at Paris, but withdrew on the French Academy insisting as a condition that every work printed should bear the imprint "characteribus Graecis e typographeo regio Parisiensi." It should not be forgotten that the large number of ligatures in the Greek of that day made the production of a fount a serious business. The Oxford Augustin Greek comprised no fewer than 354 matrices, the great primer 456, and Fournier's fount showed even 776 different sorts. The Dutch founders effected a gradual reduction of the Greek typographical ligatures. Early in the 19th century a new fashion of Greek, for which Porson was sponsor and furnished the drawings, was introduced, and has remained the prevailing form to this day. Cf. Rob. Proctor, ***The Printing of Greek in the XVth Century***, folio (Oxford, 1900).

Hebrew.

The first Hebrew types are generally supposed to have appeared in 1475 in Petrus Niger's *Tractatus contra perfidos Judaeos* (leaf 10), printed by Conrad Fyner at Esslingen. De Rossi states that a Hebrew work in four folio volumes entitled *Arba Turim*, of Rabbi Jacob ben Asher, was printed in 1475 at Pieve di Sacco in Austrian Italy, while in the same year, a few months earlier, Salomon Jarchi's *Comment. on the Pentateuch* appeared at Reggio in Italy, printed in the Rabbinical character. Numerous other Hebrew works followed before 1488, in which year the first entire Hebrew Bible was printed, with points, at Soncino, by a family of German Jews. The first English book in which any quantity of Hebrew type was used was Dr Rhys's *Cambro-Brytannicae Cymraecaeve linguae institutiones*, printed by Thomas Orwin in 1592, though already in 1524 Hebrew characters, but cut on small blocks of wood, were used by W. de Worde in Rob. Wakefield's *Oratio*. The Hebrew fount made use of in Walton's *Polyglott* in 1657 was probably the first important fount cut and cast in England, though there were as yet no matrices there for Rabbinical Hebrew In the beginning of the 18th century Amsterdam was the centre of the best Hebrew printing in Europe.

Arabic.

The first book printed in Arabic types is said to be a *Diurnale Graecorum Arabum*, printed at Fano in Italy in 1514.[1] Two years later P. P. Porrus's *Polyglott Psalter*, comprising the Arabic version, was printed at Genoa; and two years later a *Koran* in Arabic is said to have been printed at Venice. In 1505 an *Arabic Vocabulary* at Granada had the words printed in Gothic letters with the Arabic points placed over them; and in other presses where there were no Arabic types the language was expressed in Hebrew letters or cut in wood. De Guignes and others mention a fount of Arabic used by Gromors in Paris in 1539–1540 to print Postel's *Grammar*. In England some Arabic words were introduced in Wakefield's *Oratio* of 1524, but apparently cut on small blocks of wood In Minsheu's *Ductor in linguas*, 1617, the Arabic words are printed in Italic characters. Laud's gift of Oriental MSS. to Oxford in 1635, and the appointment of an Arabic lecturer, were the first real incentives to the cultivation of the language by English scholars. Previous to this it is stated that the Raphelengius Arabic Press at Leiden had been purchased by the English Orientalist, William Bedwell; but, if it was brought to England, it does not appear to have been immediately made use of. The Arabic words in Thomas Greave's *Oratio de linguae Arabicae utilitate*, printed at Oxford in 1639, were written in by hand.

Syriac type, probably cut in wood, first appeared in Postel's *Linguarum XII Alphabeta*, printed in Paris in 1538, but the characters are so rude in form and execution as to be scarcely legible. In 1555, however, Postel assisted in cutting the punches for the Syriac Peshito New Testament, printed at Vienna in 4to, the first portion of the Scriptures, and apparently the first book, printed in that language. In 1569–1572 Plantin at Antwerp included the Syriac New Testament in his *Polyglott*, and reissued it in a separate form in 1574. In England Syriac was usually expressed in the earlier works in Hebrew characters. But in 1652, when the prospectus and preliminary specimen of Walton's *Polyglott* were issued, we find Syriac type in use.

Syriac.

Armenian.

Of the Armenian character the press of the Vatican possessed a good fount in 1591, when Angelo Roccha showed a specimen in his *Bibliotheca Apostolica Vaticana*. A psalter is said to have been printed at Rome in 1565, and Rowe Mores mentions doubtfully a liturgy printed at Cracow in 1549. Armenian printing was practised in Paris in 1633; but the Armenian bishops, on applying to France for assistance in printing an Armenian Bible, in 1662, were refused, and went to Rome, where, as early as 1636, the press of the Propaganda had published a specimen of its Armenian matrices. The patriarch, after fifteen months' residence in Rome, removed to Amsterdam, where he established an Armenian press, and printed the Bible in 1666, which was followed in 1668 by a separate edition of the New Testament. In 1669 the press was set up at Marseilles, where it continued for a time, and was ultimately removed to Constantinople. In England the first Armenian type was that presented by Dr Fell to Oxford in 1667. The alphabet given in the prolegomena of Walton's *Polyglott* was cut in wood.

Ethiopic.

Of Ethiopic the earliest type appeared in Potken's *Psalter and Song of Solomon*, printed at Rome in 1513. The work was reprinted at Cologne, in 1518, in Potken's *Polyglott Psalter*. In 1548 the New Testament was printed at Rome by some Abyssinian priests. The press of the Propaganda issued a specimen of its fount in 1631, and again in Kircher's *Prodromus Coptus* in 1636. Erpenius at Leiden had an Ethiopic fount, which in 1626 was acquired by the Elzevirs. Usher attempted to procure the fount for England; but, his attempt failing, punches were cut and matrices prepared by the London founders for the London *Polyglott*, which showed the Psalms, Canticles and New Testament in the Ethiopic version.

Coptic.

Of Coptic the press of the Propaganda possessed a fount, and a specimen was issued in 1636, in which year also Kircher's *Prodromus Coptus* appeared from the same press. In England David Wilkins's edition of the New Testament was printed in 1716 from Coptic types cast with matrices which Dr Fell had presented to Oxford in 1667. The alphabets shown in the introduction and prolegomena to the London *Polyglott* of 1655 and 1657 were cut in wood.

Samaritan.

Of Samaritan the press of the Propaganda had a fount in 1636, and the Paris *Polyglott*, completed in 1645, contained the entire Pentateuch in type, the punches and matrices of which had been specially prepared under Le Jay's direction. The fount used for the London *Polyglott* in 1657 is admitted to have been an English production, and was probably cut under the supervision of Usher.

Slavonic.

Russian.

With Slavonic type a psalter was printed at Cracow as early as 1491, and reprinted in Montenegro in 1495. The only Slavonic fount in England was that given by Dr Fell to Oxford, and this, Mores states, was replaced in 1695 by a fount of the more modern Russian character, purchased probably at Amsterdam. The *Oratio Dominica* in 1700 gives a specimen of this fount, but renders the Hieronymian version in copper-plate. Modern Slavonic, better known as Russian, is said to have appeared first in portions of the Old Testament, printed at Prague in 1517–1519. Ten years later there was Russian type in Venice A Russian press was established at Stockholm in 1625, and in 1696 there were matrices in Amsterdam, from which came the types used in Ludolph's *Grammatica Russica*, printed at Oxford in that year, and whence also, it is said, the types were procured which furnished the first St Petersburg press, established in 1711 by Peter the Great. Mores notes that in 1778 there was no Russian type in England, but that Cottrell was at that time engaged in preparing a fount. It does not appear that this project was carried out, and the earliest Russian in England was cut by Dr Fry from alphabets in the *Vocabularia*, collected and published for the empress of Russia in 1786–1789. This fount appeared in the *Pantographia* in 1799.

Etruscan.

A fount of the Etruscan character cut by William Caslon about 1733 for Swinton of Oxford was apparently the first produced. Fournier in 1766 showed an alphabet engraved in metal or wood. In 1771 the Propaganda published a specimen of their fount, and Bodoni of Parma in 1806 exhibited a third in his *Oratio Dominica*.

Runic.

Runic types were first used at Stockholm in a Runic and Swedish *Alphabetarium*, printed in 1611. The fount, which was cast at the expense of the king, was afterwards acquired by the university. About the same time Runic type was used at Upsala and at Copenhagen. Voskens of Amsterdam had matrices about the end of that century, and it was from Holland that Francis Junius is supposed to have procured the matrices which, in 1677, he presented to Oxford. This fount appears in the

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[1] See Panzer vii. 2.

Oratio Dominica of 1700, and in Hickes's *Thesaurus* (1703–1705), and it remained the only one in England.

Gothic.

Matrices of Gothic type were presented to Oxford by Francis Junius in 1677, and a fount of them was used for the *Oratio Dominica* of 1700 and in Hickes's *Thesaurus*. A different fount was used for Chamberlayne's *Oratio Dominica*, printed at Amsterdam in 1715. Caslon cut a fount which appeared in his first specimen in 1734. This and the Oxford fount were the only two in England in 1820.

Scandinavian.

Founts of Icelandic, Swedish and Danish were included in Junius's gift to Oxford in 1677, and were, perhaps, specially prepared in Holland. The first-named is shown in the *Oratio Dominica* of 1700 and in Hickes's *Thesaurus*. Printing had been practised in Iceland since 1531, when a *Breviary* was printed at Hoolum, in types rudely cut, it is alleged, in wood. In 1574, however, metal types were provided and several works produced. After a period of decline, printing was revived in 1773, and in 1810 Sir George M'Kenzie reported that the Hoolum press possessed eight founts of type, of which two were Roman, and the remainder of the common Icelandic character, which, like the Danish and Swedish, bears a close resemblance to the German.

Anglo-Saxon.

For the Anglo-Saxon language the first type was cut by John Day in 1567, under the direction of Archbishop Parker, and appeared in Ælfric's *Paschal Homily* in that year and in the *Ælfredi res gestæ* of Asser Menevensis in 1574. Anglo-Saxon type was used by Browne in 1617, in Minsheu's *Ductor in linguas*; and Haviland, who printed the second edition of that work in 1626, had in 1623 made use of the character in Lisle's edition of Ælfric's *Homily*.

Irish.

The first fount of Irish character was that presented by Queen Elizabeth to O'Kearney in 1571, and used to print the Catechism which appeared in that year in Dublin, from the press of Franckton. But the fount is only partially Irish, many of the letters being ordinary Roman or Italic. It was used in several works during the early years of the 17th century, and as late as 1652 in Godfrey Daniel's *Christian Doctrine*, printed in Dublin. The Irish seminaries abroad were better supplied with Irish type. A new type was cut by Moxon, and appeared in 1681 in Boyle's New Testament, printed by Robert Everingham.

Music.

The earliest specimen of music type occurs in Higden's *Polychronicon*, printed by De Worde at Westminster in 1495. The square notes appear to have been formed of ordinary quadrats, and the staff-lines of metal rules imperfectly joined. In Caxton's edition of the same work in 1482 the space had been left to be filled up by hand. The plain chant in the Mainz psalter of 1490, printed in two colours, was probably cut in wood. Hans Froschauer of Augsburg printed music from wooden blocks in 1473, and the notes in Burtius's *Opusculum Musices*, printed at Bologna in 1487, appear to have been produced in the same manner; while at Lyons the missal printed by Matthias Hus in 1485 had the staff only printed, the notes being intended to be filled in by hand. About 1500 a musical press was established at Venice by Ottavio Petrucci, at which were produced a series of mass-books with lozenge-shaped notes, each being cast complete with a staff-line. In 1513 he removed to Fossombrone, and obtained a patent from Leo X. for his invention of types for the sole printing of figurative song (*cantus figuratus*). Before 1550 several European presses followed Petrucci's example, and music type was used, among other places, at Augsburg in 1506 and 1511, Parma in 1526, Lyons in 1532 and Nuremberg in 1549. In 1525 Pierre Hautin cut punches of lozenge-shaped music at Paris. Round notes were used at Avignon in 1532. In England, after its first use, music-printing did not become general till 1550, when Grafton printed Marbecke's Book of Common Prayer, "noted" in movable type, the four staff-lines being printed in red and the notes in black. There are only four different sorts of notes used—three square and one lozenge. About 1660 the detached notes hitherto employed began to give place to the "new tyed note," by which the heads of sets of quavers could be joined. But at the close of the 17th century music-printing from type became less common, on account of the introduction of stamping and engraving plates for the purpose. Cf. Rob. Steele, *The Earliest English Music Printing*, folio (London, 1903); Andr. Deakin, *Mus. Bibliogr.*, 8vo. (Birmingham, 1893).

Printing for the Blind.

Printing for the blind was first introduced in 1784 by Valentin Haüy, the founder of the asylum for blind children in Paris. He made use of a large script character, from which impressions were taken on a prepared paper, the impressions being so deeply sunk as to leave their marks in strong relief and legible to the touch. Haüy's pupils not only read in this way, but executed their own typography, and in 1786 printed an account of their institution and labours as a specimen of their press. The first school for the blind in England was opened in Liverpool in 1791, but printing in raised characters was not successfully accomplished till 1827, when Gall of the Edinburgh asylum printed the Gospel of St John from angular types. Alston, the treasurer of the Glasgow asylum, introduced the ordinary Roman capitals in relief, and this system was subsequently improved upon by the addition of the lower-case letters by Dr Fry, the type-founder, whose specimen gained the prize of the Edinburgh Society of Arts in 1837. Several rival systems have competed in England for adoption, of which the most important are those of Lucas, Frere, Moon, Braille, Carton and Alston (see BLINDNESS).

Initials.

The trouble and cost involved in the use of the initial director early suggested the use of woodcut initials, and Erhard Ratdolt of Venice, about 1475, is generally supposed to have been the first printer to introduce the *literae florenses*, called also *lettres tourneures*, or *typis tornatissimis*, which eventually superseded the hand-painted initials. Caxton introduced one or two kinds in 1484. Among the earliest to be used are the so called Lombardic initials or capitals. The more elaborate initials, such as those used in the Mainz indulgences and psalter, by Aldus at Venice, by Johann Schoeffer at Mainz in 1518, by Tory and the Estiennes at Paris, by Froben at Basel, and by the other great printers of their day, were known as *lettres grises*. Besides these, the ordinary "two-line letters" or large plain capitals came into use; and these were generally cast, whilst the ornamental letters were for the most part engraved on wood or metal.

Ornaments and Flowers.

Type ornaments and flowers began, like the initials, with the illuminators, and were afterwards cut on wood or metal. The first printed ornament or vignette is supposed to be the scutum or arms of Fust and Schoeffer in some copies of their 1457 Psalter, and of their edition of the Bible of 1462. There is no vignette in the Subiaco *Lactantius* of 1465 (as stated by Mr Reed, *Letter Foundries*, p. 82). In Holtrop's *Monum. typogr. des Pays-Bas* may be seen borders used by some of the earliest printers of Holland (1475–1490), which would not look bad even in the present time. Caxton in 1490 used ornamental pieces to form the border for his *Fifteen O's*. At the same time the Paris printers engraved still more elaborate border pieces. At Venice entire frames were engraved in one piece, while Aldus as early as 1495 used tasteful head-pieces cut in artistic harmony with his *lettres grises*. Early in the 16th century we observe detached ornaments and flourishes which have evidently been cast from a matrix.

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(J. H. H.)

II.—MODERN PRACTICAL TYPOGRAPHY

The printing surfaces used in the production of books and newspapers, apart from wood- or process-blocks and casts, and apart also from such surfaces as are obtained by means of the Linotype and kindred machines, are made up primarily of an aggregation of separate types, each representing a letter, mark or sign, though the actual surface employed on the printing press is frequently a duplicate copy made by a process of stereotyping or electrotyping.

Material Characteristics of Type.—A *fount* consists of a proportioned quantity of each of these letters and signs of any one particular body and face. It therefore contains single letters, both capitals ("upper case") and small letters ("lower case"), diphthongs, ligatures, such as ff, fl, accents, points, figures, fractions, commercial signs such as @, £, "peculiars" such as *, † and leaders (. . .), together with quads (pieces of metal which do not print, but are used to compensate for the shortness of occasional lines, as at the end of a paragraph), and spaces which separate words. A fount may thus have about 275 characters or *sorts*, about 100 of them consisting of italic letters, points and figures.

The numbers of the different sorts vary with different languages, and even with the style of different writers, the works of Charles Dickens, for instance, making unusually heavy demands on the vowels, while the writings of Lord Macaulay run with like persistence on the consonants. Type-founders determine the proportions of the different sorts according to a *bill of type*, or *scheme*, either numerically, when the basis of the computation is the number of lower case m's (or of A's, in the case of display type used for headings) or by weight. In the second method a fount of 125 ℔ of Roman type includes, on one scheme, 8 oz. of E, M, C; 9 oz. of T; 8 ℔ of e; 5 ℔ each of a, b, n, o, t; and so on down to 3 oz. of z. A fount of body-letters, that is those used for the reading matter of books and newspapers, as made up by one British type-founder, contains capitals 9% by weight, small capitals 4%, figures 6%, lower case letters, points and leaders 56%, spaces 15% and quads 10%; rules, accents and fractions not being supplied except in new complete founts or when specially asked for. A rule for estimating the quantity of type required for a page is to divide the number of square inches it contains by 4, when the quotient represents approximately the weight of type in ℔. But for large founts 25% and for small ones 40% should be allowed in addition, on account of unused type in the cases which cannot be completely set.

Logotypes.

For many years it was a favourite idea with inventors, especially those who were not practical printers, that great economy might be gained in composition by the use of word characters, or "logotypes," instead of single letters. The constant recurrence of certain words such as "the," "and," "is," suggested that they, as well as affixes and suffixes like ad-, ac-, -ing, -ment, should be cast in single pieces instead of being set up with their component letters. Such logotypic printing was used in 1785 in the *London Daily Universal Register*, which three years later became *The Times*, but it has never found general favour. The chief practical objection is that it involves the use of cases with an inconveniently large number of boxes. The greater the variety of characters the more "travel" of the compositor's hand over the cases is necessary for picking them up, and by so much is the speed of his work retarded.

Parts of a Type.

Each of the parts of a type has a technical name. In fig. 1, representing the capital letter M, the darkest space *a*, *a*, *a*, *a*, is called the *face*; and only that part of the type touches the paper in printing. The face is divided into the *stem*, marked 1, which comprises the whole outline of the type M; the *serifs*, or the horizontal lines marked 2, which complete the outline of the letter; the *beard*, consisting of the bevel or sloping part marked *b*, *b*, and the *shoulder* or flat portion below *b*. The shank is the entire body of the letter *d*, the front part (that shown) being known as the *belly* and the corresponding part behind as the *back*. The spaces at *h* and *k* are the *counters*, which regulate the distances apart of the stems in a line of type. The hollow groove extending across the shank at *e*, *e* is the *nick*, which enables the workman to recognize the direction of the type and to distinguish different founts of the same body. The absence of this simple expedient would retard the operation of hand-setting up by fully one-half. The earliest type-founders did not know the use of the nick. If a part of the face overhangs the shank, this part is called the *kern*, but kerned letters are avoided as much as possible. The groove *g* divides the bottom of the type into two parts called the *feet*. An impression from that part of a type on which it stands would be as =. Types must be perfectly rectangular, the minutest deviation rendering them useless. Any roughness at the sides is called *burr*, and any injury to the faces a *batter*.

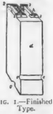

FIG. 1.—Finished Type.

Species of Letter.

Types which have the face cast in the middle of the shank, as a, c, e, m, &c., and thus leave an open space above them corresponding to that below, caused by the beard, are known as *short letters*. Those whose stem extends to the top of the shank, as b, d, f, &c., are called *ascending letters*. Those that have a stem extending over the shoulder, as g, p, &c., are called *descending letters*. Those that are both ascending and descending, and extend over the whole of the shank, as Q and j, are *long letters*. Small letters and figures cast upon the upper part of the shank, as 1^{a}, are called *superiors*; those very low down on the shank are *inferiors*, as H_2. Types that are very heavy and massive in appearance are called *fat-faced*; those that are fine and delicate, *lean-faced*. A type whose face is not in proportion to the depth of the shank (*e.g.* a small pica cast on a pica body) is a *bastard type*.

Sizes of Type.

Types of are various sizes, from those used for the smallest pocket bibles to those used for large placards, and the sizes are classified according to the dimensions of their ends or *bodies*. In a given fount the length of the end of the type which bears the face is the same for all characters, but the width varies, an i for example being narrower than a w. Each body has a distinctive name, but it used to be a confusing and inconvenient anomaly that types made by different founders, though called by the same name, were not of precisely the same size. The long primer of one maker, for example, was 89 lines to the foot, of another 89½, and of a third 92. This inconvenience was remedied in America by the founders agreeing to adopt a uniform *point-system*; the pica of 0·16604 in. was taken as a standard, six picas being 0·996 in., and was divided into twelve parts or points of 0·013837 in., other types being cast as multiples of one of these points, and specified according to the number of them they contained. This system, with the same basic unit, has been adopted by British typefounders, though not to the exclusion of older sizes, and it has been extended to regulate the thickness or *set* of types, and also the position of the faces on the bodies as regards alignment. The Didot point-system, used in France, is based on a point of 0·376 mm., the English point being 0·35145 mm. The following are specimens of the principal bodies of ordinary British and American types, with their corresponding appellations on the point-system, the first five being now mainly for display purposes:—

		Points.
The Encycl	2-line small pica .	22
The Encyclopa	Great primer . .	18
The Encyclopaedi	English	14
The Encyclopaedia	Pica	12
The Encyclopaedia Br	Small pica . . .	11
The Encyclopaedia Britan	Long primer . . .	10
The Encyclopaedia Britanni	Bourgeois	9
The Encyclopaedia Britannica	Brevier	8
The Encyclopaedia Britannica, 11	Minion	7
The Encyclopaedia Britannica, 11th	Nonpareil	6
The Encyclopaedia Britannica, 11th edition	Pearl	5

The height of types is $\frac{11}{12}$ in. Those lower than the standard dimensions are said to be "low to paper," and if surrounded by higher types will not give perfect impressions. Spaces and quads are ¾-in. high for direct printing, but for stereotyping are cut rather higher (0·83 in.).

Varieties of Face.

According to the purpose for which they are used, types are divided into two classes—book type, including Roman and Italic; and job type, including a multitude of fanciful forms of letters, chiefly founded on the shape of the Roman and Italic letters, and intended to be more prominent, delicate, elegant, &c. It is impossible to enumerate all the varieties of the latter class, as additions are being constantly made and once popular styles always going out of fashion. The leading varieties are the antiques, which are Roman letters with strokes of nearly uniform thickness, as **M**; sanserifs or grotesques, which have no serifs, as **M**; blacks, as 𝔐; and scripts, which represent the modern cursive or Italian handwriting, as ℳ. Black letter is now only a jobbing type in English-speaking countries, although it was the first character used in printing. It is still used in Germany, with certain modifications, as the principal text-letter for books and newspapers. A comparison of the numerous reproductions that have been issued of Caxton's works with any modern line of black letter will show how greatly the form and style have been altered. The present style of Roman type dates only from about the first quarter of the 18th century. Previously the approved shape was as follows:—

Printing has been defined to be the act, art, or practice

The use of this type was revived by Charles Whittingham, nephew of the founder of the Chiswick Press, about 1843, and it has since become a favourite form, under the name of old style. Some of the punches cut by the first notable English type-founder, William Caslon (1692–1766), have been preserved, and types are being constantly cast from them. Nearly all founders now produce modernized old style.

In this connexion reference may be made to the modern revival of artistic book printing in England by William Morris and others influenced by him. This development took definite form in the founts and books of the Kelmscott Press, which is distinguished by the use of three founts designed by Morris. The Troye and Chaucer founts, both Gothic, are best fitted for ornamented medieval works, while the Golden or Roman fount is without the exaggerated contraction of form laterally, the exaggerated use of thick and thin strokes, and the vicious stroke-terminations common to modern founts. It is a type of full body, designed in careful relation to the up and down strokes, and resting upon solid serifs, as with Jenson's fount, for instance, but in detail more allied to fine penmanship or black letter. The *Vale* books, often classed with the Kelmscott, may be counted with them so far as they also are controlled by one designer, from the important matter of type, decoration and illustration, to that of "build" and press work. The first Vale book in which these conditions were achieved is *Milton's Minor Poems* (1896). In this is employed the Roman type, known as the Vale fount, designed by Charles Ricketts, which differs from the Kelmscott fount in a greater roundness or fullness of body, and in a modification of details by the conditions of type-making. The second fount used in the Vale issues, first employed in *The Plays of Shakespeare* (1896), is less round in body, more traditional in detail and lighter in effect.

Manufacture of Type.—Type is made of an alloy, known as type-metal, which consists chiefly of lead, with smaller amounts of antimony and tin. The exact proportions vary in different countries and foundries and with the size and quality of the type, but in general more than 60% is lead and the antimony predominates over the tin. Sometimes small quantities of other metals, such as copper and iron, are added. Large letters, such as are used for bills and posters do not come within the province of the type-founder; they are made of wood, chiefly rock maple, sycamore, pine and lime, planed to the right size and engraved by special machinery.

Matrices for Type.

The earliest printers made their own types, and the books printed from them can now be distinguished with almost as much certainty as handwriting can be identified. The modern printer has recourse to the type-founder. The first step in the making of type, according to the old method, is the production of a *matrix*. The letter is cut on the end of a piece of fine steel, forming the punch (fig. 2), which is afterwards hardened. A separate punch is required for each character in every fount of type, and the making of them requires great care and delicacy in order that the various sorts in a fount may be exactly uniform in width, height and general proportions. During the process of its manufacture, the punch is frequently tested or measured by delicate gauges to insure its accuracy, and from time to time it is examined by means of a *smoke-proof*, that is, an impression obtained by holding it in a flame and stamping it on paper. When the letter is perfect, it is driven into a piece of polished copper, called the *drive* or *strike* (fig. 3). This passes to the justifier, who makes the width and depth of the faces uniform throughout the fount. They must then be made to line exactly with each other. When completed, the strike becomes the matrix (fig. 4), wherein the face of the type is made. But matrices are now commonly produced by the aid of an engraving engine which copies a standard drawing of each letter on any desired scale, and they may be obtained from existing founts by electrotyping.

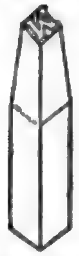
FIG. 2.—Punch.

FIG. 3.—Drive.

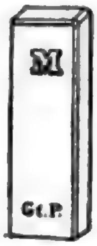

FIG. 4.—Matrix.

Type Casting.

Until well into the 19th century types were cast from the matrices in small hand-moulds, the output from which with a skilful worker was about 400 letters an hour. The mould consisted of two portions fitting closely to each other and containing the matrix with a space to receive the metal for the shank; holding it in his left hand the operator poured in the metal with his right, and after jerking it at arm's length, to bring the metal well up against the matrix, opened the two halves and threw out the type. In 1838 David Bruce, Junr., of New York, a Scotsman, who had migrated to America, invented a machine to perform substantially the same operations; this increased the rate of production to about 100 a minute for ordinary sizes, and with improvements and modifications remained a standard appliance for 40 years after its introduction. The metal, kept molten by a small furnace, was injected by a pump into the mould, which at every revolution of the axle came up to the spout of the pump, received a charge of metal, receded, opened, and discharged the type. But neither the hand mould nor the Bruce machine produced finished type. To the bottom of each there was attached a wedge-shaped *jet* (fig. 5), somewhat similar to that on a bullet cast in a hand mould. This had to be picked off by hand; the burr on the shoulder of the types had also to be rubbed off, and a groove had to be cut in the bottom to form the feet. Many efforts were made to devise machines which should perform these operations and produce finished type, one of the most satisfactory being that patented by Henry Barth, of Cincinnati, in 1888, but the principle of the divided mould which opened to discharge the type was generally retained. A new principle, however, was adopted by Frederick Wicks (1840–1910) in his rotary type casting machine, which was developed into a practical apparatus in London just at the end of the 19th century, and which is able to produce finished types, ready to be despatched to the printer without any inspection or treatment beyond packing, at a

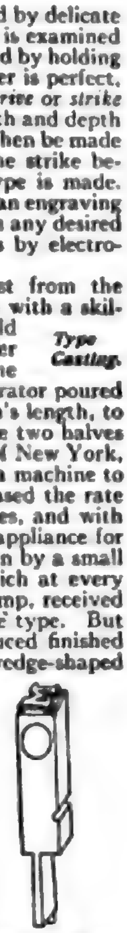
FIG. 5.—Type with jet.

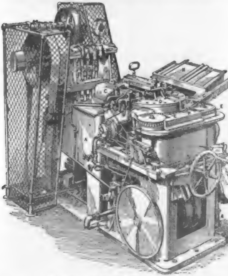

FIG. 6.—Wicks Rotary Type-casting Machine.

continuous rate of 60,000 an hour. It consists of a horizontal mould wheel, 20 in. in diameter, contained in the casing D (fig. 6), in which are cut 100 radial slots, each having a matrix at its inner end. These slots thus form moulds, and are of varying width according to the letter each has to cast. Each wheel can only produce type of the particular body for which it has been cut, but by changing the matrices the moulds can be made to cast any description of face capable of being received upon the body. The wheel is rotated once in every six seconds, so that the slots are successively presented to a jet of molten type-metal, which is pumped from the metal reservoir A by a pump B of special construction, and forced out at high pressure through a nozzle under the shield C. As soon as any particular slot has passed the jet and been filled with metal, a cam-action comes into play and gradually pushes out the formed type. This operation is completed in half a revolution, the ejected type being taken up by carriers mounted on a continuous chain E, which is moved along exactly in step with the wheel. The carriers, which are of different sizes according to the particular letters they have to hold, are raised by a cam-action as they come opposite the slots to receive the types, but fall again at the point F, depositing the letters at the end of the race G. Each successive type thus dropped pushes its predecessors farther along the race until when the row contains 200 types—the product of two revolutions of the wheel—an attendant lifts the whole series off and places them on the plate H, one row below the other. Since the sequence of the letters is of course the same in each revolution, the result is that each vertical line on the plate consists of the same character, and each sort can be easily removed and packed in any required form for despatch to the printer. As soon as each slot has been emptied of its type, another cam begins to draw in the matrix towards the centre of the wheel, so that it is in as far as it can go by the time the slot is again opposite the jet. To prevent a type from being drawn back with the matrix, the bead-cam K engages with the nicks which have already been formed on the front of the type-bodies by the operation of the machine. To ensure trueness and accuracy in the product, the conditions under which casting is conducted are maintained as uniform as possible. The composition of the type-metal alloy is kept constant; the temperature of the molten metal is carefully regulated by the aid of a pyrometer to about 800° F., so as not to volatilize the antimony it contains; the pumps work up to a pressure of 900 lb to the square inch, and by the interposition of a reducing valve deliver the metal at the nozzle at a constant pressure of 200 lb; and the moulding slots are maintained at an equably cool temperature by an elaborate system of water circulation.

Type-case.

Type-setting by Hand.—The types, received from the foundry in the packages called pages, containing about 8 lb, are placed in shallow trays called *cases*. These contain compartments or *boxes*, each of which is appropriated to some particular *sort* or character. The cases when in use stand on *frames* or sloping desks. The case at the top is the *upper case*, and that below the *lower case*. The former contains 98 equal-sized boxes, appropriated principally to the capital and small capital letters; the latter has 53 boxes of various sizes, appropriated to the lower case sorts. The difference in the size of the boxes corresponds to the difference of quantity of letters in a fount, the lower-case *e*, for instance, having the largest box. As a man picks out from the boxes seldom less than 1500 letters an hour and distributes or replaces on the average about 5000 an hour, it is necessary that the most economical allocation of the boxes should be adopted. The system of allocating the various types is called the *lay* of the case; one plan is illustrated in fig. 7.

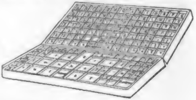

FIG. 7.—Type-case.

Composing.

The types when taken from the cases are arranged in lines (*composed* or *set up*) in an instrument called a *composing stick*, made of iron, brass or gun metal. The slide in the middle is movable so as to accommodate varying lengths of lines. The compositor fixes the "copy" or document which he has to repeat in type, in a convenient place before his eye. In his left hand he holds the composing stick, and with the thumb and first finger of the right hand lifts the letters from the boxes, and arranges them in the composing stick, every letter, point or sign being picked out separately. In this operation he is much assisted by the use of a *setting-rule*, a thin brass or steel plate which, being removed as successive lines are completed, keeps the type in place. When so many words and parts of words as will nearly fill the line have been composed, it is made the exact length required by increasing or diminishing the space between the several words. This is called *justifying* the line and is effected by means of the spaces already mentioned. If the work is not "solid"—that is, if the lines are not close together—the strips of metal called *leads* or *brasses* are inserted between each. When the composing stick is filled, the type is lifted upon a *galley*, a shallow tray of wood or metal, two or three sides of which are flanged, for the purpose of supporting the type when the galley is slightly inclined. Stickful after stickful of type is placed on the galley until it is full. The matter is then fastened up, a *proof* taken at the proof press, and the work of the *reader* or corrector of the press begins (see PROOF-READING). The proof, marked with the necessary corrections, is given back to the compositor, in order that he may make the required alterations in the type.

Imposing.

The type, being duly corrected, is made up into pages of the required length (unless the author has desired to see proof in *slip*). It is then *imposed*, that is, the pages are arranged in such a manner that, when printed and the sheet folded, they will fall in due numerical sequence. The impression from any arrangement of pages will be the reverse of that in which they are laid down. If a four-page newspaper be opened and spread out with the first page uppermost, it will be found that on this side the order of pages is 4, 1, when turned the pages are 2, 3. The type pages must be ranged in the reverse way, as 1, 4; 3, 2. Thus the fourth page is placed alongside the first, because both must be printed together on the outside; the third page is to the left, and the second to the right, because in books the odd page—the verso—is always to the right. For a quarto a sheet of paper is folded twice, that is once across its breadth and then once in a perpendicular direction down the middle. It contains four leaves, and if these are printed on both sides eight pages. The two sides of a sheet are called the outer and inner formes respectively. A sheet of octavo is folded three times, making 8 leaves or 16 pages. The size of a book depends not only upon the number of times the sheet has been folded, and described accordingly as 4to, 8vo, 12mo, &c., but upon the size of the sheets. The dimensions of the papers commonly used in book-printing are: imperial, 22×30 in.; super royal, 20¼×27¼; royal, 20 × 25; medium, 19 × 24; demy, 17½ × 22½; double crown, 20 × 30; double foolscap, 17 × 27; post, 15½ × 19½. Hence to say merely that a book is a quarto gives no precise indication of its dimensions, as a quarto of one size of paper may be smaller than an octavo of another; it is also necessary to know the size of the sheets of which it is composed.

Signatures.

When a printed book is opened, it will be found that at the foot of certain pages there is usually a letter and at the foot of another a letter and a figure, as B, B 2; farther on another letter and another letter and figure. On going through the book it will be seen that the letters are in regular alphabetical order, and occur at regular intervals of eight, twelve, sixteen, &c., pages. These designate the several sheets of which the book is composed and are called *signatures*, so that a sheet may be designated B, and the pages of which it consists are thereby sufficiently indicated. (Occasionally, numbers are used instead of letters.) These signatures assist the binder in folding, as they occupy a certain specified place in each sheet; hence to ascertain if the sheet has been folded properly it is only necessary to examine the position of the signature. The binder also is thus assisted in *gathering* or collating together the sheets of a volume in proper order. Signature A is omitted, because it would be on the title or first page, and would be both unnecessary and unsightly. By old custom J, V and W are discarded, I and J, U and V being originally used indiscriminately, by printers, while W was written UU or VV. When the alphabet is exhausted, a new one is begun, distinguished by a figure precedent, as 2 B, 2 C, &c.

Forme.

The pages of types are arranged in proper order on a flat table, covered with stone or metal, called the *imposing stone*, and are then ready to be made into a *forme*, that is, into such a state that they can be securely fastened up and moved about. The forme is enclosed in an iron frame or *chase*, sub-divided by a cross bar. The portions of the type are separated by *furniture*, which may be of metal or wood or both. It is of the same height as the chase, but lower than the type, and therefore does not print, but forms the margin of the printed pages. As the sides of the two sections of the formes are pieces of furniture of a tapering shape, called *side-sticks*, and at the top and bottom corresponding pieces, called *foot-sticks*. Small wedges, called *quoins*, are inserted and driven forward by a mallet and a *shooting-stick*, so that they gradually exert increasing pressure upon the type. Other mechanical means for locking up are also occasionally adopted. When sufficiently locked up, the whole is quite as firm and portable, however many thousands of pieces of metal it may consist of, as if it were a single plate, and is ready for use on the printing press, either directly or in the form of a stereotyped or electrotyped copy.

Distributing.

After use the type undergoes the operation of *distributing*, which is the converse of composing; it is de-composing the forme and returning the several letters to their proper boxes in the case. The forme is first washed over with an alkali or other detergent to remove the ink from its surface, and then laid down on the imposing surface, unlocked and damped; this assists the cohesion of the type, after the chase, furniture, side-sticks, &c., are removed. The compositor then takes in his left hand, supported by a setting rule, a portion of type in lines, and with the right hand takes a word or so between the finger and thumb, letting each letter drop separately into its proper box. The types are held upside down, that is, with the nicks uppermost; hence the letters of each word are read from left to right like ordinary matter when printed, but the words are of course dealt with in the inverse order.

Type-setting by Machine.—The above method of producing a printing surface depends entirely upon hand labour, but it has long been an object of inventors in connexion with printing to perfect a mechanical system by which hand-work may be done away with both in setting type and in distributing it after use. The first step in this direction was the construction of composing machines in which the compositor put together types in the required order, not by lifting them one after another from his "boxes" and placing them by hand in his "stick," but by operating a keyboard which liberated them from magazines and assembled them in the order in which the keys had been struck. Such machines were followed as a natural correlative by distributing machines which performed the converse operation. Then the idea occurred of avoiding distribution altogether, by returning the printing surface to the melting-pot and using the metal over again to produce an entirely new printing surface as required, instead of sorting the types into their various kinds to be set up again either by hand or by machine. There are two main solutions of this problem. One is to manufacture ordinary movable types at a cost that is less than that of distribution, when it obviously becomes advantageous to treat the formes, after use, as old metal and return them directly to the melting pot without distribution. In 1900 *The Times* began to adopt this method, thus securing the advantage of fresh new type for each issue. In its offices for several years type made by the Wicks casting machine was set up by composing machines, and after being used in making the necessary stereotype plates was returned to the foundry to be melted and recast. The other solution depends upon the employment of apparatus which are in effect combinations of type-setting and type-casting machines, and may be divided into two broad classes: (*a*) those in which, by the operation of a keyboard, letters are translated into metal types which appear as a product for use in the printing-press, not singly, but cast into complete bars or lines of type; and (*b*) those in which the final product is separate types, delivered made up into lines of the required length. The former class is exemplified by the Linotype, the Typograph, and the Monoline machines, the latter by the Lanston Monotype, the Tachytype and the Goodson. In machines of the Linotype class, which have come into extensive use, especially for newspaper printing, it is impossible to make corrections or alterations in the line of type after it has been cast. The smallest change, such as the addition of a comma, involves the resetting and recasting of a whole line, while, if two or three words have to be added or removed, the compositor may have to recast a considerable number of lines, perhaps a whole paragraph. Machines of the second class, like the Monotype, which has been employed for setting up the present edition of the *Encyclopaedia Britannica*, appeal rather to the book printer, though the Monotype is used by such newspapers as *The Times* (London) and the *Sun* (New York). They have the advantage that corrections can be made as with hand-set type; but for newspaper work the fact that the manipulation of the keyboard does not, as with the Linotype, directly produce a printing surface but merely a punched strip of paper, which has then to be passed through a separate casting machine, inevitably introduces some delay. This is a matter that must be taken into account in the hurried conditions under which a daily paper is produced, when the shortest possible interval must elapse between the time when the latest news is received and the actual printing is begun. A machine invented by Mr H. Gilbert-Stringer is designed to combine the advantages of the Linotype and Monotype machines by casting at a single operation separate types properly arranged in lines and uniformly spaced. Up to the point where the matrices are ranged in a line ready for the bar of type to be cast, the mechanism may be identical with that of the Linotype; from that point each matrix is separately pushed into a mould which is automatically varied in size to suit the size of the particular letter it is casting, and also casts the spaces between the words (determined by the use of a modified Schuckers wedge-space), so that when all the individual types and spaces in the line are assembled after casting they exactly fill the line. The machine requires only one operator, and while one line is being cast the matrices which have formed the preceding one are being distributed to the magazine, as in the Linotype, and the following one is being set up. The matrices differ from those of the Linotype in that the face is impressed on their broad flat surface, not on the thin edge.

Composing Machines.—An early attempt to make a machine for setting up ordinary foundry type was patented in England by Dr William Church in 1822. In the machine of Young and Delcambre, which was used in London for composing the *Family Herald* in 1842, and was the forerunner of the Kastenbein machine adopted in *The Times* office in 1869, the types were arranged in tubes placed either vertically or horizontally, and the lowest or endmost letter was, when wanted, ejected from the tube by a pusher actuated by a finger-key. It then passed down the channels of a guide-plate to a common point, whence it was pushed forward by a reciprocating motion to the line of previously composed matter and divided into lines of the required length. To the same group belong the Fraser machine, the Hattersley and the Empire, also known in America as the Burr. Another group of machines developed from the rotary composer was invented by Alexander Mackie of Warrington in 1871, and used in the office of the *Warrington Guardian*. In this the types were arranged in vertical tubes round a rotating disk, and the letters were automatically selected by a strip of paper previously punched with holes through which feelers passed and caused the desired type to be ejected upon a travelling band. This device of using a paper strip perforated in different positions to correspond to different letters was patented by Felt in 1860 (*U.S. Patent Spec.* No. 28,463), and he also utilized it for effecting distribution, the "dead" or used type being dealt with by another machine through which the paper strip was run in the reverse direction. This quality, however, was not so valuable as it might appear at first sight, since any correction, however simple, of necessity made the perforated paper ineffectual as a guide in distribution. The Thorne machine, exhibited in the Paris Exhibition of 1878, was a development of the principle of a rotating disk, but the types, which were contained in a vertical cylinder, were selected by touching keys in the ordinary manner. When liberated they fell upon a rotating table, whence they were deflected by a finger upon a travelling band and delivered into the composing race. The American Simplex machine resembles the Thorne very closely. The Wicks composing machine, again, adopts a different principle from both the above groups. The types are ejected upon a straight race set at an angle of 45°. Thus each has to travel a different distance from the other—a result which the inventors of the Delcambre group of machines were at pains to avoid; and when several keys are struck together so as to give a combination like "and," the several types delivered to the race follow each other in proper succession to the point of assembly, the letter whose key is nearest to the left side of the keyboard preceding those whose keys are more to the right.

The Paige composing, justifying and distributing machine—an American invention—is one of the most remarkable pieces of mechanism ever put together. It contains 18,000 parts, and the patent specifications form an imposing volume. It is operated by keys in the ordinary way, but automatic mechanism advances the ejected letters in words, spaces them and inserts the lines in the "galley" with "leads" if desired; at the same time other mechanism automatically distributes dead matter and refills the tubes which contain the supplies of types. Two machines were made, and are said to have done good work, but the cost of construction and the complicated nature of the mechanism made the apparatus impracticable commercially, and the two that were made are now on view as mechanical curiosities, the one in the Columbia Institute and the other in Cornell University. The Paige machine dispensed with the guide-plate of the Delcambre group, the letters being ejected on a plane along which a driver passed at intervals and swept the type into a receiving race on the left of the machine. The Dow composing and justifying machine, a later American invention, adopts this characteristic of the Paige, but has two drivers meeting at the centre of the plane which receives the letters. The types having been swept to the centre by these, a vertical driver forces them downwards into a vertical receiver. When a line has been set a justifying key is touched, the vertical line passes to a horizontal position, and is driven forwards to a point where apparatus measures it, and having removed temporary brass spaces replaces them with others selected from a series of ten different thicknesses.

Distributing Machines.—There are two main classes of distributing machines. One, which is exemplified by the Delcambre or the Fraser machine, is operated by a keyboard; the compositor strikes the keys corresponding to the letters of the printed matter he wishes to distribute, and thus opens gates through which the types pass and find their way down a guide-plate to their proper tubes. The other comprises a number of machines which agree in requiring the type to be specially nicked for their use. Each type has its own particular combination of nicks, and the receptacles in which the type is collated are provided at their entrances with wards corresponding to these nicks, so that each type can only enter the one receptacle for which its nicks are arranged (fig. 8). In some cases, as in the Empire and the Dow, the distributor is a separate machine; in others, as the Thorne and the Simplex, it is combined with the composing machine in such a way that the two work simultaneously.

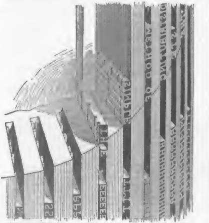
FIG. 8.—Nick System of Distribution (Simplex Machine).

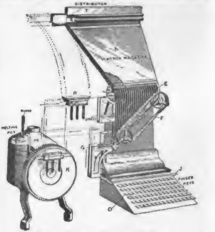

FIG. 9.—Diagram of Linotype Machine.

Linotype.—An enormous amount of ingenuity has been expended on the Linotype, which was developed into a practical machine by Ottmar Mergenthaler, of Baltimore, though two of its elements—the solid bar of type and the wedge space—were invented by others, the former by T. W. Smith, of the Caslon Foundry, and the latter by Jacob W. Schuckers, of Washington. The following will give a general idea of its working: In the magazine A (fig. 9) are a series of matrices, formed with the characters in intaglio on one edge, which are discharged by gates, operated from the keyboard D into the chutes E, and thence upon the travelling belt F; this delivers them upon a revolving pusher wheel by which they are set up in proper order in the assembler block G. Above the assembler block is a space magazine, and from this the space key J releases a space bar, when desired, which drops into place in the line. As the matrices are forced into the assembler block they move to the left against the resistance of a sliding abutment, thus being held compactly in place in the line. As soon as a complete line is set up, the compositor operates a hand lever by which the assembler block and matrices are raised to the level of a horizontal slide, where the line is grasped between two jaws and carried to the left, and lowered into position opposite the mouth of the mould wheel K. Here the justification of the line is effected by means of an upwardly moving plunger which drives the wedge-shaped spaces, seen in fig. 10, into the line, and thus expands it to the exact length required. The matrices are then locked firmly in a vice with the characters opposite the mouth of the mould. At this time the pump plunger in the melting pot M (fig. 9) is forced downwards by mechanism actuated by suitable cams on the driving shaft, and a jet of molten type metal is ejected into the mould and against the characters on the matrices, thus casting the bar or "slug." The cast bar is next forced, by a revolution of the wheel K, between a pair of knives, by which it is trimmed, and into a galley, where it is pushed along by a packer arm and placed beside its fellows in a column ready for use.

It is next necessary to distribute the matrices to the magazines, in order that the operation of the machine may be carried on continuously. The matrices and spaces are raised from the vice and brought opposite a bar R, which carries on its under side a series of undercut ribs corresponding to the teeth which are shown at the edges of the V-shaped notch in the top of the matrices (fig. 10) and the matrices are pushed on to this bar so as to be suspended by the ribs. They are next pushed still farther towards the right of the machine into a box having ribs engaging the notches in the side of the matrices, but with downwardly inclined grooves crossing these ribs, by which the shoulders at the upper end of the space bars are allowed to descend, and the spaces are thus dropped out of line and fall through a chute into the space-box from which they originally came. The matrices are pushed still farther to the right, where their teeth slide along the distributor bar T, being carried by two screws which engage opposite sides of the matrices and keep them separated so that they hang loosely from the distributor bar. The ribs of the distributor bar are so arranged as to support each matrix by one or more pairs of teeth until it arrives opposite the mouth of its own magazine channel, where they are interrupted in such a manner that the matrix is unsupported and drops into the magazine for further use. It will thus be apparent that there is a constant circulation of the matrices through the machine, and the composing of one line, the casting of another and the distribution of a third are all carried on at the same time, which adds greatly to the speed of the operation. The machine may be fitted with double magazine, which with double-letter matrices gives 360 characters or four faces ready for use, or even with three magazines, which provide for 540 characters or six faces, the movement of a hand lever bringing the desired magazine into use.

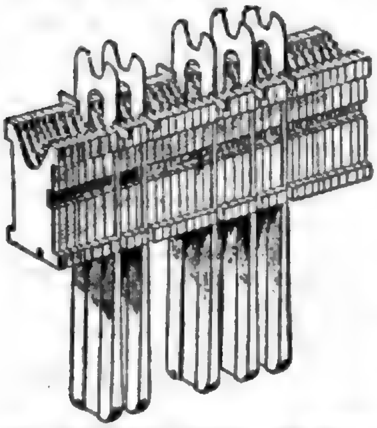
FIG. 10.—Line of Matrices with Spaces.

Lanston Monotype.—In the Lanston apparatus there are two distinct machines, a ribbon-punching machine and a type-casting and composing machine. The first of these is a small device resembling a typewriter, having a number of keys, 257 in all, corresponding to all the characters used in a fount of type, with some additions representing certain movements to be performed by the composing machine. These keys, when depressed, admit compressed air to a plunger or combination of two plungers working punches, whereby perforations are made in a strip of paper fed step by step through the machine. Most of the keys make two perforations, though some a single one only. These perforations stand in a transverse line across the strip, as shown in fig. 11, and their relative position in the line varies with the particular key operated. At the end of each word a spacing key is struck, and suitable perforations are made in the strip, and as the end of a line is neared, a bell rings to warn the operator, who, by looking at a line scale facing him on the machine, is enabled to see how many units of space remain to be filled, and can then determine whether another word or syllable can be set up. If not, it then becomes necessary to provide proper space-type to justify or fill out the line, which is done by increasing the width of the normal space-types already provided for in the proportion which the number of units of space still vacant in the line bears to the number of space-types which the line contains. For example, if there are ten space-types and $\frac{1}{16}$ of an inch of space remains to be filled, each space-type must be increased in thickness just $\frac{1}{160}$ of an inch completely to fill the line. It is not necessary, however, for the operator to make this calculation, for he has only to consult the scale provided for this purpose, and is referred at once to the proper keys to punch the justifying perforations in the strip. Each time the space key is depressed a pointer rises one step against a cylindrical scale placed vertically in front of the machine, and when the operator has finished setting a line he presses a special key which causes the cylinder to rotate until it automatically stops with the required number at the end of the pointer. This number is in the form $\frac{3}{4}$, and to complete the justification of the line the operator has only to depress the appropriate keys in the top two rows of the keyboard, in this case No. 3 of the top row and No. 4 of the second.

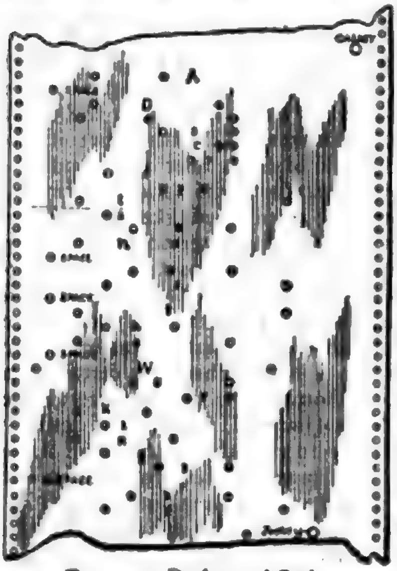

FIG. 11.—Perforated Strip.

The ribbon thus prepared in the punching machine is used to control all the movements of the casting or composing machine. The matrices for making the type faces are formed in a plate about 3 in. square, and any character is brought opposite the casting point by the movement of the matrix-carrier in two directions, or rather by the resultant of two such independent movements. As the perforations for controlling the galley movements and those for justifying the line are necessarily made after the others in the perforating machine, and these operations must be provided for in the composing machine before the line is set up, the latter machine is so organized that the ribbon is passed through and the types are set in the reverse order to that in which the strip was punched. The perforated ribbon is wound from one wheel off to another, passing over the edge of a tracker board in which there are a number of holes corresponding to those which may occur in the ribbon, and each of these holes communicates by a tube with a small piston which controls some device for performing one of the various operations of the machine. As the ribbon passes over the tracker board, a jet of compressed air passes to the appropriate operating device whenever a ribbon perforation or any combination of them coincides with the proper holes. The two perforations on each transverse line control two stop pins which limit the movements of the matrix-carrier to bringing the proper matrix to the casting-point, while the justifying perforations set in motion devices which open the space mould to cast space type of the exact size to effect the proper justification of the line, and the galley perforation starts the feeding device which moves the galley for the next line of type. The matrix-carrier may be readily removed and another carrying a different style or size of type substituted therefor.

In modern printing it is often the case that the printing surface actually used in the press (see PRINTING) is not the original forme of type, whether consisting of separate type set up by machine or by hand, or of Linotype slugs, but a reproduction of it made by electrotyping or by stereotyping. Of these two processes the former is the slower and the more costly, but it produces the better results, since electrotyped plates are capable of yielding a larger number of sharp impressions than are stereotypes.

Electrotyping.—In making an electrotype, a moulding composition consisting mainly of wax with a little blacklead, is poured when molten into a shallow metal tray, and, when it has set, its surface is brushed over with blacklead and polished. An impression of the forme, which is also blackleaded, is next taken in the wax while it is still warm, often by the aid of a hydraulic press, and the mould thus obtained, after being separated from the forme, undergoes a process of *building up*, which consists of dropping heated wax upon those portions which require to be more deeply sunk in the finished type, that is, upon those places where "whites" are to appear in the print. The face of the finished mould is then carefully covered with blacklead, which is a conductor of electricity, and the whole is immersed in an electrotyping bath, where copper is deposited on the blackleaded portions by means of the current from a Smee's battery or a dynamo machine. When the deposit, or *shell*, is sufficiently thick, it is disengaged from the wax mould, backed with a metal which resembles type-metal but contains a larger proportion of lead, and trimmed and planed. For use in rotary presses curved electrotypes may be produced.

Stereotyping.—The great advantage of stereotyping is in connexion with the production of newspapers, where the desideratum is the printing off of a large number of copies in a short time. For this purpose, in the first place, rotary machines must be employed, and stereotyping affords a ready means of obtaining curved printing surfaces to fit their cylinders. It is true that stereotyping is not absolutely necessary for rotary printing, since it has been found possible to print from movable type clamped on the cylinders in curved frames known as "turtles." But to set up duplicate formes of type is impracticable, and, therefore, this device does not permit the utilization of more than one press. Herein lies the second great advantage of stereotyping, for it enables the printer to obtain as many replicas of each forme as he desires, and thus not only to employ a number of machines simultaneously, but also to "dress" each of them with several duplicates of the same forme, as is required in the later developments of high-speed presses.

The first attempt at making stereotypes was by means of moist clay into which, after it had been impressed with the type and baked, molten type metal was poured; but this method did not yield a curved plate. Later the clay was replaced by papier-mâché, which being flexible can be bent to the required shape. This papier-mâché, known as *flong* and composed of several sheets of paper united by a paste capable of withstanding a high temperature without burning, is moistened and laid over the forme of type, into which it is well pressed either by beating with a long-handled brush or, according to the more modern and expeditious method, by being passed through a moulding press. The flong is next dried, for which

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purpose it is either placed with the type in a heated chamber covered with blankets which absorb the moisture, or is removed from the type and heated separately. Sometimes these two methods are used in combination; processes have also been devised for pressing the flong dry upon the type, when subsequent drying becomes unnecessary. For casting a plate the matrix thus prepared is fastened in a casting mould or *box* curved to the circumference of the cylinder of the press, and molten stereo-metal (a softer form of type-metal) is poured upon it. During this process the box stands upright, but while the matrix is being placed in position it lies horizontally, a swivel mounting enabling it to be readily turned. After time has been allowed for solidification, the cast is taken out, stripped from the matrix and adjusted on a "finishing saddle," where a machine cuts off the superfluous metal from its upper end and forms a bevel by which it can be clamped on the press. It is then placed face downwards in another machine which shaves out and smooths its interior surface, and finally it is set face upwards, while men with chisels remove protruding pieces of metal that might take ink and print.

Up to the end of the 19th century the general method of stereotyping was as outlined above, though of course there were variations in different establishments. The time required to produce a plate, as distinct from making the matrix, was about 1 or 1½ minute, and the process was expensive in labour since it required the employment of half-a-dozen men. This time may seem short enough, but when plates are needed by the score, as may be the case with a paper having a large circulation, the delay entailed by the preparation of the whole number by this method becomes of serious importance. Means were therefore sought to reduce it by the adoption of automatic mechanism. In the Autoplate machine, invented in America by Henry A. Wise Wood, and first used by the *New York Herald* in 1900, the operation of casting is performed automatically from the time the matrix is put in position until the finished plate is ready to be placed on the printing press, and from a single matrix four plates ⅞ in. thick, or seven or eight ½ in. thick, can be produced every minute, by the aid of three men only. The casting is done against a horizontal cylinder or core, the interior of which is cooled by water. Below it is a frame or "back" carrying the matrix. This back has an up and down movement of about six inches, and when it is in its topmost position there is a semicircular space between it and the core equal in length, breadth and thickness to the plate which has to be cast. Molten metal having been injected into this space by a pump, there is a pause of a few seconds to permit of solidification, and then the back falls, bringing away the matrix with it. Immediately afterwards the cylinder makes a half turn, and presents what was previously its upper half to the matrix for another cast. The first cast is taken with it as it turns, and is then pushed along from the top of the core against two rotating saws which trim its edges. Next it comes under a shaving arch, where it pauses while its interior surface is smoothed to proper thickness, and finally water is directed against its back, to cool it without wetting its printing face. The Junior Autoplate is a simpler machine which does not perform so many operations. In it the casting core is vertical, not horizontal, but the matrix is still automatically stripped from the plate, the casts are made alternately on the two halves of the cylinder, and as one plate is being removed another is being cast. The machine also automatically cuts off the sprue which is left on the top of the plate as it stands in the casting box. About three plates a minute are produced, but they are not delivered completely finished, and have to undergo several further operations before they are ready to be placed on the press. The Double Junior consists of two Junior Autoplates served from a common melting-pot, and its capacity is six plates a minute, with two matrices; and another machine, the Autoshaver, has been devised which can shave, cool and deliver that number of plates automatically, no labour being required except to take the plate from the casting machine and place it on the Autoshaver.

See *Practical Printing*, by John Southward and Arthur Powell (5th ed., London, 1900); *Modern Printing*, by John Southward (London, 1898); *The American Handbook of Printing*, by Edmund G. Gress (New York, 1907); *History of Composing Machines*, by John S. Thompson (Chicago, 1904); *Traité de la typographie*, by Henri Fournier (4th ed., Paris, 1904); "Type Casting and Composing Machines," by L. A. Legros, *Proc. Inst. Mech. Eng.* (London, 1908); "Modern Stereotypy and the Mechanics of the Newspaper," by Henry A. Wise Wood, *Journ. Franklin Inst.* (Philadelphia, 1910). (J. So.; H. M. R.)

TÝR, the Scandinavian god of battle. He is not a prominent figure in Northern mythology, for even in this special capacity he is overshadowed by Odin, and there are hardly any traces of worship being paid to him. Among other Teutonic peoples, however, he seems at one time to have been a deity of considerable importance. In Anglo-Saxon he was called Tī (*Tī*, *Tīg*, gen. *Tīwes*, whence "Tuesday") and equated with the Roman Mars. He is also identified with the German god mentioned more than once by Tacitus, as well as in inscriptions, by the name Mars. His Teutonic name is the same as the word for "god" in several other Indo-European languages (*e.g.* Lat. *dīvus*, Lith. *dëvas*, Skr. *devas*), and even in Old Norse the plural (*tívar*) was still used in the same sense. (See TEUTONIC PEOPLES § *Religion*, *ad fin.*) (H. M. C.)

TYRANT (Gr. *τύραννος*, master, ruler), a term applied in modern times to a ruler of a cruel and oppressive character. This use is, however, based on a complete misapprehension of the application of the Greek word, which implied nothing more than unconditional sovereignty. Such rulers are not, as is often supposed, confined to a single period, the 7th and 6th centuries B.C. (the so-called "Age of the Tyrants") of Greek history, but appear sporadically at all times, and are frequent in the later city-states of the Greek world. The use of the term "tyrant" in the bad sense is due largely to the ultra-constitutionalists of the 4th century in Athens, to whom the democracy of Pericles was the ideal of government. Thus the government which Lysander set up in Athens at the close of the Peloponnesian War is called that of the "Thirty Tyrants" (see CRITIAS). The same term is applied to those Roman generals (really 18) who usurped authority locally under Gallienus.

TYRAS, a colony of Miletus, probably founded about 600 B.C., situated some 10 m. from the mouth of the Tyras River (Dniester). Of no great importance in early times, in the 2nd century B.C. it fell under the dominion of native kings whose names appear on its coins, and it was destroyed by the Getae about 50 B.C. In A.D. 56 it seems to have been restored by the Romans and henceforth formed part of the province of Lower Moesia. There exists a series of its coins with heads of emperors from Domitian to Alexander Severus. Soon after the time of the latter it was destroyed by the Goths. Its government was in the hands of five archons, a senate, a popular assembly and a registrar. The types of its coins suggest a trade in wheat, wine and fish. The few inscriptions are also mostly concerned with trade. Its remains are scanty, as its site has been covered by the great medieval fortress of Monocastro or Akkerman (*q.v.*).

See E. H. Minns, *Scythians and Greeks* (Cambridge, 1909); V. V. Latyshev, *Inscriptiones Orae Septentrionalis Ponti Euxini*, vol. i. (E. H. M.)

TYRCONNELL, RICHARD TALBOT, EARL [TITULAR DUKE] OF (1630–1691), Irish Jacobite, came of an ancient Anglo-Norman family, the Talbots of Malahide. His father, Sir William Talbot (d. 1633), was a Roman Catholic lawyer and politician of note. His brother Peter was Roman Catholic archbishop of Dublin. Richard Talbot served as a royalist during the Great Rebellion. He was present in Drogheda (Tredah) when it was stormed by Cromwell on the 3rd of September 1647, and was one of the few members of the garrison who escaped from the massacre; he fled to Spain. He then lived like many other royalist refugees, partly by casual military service, but also by acting as a subordinate agent in plots to upset the Commonwealth and murder Cromwell. He was arrested in London in November 1655 and was examined by Cromwell. Once more he escaped, but it was said by his enemies that he was bribed by the Protector, with whom one of his brothers was certainly in correspondence. After the Restoration he had a place in the household of the duke of York (James II.). He was actively engaged in an infamous intrigue to ruin the character of Anne Hyde, the duke's wife, but continued in James's employment and saw some service at sea in the naval wars with the Dutch. He accumulated money by acting as agent for Irish Roman Catholics who sought to recover their confiscated property. He was arrested in connexion with the Popish Plot agitation in 1678, but was allowed to go into exile. He returned just before the death of Charles II., and during the reign of James II. he was the chief agent of the king's policy in Ireland. He was appointed commander-in-chief and created earl of Tyrconnell in 1685. The duty assigned him was to create a Roman Catholic army which might be used to coerce England. In February 1687 he was appointed lord deputy, and became the civil as well as the military governor of Ireland. Tyrconnell, who foresaw the revolution in England, entered into intrigues for handing Ireland over to the king of France in order to secure the interest of his fellow Roman Catholics. For a time he made a pretence of protecting the Protestants, but when the revolution of 1688 occurred in England he threw himself, after some hesitation, into the struggle against William III., and when James fled to France Tyrconnell was left as his representative. When William raised the siege of Limerick, Tyrconnell went over to France to seek help, and after his return (January 1691) he was little more than a spectator of the military operations. When he did act it was to thwart the French General St Ruth and his own countryman Sarsfield. He became so unpopular that he was compelled to retire to Limerick, where he died of apoplexy on the 14th of August 1691. In 1689 King James created him duke of Tyrconnell, but the title was recognized only by the Jacobites.

TYRCONNELL (*Tir-Conaill*), an ancient kingdom of Ireland. Conall Gulban, a son of Niall of the Nine Hostages, king of Ireland, acquired the wild territory in the north-west of Ulster (the modern Co. Donegal, &c.), and founded the kingdom about the middle of the 5th century. Of the several branches of his family, the O'Connells, O'Cannanans and O'Dohertys may be mentioned. The kings of Tyrconnell maintained their position until 1071.

TYRE (Phoen. and Hebr. צר, צור = "rock," Assyr. *Ṣurru*, Egypt. *Dara*, Early Lat. *Sarra*), the most famous city of Phoenicia. It is now represented by the petty town of Sur (about 5,000 inhabitants), built round the harbour at the north end of a peninsula, which till the time of Alexander's siege was an island, without water or vegetation. The mole which he constructed has been widened by deposits of sand, so that the ancient island is now connected with the mainland by a tongue of land a quarter of a mile broad. The greatest length of the former island, from north to south, is about ¾ m. and its area about 142 acres. The researches of Renan have refuted the once popular idea that a great part of the original island has disappeared by natural convulsions, though he believes that the remains of a submerged wall at the south end indicate that about 15 additional acres were once reclaimed and have been again lost. On this narrow site Tyre was built; its 25,000 inhabitants were crowded into many-storeyed houses loftier than those of Rome; and yet place was found not only for the great temple of Melqarth with its courts, but for docks and warehouses, and for the purple factories, which in Roman times made the town an unpleasant place of residence (Strabo xvi. 2, 23). In the Roman period the population occupied a strip of the opposite mainland, including Palaetyrus. Pliny (*Nat. Hist.* v. 19) gives to the whole city, continental and insular, a compass of 19 Roman miles; but this account must be received with caution. In Strabo's time the island was still the city, and Palaetyrus on the mainland was distant 30 stadia; modern research, however, indicates an extensive line of suburbs rather than one mainland city that can be identified with Palaetyrus. This name was given by the Greeks to the settlement on the coast under the mistaken impression that it was more ancient than that on the island; the Assyr. *Ushu*, frequently mentioned in the Amarna letters, makes it probable that Usu or Uzu was the native name. Owing to the paucity of Phoenician remains the topography of the town and its surroundings is still obscure. The present harbour is certainly the Sidonian port, though it is not so large as it once was; the other ancient harbour, the Egyptian port, has disappeared, and is supposed by Renan to have lain on the south side of the island, and to be now absorbed in the isthmus. The most important ruins are those of the cathedral, with its magnificent columns of rose-coloured granite, now prostrate. The present building is assigned by De Vogüé to the second half of the 12th century, but the columns may have belonged to the 4th-century church of Paulinus (Euseb. *H.E.* x. 4). The water-supply of ancient Tyre came from the powerful springs of Ras-al 'Ain (see AQUEDUCT) on the mainland, one hour south of the city, where there are still remarkable reservoirs, in connexion with which curious survivals of Adonis worship have been observed by travellers. Tyre was still an important city and an almost impregnable fortress under the Arab Empire. From 1124 to 1291 it was a stronghold of the crusaders, and Saladin himself besieged it in vain. After the fall of Acre the Christians deserted the place, which was then destroyed by the Moslems. The present town has arisen since the Motāwila (Metāwila or Mutāwileh) occupied the district in 1766.

The most important references to Tyre in the Bible are 1 Kings v., vii., ix.; Is. xxiii.; Am. i. 9 seq.; Ezek. xxvi.–xxviii.; 2 Macc. iv. 18 sqq.; Mark iii. 8, vii. 24 sqq.; Matt. xi. 21 seq. (and parallels); Acts xii. 20. Cf. also Joshua xix. 29; 2 Sam. xxiv. 7; Ezra iii. 7; Neh. xiii. 16; Ps. xlv. 12, lxxxiii. 7, lxxxvii. 4. For the history of Tyre see PHOENICIA. See also Renan, *Mission de Phénicie* (1864); Pietschmann, *Gesch. der Phönizier* (1889), 61–72; F. Jeremias, *Tyrus bis zur Zeit Nebukadnesars* (1891); H. Winckler, *Altor. Forschungen*, ii. 65 sqq.; A. Socin in Baedeker, *Pal. u. Syrien*.
(W. R. S.; G. A. C.*)

TYREE, an island of the Inner Hebrides, Argyllshire, Scotland. Pop. (1901), 2192. It is situated fully 2 m. S.W. of Coll, the isle of Gunna lying in the channel between the two islands, and has an extreme length from north-east to south-west of nearly 12 m. and a breadth varying from ¾ m. to 4½ m. Carnan Mor (460 ft.) is the highest point; there are several lakes. On the south-western point of Balephuill Bay are ruins of St Patrick's temple, besides duns and ancient chapels. Steamers call from Oban regularly at the small harbour of Scarinish. SKERRYVORE, a lonely rock in the Atlantic, 14 m. south-west, belongs to the parish of Tyree. The massive lighthouse, which Alan Stevenson erected in 1833–1843, was constructed of granite from the quarries of Hynish at the south-eastern extremity of Tyree.

TYRONE, EARLS OF. The earldom of Tyrone was first conferred by Henry VIII. in 1542 on Conn Bacach O'Neill, and was forfeited in 1614 when an act of attainder was passed against his grandson Hugh, 2nd earl (more strictly 3rd earl, for his brother Brien was for some years *de jure* holder of the title though never recognized as such), the famous rebel who fled from Ireland with the earl of Tyrconnell in 1607 (see O'NEILL). Descendants of the 1st earl in Spain continued to style themselves earls of Tyrone till the death early in the 18th century of Owen O'Neill, grandson of Owen Roe O'Neill. In 1673 Richard Power, 6th Baron Le Power and Coroghmore, governor of Waterford, was created viscount of Decies and earl of Tyrone, being succeeded in these titles by his two sons successively, on the death of the younger of whom in 1704 they became extinct. A daughter of this last earl married Sir Marcus Beresford, Bart., of Coleraine, Co. Derry, in 1717; and in 1720 Beresford was created Baron Beresford and Viscount of Tyrone. In 1746 he was further created earl of Tyrone, and after his death in 1763 his widow became in 1767 Baroness La Poer in her own right. The only surviving son of this marriage inherited the titles of both his parents, all of which were in the peerage of Ireland, and in 1786 he was created a peer of Great Britain as Baron Tyrone of Haverfordwest in the county of Pembroke; three years later he was created marquess of Waterford, with which dignity the earldom of Tyrone has remained conjoined.

TYRONE, a county of Ireland in the province of Ulster, bounded N. and W. by Donegal, N.E. by Londonderry, E. by Lough Neagh and Armagh and S. by Monaghan and Fermanagh. The area is 806,658 acres or about 1260 sq. m. The surface is for the most part hilly, rising into mountains towards the north and south, but eastward towards Lough Neagh it declines into a level plain. Running along the north-eastern boundary with Londonderry are the ridges of the Sperrin Mountains (Sawel, 2240 ft., and Meenard, 2061 ft.). Farther south there is a range of lower hills, and Mullaghcarn, north-east of Omagh, reaches 1778 ft. South of Clogher a range of hills, reaching 1255 ft. in Slieve Beagh, forms the boundary between Tyrone and Monaghan. On each side of the Mourne River near Omagh rise the two picturesque hills Bessy Bell and Mary Gray. The Foyle forms a small portion of the western boundary of the county, and receives the Mourne, which flows northward by Newton Stewart. The principal tributaries of the Mourne are the Strule (constituting its upper waters), the Derg from

Lough Derg, and the Owenkillew, flowing westward from Fir Mountain. The Blackwater rises near Fivemiletown and forms part of the south-eastern boundary of the county with Monaghan and Armagh. With the exception of Lough Neagh, bounding the county on the east, the lakes are small, also few in number. Lough Fea is picturesquely situated in the north-west, and there are several small lakes near Newtown Stewart.

Geology.—The Sperrin Mountains in the north consist of ordinary "Dalradian" mica schists, covered mostly with grass. Lower Carboniferous Sandstone occurs as an outlier between the mountains and Strabane. The relation of the northern schists to the gneissic and "green rock" axis that forms the central moorland of Tyrone is obscure; intrusions of granite have evidently coarsened the structure of this axis. Ancient perlitic rhyolites occur among the "green rocks" on its northern flank. Omagh lies on Lower Carboniferous Sandstone, which, fringed by Old Red Sandstone, stretches west from the town to the county boundary; but the Dalradian schists appear continuously south of this from Omagh to Lack in Co. Fermanagh. A great mass of Old Red Sandstone, rising in long ranges of hills, occupies most of the south of the county, resting on Silurian shales at Pomeroy. Lower Carboniferous sandstone and limestone occur on the south flank of this upland, and extend over its east end to Cookstown. At Slieve Beagh in the extreme south Upper Carboniferous sandstones and shales are reached, and from Coalisland to Dungannon true Coal Measures appear. This coalfield includes one fine seam 9 ft. thick at Coalisland; less important coals occur in the Millstone Grit series at Dungannon. Though much denuded before Triassic times, the field doubtless continues eastward under the Triassic sandstone that stretches towards Lough Neagh. The pale clays, probably Pliocene, of the southern shore of the lake cover the flat land east of Coalisland, and are several hundred feet thick. North of Stewartstown, near Tullaghoge, a very small patch of Magnesian limestone contains Permian marine fossils; and, farther north, the county includes part of the basaltic plateaus, protecting Chalk, which extend away into Co. Londonderry. The Glacial epoch has left immense deposits of gravel and long eskers throughout the county. These are especially conspicuous north of Pomeroy. Fire-clay is raised from the collieries at Coalisland; but coal-mining here awaits exploration on the east.

Industries.—The hilly districts are unsuitable for tillage; but in the lower regions the soil is remarkably fertile, and agriculture is generally practised after improved methods, the county in this respect being in advance of most parts of Ireland. The excellent pasturage of the hilly districts supports a large number of young cattle. The proportion of tillage to pasture is roughly as 1 to 1½. Oats, potatoes and turnips are the principal crops. The cultivation of flax, formerly an important industry, has greatly deteriorated. Poultry-keeping is a growing industry. There are manufactures of linens and coarse woollens (including blankets); brown earthenware, chemicals, whisky, soap and candles are also made. There are a few breweries and distilleries, and several flour and meal mills. But for the lack of enterprise the coal and iron might aid in the development of a considerable manufacturing industry.

Branches of the Great Northern railway from Portadown (Co. Armagh) and Dungannon in the south-east, and from Enniskillen (Co. Fermanagh) and Fintona, unite at Omagh, whence a line proceeds north by Newtown Stewart and Strabane to Londonderry. From Dungannon a branch runs north to Cookstown, where it joins a branch of the Northern Counties (Midland) railway. From Victoria Bridge on the Londonderry line the Castlederg light railway serves that town. The south of the county is served by the Clogher Valley light railway. Water communication includes Lough Neagh, and the Blackwater entering it, and navigable to Moy, whence the Ulster canal skirts the boundary of the county with Co. Armagh to Caledon. The Foyle is navigable to Strabane.

Population.—The population (150,567 in 1901) shows a decrease among the most serious of Irish county populations, and emigration is heavy. About 55% of the inhabitants are Roman Catholics, 22% Protestant Episcopalians and 19% Presbyterians; about 90% constitute the rural population The chief towns are Strabane (pop. 5033), Omagh (the county town, 4789), Dungannon (3694), Cookstown (3531) and Newtown Stewart (1062). The county comprises 8 baronies. Two county members and 2 for each of the boroughs of Augher, Clogher, Dungannon and Strabane were returned to the Irish parliament; after the Union the county returned 2 members to parliament, the borough of Dungannon also returning 1; but in 1885 Dungannon was disfranchised and the county arranged in four divisions—east, mid, north and south—each returning one member. Assizes are held at Omagh and quarter-sessions at Clogher, Cookstown, Dungannon, Omagh and Strabane.

History.—Tyrone became a principality of one of the sons of Niall of the Nine Hostages in the 5th century, and from his name—Eogan—was called Tir Eogan, gradually altered to Tyrone. From Eogan were descended the O'Neals or O'Neills and their numerous septs. The family had their chief seat at Dungannon until the reign of Elizabeth, when it was burned by Hugh O'Neill to prevent it falling into the hands of Lord Mountjoy. The earldom of Tyrone had been conferred by Henry VIII. on Conn O'Neill, but on his death, when the earldom should have descended to his heir Matthew, baron of Dungannon, another son, Shane, was proclaimed chief with the consent of the people. Shane maintained a contest with English authority, but his last-remaining forces were completely defeated near the river Foyle in May 1567, and shortly afterwards he was himself killed. Tyrone was one of the counties formed at Sir John Perrot's shiring of the unreformed parts of Ulster; but his work was interrupted by the rising of Hugh O'Neill in 1596. During the insurrection of 1641 Charlemont Fort and Dungannon were captured by Sir Phelim O'Neill, and in 1645 the parliamentary forces under General Munro were signally defeated by Owen Roe O'Neill at Benburb. At the Revolution the county was for a long time in the possession of the forces of James II.

Raths are scattered over every district of the county. There is a large cromlech near Newtown Stewart, another at Tarnlaght near Coagh and another a mile above Castlederg. At Kilmeillie near Dungannon are two stone circles. There are some ruins of the ancient castle of the O'Neills, near Benburb; mention may also be made of the ruins of the castles of Newtown Stewart, Dungannon, Strabane and Ballygawley.

TYRONE, a borough of Blair county, Pennsylvania, U.S.A., about 15 m. N.E. of Altoona, on the Little Juniata river, a small tributary of the Juniata river. Pop. (1910) 7176. Tyrone is served by the main line and three short branches of the Pennsylvania railway (which has repair shops here), and is connected with Altoona by an electric line. The borough is situated about 910 ft. above sea-level, in an agricultural and lumbering region, and there are deposits of limestone in the vicinity. It is a distributing point for the Clearfield coal region to the northward. At the village of Birmingham, 3 m. east, is a school for girls (founded 1853; incorporated 1907). Tyrone was laid out as a village in 1851, and was incorporated as a borough in 1857.

TYRRELL, GEORGE (1861–1909), Irish divine, was born in Dublin on the 6th of February 1861, and came of a family noted for its intellectual distinction. He was educated under Dr Benson at Rathmines School and entered Trinity College in 1878. He was greatly influenced by the writings of Cardinal Newman, and early in 1879 entered the Roman Catholic Church. In 1880 he joined the Society of Jesus and passed his novitiate at Manresa and other houses of the order, becoming teacher of philosophy at Stonyhurst. He had a keen sympathy with the difficulties experienced by the ordinary lay mind in trying to reconcile the conservative element in Catholicism with the principle of development and growth, and in *The Faith of the Millions*, *Hard Sayings* and *Nova et vetera* he attempted to clear them away. His writings have been described as "apologetic in intention, meditative in method and mystical in substance," and Tyrrell himself certainly combined in a wonderful way the judicial and the enthusiastic types of character. Besides the influence of Newman, the friendship and work of Robert Dolling made a great impression on him, and as he admitted, saved him from being contented with a merely academic and ecclesiastical type of religion. Tyrrell privately circulated among his friends writings in which he drew a clear line of distinction between religion as a life and theology as the incomplete interpretation of that life. One of these, the *Letter to a Professor of Anthropology*, was translated without his knowledge into Italian, and extracts from it were published in the *Corriere della Sera* of Milan in January 1906. For at least eight years before this he had been more or less in conflict with the authorities of his order, through his sympathy with "modernist" views, but the publication of this letter (afterwards issued by Tyrrell as *A Much Abused Letter*) brought about his expulsion from the order in February 1906. "The conflict," he wrote, "such as it is, is one of opinion and tendencies, not of persons; it is the result of mental and moral necessities created by the antitheses with which the Church is wrestling in this period of transition." Tyrrell found no bishop to give him an ecclesiastical status and a *celebret*, and he never regained these privileges. In July 1907 the Holy Office published its decree condemning certain modernist propositions, and in September the pope issued his encyclical *Pascendi Gregis*. Tyrrell's criticism of this document appeared in *The Times* on the 30th of September and the 1st of October, and led to his virtual excommunication from the Church. In the few years that remained to him he gave himself with patience and dignity to the work of his life. He had already published *Lex orandi*, insisting that the true interpretation of the creed is determined by its prayer value, and in 1906 he wrote *Lex credendi*. This was followed by *Through Scylla and Charybdis*, in which he developed his favourite view of revelation as experience; *Mediaevalism*, a vigorous apologia in reply to a Lenten pastoral of Cardinal Mercier, archbishop of Malines, who had attacked him as the chief exponent of Modernism; and *Christianity at the Cross Roads*, which emphasizes the distinction between his own position and that of the Liberal Protestants, and is of special interest for its treatment of the eschatological problems of the Gospels. On the 6th of July 1909 he was suddenly taken ill, on the 10th he received conditional absolution from a priest of the diocese of Southwark, and on the 12th extreme unction from the prior of Storrington. His intimate friend, the Abbé Bremond, gave him the last absolution and remained with him until his death on the 15th of July 1909. Such appear to be the facts, but Tyrrell's relations with Rome were such that a good deal of mystery was made as to whether he really received the last rites of his Church in any authorized manner. About his own saintly and sympathetic character, and his essential religiousness, there was no doubt.

See the estimates by Baron F. von Hügel and Rev. C. E. Osborne in *The Hibbert Journal* for January 1910; also the obituary in *The Times* (July 16, 1909), and the *Life*, by Miss M. D. Petre.

TYRRELL, SIR JAMES (d. 1502), the supposed murderer of the English king Edward V., and of his brother Richard, duke of York, was a son of William Tyrrell and a grandson of Sir John Tyrrell (d. *c.* 1437), who was treasurer of the royal household and was on three occasions Speaker of the House of Commons. The family is said to descend from Walter Tirel, the murderer of William Rufus. During the Wars of the Roses James Tyrrell fought for the Yorkists; in 1471 he was knighted; and in 1477 he was member of parliament for Cornwall. With regard to his share in the murder of the prince in 1483 he appears to have been selected by Richard III. and sent to the Tower of London, where he supervised the crime which was carried out by his subordinates. Afterwards he received several appointments from Richard and was sent to Flanders. He was also employed by Henry VII. and was made governor of Guisnes, but he seems to have incurred the king's displeasure through his friendship with Edmund de la Pole, earl of Suffolk. Having been treacherously seized he was conveyed to England and was executed on the 6th of May 1502. Just before his death he made a confession about the murder of the princes.

Members of the same family were Sir Thomas Tyrrell (1594–1672), justice of the common pleas under Charles II., and Anthony Tyrrell (1552–*c.* 1610), a Roman Catholic priest and spy, who afterwards became a clergyman of the Church of England.

TYRTAEUS, Greek elegiac poet, lived at Sparta about the middle of the 7th century B.C. According to the older tradition he was a native of the Attic deme of Aphidnae, and was invited to Sparta at the suggestion of the Delphic oracle to assist the Spartans in the second Messenian war. According to a later version, he was a lame schoolmaster, sent by the Athenians as likely to be of the least assistance to the Spartans (Justin iii. 5; Themistius, *Orat.* xv. 242; Diod. Sic. xv. 67). A fanciful explanation of his lameness is that it alludes to the elegiac couplet, one verse of which is shorter than the other. According to Plato (*Laws*, p. 629 A), the citizenship of Sparta was conferred upon Tyrtaeus, although Herodotus (ix. 35) makes no mention of him among the foreigners so honoured. Basing his inference on the ground that Tyrtaeus speaks of himself as a citizen of Sparta (*Fr.* 2), Strabo (viii. 362) is inclined to reject the story of his Athenian origin. Suidas speaks of him as "Laconian or Milesian"; possibly he visited Miletus in his youth, where he became familiar with the Ionic elegy. Busolt, who suggests that Tyrtaeus was a native of Aphidnae in Laconia, conjectures that the entire legend may have been concocted in connexion with the expedition sent to the assistance of Sparta in her struggle with the revolted Helots at Ithome (464). However this may be, it is generally admitted that Tyrtaeus flourished during the second Messenian war (*c.* 650 B.C.)—a period of remarkable musical and poetical activity at Sparta, when poets like Terpander and Thaletas were welcomed—that he not only wrote poetry but served in the field, and that he endeavoured to compose the internal dissensions of Sparta (Aristotle, *Politics*, v. 6) by inspiring the citizens with a patriotic love for their fatherland. About twelve fragments (three of them complete poems) are preserved in Strabo, Lycurgus, Stobaeus and others. They are mainly elegiac and in the Ionic dialect, written partly in praise of the Spartan constitution and King Theopompus (*Εὐνομία*), partly to stimulate the Spartan soldiers to deeds of heroism in the field (*Ὑποθῆκαι*—the title is, however, later than Tyrtaeus). The interest of the fragments preserved from the *Εὐνομία* is mainly historical, and connected with the first Messenian war. The *Ὑποθῆκαι*, which are of considerable merit, contain exhortations to bravery and a warning against the disgrace of cowardice. The popularity of these elegies in the Spartan army was such that, according to Athenaeus (xiv. 630 F), it became the custom for the soldiers to sing them round the camp fires at night, the polemarch rewarding the best singer with a piece of flesh. Of the marching songs (*Ἐμβατήρια*), written in the anapaestic measure and the Doric dialect, only scanty fragments remain (Lycurgus, *In Leocratem*, p. 211, § 107; Pausanias iv. 14, 5. 15, 2; fragments in T. Bergk, *Poetae lyrici graeci*, ii.).

Verrall (*Classical Review*, July 1896, May 1897) definitely places the lifetime of Tyrtaeus in the middle of the 5th century B.C., while Schwartz (*Hermes*, 1899, xxxiv.) disputes the existence of the poet altogether; see also Macan in *Classical Review* (February 1897); H. Weil, *Études sur l'antiquité grecque* (1900), and C. Giarratani, *Tirteo e i suoi carmi* (1905). There are English verse translations by R. Polwhele (1792) and imitations by H. J. Pye, poet laureate (1795), and an Italian version by F. Cavallotti, with text, introduction and notes (1898). The fragment beginning *Τεθνάμεναι γὰρ καλὸν* has been translated by Thomas Campbell, the poet. The edition by C. A. Klotz (1827) contains a dissertation on the war-songs of different countries.

TYRWHITT, THOMAS (1730–1786), English classical scholar and critic, was born in London on the 27th of March 1730, where he died on the 15th of August 1786. He was educated at Eton and Queen's College, Oxford (fellow of Merton, 1755). In 1756 he was appointed under-secretary at war, in 1762 clerk of the House of Commons. In 1768 he resigned his post, and spent the remainder of his life in learned retirement. In 1784 he was elected a trustee of the British Museum, to which he bequeathed a portion of his valuable library.

His principal classical works are: *Fragmenta Plutarchi II. inedita* (1773), from a Harleian MS.; *Dissertatio de Babrio* (1776), containing some fables of Aesop, hitherto unedited, from a Bodleian MS.; the pseudo-Orphic *De lapidibus* (1781), which he assigned to the age of Constantius; *Conjecturae in Strabonem* (1783); Isaeus *De Meneclis hereditate* (1785); Aristotle's *Poetica*, his most important work, published after his death under the superintendence of Dr Burgess, bishop of Salisbury, in 1794. Special mention is due of his editions of Chaucer's *Canterbury Tales* (1775–1778); and of *Poems, supposed to have been written at Bristol by Thomas Rowley* *and others in the Fifteenth Century* (1777–1778), with an appendix to prove that the poems were all the work of Chatterton. In 1782 he published a *Vindication of the Appendix* in reply to the arguments of those who maintained the genuineness of the poems. While clerk of the House of Commons he edited *Proceedings and Debates of the House of Commons*, 1620–1621 from the original MS. in the library of Queen's College, Oxford, and Henry Elsynge's (1598–1654) *The Manner of holding Parliaments in England.*

TYTLER, WILLIAM (1711–1792), of Woodhouselee, Scottish historian and antiquarian, son of Alexander Tytler of Edinburgh, was born in that city on the 12th of October 1711. He was educated at the High School and the University, and was in 1744 admitted into the society of Writers to the Signet. In 1759 he published an *Inquiry, Historical and Critical*, defending the character of Mary, Queen of Scots, and in 1783 the *Poetical Remains of James the First, King of Scotland.* He died at Woodhouselee on the 12th of September 1792. His life, written by Henry Mackenzie, was published in 1796.

His son Alexander Fraser Tytler, Lord Woodhouselee (1747–1813), Scottish judge, was born at Edinburgh on the 15th of October 1747. He was called to the Edinburgh bar in 1770. His first work, a supplement to Lord Kames's *Dictionary of Decisions*, entitled *The Decisions of the Court of Session*, was published in 1778, and a continuation appeared in 1796. In 1780 he was appointed conjoint professor of universal history in the university of Edinburgh, becoming sole professor in 1786. In 1783 he published *Outlines* of his course of lectures, extended and republished in 1801 under the title of *Elements of General History.* In 1790 he was appointed judge-advocate of Scotland, and while holding this office he wrote a *Treatise on the Law of Courts-Martial.* In 1801 he was raised to the bench, taking his seat (1802) in the court of session as Lord Woodhouselee. He died at Edinburgh on the 5th of January 1813.

Besides the works already mentioned, he wrote *Life and Writings of Dr John Gregory* (1788); *Essay on the Principles of Translation* (1790); a dissertation on *Final Causes*, prefixed to his edition of Derham's *Physico-Theology* (1799); a political pamphlet entitled *Ireland profiting by Example* (1799); an *Essay* on Laura and Petrarch (1801); and *Memoirs of the Life and Writings of Henry Home of Kames* (1807).

Patrick Fraser Tytler (1791–1849) Scottish historian, son of Lord Woodhouselee, was born at Edinburgh on the 30th of August 1791. He was called to the bar in 1813; in 1816 he became king's counsel in the exchequer, and practised as an advocate until 1832. He contributed to Allison's *Travels in France* (1815); his first independent essays were papers in *Blackwood's Magazine.* His great work, the *History of Scotland* (1828–1843) covered the period between 1249 and 1603. While occupied on this work Tytler removed to London, and it was largely owing to his efforts that a scheme for publishing state papers was carried out. Tytler was one of the founders of the Bannatyne Club and of the English Historical Society. He died at Great Malvern on the 14th of December 1849. His life (1859) was written by his friend, John W. Burgon, dean of Chichester.

His other works include: contributions to Thomson's *Select Melodies of Scotland* (1824); *Life of James Crichton of Cluny, commonly called the Admirable Crichton* (1819; 2nd ed., 1823); a *Memoir of Sir Thomas Craig of Riccarton* (1823); an *Essay on the Revival of Greek Literature in Italy*, and a *Life of John Wickliff*, published anonymously (1826); *Lives of Scottish Worthies*, for Murray's *Family Library* (1831–1833); *Historical View of the Progress of Discovery in America* (1832); *Life of Sir Walter Raleigh* (1833); *Life of Henry VIII.* (1837); *England under the Reigns of Edward VI. and Mary*, from original letters (1839); *Notes on the Darnley Jewel* (1843), and on the *Portraits of Mary Queen of Scots* (1845).

TYUMEÑ, a town in West Siberia, in the government of Tobolsk, situated where the chief highway from Russia across the Urals touches the first navigable river (the Tura) of Siberia Pop. (1900), 29,651. A railway passing through Ekaterinburg (202 m west by rail) and the principal ironworks on the eastern slopes of the middle Urals connects Tyumen with Perm, the terminus of steamboat traffic on the Kama and Volga. Tyumeñ has regular steam communication with Omsk and Semipalatinsk Irtysh (steamers penetrating as far as Lake Zaisan in Dzungaria), with Tomsk, and other places in the Altai, and with the Arctic Ocean and the fisheries of the lower Ob. The town is well built, and stands on both banks of the Tura, here spanned by a bridge. The inhabitants have always been renowned for their industrial skill. Woollen cloth, linen, belts, barges, paper, and especially boots and gloves, are manufactured to a large amount; and Tyumeñ carpets have a great reputation in Russia and Siberia.

TZETZES, JOHN, Byzantine poet and grammarian, flourished at Constantinople during the 12th century A.D. Tzetzes has been described as a perfect specimen of the Byzantine pedant. Excessively vain, he resented any attempt at rivalry, and violently attacked his fellow grammarians. Owing to want of books, he was obliged to trust to his memory; hence he is to be used with caution. But he was a learned man, and deserves gratitude for his efforts to keep up the study of ancient Greek literature. Of his numerous works the most important is the *Book of Histories*, usually called *Chiliades* ("thousands") from the arbitrary division by its first editor (N. Gerbel, 1546) into books each containing 1000 lines (it actually consists of 12,674 lines in "political" verse). It is a collection of literary, historical, theological and antiquarian miscellanies, whose chief value consists in the fact that it to some extent makes up for the loss of works which were accessible to Tzetzes. The whole production suffers from an unnecessary display of learning, the total number of authors quoted being more than 400 (H. Spelthahn, *Studien zu den Chiliaden des Johannes Tzetzes*, diss., Munich, 1904). The author subsequently brought out a revised edition with marginal notes in prose and verse (ed. T. Kiessling, 1826; on the sources see C. Harder, *De J. T. historiarum fontibus quaestiones selectae*, diss., Kiel, 1886). The *Chiliades* is based upon a collection of *Letters* (ed. T. Pressel, 1851), which has been called an index to the larger work, itself described as a versified commentary on the letters. These letters (107 in number) are addressed partly to fictitious personages, and partly to the great men and women of the writer's time. They contain a considerable amount of biographical details. The *Iliaca*, an abridgment of and supplement to the *Iliad*, is divided into three parts—*Antehomerica*, *Homerica*, *Posthomerica*—containing the narrative from the birth of Paris to the return of the Greeks after the fall of Troy, in 1676 hexameters (ed. C. Lehrs and F. Dübner, 1868, in the Didot series, with Hesiod, &c.) The Homeric *Allegories*, dedicated to the empress Irene, in "political" verse, are two didactic poems in which Homer and the Homeric theology are explained on euphemistic principles (ed. P. Matranga, in his *Anecdota graeca*, i. 1850). Tzetzes also wrote commentaries on a number of Greek authors, the most important of which is that on the *Cassandra* or *Alexandra* of Lycophron (ed. C. G. Müller, 1811), in the production of which his brother Isaac is generally associated with him. Mention may also be made of a dramatic sketch in iambic verse, in which the caprices of fortune and the wretched lot of the learned are described; and of an iambic poem on the death of the emperor Manuel, noticeable for introducing at the beginning of each line the last word of the line preceding it[1] (both in Matranga, *An. gr.* ii.).

For the other works of Tzetzes see J. A. Fabricius, *Bibliotheca graeca* (ed. Harles), xi. 228, and C. Krumbacher, *Geschichte der byz. Litt.* (2nd ed., 1897); monograph by G. Hart, "De Tzetzarum nomine, vitis, scriptis," in Jahn's *Jahrbücher für classische Philologie.* Supplementband xii. (Leipzig, 1881).

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[1] This versification is called *κλιμακωτός* (*κλῖμαξ*, ladder), a term more commonly applied to a verse in which each word contains one letter more than the one which precedes it.

U The twenty-first letter of the English alphabet. It is a modification made in manuscript writing of the Latin inscriptional V, and is itself found on the inscriptions of Rome as early as the latter part of the 2nd century A.D. The symbols U, V, Y are all of the same origin, but what the origin is has been much disputed. In the Phoenician alphabet T is the last symbol, but there can be little doubt that when the Greeks introduced symbols for vowels, which had not been indicated in the alphabet they had borrowed, they took the sixth symbol of the Phoenician alphabet (see F) in its ordinary form Y and placed it at the end of the alphabet with the value of a vowel. This vowel was apparently *u* (English *oo* in *moon*), though Ionic and Attic Greek at a very early period changed it to the sound of the French *u*. In other dialects the earlier value long persisted, and in modern Tzakonian, the representative of the ancient Lacônian, it still survives. In some places, *e.g.* Boeotia, the sound seems to have changed, in connexion with dental consonants, in the same way as the English sound, in certain cases *j* (*y*) being inserted in front of it. This seems to be the only feasible explanation of such spellings as *τιούχα* (*τύχη*), *πολιούξενος* (*πολύξενος*), which appear after the Boeotians adopted the Ionic alphabet. A similar change must have existed in very early Attic and Iónic to account for the change of *t* before *υ* into *s* in *σύ*, "thou" for *τύ*; some authorities think it was universal in the earliest Greek. Greek nowhere shows the symbol in the bowl shape that it has in the Semitic alphabet. From the 7th century B.C. both Y and V are found, sometimes both in the same area. Another form somewhat later has the upper strokes curved outwards T, while the angle is much less deep than in the other forms. It is noticeable that the symbol for *u* in the syllabary which was used to write Greek in Cyprus has this form amongst others. The name of the sixth symbol in the Phoenician alphabet was *Wāw* (*Vau*), but though U has taken its form, in Greek its name was *ῦ* (*i.e.* English *oo*, as in moon, except in Attic and Ionic, where it was like the French *u* in *lune*), not *upsilon*, as is frequently stated. In Sweet's terminology *u* (*oo*), as pronounced in English "put" or "too," is a high back wide round, while the sound in the French *sou* or the Scotch pronunciation of "book" is a high back narrow round. The high front corresponding sound is found in the French *lune*. With this the German "modified u" (*ü*) is often equated, but it is not really identical, being a mid front narrow round vowel. The pitch of the vowel *u* is among the lowest of the vowel sounds; the rounding and protrusion of the lips make the breath passage longer than it is for other vowels, and so its production may be compared to that of a sound made upon a flute when all the finger-holes are covered. In modern English *ū* preceded by *j* (*y*) arises from three different sounds in middle English: (*a*) the long French *u* (*ü*) brought in with borrowed words from French (duke), (*b*) *ēu* (Early English *ēow*) as in "new," (*c*) a more open sound *ĕu* (Early English *ĕaw*) as in "dew" (Sweet, *New English Grammar*, § 806). The *y*-sound was dropped after *r*, *ch* and *dzh*, as in "true," "choose," "juice" (ibid., § 857). In the literary dialect also it generally disappears after *l*, as in "lurid," "lute." In some provincial and American pronunciations it is dropped everywhere except initially, so that "Tuesday" is pronounced *Toosday*, "new" *noo*. (P. Gi.)

UAKARI (*Ouakari*), the native name of certain tropical American monkeys, distinguished from all other New World monkeys by their short tails. The three known species constitute the genus *Uacaria* (or *Cothurus*) of zoologists, and are confined to the forests of Amazonia and the neighbourhood. One of them (*U. calva*) is remarkable for its long, silky, pale chestnut fur and brilliant scarlet face, which is naked (see PRIMATES).

UBANGI, a river of Equatorial Africa, the chief northern affluent of the Congo (*q.v.*). The Ubangi (otherwise Mubangi or Mobangi) enters the Congo by various mouths between 0° 22′ and 0° 37′ S. and 17° 40′ and 17° 50′ E. The main channel, fully 1 m. wide, joins the Congo in 0° 31′ S. The Ubangi is formed by the junction of the Mbomu and the Welle, both of which rise on the north-eastern rim of the Congo basin.

The water-parting between the Bahr-el-Ghazal affluents (Nile system) and the Mbomu headstreams is not very clearly marked, but high hills running parallel with the Nile between Albert Nyanza and Dufile sharply separate the valley of the Welle and other west-flowing streams from that of the Mountain Nile. The chief of the headstreams of the Welle (known in its upper course as the Kibali) rises on the western slope of a hill about 40 m. west of Wadelai. It is joined by several small streams, the main river flowing in a W.N.W. direction. After a course of over 700 m. (during which it receives one large southern tributary—the Bomokandi—and other considerable affluents) the Welle joins the Mbomu in 4° 10′ N. 22° 37′ E. The Mbomu, which has two large northern tributaries, the Shinko and the Balo, rises in 4° 50′ N. 27° 12′ E. For some distance it runs parallel to and about 100 m. north of the lower course of the Welle. About 23° 12′ E. it turns sharply south until its junction with the Welle. In its lower course the Mbomu is interrupted by many falls and rapids. A short distance below the junction of the Mbomu and Welle the Kotto, coming from beyond 8° N., on the borders of Darfur, and forming the most northerly extension of the Congo basin, enters the united stream, now known as the Ubangi, on the right bank. The remaining tributaries, mostly on the right bank, are smaller, but the Kemo, which joins the Ubangi near its most northern point (5° 8′ N.), is of some importance as offering water communication to within a short distance of the Shari basin. Below the Kemo confluence the Ubangi, which has hitherto continued to flow W.N.W., makes a great bend south and runs into the Congo after a southerly course of 400 m. Shortly after receiving the Kemo the river forces its way through a line of hills whose tops rise 600 to 800 ft. above the banks of the stream. Here are the Zongo or Grenfell rapids, which are a barrier to navigation save for small boats at flood season. Above the Zongo rapids the river is navigable up to the confluence of the Welle and Mbomu, and the Welle is navigable at high flood up to the Bomokandi confluence in 26° 8′, though the stream is much interrupted by rapids.

From the Mbomu-Welle confluence to the junction of the Ubangi with the Congo the river has a course of fully 700 m., while the Ubangi-Welle combined exceeds 1400 m. From its mouth to Zongo rapids, a distance of 350 m., the stream is navigable by steamers drawing 3 ft. of water. In general the Ubangi flows through a fertile and forested region.

The Welle was discovered from the north by G. A. Schweinfurth in 1870; *i.e.* seven years before the discovery of the course of the Congo by H. M. Stanley. By Schweinfurth the Welle was believed to belong to the Chad system, but W. Junker, who (1882–1883) followed the river to near its confluence with the Mbomu, made it clear that the Welle belonged to the Congo system. In 1885 the Rev. George Grenfell, of the Baptist Missionary Society (who had discovered the mouth of the river in 1884), ascended the Ubangi as far as the Zongo rapids. He was followed in 1886–1889 by the Belgian A. van Gèle, who in the last-named year finally established the identity of the Ubangi with Schweinfurth's Welle. The Mbomu was discovered from the north in 1877 by a Greek, Dr P. Potagos, and its upper course was followed for some distance by Junker. The Ubangi and the Mbomu form the frontier between Belgian Congo and French Congo, the northern banks of both streams belonging to France.

See, besides the works of Schweinfurth, Junker and other travellers, A. J. Wauters, *Les Bassins de l'Ubangi (inférieur) et de la Sanga*, with map (Brussels, 1902); Dr Cureau's map (1 : 1,000,000) of the upper Ubangi in *La Géographie* (October 1900); the CONGO and works there cited.

ÚBEDA, a town of southern Spain, in the province of Jaen; 2000 ft. above sea-level, in the Loma de Úbeda, a range on the right bank of the Guadalquivir. Pop. (1900), 19,913. The surrounding country produces wheat, wine, olives and fruit. Úbeda has a station 6 m. south on the Madrid-Almeria railway. Portions of the old walls, with towers and gates, still remain, and there are three late Gothic churches, the oldest of which, San Salvador, dates from 1540 to 1556, and contains some interesting paintings. An important fair is held from the 29th of September to the 5th of October. Oil, soap, esparto and linen fabrics are manufactured. Úbeda was an important town under Moorish rule.

UDAD, Aoudad or Audad, the Moorish name of the Barbary sheep, or arui, *Ovis* (*Ammotragus*) *lervia*, the only wild sheep found in Africa, where it inhabits all the mountain ranges of the north, descending to the eastward far into the heart of the Sudan. The udad is distinguished by the abundant hair on the throat and fore-quarters of the rams, and the length of the tail. In the absence of face-glands and in the structure of the horns the species approximates to the goats. The "lion-coloured" coat approximates to the hue of the limestone rocks on which these sheep dwell.

UDAIPUR, Oodeypore or Mewar, a native state of India, in the Rajputana agency. Area, 12,691 sq. m. Pop. (1901), 1,030,212. Estimated revenue £200,000; tribute £17,000. The greater part of the country is level plain. A section of the Aravalli Mountains extends over the south-western and southern portions, and is rich in minerals, but the mines have been long closed. The general inclination of the country is from south-west to north-east, the Banas and its numerous feeders flowing from the base of the Aravalli range. There are many lakes and tanks in the state, the finest of which is the Debar or Jaisamand, with an area of nearly 21 sq. m.; it is considered to be the largest artificial sheet of water in the world. A portion of the state is traversed by the Malwa line of the Rajputana railway. A branch from Chitor towards Udaipur was taken over by the state in 1898, and was extended nearer to the capital. Like the rest of Rajputana the state suffered severely from famine in 1900. The ancient coinage is of the Sasanian or Persian type, copper issues of this type being still in circulation. Modern coins bear on the reverse the words "Friend of London."

The chief, whose title is maharana, is the head of the Sisodhyia clan of Rajputs, and claims to be the direct representative of Rama, the mythical king of Ajodhya. He is universally recognized as the highest in rank of all the Rajput princes. The dynasty offered a heroic resistance to the Mahommedans, and boast that they never gave a daughter to a Mogul emperor. They are said to have come from Gujarat and settled at Chitor in the 8th century. After the capture of Chitor by Akbar in 1568 the capital was removed to Udaipur by Maharana Udai Singh. During the 18th century the state suffered greatly from internal dissension and from the inroads of the Mahrattas. It came under British protection in 1817. The Maharana Fateh Singh, G.C.S.I. (b. 1848), succeeded by adoption in 1884.

The name of *Mewar* is derived from the Meos, or Minas, a tribe of mixed Rajput origin, who have likewise given their name to a different tract in northern Rajputana, called Mewat, where they are now all Mahommedans. About 1400 a sub-division of the Mewatis, called Khanzadas, made themselves the dominant power in this tract; and at the end of the 18th century, and again during the Mutiny, they were notorious for their ravages in the Upper Doab, around Agra and Delhi. In 1901 the total number of Mewatis in Rajputana was 168,596, forming 13% of the population in the state of Alwar. Down to 1906 the Mewar residency was the title of a political agency in Rajputana, comprising the four states of Udaipur, Banswara, Dungarpur and Partabgarh; area, 16,970 sq. m.; pop. (1901), 1,336,283. But in that year the three last states were separated from Udaipur, and formed into the Southern Rajputana States agency. The Mewar Bhil Corps, raised as a local battalion in 1840, which was conspicuously loyal during the Mutiny, was in 1897 attached to the Indian army, with its headquarters at Kherwara.

The city of Udaipur is 2469 ft. above sea-level. Pop. (1901), 45,976 It is situated in a valley amid wooded hills, on the bank of a large lake (Pichola), with palaces built of granite and marble. The maharana's palace, which crowns the ridge on which the city stands, dates originally from about 1570, but has had additions made to it till it has become a conglomeration of various architectural styles. On Lake Pichola are two islands, on which are palaces dating respectively from the middle of the 17th and of the 18th centuries. In one of these the European residents were sheltered during the Indian Mutiny. In the neighbourhood are Eklingji (with a magnificent temple of the 15th century), and Nagda, the seat of the ancestors of the chiefs of Udaipur, with a number of temples, two of which are said to date from the 11th century.

There is another Udaipur State in the Central Provinces (till 1905 one of the Chota Nagpur states of Bengal). Area, 1052 sq. m.; pop. (1901), 45,391. Its capital is Dharmjaygarh.

UDAL, NICHOLAS (1504–1556), English schoolmaster, translator and playwright, author of the earliest extant English comedy, *Roister Doister*, came of the family of Uvedale, who in the 14th century became lords of Wykeham, Hants, by marriage with the heiress of the Scures. The name was probably pronounced Oovedale, as it appears as Yevedale, Owdall, Woodall, with other variants. He latinized it as Udallus, and thence anglicized it as Udall. He is described as Owdall of the parish of St Cross, Southampton, 12 years old at Christmas 1516, when admitted a scholar of Winchester College in 1517 (*Win. Schol. Reg.*). He was therefore not 14 (as Anthony Wood says) but 16½ years of age when admitted a scholar of Corpus Christi College, Oxford, in June 1520; he is called Wodall as a lecturer at that college in 1526 to 1528 (T. Fowler, *Hist. C. C. C.*).

With John Leland he produced "dites" (ditties) "and interludes" (B.M. MS. 18A lxiv.) at Anne Boleyn's coronation on the 31st of May 1533. Leland's contributions are all in Latin; those of "Udallus," which form the chief part, are mostly in English, the speeches being each spoken by a "child," at Cornhill beside Leadenhall," "at the Conducte in Cornhill" and "at the little Conducte in Cheepe." His *Floures for Latine Spekynge, selected and gathered out of Terence and the same translated into Englysshe*, published by Bartlet (*in aedibus Bertheleti*), were dedicated "to my most sweet flock of pupils, from the monastery of the monks of the order of Augustine," on the 28th of February 1533–1534. There were no monks of that order, and whether Austin Friars or Augustinian canons were meant is open to doubt. The book was prefaced with laudatory Latin verses by Leland and by Edmund Jonson. The latter was a Winchester and Oxford contemporary of Udal's, in 1528 lower master (*hostiarius*) at Eton, a post which he left to become master of the school of St Anthony's Hospital, then the most flourishing school in London. From the dedication we may infer that Udal was usher under Jonson and "the sweet flock" was at St Anthony's school next door to Austin Friars. At Midsummer 1534 he became head master of Eton (*informator puerorum* or *ludi grammaticalis*; *Eton Audit Book*. 25–26 Hen. VIII.). It has been suggested (*Dic. Nat. Biog.*) that the *Floures* was dedicated to Eton boys in advance; but this is unlikely, as in those days schools never got their masters till the place was vacant, or on the verge of vacancy. At Eton Udal's salary was £10 and £1 for livery, with "petty receipts" of 8s. 4d. for *obits*, 2s. 8d. for laundress, 2s. for candles for his chamber, and 23s. 4d. "for ink, candles and other things given to the grammar school by Dr Lupton, provost." One of his school books, *Commentaries on the Tusculan questions of Cicero* (ed. Berouldus, 1509), with the inscription "sum Nicolai Udalli 1536," is in the King's Library at the British Museum.

There was a yearly play, 3s. being paid for the repair of the dresses of the players at Christmas, and 1s. 4d. to a servant of the dean of Windsor for bringing his master's clothes for the players. A payment for repair of the players' dresses recurs every year. Udal has been credited (E. K. Chambers, *Mediaeval Stage*, ii. 144, 192) with producing a play at Braintree while vicar there, recorded in the churchwardens' accounts for 1534 as "Placidas *alias* Sir Eustace." The play is actually called in the accounts (only extant in 17th-century extracts) "Placy Dacy *alias* St Ewastacy," and is the old play of Placidas, mentioned in the 9th century. Udal did not become vicar of Braintree till the 27th of September 1537 (Newcourt's *Repert.* ii. 89). At Michaelmas he resigned the mastership of Eton to reside at Braintree, being called "late schole-master wose roome nowe enjoyeth and occupieth Mr Tindall" in a letter from the provost to Thomas Cromwell, then privy seal, on the 7th October 1537 (*Lett. and Pa. Hen. VIII.*, 1537). He returned to Eton, however, or rather to Hedgeley, the school being removed there on account of the plague, at Midsummer 1537, being paid for the third and fourth terms of the school year

(*Eton Audit Book*, 29–30 Hen. VIII.). In October 1538 "Nicholas Uvedale, professor of the liberal arts, *informator* and schoolmaster of Eton," was licensed to hold the vicarage of Braintree, "with other benefices," without personal residence. The accounts of Cromwell for 1538 include "Woodall, the scholemaster of Eton, to playing before my lord, £5." Presumably he brought a troupe of Eton boys with him. In that year he published a second edition of his *Floures of Terence* for the benefit of Eton boys. The often-questioned account of Thomas Tusser (*Five Hundred Pointes of Good Husbandrie*) is typical of Eton at the time, as Udal's predecessor Cox is said in Ascham's *Scholemaster* to have been "the best scholemaster and greatest beater of our time":—

> "From Powles[1] I went to Aeton sent,
> To learn straightwaies the Latin phraise;
> Where fifty-three stripes given to me at once I had;
> For fault but small or none at all
> It came to pass thus beat I was:
> See, Udall, see, the mercie of thee to mee, poor lad."

Udal's rule of the rod at Eton was brought to an abrupt conclusion by his being brought up before the privy council on the 14th of March 1540/1541 for being "counsail" with two of the boys, Thomas Cheney, a relation of the lord treasurer of the household, and Thomas Hoorde, for stealing some silver images and chapel ornaments. He denied the theft, but confessed to a much more scandalous offence with Cheney, and was sent to the Marshalsea prison. He tried, but failed, to get restored to Eton. Attempts have been made to whitewash him. But his own confession, and an abject letter of repentance with promises of amendment, addressed (probably) to Wriothesley, a Hampshire man and a family friend, cannot be got over. It shows that he was a bad schoolmaster as well as an immoral one, since he pleads "myn honest chaunge from vice to vertue, from prodigalitee to frugall lyving, from negligence of teachyng to assiduitee, from play to studie, from lightness to gravitee." In 1542–1543, after the bursar of Eton had ridden up to London to the provost, Udal was paid "53s. 4d. in full satisfaction of his salary in arrears and other things due to him while he was teaching the children"; but on the other side of the account appears an item of "60s. received from Dr Coxe for Udal's debts." So no money passed to Udal.

He seems to have maintained himself by translating into English, in 1542, Erasmus's *Apophthegms* and other works. In 1544 he published a new edition of the *Floures of Terence*. He seems to have taken a schoolmastership in Northumberland or Durham, as Leland in one of his *Encomia* speaks of him, probably at this time, as translated to the Brigantes. He seems to have been made to resign his living at Braintree, a successor being appointed on the 14th of December 1544. He purged himself, however, by composing the *Answer to the Articles of the Commoners of Devonshire and Cornwall* (Pocock, *Troubles of the Prayer Book of 1549*, Camd. Soc., new series, 37, 141, 193), when they rose in rebellion in the summer of 1549 against the First Prayer Book of Edward VI. In 1551 he received a patent for printing his translation of Peter Martyr's two works on the Eucharist and the Great Bible in English (Pat. 4 Edw. VI. pt. 5, m. 5, Shakespeare Soc. iii. xxx.). He was rewarded by being made a canon of Windsor on the 14th of December 1551. On the 5th of January "after the common reckoning 1552" (*i.e.* 1551/2) he edited a translation of Erasmus's *Paraphrases* of the Gospels, himself translating the first three, while that on St John was being translated by the princess Mary, till she fell sick and handed her work over to Dr Malet. The work was done at the suggestion and expense of the dowager queen Katharine, in whose charge Mary was. A translation by Udal of Geminus's *Anatomie* or *Compendiosa totius anatomiae delineatio*, a huge volume with gruesome plates, was published in 1553." Udal's preface is dated the 20th of July 1552 "at Windesore. In June and September 1553 (*Trevelyan Pap.* Camd Soc. 84, ii. 31, 33) "Mr Nicholas Uvedale" was paid at the rate of £13, 6s. 8d. a year as "scholemaster to Mr Edward Courtney, beinge within the Tower of London, by virtue of the King's Majesty's Warrant"—the young earl of Devon, who had been in prison ever since he was twelve years old.

Queen Mary on the 3rd of December 1554 issued a warrant on Udal's behalf reciting that he had "at soundrie seasons convenient heretofore shewed and myndeth hereafter to shewe his diligence in setting forth Dialogues and Enterludes before us for our royal disporte and recreacion," and directing "the maister and yeomen of the office of the Revells" to deliver whatever Udal should think necessary for setting forth such devices, while the exchequer was ordered to provide the money to buy them (Loseley MSS. Kempe 63, and *Hist. MSS. Com. Rep.* vii. 612). One of these interludes was probably *Roister Doister*; for it was in January 1553, *i.e.* 1554, that Thomas Wilson, master of St Katharine's Hospital by the Tower, produced the third edition of *The Rule of Reason*, the first text-book on logic written in English, which contains, while the two earlier editions, published in 1551 and 1552 respectively, do not contain, a long quotation from *Roister Doister*. It gives under the heading of "ambiguitie," as "an example of such doubtful writing whiche, by reason of poincting, maie have double sense and contrarie meaning . . . taken out of an intrelude made by Nicholas Udal," the letter which Ralph Roister procured a scrivener to compose for him, asking Christian Constance, the heroine, to marry him. Roister's emissary read it—

> "Sweete mistresse, where as I love you nothing at all,
> Regarding your substance and richnesse chiefe of all,"

and so on; whereas it was meant to read—

> "Sweete mistresse, whereas I love you (nothing at all
> Regarding your substance and richnesse) chiefe of all,
> For your personage, beautie, demeanour and wit."

The play was entered at Stationers' Hall, when printed in 1566. Only one copy is known, which was given to Eton by an old Etonian, the Rev. Th. Briggs, in 1818, who privately printed thirty copies of it. As the title-page is gone the only evidence of its authorship is Wilson's quotation. Wilson being an Etonian, it has been argued that his quotation was a reminiscence of his Eton days, and that the play was written for and first performed by Eton boys. But the occurrence of the quotation first in the edition of 1554, and its absence in the previous editions of 1551 and 1552, coupled with the absence of anything in the play to suggest any connexion with a school, while the scene is laid in London and among London citizens and is essentially a London play, furnish a strong argument that *Roister Doister* first appeared in 1553, and therefore could not have been written at Eton or for Eton boys.

Nor could it have been written at Westminster School or for Westminster boys, as argued by Professor Hales in *Eng. Studien* (1893) xviii. 408. For though Udal did become head master of Westminster, he only became so nearly two years after Wilson's quotation from *Roister Doister* appeared. He was at Winchester in the interval, for Stephen Gardiner, bishop of Winchester and chancellor, by will of the 8th of November 1555 (P.C.C. 3 Noodes), gave 40 marks (£26, 13s. 4d.) to "Nicholas Udale, my scholemaister." In what sense he was Gardiner's schoolmaster it is hard to guess. He was not head master or usher of Winchester College; but he may have been master of the old City Grammar or High School, to which the bishop appointed (A. F. Leach, *Hist. Winch. Coll.* 32, 48). The schoolhouse had been leased out for 41 years in 1544 but it is possible Gardiner had revived the school or kept a school at his palace of Wolvesey. At Westminster "Mr Udale was admitted to be scholemaster 16 Dec. anno 1555" (*Chapter Act-Book*).

The last act of the secular canons, substituted by Henry VIII. for the monks, was the grant of a lease on the 24th of September 1556. When the monks re-entered, on Mary's restoration of the abbey (Nov. 21, 1556), the school did not, as commonly alleged, cease, nor had Udal ceased to be master (Shakespeare Soc. iii. xxxiv.) when he died a month later. The parish register of St Margaret's, Westminster, under "Burials in December A.D. 1556" records "11 die Katerine Woddall," "23 die Nicholas

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[1] Tusser was a chorister of St Paul's.

Yevedale," *i.e.* Udal. Katharine was perhaps a sister or other relation, as Elizabeth Udall was buried there on the 8th of July 1559. The abbey cellarer's accounts ending Michaelmas 1557 contain a payment "to Thomas Notte, usher of the boys, £6, 10s., and to the scholars (*scolasticis vocatis le grammer childern*), £63, 6s. 8d.," showing that the usher carried on the school after Udal's death. Next year (1557–1558) the abbey receiver accounted for £20 paid to John Passey, (the new) schoolmaster, to Richard Spenser, usher, £15, and £133, 6s. 8d. for 40 grammar boys. So it is clear that the school never stopped. Udal therefore was master of Westminster for just over two years. He died at the age of 52.

Roister Doister well deserves its fame as the first English comedy. It is infinitely superior to any of its predecessors in form and substance. It has sometimes been described as a mere adaptation of Plautus's *Miles Gloriosus*. Though the central idea of the play—that of a braggart soldier (with an impecunious parasite to flatter him) who thinks every woman he sees falls in love with him and is finally shown to be an arrant coward—is undoubtedly taken from Plautus, yet the plot and incidents, and above all the dialogue, are absolutely original, and infinitely superior to those of Plautus. Even the final incident, in which the hero is routed, is made more humorous by the male slaves being represented by maid-servants with mops and pails.

The play was printed by F. Marshall in 1821; in Thomas White's *Old English Dramas* (3 vols., 1830); by the Shakespeare Society, vol. iii., the introduction to which contains the fullest and most accurate account of his life; in Edward Arber's reprints in 1869; and Dodsley's *Old Plays* (1894), vol. iii. (A. F. L.)

UDAL (Dan. *odel*), a kind of right still existing in Orkney and Shetland, and supposed to be a relic of the old allodial mode of landholding existing antecedently to the growth of feudalism in Scotland (see Allodium). The udal tenant holds without charter by uninterrupted possession on payment to the Crown, the kirk, or a grantee from the Crown of a tribute called scat (Dan. *skat*), or without such payment, the latter right being more strictly the udal right. Udal lands descend to all the children equally. They are convertible into feus at the option of the udallers.

UDINE, a town and archiepiscopal see of Venetia, Italy, capital of the province of Udine, situated between the Gulf of Venice and the Alps, 84 m. by rail N.E. of Venice, 450 ft. above sea-level. Pop. (1906), 25,217 (town); 40,627 (commune). The town walls were in the main demolished towards the end of the 19th century. The old castle, at one time the residence of the patriarchs of Aquileia, and now used as a prison, was erected by Giovanni Fontana in 1517 in place of the older one destroyed by an earthquake in 1511. The Romanesque cathedral contains some interesting examples of native art (by Giovanni Martini da Udine, a pupil of Raphael, and others). The church of S. Maria della Purità has frescoes by Giovanni Battista and Domenico Tiepolo. In the principal square stands the town hall, built in 1448–1457 in the Venetian-Gothic style, and skilfully restored after a fire in 1876; opposite is a clock tower resembling that of the Piazza di San Marco at Venice. In the square is a statue of Peace, erected in commemoration of the peace of Campo Formio (1796), which lies 5 m. to the W.S.W. The archiepiscopal palace and Museo Civico, as well as the municipal buildings, have some valuable paintings. The leading industry of Udine is silk-spinning, but it also possesses manufactures of linen, cotton, hats and paper, tanneries and sugar refineries, and has a considerable trade in flax, hemp, &c. Branch railways lead to Cividale del Friuli and S. Giorgio di Nogaro, and a steam tramway to S. Daniele del Friuli.

The origin of Udine is uncertain; though it lay on the line of the Via Iulia Augusta, there is no proof of its existence in Roman times. In the middle ages it became a flourishing and populous city; in 1222 or 1238 the patriarch Berthold made it the capital of Friuli, and in 1420 it became Venetian. In 1752 it became an archbishopric. (T. As.)

UEBERWEG, FRIEDRICH (1826–1871), German historian of philosophy, was born on the 22nd of January 1826 at Leichlingen, in Rhenish Prussia, where his father was Lutheran pastor. Educated at Göttingen and Berlin, he qualified himself at Bonn as *Privatdozent* in philosophy (1852). In 1862 he was called to Königsberg as extraordinary professor, and in 1867 he was advanced to the ordinary grade. He married in 1863, and died on the 9th of June 1871. His compendious *History of Philosophy* is remarkable for fullness of information, conciseness, accuracy and impartiality. At first he followed Beneke's empiricism, and strongly opposed the subjectivistic tendency of the Kantian system, maintaining in particular the objectivity of space and time, which involved him in a somewhat violent controversy. His own mode of thought he preferred later to describe as an ideal realism, which refused to reduce reality to thought, but asserted a parallelism between the forms of existence and the forms of knowledge. Beneke and Schleiermacher exercised most influence upon the development of his thought.

Works.—*System der Logik* (1857; 5th ed., 1882; Eng. trans. of 3rd ed. by T. M. Lindsay, 1871); *Grundriss der Gesch. der Phil.* (1863–1866, 8th ed., M. Heinze, 1894–1898; Eng. trans., G. S. Morris, 1872; 4th ed., 1885); an essay (1861) on the authenticity and order of Plato's writings, crowned by the Imperial Academy of Vienna; *Schiller als. Hist. und Phil.* (published by Brasch from his papers, Leipzig, 1884). See F. A. Lange, *Friedrich Ueberweg* (Berlin, 1871); M. Brasch, *Die Welt- und Lebensanschauung Friedrich Ueberwegs* (Leipzig, 1889).

UELZEN, a town of Germany, in the Prussian province of Hanover, on the Ilmenau, east of the famous Lüneburger Heide, at the junction of the railway connecting Hamburg, Hanover, Bremen and Stendal, 52 m. S.E. of Hamburg. Pop. (1905), 9329. The town has four Evangelical churches, one of which, dedicated to the Holy Ghost, has a valuable altarpiece dating from the 14th century. The principal industries are flax, sugar, tobacco and machinery, and there is a trade in cattle and horses. In the vicinity are some interesting Slavonic remains and the former Benedictine monastery of Ullesheim.

Founded in the 10th century as Löwenwold, Uelzen became in the middle ages an active member of the Hanseatic League.

See Jaenicke, *Geschichte der Stadt Uelzen* (Hanover, 1889).

UFA, a government of south-eastern Russia, on the western slope of the Ural Mountains. It has the governments of Vyatka and Perm on the N., Orenburg on the E. and S., Samara and Kazañ on the W., and comprises an area of 47,094 sq. m. Several craggy and densely wooded ranges, running from S.W. to N.E. parallel to the main chain of the southern Urals, occupy its eastern part. They rise to altitudes of 2500 to 3500 ft.; their highest peaks—Iremel (5230 ft.), Urenga (4115 ft.) and Taganai (3935 ft.)—ascend above the limits of arboreal vegetation, but in no case reach those of perpetual snow. Southward Ufa extends over the slopes of the Obshchiy Syrt plateau, the angular space between the latter and the Urals being occupied by elevated plains (1000 to 1500 ft.), deeply grooved by the river valleys, and sometimes described as the "Ufa plateau." Towards the Kama the fertility of the soil increases, and the black-earth regions of Menzelinsk and Birsk are granaries for that part of Russia.

The geological structure of Ufa is very varied. The main range of the Urals consists of gneisses and various crystalline slates resting upon granites and syenites; next comes a broad strip of limestones and sandstones, the fossil fauna of which is intermediate between the Upper Silurian and the Lower Devonian. These form the highest elevations in the government. Farther west the Devonian deposits are followed by Lower and Upper Carboniferous and Artinsk schists, which, together with Permian deposits, cover western Ufa. Quaternary deposits are extensively developed in all the valleys, most of which were occupied by lakes during the Lacustrine period. There is great wealth in iron (Devonian) and copper (Permian). The district of Zlatoust is celebrated for its granite, epidote, nephrite and a variety of decorative stones and minerals. Coal is found over a wide area.

Ufa belongs almost entirely to the drainage area of the Byelaya, a tributary of the Kama which rises in Orenburg and flows north and north-west through Ufa, receiving a number of tributaries, among which the Syun, the Tanyp and the Ufa are also navigable. The Byelaya is an important channel for trade; but it sometimes drops to so low an ebb in summer that steamers cannot proceed beyond Birsk. The Kama flows for 120 m. along the western border of the government.

The average temperature at the city of Ufa is 37° F., and the winter is extremely cold (January 5·5° F., July 68° F.); at the Zlatoust observatory the average temperature is only 32·2° (January 2°; July 61·8°). Even in the hilly tracts of Zlatoust the annual rainfall is not more than 19 in. The rivers are frozen 158 days at Ufa and 202 at Zlatoust.

The estimated population in 1900 was 2,620,600. The government is divided into six districts, the chief towns of which are Ufa, Belebey, Birsk, Menzelinsk, Sterlitamak and Zlatoust. Towns have sprung up around the ironworks at Zatkinsk, Yurezañ and Katav-Ivanovsk. The Russian element in the population has rapidly increased (in 1897, 45%; in 1865, 36%), the other ethnographical elements being mainly Bashkirs, Tatars and Meshcheryaks, together with Chuvashes and Cheremisses, Votyaks and Mordvinians. Since the wholesale plundering of the Bashkir lands, which took place under Alexander II., the land has been sold by the nobles, and bought chiefly by the merchant class. Large estates are common, though it is the peasants and the peasants' co-operative societies that cultivate most of the area under crops. Agriculture has greatly developed, owing partly to the Russian immigration and partly to the educational efforts of the local councils; in 1900 there were 4,860,000 acres (16%) under crops and 9,780,000 acres (32½%) under cultivation. The principal crops are rye, wheat, oats, barley, millet, buckwheat and potatoes.

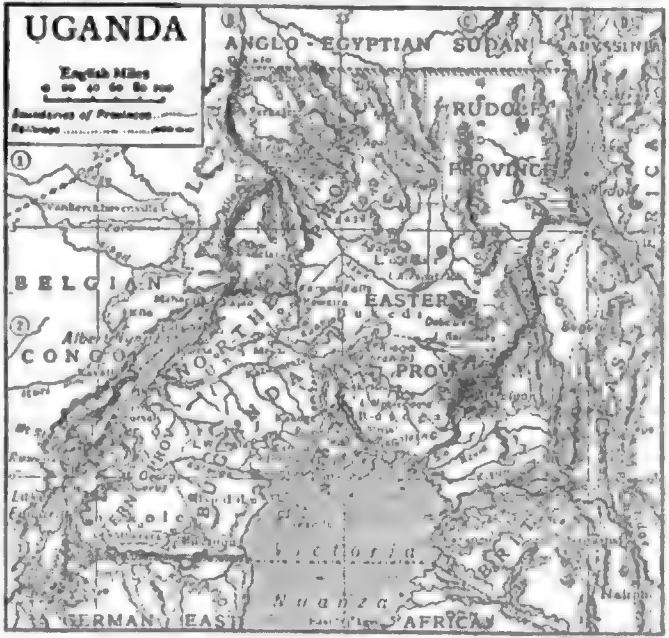
The government is rich in antiquities belonging to three different periods—the Finnish or Chud period, the period of the Bulgarian empire, and the period of the Nogai Tatar domination. The burial-mounds of the Chudes contain brass implements and decorations, and in one of them near Ufa a coffin sheeted with silver was found. Remains from the Bulgarian epoch have been discovered at Menzelinsk. But it is the ruins of the Mongol period which are of greatest value; the remains of a large town, with a mausoleum and a palace, have been found near Ufa and extend several miles along the Byelaya River. (P. A. K.; J. T. Be.)

UFA, a town and river-port of Russia, capital of the government of the same name, situated 326 m. by rail N.E. of Samara, on the main line from Moscow to Siberia, at the confluence of the Ufa with the Byelaya. Pop., 49,275. The better part of the town contains two cathedrals and a few churches; the remainder is a scattered aggregation of small wooden houses. There are a museum, a public library and a theological seminary; and the industries include iron and copper works, machinery works and saw-mills.

Ufa was founded in 1574. The wooden kreml, or fort, protected by wooden towers and an outer earthen wall, had to sustain the attacks of the revolted Bashkirs and Russian serfs in 1662 and at later dates; and in 1773 Chika, one of the chiefs of the Pugachev revolt, besieged it for four months.

UGANDA, a British protectorate in Eastern Equatorial Africa, lying between Lakes Victoria and Albert and between the Mountain Nile and Lake Rudolf. The same name was originally applied to the Bantu kingdom of Buganda, which is one of the five provinces of the protectorate, but which is now styled officially by the correct native name of "Buganda." The Swahili followers of the first explorers always pronounced the territorial prefix, Bu, as a simple vowel, U; hence the incorrect rendering "Uganda" of the more primitive Bantu designation. It was first applied to the kingdom of Mutesa, discovered by J. H. Speke in 1862, and in time came to include the large protectorate which grew out of the extension of British influence over Buganda.

Boundaries and Area.—On the north the frontier of the protectorate is an undetermined line running between Lado (which lies a little north of 5° N.) on the Mountain Nile and the watershed of Lake Rudolf. This northern boundary is in any case conterminous with the southern boundary of the Anglo-Egyptian Sudan. On the east the limit of the Uganda Protectorate in 1901 was the *thalweg* of Lake Rudolf and a line drawn from the south-eastern coast of that lake south along the edge of the Laikipia and Kikuyu escarpments to the frontier of German East Africa. The southern frontier of Uganda was the 1st degree of S. lat.; the western was the 30th meridian of E. long., from the German frontier on the south, across Albert Edward Nyanza and the Semliki River to the line of water-parting between the systems of the Congo and the Nile (in the country of Mboga); thence northwards this western boundary descended to the north coast of Albert Nyanza at Mahagi, and then followed the main stream of the Nile to about 5° N. In 1904, however, it was found that the 30th meridian had been placed some 25 m. west of its true position in the maps used when the frontier was agreed upon, and that if it was maintained as the dividing line it would cut off the Uganda Protectorate from access to Albert Edward Nyanza while giving a corner of the Congo forest to Uganda. A survey commission was subsequently despatched, and in 1910 British, Belgian and German delegates met in Brussels to draw up a new frontier line. Germany was interested in the dispute, inasmuch as the southern frontier of the Uganda Protectorate coincided with the northern frontier of German East Africa. Moreover Germany, Great Britain and Belgium (as inheritor of the Congo State) had conflicting claims in the region N.E. of Lake Kivu. On the 14th of May 1910 a protocol was signed defining the new frontier as follows: From the north end of Lake Kivu the Congo-German frontier turns east by north, traversing the volcanic region of Mfumbiro, and crosses the summit of Mt Karissimbi to the summit of Mt Sabyino, where the British, Belgian and German frontiers meet. From Mt Sabyino the frontier between Belgian Congo and the Uganda Protectorate goes in a direct line north to Mt Nkabwe, and thence along the Ishasha River, to its mouth on the S.E. shores of Albert Edward Nyanza. Thence it crosses that lake in a straight line and afterwards the Ruwenzori to its highest point, Margherita peak, whence it follows the Lamia River to its junction with the Semliki. From that point the frontier is formed by the Semliki to its mouth and the middle of Albert Nyanza to a point opposite Mahagi, where it meets the Congo-Sudan frontier.



Meantime in 1903 the then Eastern province of the Uganda Protectorate had been transferred to the adjoining East Africa Protectorate, the new eastern boundary being the west coast of Lake Rudolf, the river Turkwel, the eastern flanks of Mt Elgon, the Sio River, and a line running south from the mouth of the Sio across Victoria Nyanza to 1° S. The area of the protectorate, approximately 150,000 sq. m. in 1901, has been reduced by these changes to about 110,000 sq. m.

Climate.

Physical Features.—The protectorate, with a singularly diversified surface of lofty plateaus, snow-capped mountains, vast swamps, dense forests and regions of desolate aridity (valley of Lake Rudolf), offers a remarkable variety of climates. The Rudolf province lies low—an average altitude of not more than 2000 ft.—is extremely hot, and has a very poor rainfall. In some of its districts no rain falls for two years at a time, elsewhere scarcely as much as 10 in. per annum. The Eastern province is abundantly watered near Victoria Nyanza and around Mt Elgon and the noble Debasien mountain (about 50 in. to 100 in. annually); elsewhere, in Karamojo and the northern regions, the rainfall lessens to about 20 in. Busoga and the western part of the Elgon district in this province have a regular West African climate—hot, moist and not over-healthy. These are the conditions of Buganda, a country with an annual rainfall of from 60 to 80 in., a regular West African climate, and severe and frequent thunderstorms. Much the same may be said about the Western province, except for the cooling influence of the Ruwenzori snow range, which pleasantly affects Toro and northern Ankole. The rainfall on Ruwenzori and the central Semliki valley is quite 100 in. per annum. Along the Ruwenzori range are glaciers and snowfields nearly 15 m. in continuous length and some 5 m. in breadth. The Northern (formerly called the Nile) province is perhaps the hottest part of Uganda. Like the districts round Lake Rudolf, the average altitude (near the Nile) is not more than 2000 ft., but the rainfall is more abundant than in the terrible Rudolf region, being an average of 30 in. per annum.

Mountains, Lakes and Rivers.

The surface of the protectorate is diversified. Mount Elgon (*q.v.*) just outside the Eastern province is one of the leading physical features of the Uganda and East Africa protectorates. It consists of the vast crater—some 10 m. in diameter—of an extinct volcano, the rim of which rises in several places to over 14,000 ft. Terraces and buttresses extend and ramify in all directions from the central crater, so that the giant volcano and its surrounding heights form a mountain country (notable for its innumerable cascades and dense forests) the size of Montenegro. The mass of Elgon can be seen from the north-east coast of Victoria Nyanza, from near the main Nile stream, from the heights overlooking Lake Rudolf and from the Kikuyu escarpment. The Eastern province consists of well-forested, undulating land (Busoga) on the coast of the lake, a vast extent of marsh round the lake-like backwaters of the Victoria Nile (Lakes Ibrahim or Kioga, Kwania, &c.) and a more stony, open, grain-growing country (Bukedi, Lobor, Karamojo). The Turkana country west of Lake Rudolf has been of late years terribly arid. A little vegetation is met with in the stream valleys, but most of the rivers marked on the map have ceased to show running water in their lower courses. A good deal of high land—rising in some peaks to near 10,000 ft.—is found in the eastern part of the Northern province, and these heights attract moisture and nourish permanent streams flowing Nilewards. But much of the lower ground is stony and poor in vegetation, while the lowland near the main Nile is exceedingly marshy.

The Ripon Falls, in the centre of the northern coast of the Victoria Nyanza, at the head of the exquisitely beautiful Napoleon Gulf, mark the exit of the fully born Nile from the great lake. The Victoria Nile tumbles over 50 m. of cascades and rapids (descending some 700 ft. in that distance) between Ripon Falls and Kakoge. Here it broadens into Lake Ibrahim (Kioga) (in reality a vast backwater of the Nile discovered by Colonel Chaillé Long in 1874), and continues navigable (save for sudd obstacles at times) right through Lake Ibrahim and thence northwards for 100 m. to Foweira and Karuma Falls. Between Karuma and Murchison Falls the Victoria Nile is unnavigable. At Fajao the navigation can be resumed into Lake Albert. The main Nile stream when it quits Lake Albert continues navigable as far north as Nimule (3° 40′ N.). Between Nimule and Fort Berkéley the river flows through a deep gorge and falls nearly 1000 ft. Navigability really only begins again at Gondokoro on the Sudan frontier, from which point steamers ply to Khartum (see NILE).

The geography of the Western province includes many interesting features, the in many ways peculiar Albert Nyanza (*q.v.*), the great snowy range of Ruwenzori (*q.v.*), the dense Semliki, Budonga, Mpanga and Bunyaraguru forests, the salt lakes and salt springs of Unyoro and western Toro, the innumerable and singularly beautiful crater lakes of Toro and Ankole, the volcanic region of Mfumbiro (where active and extinct volcanoes rise in great cones to altitudes of from 11,000 to nearly 15,000 ft.), and the healthy plateaus of Ankole, which are in a lesser degree analogous in climate and position, and the Nandi plateau on the east of Victoria Nyanza. Ruwenzori is a snowy range, and not a single mountain. Its greatest altitude—the Duke of the Abruzzi's Mt Stanley (Margherita Peak)—is 16,816 ft., and therefore the third highest point on the African continent. The Uganda Protectorate is a land of great lakes, and includes partially or wholly the water areas of Victoria Nyanza (about 27,000 sq. m.), Lake Rudolf (about 3500 sq. m.), Lake Ibrahim-Kioga-Kwania (800 sq. m.), Albert Nyanza (2700 sq. m.), and Lakes Albert Edward and Dweru[1] (1500 sq. m.), besides the small crater lakes of Toro and Ankole (singularly beautiful), the lake-swamps Salisbury and Kirkpatrick in the Eastern province, Lakes Wamala in Buganda, and Kachera in Ankole. The water of Lake Victoria is perfectly fresh. This is the case with all the other lakes except Rudolf, Albert Nyanza and Albert Edward, in which the water ranges from salt to slightly brackish.

Geology.—Wide tracts remain geologically unexplored. Archean rocks—gneiss, schist and granite—cover large areas through which the Nile cuts its way in alternate narrow gorges and open reaches. In Ankole and Koki rocks consisting of granular quartzite, schistose sandstone, red and brown sandstone, and shales with cleaved killas rest on the Archean platform and possibly represent the Lower Witwatersrand beds of the Transvaal. No traces of the Karroo formation have been detected. Volcanic rocks occur in Usoga and elsewhere. The Nile at the Ripon Falls leaps over a basalt dike. The rocks on the verge of the Kisumu province of East Africa are mainly volcanic (basalt, tuff, lava, kenyte). West of the volcanic region, nearer to Lake Victoria and the Eastern province, ironstone, granite, gneiss and schistose formations predominate, with phonolite in places.

Petrology and Mineralogy.

Iron ore (haematite) is abundant. In the Eastern province the rocks are mainly quartz, gneiss and granite, with sandstone in Busoga, basalt round Mt Elgon, slate (Busoga) and ironstone (Busoga and Bukedi). In the Rudolf province there are the basalt, lava, tuff and kenyte of the volcanic Rift valley, overlying a formation of granite, gneiss and quartz. Gold—in some cases alluvial—is found in the mountainous country to the north-west of Lake Rudolf. Gneiss, granite and quartz—the decomposed granite giving the red "African" clay—are the leading features in the formations of the Northern province, of Buganda, and of the Western province, with some sandstone in the littoral districts of Buganda and in Ankole, and eruptive rocks and lava in south-western Ankole and on the eastern flanks of Ruwenzori. There are indications of copper in Busoga, of gold in Unyoro. Iron is found nearly everywhere. Graphite is present in Buganda and Unyoro.

Flora.—The vegetation is luxuriant except in the Rudolf region, which has the sparse flora of Somaliland. In the Western province, Busoga and the Elgon district the flora is very West African in character. The swampy regions of the Nile and of the Eastern province are characterized by an extravagant growth of papyrus and other rushes, of reeds and coarse grass. There are luxuriant tropical forests in the coast region of Buganda, in Busoga, west Elgon, western Unyoro, eastern Toro, the central Semliki valley and north-west Ankole. The upper regions of Mt Elgon, Mt Debasien and Mt Agoro are clothed with forests of conifers—juniper and yew—and witch-hazels (*Trichocladus*). There are also giant yew-trees (*Podocarpus*) on the flanks of Ruwenzori and the Mfumbiro volcanoes between 7000 and 9000 ft., but no junipers. The alpine vegetation on all these lofty mountains is of a mixed Cape and Abyssinian character—witch-hazels, senecios, lobelias, kniphofias, everlasting flowers, tree heaths and hypericums. The really tropical vegetation of Buganda is nearly identical with that of West Africa, but there is no oil-palm.

Fauna.—The fauna also has many West African affinities in the hot, forested regions. In the Kisumu province of East Africa even, there are several West African mammals such as the broad-horned tragelaph and the forest pig. These are also found in part of the Semliki forests. As a rule, however, the fauna of the Upper Semliki valley, of parts of Ankole, Buganda and Unyoro, of the Northern, Rudolf and Eastern provinces, is of that "East African," "Ethiopic" character which is specially the feature of South and East Africa and of the Sudan right across from Abyssinia to the river Senegal. Among notable mammals the chimpanzee is found in Unyoro, Toro and north-west Ankole, and has only recently become extinct in Buganda; the okapi inhabits the Semliki forests on the Congo frontier; the giraffe (the male sometimes developing five horn cores) is common in the Northern, Eastern and Rudolf provinces; there are three types of buffalo—the Cape, the Congo and the Abyssinian; two species of zebra (one of them Grévy's), the African wild ass, the square-lipped ("white") and pointed-lipped ("black") rhinoceroses, the elephant, hippopotamus, water tragelaph ("Speke's antelope"), Cape ant-bear, aard-wolf (*Proteles*), hunting-dog, and nearly every genus and most of the species of African antelopes. The birds are more West African than the mammals, and include the grey parrot, all the genera of the splendidly-coloured turacoes, the unique "whale-headed stork," and the ostrich.

Inhabitants.—The inhabitants in 1909 numbered about 3,500,000 natives, 3000 British Indians and Arabs, and 507 Europeans (British, French, Germans, Italians and Maltese). Of these last 119 were women. The races indigenous to the protectorate are mainly of the Negro species (with slight Caucasian intermixture), and may be divided into the following categories. (1) *Pigmy-prognathous* (so-called "Congo" pigmies of Semliki forest, of Kiagwe in Buganda, and of the western flanks of Mt Elgon and the types of Forest Negroes); (2) *Bantu negroes* (Banyoro, Bairu, Basese, Basoga, Bakonjo, Baganda, Masaba and Kavirondo); (3) *Nile negroes* (Aluru, Bari, Madi, Acholi, Gang, Lango, Latuka, Tesi, Sabei (Nandi), Turkana and Karamojo); (4) *Hamitic* (some tribes on islands and the north coast of Lake Rudolf; and the remarkable "Hima" or "Huma" aristocracy in Unyoro, Buganda, Toro and Ankole). The pigmies are generally known as Bambute or Bakwa in the Semliki forests. They are both reddish yellow and brownish black (according to individual variation) in skin colour, with head hair often tending to russet, and body hair of two kinds—black and bristly on the upper lip, chin, chest, axillae and pubes; and yellowish and fleecy on the cheeks, back and limbs. Their faces are remarkable for the long upper lip and the depressed broad nose with enormous alae. Associated with these pigmies is the "Forest Negro" type (Lendu, Lega, Baamba, Banande) of normal human stature, but short-legged and unusually prognathous. The Bantu negroes represent the future ruling race of the protectorate, and include the remarkable Baganda people. These last, prior to the arrival of Arabs and Europeans, displayed a nearer approach to civilization than has as yet been attained by an unaided Negro people. Their dynasty of monarchs can be traced back with tolerable certainty to a period coincident with the reign of Henry IV. of England (A.D. 1400). The first Buganda king was probably a Hamite of the Hima stock (from Unyoro). Until recent years the Baganda and most of the other Bantu peoples of the protectorate worshipped ancestral and nature spirits who had become elevated to the rank of gods and goddesses. The Baganda are now mainly Christian. There is also a "totem" system still in vogue. All the Baganda belong to one or other of twenty-nine clans, or "Biká," which are named after and have as totem familiar beasts, birds, fish or vegetables. The Baganda are not a very moral people, but they have an extreme regard for decency, and are always scrupulously clothed (formerly in bark-cloth, now in calico). As a general rule, it may be said that all the Bantu tribes in the western half of the protectorate, including the Basoga, are careful to consider decency in their clothing, while the Nilotic negroes are often completely nude in both sexes. More or less, absolute nudity among men is characteristic even of the Bahima (Hamites). But in this aristocratic caste the women are scrupulously clothed.

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[1] In 1909 Albert Edward Nyanza was renamed by British geographers (with the consent of Edward VII.) Lake Edward, and Lake Dweru Lake George, in honour of George V.

The Nile negroes and Hima are tall people. The former are seldom handsome, owing to their flat faces and projecting cheek-bones. The Bahima are often markedly handsome, even to European eyes. In the Bahima the proportion of Caucasian blood is about one-fourth, in the Nile negroes and Bantu from one-sixteenth to none at all. The aboriginal stock of the Uganda Protectorate is undoubtedly the pigmy-prognathous, which has gradually been absorbed, overlaid or exterminated by better developed specimens of the Negro sub-species, or by Negro-Caucasian hybrids from the north and north-east.

The languages spoken in the Uganda Protectorate belong to the following stocks: (1) *Hamitic* (Murle and Rendile of Lake Rudolf), (2) *Masai* (Bari, Elgumi, Turkana, Sūk, &c.), (2*a*) Sabei, on the northern slopes of Elgon and on Mt Debasien; (2*b*) *Nilotic* (Acholi, Aluru, Gang, &c.); (3) *Madi* (spoken on the Nile between Aluru and Bari, really of West African affinities); (4) Bantu (Lu-ganda, Runyoro, Lu-konjo, Kuamba, Lihuku, the Masaba languages of west Elgon and Kavirondo, &c.), and lastly, the unclassified, isolated *Lendu* and *Mbuba* spoken by some of the pigmy-prognathous peoples.

Towns.—The seat of the British administration is Entebbe ("a throne") on the south shores of a peninsula projecting into the Victoria Nyanza in 0° 4′ 2″ N. 32° 27′ 45″ E. It contains a number of commodious official residences, churches, hospitals, a laboratory, covered market, &c. The port is protected by a breakwater and provided with a pier on which is the customs-house. The native capital of Buganda is Mengo (pop. about 70,000), situated some 20 m. N. by E. of Entebbe. It is a straggling town built on seven steep hills: on one hill is the royal residence; on another (Namirembe = the hill of peace) was the cathedral of St Paul, destroyed by lightning in September 1910, and other buildings of the Anglican mission. St Paul's was a fine Gothic church of brick, built by the Baganda in 1901–1904. After its destruction steps were at once taken to rebuild the cathedral. On a third hill are the cathedral and mission buildings of the Roman Catholics. On still another hill, Kampala, the British fort and government and European quarters are situated. Some 7½ m. S. by E. of Kampala, and connected with it by monorail, is Kampala Port, on Victoria Nyanza. The capital of the Eastern province is Jinja, on the Victoria Nyanza, immediately above and east of the Ripon Falls. It is a thriving trading centre and port. Hoima is the administrative headquarters in Unyoro; Butiaba is a trading port of some importance on Lake Albert; Mbarara is the capital of Ankole. Kakindu, Mruli, Fowera and Fajao are government stations and trading posts on the Victoria Nile; Wadelai (*q.v.*), Nimule and Gondokoro (*q.v.*) are similar stations on the Mountain Nile. Bululu is a port on Lake Ibrahim.

Agriculture and Trade.—A few plantations are owned and managed by Europeans. Otherwise agriculture is in the hands of the natives. Some Baganda chiefs have started cotton, rubber and cocoa plantations, the botanic department assisting in this enterprise. Pará and *Funtumia* rubber trees are also cultivated by the department. (For the work of the botanic, forestry and scientific department, the government plantations, &c., see the *Colonial Report* [Miscellaneous], No. 64.) A forest area of 150 sq. m. has been leased to a European company. Trade is mainly conducted by native (*i.e.* Arab, Somali and Negro) traders, by British Indians and by Germans. The value of the trade during 1901–1902 was approximately £400,000 in imports (largely railway material) and £50,000 in exports. The articles exported were ivory, rubber, skins and hides, and livestock (for consumption in East Africa). These, except livestock, continue to be the main items of export. For the six years 1903–1904 to 1908–1909 the imports increased from £147,000 to £419,000, and the exports—produce of the protectorate—from £43,000 to £127,000. The imports included the transit trade (with the Belgian Congo and German East Africa), which grew from £8460 in 1903–1904 to £82,615 in 1908–1909. The transit trade in the last-named year included bullion valued at £33,000, being raw gold from the Kilo mines, Belgian Congo. Among the new industries are sugar and coffee plantations, while cotton, ground-nuts and rubber figure increasingly among the exports, cotton and cotton-seed being of special importance. Cotton goods, chiefly "Americani," are the chief imports, machinery, hardware and provisions ranking next. Large quantities of rice are imported from German East Africa. About 50% of the imports are from the United Kingdom and British possessions.

Communications.—In connexion with the railway from Mombasa to Victoria Nyanza a steamship service is maintained on the lake between Port Florence, Entebbe and other ports, including those in German territory. Government boats also ply on the Victoria Nile and Lake Kioga (Ibrahim) and on Albert Nyanza and the Mountain Nile. A railway (begun in 1910), some 50 m. long, runs from Jinja to Kakindu, *i.e.* along the Victoria Nile from its point of issue from the Nyanza to where it becomes navigable above Lake Kioga. Good roads connect Entebbe and Butiaba (the steamboat terminus on Albert Nyanza) and other districts. There is a direct telegraphic service to Gondokoro and Khartum and to Mombasa. The postal service is well organized.

Administrative Divisions and Government.—The protectorate is divided into five provinces—Rudolf, Eastern (formerly central), kingdom of Buganda, Western, and Northern (formerly Nile)—and these again into a number of administrative districts. The kingdom of Buganda, which has a thoroughly efficient and recognized native government, is subdivided into no fewer than nineteen "counties" or districts, but the other provinces have as a rule only three or four subdivisions.

The protectorate is administered by a governor and commander-in-chief, under the colonial office, residing at Entebbe, on the north-western coast of the Victoria Nyanza. He is assisted by a staff of officials similar to the functionaries of a Crown colony, but there is at present no legislative council. The natives are ordinarily under the direct rule of their own recognized chiefs, but in all the organized districts the governor alone has the power of life or death, of levying taxes, of carrying on war, of controlling waste lands and forests, and of administering justice to non-natives. In the case of Buganda special terms were accorded to the native king and people in the settlement dated the 10th of March 1900. The king was secured a minimum civil list of £1500 a year out of the native revenues, pensions were accorded to other members of the Buganda royal family; the salaries of ministers and governing chiefs were guaranteed; compensation in money was paid for removing the king's control over waste lands; definite estates were allotted to the king, royal family, nobility and native landowners; the native parliament or "Lukiko" was reorganized and its powers were defined; and many other points in dispute were settled. The king was accorded the title of "His Highness the Kabaka of Buganda," and his special salute was fixed at eleven guns. By this agreement the king and his people pledged themselves to pay hut and gun taxes to the administration of the protectorate. Somewhat similar arrangements on a lesser scale were made with the king of Ankole, the kings of Toro and Unyoro, and with the much less important chieftains or tribes of other districts. The territories north and north-east of these Bantu kingdoms are inhabited by Nilotic negroes and up to 1909 were left almost unadministered, except in close vicinity to the Nile banks.

The education of the natives is confined to the schools maintained by the missionaries, who are doing an excellent work. Manual, technical and higher education is provided. In 1909–1910 there were in the Anglican schools over 36,000 scholars, of whom 17,000 were girls. Of the total number of scholars over 26,000 were in the kingdom of Buganda. The Roman Catholic schools had in 1909 over 11,000 scholars. (See the *Col. Off. Report on Uganda*, No. 686.)

Expenditure and Revenue.

The expenditure for 1902–1903 was fixed at £210,000, of which about £170,000 was furnished by an imperial grant-in-aid and the balance from local revenue. Between 1903 and 1909 the revenue increased from £51,000 to £102,000. Revenue is chiefly derived from hut and poll taxes, customs, wharfage dues, game licences and land tax. The hut and poll taxes yield about £62,000 a year. The expenditure increased from £186,000 in 1903 to £256,000 in 1909. Deficiencies are made good by parliamentary grants. The rupee (1s. 4d.) is the standard coin, with a subsidiary decimal coinage.

History.—The countries grouped under this protectorate were invaded at some relatively remote period—say, three to four thousand years ago—by Hamitic races from the north-east (akin to the ancestors of the ancient Egyptians, Gallas, Somalis), who mingled extensively with the Nile negroes first, and then with the aboriginal inhabitants of Buganda, Unyoro and Nandi. These Hamites brought with them a measure of Egyptian civilization, cattle, and the arts of metallurgy, pottery and other adjuncts to neolithic civilization. There was probably no direct intercourse with Egypt by way of the Nile, owing to the lake-like marshes between Bôr and Fashoda, but instead an overland traffic with Ethiopia (the Land of Punt) via Mt Elgon and the Rudolf regions. In time even this intercourse with the non-negro world died away, and powerful kingdoms with an aristocracy of Galla descent grew up in Buganda, Unyoro and Ankole.

The kingdom of Buganda especially dominated the lands of Victoria Nyanza in the 19th century. In the 'forties and 'fifties Egyptian officials, Austrian missionaries, and British, Dutch, Italian, and German explorers had carried our knowledge of the Nile beyond Khartum as far south as Gondokoro. In the same period of time the Zanzibar Arab traders were advancing from the south on the Bahima kingdoms of the western Victoria Nyanza and on Buganda. King Suna of Buganda first heard of the outer world of white men in 1850 from a runaway Baluch soldier of Zanzibar. Captains Burton and Speke, on their Tanganyika expedition, heard of Buganda from the Arab traders in 1857. Captain Speke in 1862 reached Buganda, the first of all Europeans to enter that country. In the early 'seventies Sir Samuel Baker (who had discovered Albert Nyanza) extended the rule of the Egyptian Sudan as far south as the Victoria Nile. General Gordon, who succeeded Baker, and who had Dr Emin Bey (afterwards Emin Pasha) as lieutenant, attempted through Colonel Charles Chaillé Long, in 1874, not only to annex Unyoro but also Buganda to the Egyptian dominions, and thoroughly established Egyptian control on Albert Nyanza. But owing to the indirect influence of the British government, exercised through Sir John Kirk at Zanzibar, the Egyptian dominions were prevented from coming south of the Victoria Nile.

Suna, the powerful king or emperor of Buganda, who was the first to hear of a world beyond Negroland, had been succeeded in 1857 by his still more celebrated son, Mutesa (*Mutesa* means the measurer). Mutesa had received Speke and Grant in a most friendly manner. Subsequent to their departure he had opened up relations with the British agent at Zanzibar. In 1875 he received an epoch-making visit from Sir H. M. Stanley. Stanley, in response to Mutesa's questions about religion, obtained from that king an invitation to Anglican missionaries, which he transmitted to London through the *Daily Telegraph*.[1] Having made the first survey of Victoria Nyanza and confirmed Speke's guesses as to its shape and area, Stanley passed on (half discovering Ruwenzori on the way) to the Congo.

Christian Missions, 1877–1879.

Meanwhile the Zanzibar Arabs had reached Buganda in ever-increasing numbers as traders; but many of them were earnest propagandists of Islam, and strove hard (with some success) to convert to that religion the king and chiefs of Buganda and adjoining countries. In 1877 the Rev. C. T. Wilson, one of a party of missionaries sent in answer to Stanley's appeal by the Church Missionary Society of England, arrived in Uganda, and towards the end of 1878 was joined by Alexander Mackay. In 1879 another party arrived by the Nile route; and Wilson, after thirteen months' actual residence, left for England with Dr R. W. Felkin, who had arrived only three months before, taking with him envoys from Mutesa. In the same year the French Roman Catholic mission of the White Fathers of Algeria was inaugurated, and thus from 1879 dates the triangular rivalry of the creeds of Anglican and Roman Christianity and of Islam.

Mutesa succeeded by Mwanga, 1884.

In 1882 Islam gained an ascendancy, and the French withdrew for a time. In the autumn of 1884 Mutesa died. A great change had been wrought in Uganda during the latter years of his reign. Calico, fire-arms and swords had replaced the primitive bark-cloth and spear, while under the teaching of the missionary-engineer Mackay the native artisans had learnt to repair arms and use European tools. Mutesa was a clever man of restless energy, but regardless of human life and suffering, and consumed by vanity. He was succeeded by Mwanga, a cruel, weak and vicious youth. The intrigues of the Arabs led him to suspect the designs of the missionaries. He was alarmed at their influence over numbers of his people and resolved to stamp out Christianity.

In the early 'eighties the aspirations of several European powers turned towards Africa as a field for commercial and colonial expansion. The restless Arabs of Zanzibar had since 1857 steadily advanced Zanzibar influence to Tanganyika, Nyasa, and even through the Masai countries to the north-east coast of Victoria Nyanza and the "back door" of Uganda. In 1882 the Royal Geographical Society despatched Joseph Thomson to discover through Masailand the direct route to Victoria Nyanza. Thomson succeeded (he also discovered Lake Baringo and Mt Elgon), but turned back from the frontier of Busoga in order not to provoke Mutesa to hostilities. Mr H. H. Johnston was despatched on a scientific mission to Kilimanjaro, and concluded treaties on which the British East Africa Company was subsequently based. The vague stir of these movements had perturbed Mutesa, and they were regarded with deep suspicion by his successor, Mwanga.

Murder of Bishop Hannington, 1885.

Religious Feuds.

The annexations of Emin on Albert Nyanza, the visit of Thomson to the closed door of Busoga, the opposition of the Europeans to the slave trade, and, lastly, the identification of the missionaries with political embassies and their letters of introduction from secular authorities, added to Mwanga's fears, and early in 1885, simultaneously with the return of the French Fathers, the long smouldering hostility broke out, and the Christian converts were seized and burnt at the stake. Bishop Hannington, who attempted to enter Buganda by the forbidden route from the east, was murdered, and the Rev. R. P. Ashe and Mackay only redeemed their lives by presents. The Buganda Christians showed heroism, and in spite of tortures and death the religion spread rapidly. Mwanga now determined to rid himself of Christians and Mahommedans alike by inducing them to proceed to an island in the lake, where he meant to leave them to starve. The plot was discovered, and Mwanga fled to the south of the lake, and Kiwewa, his eldest brother, was made king. The chiefs of the rival creeds—British (Anglicans), French (Catholics), and Ba-Islamu, as they were called—divided the chiefships. The Mahommedans now formed a plot to oust the Christians, and treacherously massacred a number of their chiefs and then defeated their unprepared adherents. Kiwewa, refusing to submit to circumcision, was (after reigning three or four months) expelled by the Ba-Islamu, who placed another brother, Kalema, on the throne and began a fanatical propaganda, forcing the peasantry to submit to the hated circumcision. The British and French factions, who had taken refuge in Ankole, could not agree even in their common exile, and nearly came to blows, but on the spur of threatened famine they agreed to combine and to take back Mwanga as their king and strike a blow for supremacy in Buganda. In May 1889 Mwanga, aided by the trader Charles Stokes, approached Buganda by water, and after several bloody battles captured the capital, but shortly afterwards was again defeated, and Kalema and the Ba-Islamu reoccupied Mengo (the native capital). Appeals for help were sent to Frederick John Jackson (subsequently lieutenant-governor of British East Africa), who had arrived on the east of the lake with a caravan of some 500 rifles, sent by the newly-formed East African Chartered Company. He replied saying he would come if all the expenses were guaranteed and the British flag accepted. Père Lourdel, who was Mwanga's chief adviser at this time, counselled acceptance of these terms, but Jackson at first marched in a different direction northwards. Returning three months later, he found that Dr Karl Peters, a German in command of an "Emin Pasha Relief" expedition, had passed through his camp, read his letters, and, acting on the information thus obtained, had marched to Buganda, arriving in February 1890, where with the aid of Lourdel he concluded a treaty which was kept secret from the British party, who repudiated it. The Baganda Christians, before the arrival of Peters, had again engaged the Mahommedans and driven them to the frontier of Unyoro, where King Kabarega gave them an asylum and aid. Kalema died later in the same year—1890—and was succeeded by Mbogo, a half brother of King Mutesa. The posts of honour had been divided between the rival factions. Peters's treaty had given fresh offence and added to the disputes arising in the division of the offices of state, and the factions were on the point of fighting. Jackson arrived in April with 180 gun-men (a portion of his caravan having mutinied), and presented a new treaty, which was refused by the French. Feeling ran high, and Jackson withdrew his treaty, and, taking a couple of envoys who should bring back word whether Uganda was to be French or British, he left the country, Mr Ernest Gedge remaining in charge of his expedition.

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[1] The letter was entrusted to Linant de Bellefonds, a Belgian in the Egyptian service, who had been sent to Buganda by Gordon. On his return journey Bellefonds was murdered by the Bari. When his body was recovered Stanley's letter was found concealed in one of his boots and was forwarded to England.

French and British Factions.

Lugard's Arrival, 1890.

While these events were happening in Uganda the Anglo-German treaty of July 1890 had assigned Uganda to Great Britain, and in October 1890 Captain F. D. Lugard, then at Kikuyu, halfway between the coast and the lake, received instructions to go to Uganda. He had with him Messrs De Winton and W. Grant, some 50 Sudanese soldiers, and about 250 porters, armed with Snider carbines. Marching with unprecedented rapidity, he entered Mengo on the 18th of December. Lugard, by introducing the names "Protestant" and "Catholic"—till then unknown—and by insisting that all religion was free, endeavoured to dissociate it from politics, and urged that as Uganda was now under Great Britain there could be no hostile "French" faction. This attitude was welcome to neither faction, and for some days the position of the new arrivals on the little knoll of Kampala was very precarious. Lugard's first object was to obtain a treaty which would give him a right to intervene in the internal affairs of the country. The hostile French faction was much the stronger, since at this time the king (whom the whole of the pagan party followed) was of that faction; but after some critical episodes the treaty was signed on the 26th of December. Lugard then endeavoured to settle some of the burning disputes relative to the division of lands and chiefships, &c., and to gain the confidence of both parties. In this he was to some extent successful, and his position was strengthened by the arrival in January 1891 of Captain (subsequently Colonel) W. H. Williams, R.A., with a small force of Sudanese and a maxim. In April Lugard, hoping to achieve better results away from the capital, led the combined factions against the Mahommedans, then raiding the frontier, whom he defeated. Seeing that the situation in Buganda was impossible unless they had a strong central force, which the company could not provide, Lugard and Williams had formed the idea of enlisting the Sudanese who had been left by Emin and Stanley at the south end of the Albert Lake. Taking with him Kasagama, the rightful king of Toro, he traversed the north of Ankole, with which country he made a treaty, and passing thence through Unyoro, along the northern slopes of Ruwenzori, reached Kavali at the south end of Lake Albert, defeating the armies of Unyoro who opposed his progress. He brought away with him 8000 Sudanese men, women, children and slaves, under Selim Bey (an Egyptian officer). Some of these he left at the posts he established along southern Unyoro. After an absence of six months from Buganda, Lugard reached the capital at the end of the year (1891) with 200 or 300 Sudanese soldiers and two or three times that number of followers. Lugard little thought that in bringing these Sudanese, already (some of them) infected with the sleeping-sickness of the Congo forests, he was to introduce a disease which would kill off some 250,000 natives of Uganda in eight years. Meanwhile Williams, amid endless difficulties, with a mere handful of men, had managed to keep the two factions from civil war, though fighting had actually occurred in Buddu and in the Sese Islands.

Civil War, 1891.

After Lugard's return a lull occurred till the coast caravan left, when lawlessness again broke out and several murders were committed. On the 22nd of January the killing of a Protestant at the capital (Mengo) produced a crisis. Lugard appealed to the king to do justice, but he himself was treated with scant courtesy, and his envoy was told that the French party would sack Kampala if Lugard interfered on behalf of the murdered man. In spite of strenuous efforts on the part of the British administrator to avert war the French party determined to fight, and finally attacked the British, who had assembled round Kampala. The king and French party were defeated and fled to the Sese Islands. The king and chiefs (except two ringleaders) were offered reinstatement, and they appeared anxious to accept these terms, but the French bishop joined them in the islands, and from that day all hopes of peace vanished. Fighting was recommenced by a "French" attack on "British" canoes, and Williams thereupon attacked the island and routed the hostile faction. After this the "French" slowly concentrated in Buddu in the south, the Protestants migrating thence. Williams then led a successful expedition against the Sese islanders and went on to the south of the lake to obtain one of the young princes—heirs to the throne—who were at the French mission there. But the Fathers were hostile, and though Mwanga was eager to accept Lugard's offers of reinstatement, he was a prisoner in the hands of his party. He succeeded eventually in escaping, and arrived in Mengo on the 30th of March (1892). A new treaty was made, and the British flag flew over the capital, while the French party were given a proportion of chiefships and assigned the province of Buddu. These conditions they themselves said were liberal, nor could they have ventured to assume their old positions throughout Uganda.

The Mahommedans had all this time refrained from attacking the capital as had been expected. They now clamoured for recognition, and Lugard went to meet them, and after a somewhat precarious and very difficult interview he succeeded in bringing back their king Mbogo to Kampala, and in assigning them three minor provinces in Uganda.[1]

The Question of Evacuation, 1892.

Lugard on his return to Uganda at the end of 1891 had received orders to evacuate the country with his whole force, as the company could no longer maintain their position. A reprieve till the end of 1892 followed, funds having been raised through the efforts of Bishop Tucker by the Church Missionary Society and friends. The lives of many Europeans were at stake, for anarchy must follow the withdrawal, and it seemed impossible to repudiate the pledges to Toro, or to abandon the Baganda who had fought for the British. In June 1892, therefore, Lugard determined to leave for England to appeal against the decision for abandonment. Williams remained in Uganda, where the outlook was now fairly promising, and every effort

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[1] Since reduced to one.

Portal's Mission.

was made to reduce expenses. On arrival in England Lugard found that the British Government had decided not to come to the help of the company, and Uganda was to be left to its fate. A strong movement was set on foot for the "retention of Uganda," and on the 10th of December Lord Rosebery despatched Sir Gerald Portal to report on the best means of dealing with the country, and a subsidy was given to the company to enable them to retain their troops there till the 31st of March 1893. Captain (afterwards General Sir) J. R. L. Macdonald, who had been in charge of a railway survey to Uganda, was directed to inquire into the claims put forward by France for compensation for the priests. His report was set aside by the government, which, without admitting liability, but to close the controversy with France, agreed to pay £10,000 to the French priests, and the foreign office published a categorical reply by Lugard to the accusations made. Portal and his staff reached Uganda in March, and Williams left soon afterwards with the original troops of the company, leaving Selim Bey and the Sudanese and Portal's large escort in Uganda. The country on Portal's arrival bore every mark of prosperity and revival. By increasing the territory of the Roman Catholics, and giving them estates on the road from Buddu to the capital, Portal gave effect to projects which the Protestants had violently opposed. He added also to their chiefships, and on the 1st of April hoisted the British flag, made a new treaty with Mwanga, and sent Major Roderick Owen to enlist 400 Sudanese from the Toro colonies. He recommended to the imperial government the retention of Uganda (*i.e.* Buganda), the abandonment of Unyoro and Toro, and the construction of a railway half-way only to the lake. He departed after two and a half months' residence, leaving Macdonald in charge. During Macdonald's administration the Sudanese under Selim Bey began to conspire against the British control. The movement was checked and Selim Bey was deported to the coast.

Colvile's Occupation of Unyoro.

In November 1893 Colonel (Sir Henry) Colvile arrived to take charge, and at once led the whole of the Baganda army against King Kabarega of Unyoro. Major R. Owen defeated the hostile army, first in the south and later in the north, and the Baganda chiefs scattered the main body, while Colvile occupied the capital and built a line of forts from Buganda to Lake Albert, of which he left Major A. B. Thruston in command. This officer fought a number of brilliant actions, and aided by Major (later Colonel) G. G. Cunningham, Captain Seymour Vandeleur, William Grant and others, he overran Unyoro and broke down all resistance. In June 1894 Uganda (*i.e.* the kingdom of Buganda) was declared a protectorate, and at the end of the year Sir Henry Colvile was invalided. Mr F. J. Jackson now took temporary charge, pending the arrival in June 1895 of Mr E. J. L. Berkeley, the first administrator.

At this time also it was decided to construct a railway to Uganda, but work was not begun till December 1896. Peace seemed assured in Uganda; territorial limits to religious teaching were abolished, English Roman Catholic priests were added to the French Fathers, and the material progress of the country was very marked. European traders settled in the country, good permanent houses were built, roads were made and kept in repair, and many new industries introduced, chief among which were the expression of oil from various oilseeds and the cultivation of coffee. Trees were imported and land set aside for planting forests. The success of these efforts at progress was largely due to Mr G. Wilson, C.B., who had been sent to Uganda from East Africa as an assistant administrator in 1896. In this year also the protectorate was extended over Unyoro and Busoga.[1]

Rebellion of 1897.

In the middle of 1897 this era of peace was rudely interrupted. Colonel Trevor Ternan was acting commissioner, and Macdonald had returned to East Africa in command of an exploring expedition, for which Ternan had been ordered to supply 300 Sudanese. In June Wilson discovered a plot to revolt, and in July Mwanga fled to the south of Buddu and raised the standard of rebellion. The rebels were defeated, while Mwanga was made a prisoner by the Germans. Ternan, unaware of the disaffection of his men, now sent three companies to Macdonald, selecting those who had been continuously fighting in Unyoro, Nandi and Buddu. This caused great discontent, which was increased by the fact that their pay was six months in arrears and their clothing long overdue. The men, too, resented the fact that their pay was but a fifth of that given to Zanzibari porters and to those of their own body enlisted in the adjoining protectorate. They were sore at again being sent on service without their wives, and complained of harsh treatment from their officers. Necessaries had been delayed in the attempt to import steamers from the coast before the railway was made.

Sudanese Mutiny.

After Colonel Ternan's departure on leave the three companies who had joined Macdonald broke out into revolt in the Nandi district (East Africa) and set off to Uganda, looting the countries they passed through. Macdonald and Jackson followed with a force of Zanzibaris. Meanwhile Major Thruston—a man justly loved by his soldiers, in whom he had complete confidence—hurried to the garrison at Luba's, near the Ripon Falls, relying on his personal influence to control the men, and risking his life in the heroic attempt. He and two other Europeans were seized and made prisoners. On the 19th of October a battle was fought between the mutineers and Macdonald's force, in which the former were defeated. The same night the Sudanese leaders, fearful lest their men might submit, murdered Thruston and his companions and sent letters to Uganda to incite their comrades to mutiny. Wilson, however, had already disarmed the troops in Kampala, who remained loyal, as also did Mbogo, the ex-king of the Baganda Mahommedans. A large Protestant army now went to the assistance of Macdonald, and from the 19th of October to the 9th of January the siege of Luba's continued, with constant skirmishes, among the killed being the Rev. G. Pilkington. Early in January Mwanga escaped from the Germans, and, declaring himself a Mahommedan, reached Buddu with a large force, which Major Macdonald defeated with the aid of the Baganda army. He then disarmed the Sudanese garrisons in Buddu. The garrisons in Unyoro (about 500) and in Toro remained loyal. Meanwhile the Sudanese at Luba's (numbering 600, with 200 Mahommedan Baganda) escaped, proceeded up the east bank of the Nile and crossed the river, making their way to Mruli. It appeared probable that if they reached that point the Sudanese garrisons in Unyoro would revolt as well as the Baganda Mahommedans, and the last hope of the Europeans would be lost. Leaving a small column to deal with Mwanga's force in the south, and another with Kabarega, Macdonald pursued the mutineers, overtook them in the swamps of Lake Kioga, and after a couple of successful skirmishes returned to Kampala, leaving Captain (afterwards Colonel) E. G. Harrison in command. That officer, crossing a swamp supposed to be impassable, attacked the rebel stockade at Kabagambi, and carried it with great gallantry. Captain Maloney was killed and Lieut. Osborne wounded, but the crisis was past. A large number of Indian troops arrived early in 1899, and in May Colonel C. G. Martyr inflicted another heavy defeat on the mutineers at Mruli. Mwanga, however, managed to get through and join Kabarega and the rebels in the north. These were dealt with in a series of engagements, but it was not till June 1899 that Colonel J. T. Evatt had the good fortune to capture Kings Mwanga and Kabarega, who were deported to the coast and subsequently removed to the Seychelles, where Mwanga died in 1903. Colonel Martyr at the close of the year (1899) undertook an expedition up the Nile, and extended the limits of the protectorate in that direction. Major H. H. Austin, who had come up to Uganda in 1897 with Macdonald and had fought through the mutiny operations, revealed the regions north of Mt Elgon. Colonel C. Delmé-Radcliffe finally subdued the last remnant of the Sudanese mutineers in 1900–1901. The year 1899 had been a costly one, £329,000 being voted in aid. In the autumn of 1899 Sir Harry Johnston was sent out as special commissioner to Uganda, being also given the rank of commander-in-chief. By extensive reorganizations, and in spite of having to cope with a rising in Nandi, his commission resulted in the reduction of expenditure and increase of local revenue. He gave the kingdom of Buganda a definite constitution, settled the land question in the provinces of Buganda, Busoga, Unyoro, Toro and Ankole, and also the question of native taxation. By the treaty of Mengo, signed in March 1900, the young king of Buganda, Daudi Chwa, a son of Mwanga, born in 1896, was accorded the title of his Highness the Kabaka. During his minority the kingdom of Buganda was governed by regents. In 1900, the Uganda Protectorate was divided into six provinces, but in 1903 the Eastern and part of the Central provinces were transferred to the British East Africa Protectorate.

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[1] Toro, Ankole, Bukedi and the other countries now included in the protectorate were added by Sir Harry Johnston in 1899-1901.

In 1902 the Uganda railway, begun in 1896, was finished. Its terminus is at Kisumu (Port Florence) on Kavirondo Gulf, Victoria Nyanza. It is some 580 m. long, ascends in places to altitudes of 7000 and 8000 ft. (highest point 8300 ft.), but has only one tunnel. Its cost was about £5,300,000. (See British East Africa.)

Colonel Sir James H. Sadler succeeded Sir Harry Johnston in 1902 and was transferred to East Africa in 1905. His place in Uganda was taken by Sir Henry Hesketh Bell, who was made the first governor of Uganda in 1906. The ravages of sleeping-sickness between 1901 and 1909 destroyed upwards of a quarter of a million people, and the whole of the native population had to be removed from the lake shores and the Sese Islands; but nevertheless the protectorate continued to make steady progress in civilization and in the development of its material resources. Its transit trade, especially with the Belgian Congo, became of great importance. To facilitate commerce with the Congo and with the Anglo-Egyptian Sudan and to open up the Busoga region the British government in 1910 voted money to build a railway from Jinja to Kakindu. The work was carried out under the superintendence of Captain H. E. S. Cordeaux, who became governor of the protectorate in 1910.

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UGLICH, a town of Russia, in the government of Yaroslavl, on the upper Volga, 63 m. W. by S. of the city of Yaroslavl. Pop., 9698. Its historical remains are mostly associated with Prince Dmitri, son of Ivan the Terrible, who was believed to have been murdered (1591) here by Boris Godunov. The wooden house (built in 1481, restored in 1892) which the prince occupied, a church of St Demetrius, erected at the spot where he was killed, and a kiosk on the site of a convent where his mother was forcibly consecrated a nun, are the principal memorials of this incident. The cathedral was erected in the 13th century, but subsequently restored, and contains the grave of Prince Roman. The industries include paper-mills, flour-mills, distilleries, copper works, and linen factories; and the samovars (tea-urns) and sausages made here are famous.

The local annals go as far back as the 9th century. Until the 14th century Uglich was a separate principality, which extended over eastern Tver. In 1329 the sons of Prince Roman the Saint renounced their independence in favour of Moscow, and fifty years later the Uglich princes sold their rights to the great prince of Moscow. The Tatars plundered the town in 1237, 1293 and 1408, and the Lithuanians did the same at a later date.

UHDE, FRITZ KARL HERMANN VON (1848–), German painter, was born at Wolkenburg in Saxony. His artistic career, for which he studied first in Dresden, was interrupted for nearly ten years by military service, which included the two years of the Franco-German War, but in 1877 he again turned his attention to art, studying under Munkacsy in Paris and afterwards independently in Holland. His inclination was from the first directed towards religious subjects. He revived the practice of treating Biblical episodes realistically by transferring them to modern days. Thus in the "Come, Lord Jesus, be our Guest," of the Berlin National Gallery, Christ appears among the peasant family assembled for their meal in a modern German farmhouse "parlour," and in "The Sermon on the Mount" (Berlin, private collection) addresses a crowd of 19th century harvesters. Similar in conception are "Suffer Little Children to come unto Me" (Leipzig Museum), "The Holy Night" (Dresden Gallery), "The Last Supper," "The Journey to Bethlehem" (Munich Pinakothek) and "The Miraculous Draught of Fishes." Other works of his in public collections are: "Saying Grace," at the Luxembourg in Paris; "Christ at Emmaus," at the Staedel Institute, Frankfort; "The Farewell of Tobias," at the Liechtenstein Gallery, Vienna; and a portrait of the actor Wohlmuth, at the Christiania Museum. Von Uhde became professor and honorary member of the academies of Munich, Dresden and Berlin.

UHLAND, JOHANN LUDWIG (1787–1862), German poet, was born at Tübingen on the 26th of April 1787. He studied jurisprudence at the university of his native place, but also devoted much time to medieval literature. Having graduated as a doctor of laws in 1810, he went for some months to Paris; and from 1812 to 1814 he worked at his profession in Stuttgart, in the bureau of the minister of justice. He had begun his career as a poet in 1807 and 1808 by contributing ballads and lyrics to L. von Seckendorff's *Musenalmanach*; and in 1812 and 1813 he wrote poems for J. Kerner's *Poetischer Almanach* and *Deutscher Dichterwald*. In 1815 he collected his poems in a volume entitled *Gedichte*, which almost immediately secured a wide circle of readers. To almost every new edition he added some fresh poems. He wrote two dramatic works—*Ernst, Herzog von Schwaben* and *Ludwig der Baier*—the former published in 1818, the latter in 1819. These, however, are unimportant in comparison with his *Gedichte*. As a lyric poet, Uhland must be classed with the writers of the romantic school, for, like them, he found in the middle ages the subjects which appealed most strongly to his imagination. But his style has a precision, suppleness and grace which sharply distinguish his most characteristic writings from those of the romantic poets. Uhland wrote manly poems in defence of freedom, and in the states assembly of Württemberg he played a distinguished part as one of the most vigorous and consistent of the liberal members. In 1829 he was made extraordinary professor of German literature at the university of Tübingen, but he resigned this appointment in 1833, when it was found to be incompatible with his political views. In 1848 he became a member of the Frankfort parliament.

Uhland was not only a poet and politician; he was also an ardent student of the history of literature. In 1812 he published an interesting essay on *Das altfranzösische Epos*; and ten years afterwards this was followed by an admirable work on Walther von der Vogelweide. He was also the author of an elaborate study of *Der Mythus von Thôr nach nordischen Quellen* (1836), and he formed a valuable collection of *Alte hoch- und niederdeutsche Volkslieder*, which appeared in 1844–1845. He died at Tübingen on the 13th of November 1862.

Uhland's *Gesammelte Werke*, edited by H. Fischer, were published in 1892 in 6 vols.; also by L. Frankel (2 vols., 1893) and L. Holthof (1901). His *Gedichte* passed through nearly fifty editions in the poet's lifetime; jubilee edition of the *Gedichte und Dramen* (1886). A critical edition by E. Schmidt and J. Hartmann appeared in 1898 (2 vols.). Uhland's *Schriften zur Geschichte der Dichtung und Sage* were published in 8 vols. (1865–1873); his *Tagebuch von 1810–1820* by J. Hartmann (1893). See F. Notter, *L. Uhland, sein Leben und seine Dichtungen* (1863); K. Mayer, *L. Uhland, seine Freunde und Zeitgenossen* (2 vols., 1867); *L. Uhlands Leben* (with *Nachlass*), by his widow (1874); A. von Keller, *Uhland als Dramatiker* (1877); H. Dederich, *L. Uhland als Dichter und Patriot* (1886); W. L. Holland, *Zu Uhlands Gedachtnis* (1886); H. Fischer, *L. Uhland* (1887); H. Mayne, *Uhlands Jugenddichtung* (1899).

UIGHUR, or OUIGHOUR, the name of a Turkish tribe and dynasty who came from the East and ruled in Kashgaria from the 10th to the 12th centuries. They used a variety of the Syriac alphabet. (See TURKS.)

UIST, NORTH AND SOUTH, islands of the outer Hebrides, Inverness-shire, Scotland. North Uist lies S.W. of Harris (Long Island), from which it is separated about 8 m. by the Sound of Harris. The island measures 14 m. in length by 16 m. in greatest width, but the coasts are extremely indented. The highest point is Mt Eaval (1138 ft.). The principal sea-lochs are Loch Maddy and Loch Eport, both on the east. On the east coast the surface is mostly swampy moorland, but on the west there is some fertile soil. The inhabitants are chiefly engaged in crofting, fishing and cattle-rearing. The principal village, Loch Maddy, is the centre of a large trade, and is a favourite resort of anglers, being a regular calling station for the steamers from Oban and Portree The islands belonging to the parish of North Uist comprise—to the south-west Balleshare and Illeray (pop., 383), Kirkibost, Heisker (98), and the Monach group, with a lighthouse on Shillay; to the south, Grimisay (290) and Ronay; to the north-east, Levera; to the north, Boreray (118) and Vallay.

South Uist has a population (1901) of 3541, an extreme length of 22 m. and an extreme width of 8 m. Towards the north-east it becomes mountainous, the highest points being Buail'a Choill (2034), Ben More (1994) and Hecla (1988). The chief sea-lochs are Loch Boisdale, largely frequented by anglers, Loch Eynort and Loch Skiport on the east coast. On the east side the surface is mainly alluvial peat, broken by hills, but on the west there is a belt of productive land. Besides crofting, the inhabitants are engaged in the fisheries and cattle-raising. Steamers from Oban call regularly at the village of Loch Boisdale. The islands attached to the parish of South Uist include, to the south, Eriskay (pop., 3478), where Prince Charles landed on the 2nd of August 1745; to the north-east, Wiay; to the north, Grimisay, Fladda, just off the north-east shore of Benbecula, and Benbecula (pop., 1417), with an area of 40 sq. m., from which there is at low tide a ford to North and South Uist.

UITENHAGE, a town of the Cape province, South Africa, in the valley of the Zwartkops river, 270 ft. above the sea, 21 m. by rail N.N.W. of Port Elizabeth. Pop. (1904), 12,193, of whom 6680 were whites. It was founded in 1804 by De Mist, the Batavian commissioner, who took over Cape Colony from the British in 1803. Many natives find employment in the mills along the Zwartkops, where vast quantities of wool from the sheep farms of the eastern part of the province are cleansed and forwarded for shipment at Port Elizabeth. Extensive railway works are established here. There are in addition large flower and fruit nurseries. The town is laid out in rectangular blocks, and contains a handsome town-hall, court-house and public offices.

UJEST (Polish, *Viast*), a small town on the Klodnitz in Prussia, which gives the title of duke to the head of the family of Hohenlohe-Öhringen, a branch (1823) of that of Hohenlohe-Ingelfingen (see HOHENLOHE). Prince Hugo of Hohenlohe-Öhringen was created duke of Ujest in 1861, and in 1807 was succeeded by his son Christian Kraft (b. 1848). The duke is an hereditary member of the upper houses of Württemberg and Prussia.

UJIJI, a town in German East Africa, also known as Kavele, situated on the eastern shores of Lake Tanganyika, in 4° 55′ S., 29° 40′ E. It is connected with Cape Town by an overland telegraph line. The population (about 14,000) is composed of Arabs and members of numerous Central African tribes. Ujiji is the meeting-point of merchants from all parts of Tanganyika, and the terminus of the caravan route from Dar-es-Salaam. Arabs from Zanzibar made Ujiji their headquarters during the first half of the 19th century, and it became a great slave and ivory mart. In 1858 Richard Burton and J. H. Speke reached Ujiji from Zanzibar, being the first Europeans to see Lake Tanganyika. In 1869 David Livingstone, coming from the south, arrived at Ujiji, and it was here that H. M. Stanley found him on the 28th of October 1871. In 1890 it came within the German sphere of influence. (See TANGANYIKA and GERMAN EAST AFRICA.)

UJJAIN, or UJAIN, a city of central India, in the state of Gwalior, on the right bank of the river Sipra, with a station on the branch of the Rajputana railway from Ratlam to Bhopal. Pop. (1901) 39,892. Ujjain, known as Avanti in the Buddhist period and as Ozene to the Greeks, is one of the seven sacred cities of the Hindus and the traditional capital of King Vikramaditya, at whose court the "nine gems" of Sanskirt literature are said to have flourished. It marks the first meridian of longitude in Hindu geography. It is heard of first as the residence of Asoka (afterwards emperor), when viceroy of the western provinces. It was sacked by the Mahommedans in 1235. Under Akbar it became the capital of Malwa, and during the last half of the 18th century it was the headquarters of Sindhia. It contains few old buildings, though relics of antiquity are often found on the abandoned site of the old city. It is now a centre of the trade in Malwa opium, with a wealthy colony of Bohra merchants. The principal institutions are the Madhava College (called after the present Maharaja), two state hospitals, and a dispensary belonging to the Canadian Presbyterian mission. A great religious festival is held here every twelfth year.

UJVIDÉK (German, *Neusatz*), a town of Hungary in the county of Bács-Bodrog, 171 m. S.S.E. of Budapest by rail. Pop. (1900), 28,763. It is situated on the left bank of the Danube near the terminus of the Franz-Josef canal. It is the seat of a Greek Orthodox bishop, and has become the literary and religious centre of the Servians in Hungary, especially since the foundation in 1864 of the *Matica Srbska*, or Servian Literary Society. The town was founded in the middle of the 18th century, and was almost totally destroyed during the revolution of 1848–49. On the opposite bank of the Danube, connected with Ujvidék by a railway bridge, lies Pétervárad or Peterwardein.

UKAZ, or UKASE (Russ., from *ukazat*, a shortened form of *ukazlivat*, to show, announce, prescribe), a term applied in Russia to an edict or ordinance, legislative or administrative, having the force of law. A ukaz proceeds either from the emperor or from the senate, which has the power of issuing such ordinances for the purpose of carrying out existing decrees. All such decrees are promulgated by the senate. A difference is drawn between the ukaz signed by the emperor's hand and his verbal ukaz, or order, made upon a report submitted to him. (See RUSSIA: *Constitution and Government*.)

UKRAINE ("frontier"), the name formerly given to a district of European Russia, now comprising the governments of Kharkov, Kiev, Podolia and Poltava. The portion east of the Dnieper became Russian in 1686 and the portion west of that river in 1793.

ULAN (formerly spelt Uhlan), originally a Polish cavalry soldier armed with a lance. These troops were light cavalry, and wore the national dress and *czapka* (or lancer cap). They were introduced into the Prussian service in 1740, but failed to distinguish themselves in the first Silesian War, and it was only after the treaty of Tilsit (1807) that Ulan regiments were again formed in the Prussian army. In the Austrian army a "Uhlanpulk" of Poles was formed in 1784 and ordinary Ulan regiments of Austrian cavalry in 1791. The Austrian Ulans no longer carry the lance. In the German army of to-day Ulans are classed as heavy cavalry and wear the distinctive lancer dress inherited from the original Polish light horse. (See Cavalry and Lance.)

ULBACH, LOUIS (1822–1889), French writer, was born at Troyes (Aube) on the 7th of March 1822. He was encouraged to take up a literary career by Victor Hugo. He became dramatic critic of the *Temps*, and attracted attention by a series of satirical letters addressed to the *Figaro* over the signature of "Ferragus," and published separately in 1868. He edited the *Revue de Paris* until its suppression in 1858, and in 1868 he founded a paper, *La Cloche*, which was suppressed in 1869 for its hostility to the empire. Ulbach was imprisoned for six months, and when on his release he revived the paper he got into trouble both with the commune and the government, and was again imprisoned in 1871–1872. In 1878 he was made librarian of the arsenal, and died in Paris on the 16th of April 1889.

Among his works are: *Voyage autour de mon clocher* (1864), *Nos contemporains* (1869–1871), *Aventures de trois grandes dames de la cour de Vienne* (3 vols., 1876); *Les Buveurs de poisons: la fée verte* (1879), *La Vie de Victor Hugo* (1886), &c.

ULCER, an open sore (derived through the French from Lat. *ulcus*, Gr. ἕλκος). When a portion of animal tissue dies in consequence of an infection or injury, the death of that tissue taking place by gradual breaking down or disintegration, the process is termed *ulceration* and the result an ulcer. When the ulcer is spreading the place is painful and the surrounding parts are flushed with extra blood, but under appropriate treatment the destructive process ceases and the ulcer gradually heals. The bright surface of the ulcer becomes glazed over, and those changes take place in it which occur in an open wound. The ulcer gradually contracts, and round its edges cicatrization, or scarring, occurs. Ulcers may arise from various causes in different parts of the body, and in association with certain specific diseases, such as syphilis, tubercle, cancer and typhoid fever. (For Gastric Ulcer see the separate article.) (E.O.*)

ULEÅBORG (Finnish, *Oulu*), a province in the grand duchy of Finland, including a wide territory to the north of Kuopio and nearly reaching Varangerfjord, taking in the high dreary plateau of Laponia (16,000 sq. m.) and the fertile plains of Österbotten. It has a total area of 63,970 sq. m., with a population, chiefly agricultural in Österbotten and nomadic in Laponia, of (1904) 295,187. The bulk of the inhabitants (99%) are Finnish. There are immense forests, and only 0·4% of the area is under culture. The capital of the government is Uleaborg, a seaport on the Gulf of Bothnia, now connected by railway with Helsingfors (498 m.); pop. (1904), 17,737.

ULEMA (Arab. *'ulamā*, sing. *'ālim*, literally "knowers," in the sense of *scientes*), the learned of Islām, theologians, canon-lawyers, professors, judges, muftis, &c., all who, whether in office or not, are versed theoretically and practically in Muslim science in general. By "science" in this case is especially meant what is learned from tradition, books or men, and through the intellect. In a narrower sense, Ulema is used, in a Muslim state, of a council of such learned men, holding government appointments. If all conception of intermediary priesthood be eliminated, the Ulema may be said to be equivalent to the secular clergy of Roman Christendom (see Dervish). Opposed to them, again, are the *'ārifs* ("knowers," "perceivers," *sentientes*, as opposed to *scientes*), to whom religious knowledge comes in the vision of the mystic, not by tradition or reason (see Ṣūfiism).

On the training of the ulema see Sunnites. (D. B. Ma.)

ULFELDT, KORFITS (1606–1664), Danish statesman, was the son of the chancellor Jacob Ulfeldt. After a careful education abroad he returned to Denmark in 1629 and quickly won the favour of Christian IV. In 1634 he was made a Knight of the Elephant, in 1636 became councillor of state, in 1637 governor of Copenhagen, and in 1643 lord treasurer. In 1637 he married the king's daughter Leonora Christina, who had been betrothed to him from her ninth year. Ulfeldt was the most striking personality at the Danish court in all superficial accomplishments, but his character was marked by ambition, avarice and absolute lack of honour or conscience. He was largely responsible for the disasters of the Swedish war of 1643–45, and when the treaty of Brömsebro was signed there was a violent scene between him and the king, though Ulfeldt's resignation was not accepted. In December 1646 he was sent as ambassador extraordinary to the Hague, but the results of his embassy by no means corresponded to its costliness, and when he returned to Denmark in July 1647 he found the king profoundly irritated. Ulfeldt, supported by the Raad and the nobility, who objected to Christian's fiscal policy, resisted his father-in-law, and triumphed completely. As lord high steward he was the virtual ruler of Denmark during the two months which elapsed between the death of Christian IV. and the election of Frederick III. (July 6, 1648); but the new king was by no means disposed to tolerate the outrageous usurpations of Ulfeldt and his wife, and this antagonism was still further complicated by allegations of a plot (ultimately proved to be false, but believed at the time to be true) on the part of Dina Winhavers, a former mistress of Ulfeldt, to poison the royal family. Dina was convicted of perjury and executed, but Ulfeldt no longer felt secure at Copenhagen, and on the day after the execution he secretly quitted Denmark (July 14, 1651), with his family. After living for a time in concealment at Amsterdam, he migrated to Barth in Swedish Pomerania, and began the intrigues which have branded his name with infamy. In July 1657 he eagerly responded to the invitation of Charles X. of Sweden, when he invaded Denmark, and entered the service of his country's deadliest foe, for the express purpose of humiliating his sovereign and enriching himself. He persuaded the commandant of Nakskov, the one fortress of Laaland, to surrender to Charles X., and did his best to convince his countrymen that resistance was useless. Finally, as one of the Swedish negotiators at the congress of Taastrup, he was instrumental in humiliating his native land as she had never been humiliated before. Ulfeldt's treason was rewarded by Charles X. of Sweden with the countship of Solvitsburg in Blekinge; but the discontented renegade began intriguing against his new master, and in May 1659 was condemned to death. The Swedish regents, on the 7th of July, amnestied him, and he returned to Copenhagen to try to make his peace with his lawful sovereign, who promptly imprisoned him and his wife. In the summer of 1660 they were conveyed to Hammershus in Bornholm, as prisoners of state. Their captivity was severe to brutality; and they were only released (in September 1661) on the most degrading conditions. The fallen magnate henceforth dreamed of nothing but revenge, and in the course of 1662, during his residence at Bruges, he offered the Danish crown to the elector of Brandenburg, proposing to raise a rebellion in Denmark for that purpose. Frederick William betrayed Ulfeldt's treason to Frederick III., and the Danish government at once impeached the traitor; on the 24th of July 1663 he and his children were degraded, his property was confiscated, and he was condemned to be beheaded and quartered. He escaped from the country, but the sentence was actually carried out on his effigy; and a pillory was erected on the ruins of his mansion at Copenhagen. He died at Basel, in February 1664.

See Julius Albert Fridericia, *Adelsvaeldens sidste dage* (Copenhagen, 1894); *Danmarks riges historie*, vol. iv. (Copenhagen, 1897–1905); Robert Nisbet Bain, *Scandinavia*, chs. vii., ix., x. (Cambridge, 1905).

ULFILAS (*c.* 311–383), the apostle of Christianity to the Gothic race, and, through his translation of the Scriptures into Gothic, the father of Teutonic literature, was born among the Goths of the trans-Danubian provinces about the year 311.[1] The Arian historian Philostorgius (*Hist. eccl.* ii. 5) says that his grand-parents were Christian captives from Sadagolthina in Cappadocia, who had been carried off to the lands beyond the Danube in the Gothic raid of 264, and became so naturalized that the boy received a Gothic name, *Wulfila* (Little Wolf).

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[1] Krafft gives 313 as the date; Waitz, 318.

An authoritative record of the outlines of his life was only discovered early in the 19th century in a writing of Auxentius of Milan, his pupil and companion. At an early age Ulfilas was sent, either as an envoy or as a hostage for his tribe, to Constantinople, probably on the occasion of the treaty arranged in 332. During the preceding century Christianity had been planted sporadically among the Goths beyond the Danube, through the agency in part of Christian captives, many of whom belonged to the order of clergy, and in part of merchants and traders. Ulfilas may therefore have been a convert to Christianity when he reached Constantinople. But it was here probably that he came into contact with the Arian doctrines which gave the form to his later teaching, and here that he acquired his command over Greek and Latin. For some time before 341 he worked as a lector (reader of the Scriptures), probably among his own countrymen in Constantinople, or among those attached as *foederati* to the Imperial armies in Asia Minor. From this work he was called to return as missionary bishop to his own country, being ordained by Eusebius of Nicomedia and "the bishops who were with him," probably at Antioch, in 341. This ordination of Ulfilas by the chiefs of the semi-Arian party is at once an indication of their determination to extend their influence by active missionary enterprise, and evidence that Ulfilas was now a declared adherent of the Arian or semi-Arian party. He was now thirty years of age, and his work as "bishop among the Goths" covered the remaining forty years of his life. For seven of these years he wrought among the Visigoths beyond the Danube, till the success which attended his labours drew down the persecution of the still pagan chief of the tribe. This "sacrilegus judex" has been identified with Athanaric, a later persecutor, but the identification is not beyond question. To save his flock from extinction or dispersion, Ulfilas decided to withdraw both himself and his people. With the consent of the emperor Constantius he led them across the Danube, "a great body of the faithful," and settled in Moesia at the foot of the range of Haemus and near the site of the modern Tirnova (349). Here they developed into a peace-loving pastoral people.

The life of Ulfilas during the following thirty-three years is marked by only one recorded incident (Sozomen iv. 24), his visit to Constantinople in January 360, to attend the council convened by the Arian or Homoean party. His work and influence were not confined to his own immediate flock, but radiated by means of his homilies and treatises, and through the disciples he despatched as missionaries, among all the Gothic tribes beyond the Danube. Thus the Church beyond the Danube, which had not been extinguished on Ulfilas's withdrawal, began to grow once more, and once more had to undergo the fires of persecution. Catholic missionaries had not been wanting in the meanwhile, and in the indiscriminate persecution by Athanaric, between 370 and 375, Catholics and Arians stood and fell side by side. The religious quarrel either accentuated, or was accentuated by, political differences, and the rival chiefs, Athanaric and Frithigern, appeared as champions of Paganism and Christianity respectively. Then followed the negotiations with the emperor Valens, the general adhesion of the Visigoths under Frithigern to Arian Christianity, the crossing of the Danube by himself and a host of his followers, and the troubles which culminated in the battle of Adrianople and the death of Valens (378). The part played by Ulfilas in these troublous times cannot be ascertained with certainty. It may have been he who, as a "presbyter christiani ritus," conducted negotiations with Valens before the battle of Adrianople; but that he headed a previous embassy asking for leave for the Visigoths to settle on Roman soil, and that he then, for political motives, professed himself a convert to the Arian creed, favoured by the emperor, and drew with him the whole body of his countrymen—these and other similar stories of the orthodox church historians appear to be without foundation. The death of Valens, followed by the succession and the early conversion to Catholicism of Theodosius, dealt a fatal blow to the Arian party within the empire. Ulfilas lived long enough to see what the end must be. Hardships as well as years must have combined to make him an old man, when in 383 he was sent for to Constantinople by the emperor. A split seems to have taken place among the Arians at Constantinople. Ulfilas was summoned to meet the innovators, and to induce them to surrender the opinion which caused the dispute. His pupil Auxentius describes how, "in the name of God," he set out upon his way, hoping to prevent the teaching of these new heretics from reaching "the churches of Christ by Christ committed to his charge." No sooner had he reached Constantinople than he fell sick, "having pondered much about the council," and before he had put his hand to the task which had brought him he died, probably in January 383. A few days later there died, also in Constantinople, his old enemy and persecutor, Athanaric.

The Arianism of Ulfilas was a fact of pregnant consequence for his people, and indirectly for the empire. It had been his lifelong faith, as we learn from the opening words of his own confession—"Ego Ulfilas semper sic credidi." If, as seems probable from the circumstances of his ordination, he was a semi-Arian and a follower of Eusebius in 341, at a later period of his life he departed from this position, and vigorously opposed the teaching of his former leader. He appears to have joined the Homoean party, which took shape and acquired influence before the council of Constantinople in 360, where he adhered with the rest of the council to the creed of Ariminum, with the addendum that in future the terms *ὑπόστασις* and *οὐσία* should be excluded from Christological definitions. Thus we learn from Auxentius that he condemned Homoousians and Homoiousians alike, adopting for himself the Homoean formula, "filium similem esse patri suo." This Arian form of Christianity was imparted by Ulfilas and his disciples to most of the tribes of the Gothic stock, and persisted among them, in spite of persecution, for two centuries.

The other legacy bequeathed by Ulfilas was of less questionable value. His version of the Scriptures is his greatest monument. By it he became the first to raise a barbarian tongue to the dignity of a literary language; and the skill, knowledge and adaptive ability it displays make it the crowning testimony of his powers as well as of his devotion to his work.

The personal qualities of the man may be inferred from his pupil's description of him as "of most upright conversation, truly a confessor of Christ, a teacher of piety, and a preacher of truth—a man whom I am not competent to praise according to his merit, yet altogether keep silent I dare not."

See Waitz, *Das Leben des Ulfilas* (1840); W. L. Krafft, *Kirchengeschichte der deutschen Völker* (Abth. i., 1854); H. Böhmer in Herzog-Hauck, *Realencyklopädie*,^{3} vol. xxi.; W. Bessell, *Das Leben des Ulfilas* (1860); C. A. Scott, *Ulfilas, Apostle of the Goths* (1885).
(C. A. S.)

ULLATHORNE, WILLIAM BERNARD (1806–1889), English Roman Catholic bishop, was born at Pocklington, Yorkshire, on the 7th of May 1806, of an old Roman Catholic family. At fifteen he went to sea, and made several voyages to the Baltic and Mediterranean. In 1823 he entered the Benedictine monastery of Downside, near Bath, taking the vows in 1825. He was ordained priest in 1831, and in 1833 went to New South Wales, as vicar-general to Bishop William Morris (1794–1872), whose jurisdiction extended over the Australian missions. It was mainly Ullathorne who caused Gregory XVI. to establish the hierarchy in Australia. He returned to England in 1836, and, after another visit to Australia, settled in England in 1841, taking charge of the Roman Catholic mission at Coventry. He was consecrated bishop in 1847 as vicar-apostolic of the western district, in succession to Bishop C. M. Baggs (1806–1845), but was transferred to the central district in the following year. On the re-establishment of the hierarchy in England Ullathorne became the first Roman Catholic bishop of Birmingham. During his thirty-eight years tenure of the see 67 new churches, 32 convents and nearly 200 mission schools were built. In 1888 he retired and received from Leo XIII. the honorary title of archbishop of Cabasa. He died at Oscott College on the 21st of March 1889.

Of his theological and philosophical works the best known are: *The Endowments of Man* (1882); *The Groundwork of the Christian Virtues* (1883); *Christian Patience* (1886). For an account of his life see his *Autobiography*, edited by A. T. Drane (London, 1891).

ULLMANN, KARL (1796–1865), German Protestant theologian, was born at Epfenbach, near Heidelberg, on the 15th of

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March 1796. He studied at Heidelberg and Tübingen, and in 1820 delivered exegetical and historical lectures at Heidelberg. In 1829 he went to Halle as professor to teach church history, dogmatics and symbolics, but in 1836 he accepted a chair at Heidelberg. A lifelong exponent of the mediating theology (*Vermittelungs-Theologie*), in 1828, with the help of Umbreit (1795–1860), he founded and edited the *Theologische Studien und Kritiken* in its interests. When Wegscheider and Gesenius were denounced by Hengstenberg as rationalists, he pleaded for freedom in theological teaching (cf. his *Theol. Bedenken*, 1830). On the other hand, he vigorously attacked David Strauss. His *Historisch oder mythisch* (1838; 2nd ed. 1866) was a reply to Strauss's *Life of Jesus*, and his criticism resulted in Strauss making numerous concessions in later works. Ullmann died on the 12th of January 1865.

In *Das Wesen des Christenthums* (1845; 5th ed., 1865; Eng. trans., 1860) Ullmann explains that Christianity is independent of the orthodox formulas, and contends that a distinction should be made between faith and dogmatics. His principal historical works are *Gregor von Nazianz* (1825; 2nd ed., 1867) and *Die Reformatoren vor der Reformation* (2 vols., 1841; 2nd ed., 1866; Eng. trans., 1854). Another well-known work is *Die Sündlosigkeit Jesu* (1854; Eng. trans., 1858 and 1870). See O. Pfleiderer, *Development of Theology* (1890); and cf. W. Beyschlag, *Karl Ullmann* (1867), and Adolf Hausrath in *Kleine Schriften religionsgeschichtlichen Inhalts* (1883).

ULM, a fortress-city of Germany, in the kingdom of Württemberg, situated on the left bank of the Danube, in a fertile plain at the foot of the Swabian Alps, 58 m. by rail S.E. of Stuttgart and 63 m. N.W. of Munich. Pop. (1905), 51,680. Ulm still preserves the dignified and old-fashioned appearance of a free imperial town, and contains many medieval buildings of historic and of artistic interest. Among these are the town hall, of the 16th century, in the Transition style from late Gothic to Renaissance, restored in recent years; the Kornhaus; the Ehingerhaus or Neubronnerhaus, now containing the industrial museum; and the commandery of the Teutonic order, built in 1712–1718 on the site of a habitation of the order dating from the 13th century, and now used as barracks. The magnificent early Gothic cathedral is capable of containing 30,000 people. Begun in 1377, and carried on at intervals till the 16th century, the building was long left unfinished; but in 1844 the work of restoration and completion was begun, being completed in 1890. Ulm cathedral has double aisles and a pentagonal apsidal choir, but no transepts. Its length (outside measurement) is 464 ft., its breadth 159 ft.; the nave is 136 ft. high and 47½ wide; the aisles, which are covered with rich net-vaulting, are 68 ft. in height. The massive and richly decorated square tower in the centre of the west façade, which for centuries terminated in a temporary spire, was completed in 1890, according to the original plans, by the addition of an octagonal storey and a tall open spire (528 ft.), the loftiest ecclesiastical erection in the world, outstripping the twin spires of Cologne cathedral by 21 ft. The towers of the choir, rebuilt in the course of the restoration, are 282 ft. high. The cathedral contains some fine stained glass, the largest organ in Germany (1856), and a number of interesting old paintings and carvings by Jörg Syrlin the elder, Jörg Syrlin the younger, Burkhard Engelberger, and other masters of the Swabian school. It belongs to the Protestant Church. Trinity church dates from 1617–1621, and there are also four Roman Catholic churches and a synagogue.

The Danube, joined by the Iller just above the town and by the Blau just below, here becomes navigable, so that Ulm occupies the important commercial position of a terminal river-port. Hence there is water communication with the Neckar, and so to the Rhine and into the interior of France. The market for leather and cloth is important, and Ulm is famous for its vegetables (especially asparagus), barley, beer, pipe-bowls and sweet cakes (Ulmer Zuckerbrot). Bleaching, brewing and brass-founding are carried on, as well as a large miscellany of manufactures.

Ulm has long been a fortress of the first rank. In 1844–1859 the German Confederation carefully fortified it, and in 1876 the new German Empire added a comprehensive outer girdle of detached forts, culminating in the powerful citadel of Wilhelmsburg. The long straight lines of works which stretched to the plateau of the Michelsberg and formed the outworks of the main fortress on the left bank of the Danube were purchased in 1900 by the municipal authorities, in order to be levelled and laid out in streets for the extension of the town in this direction. The fortifications also of Neu-Ulm, on the Bavarian side of the Danube, were ordered to be razed and devoted to municipal purposes. The citadel of Wilhelmsburg remains, and also the defences on the left bank of the Danube, further extended and strengthened. Ulm is the basis of operations for the German army behind the Black Forest, and can easily shelter a force of 100,000 men; its peace garrison is 5600.

Ulm is mentioned as early as 854, and under the Carolingian sovereigns it was the scene of several assemblies. It became a town in 1027, and was soon the principal place in the duchy of Swabia. Although burned down by Henry the Lion, it soon recovered from this disaster and became a free imperial town in 1155. Towards the close of the middle ages it appears several times at the head of leagues of the Swabian towns. Its trade and commerce prospered and in the 15th century it attained the summit of its prosperity, ruling over a district about 300 sq. m. in extent, and having a population of about 60,000. In 1803 it lost its freedom and passed to Bavaria, being ceded to Württemberg in 1809. In October 1805 General Mack with 23,000 Austrians capitulated here to Napoleon. Ulm is remarkable in the history of German literature as the spot where the Meistersinger lingered longest, preserving without text and without notes the traditional lore of their craft. In 1830 there were twelve Meistersinger alive in Ulm, but in 1839 the four survivors formally made over their insignia and gild property to a modern singing society and closed the record of the *Meistergesang* in Germany.

See E. Nübling, *Ulms Handel und Gewerbe im Mittelalter* (Ulm, 1892–1900); G. Fischer, *Geschichte der Stadt Ulm* (Stuttgart, 1863); Pressel, *Ulmisches Urkundenbuch* (Stuttgart, 1873); and *Ulm und sein Münster* (Ulm, 1877); Schultes, *Chronik von Ulm* (Stuttgart, 1881 and 1886); Hassler, *Ulms Kunstgeschichte im Mittelalter* (Stuttgart, 1872); and *Das rote Buch der Stadt Ulm*, edited by C. Mollvo (1904).

ULPIAN (Domitius Ulpianus), Roman jurist, was of Tyrian ancestry. The time and place of his birth are unknown, but the period of his literary activity was between A.D. 211 and 222. He made his first appearance in public life as assessor in the *auditorium* of Papinian and member of the council of Septimius Severus; under Caracalla he was master of the requests (*magister libellorum*). Heliogabalus banished him from Rome, but on the accession of Alexander (222) he was reinstated, and finally became the emperor's chief adviser and *praefectus praetorio*. His curtailment of the privileges granted to the praetorian guard by Heliogabalus provoked their enmity, and he narrowly escaped their vengeance; ultimately, in 228, he was murdered in the palace, in the course of a riot between the soldiers and the mob.

His works include *Ad Sabinum*, a commentary on the *jus civile*, in over 50 books; *Ad edictum*, a commentary on the Edict, in 83 books; collections of opinions, responses and disputations; books of rules and institutions; treatises on the functions of the different magistrates—one of them, the *De officio proconsulis libri x.*, being a comprehensive exposition of the criminal law; monographs on various statutes, on testamentary trusts, and a variety of other works. His writings altogether have supplied to Justinian's *Digest* about a third of its contents, and his commentary on the Edict alone about a fifth. As an author he is characterized by doctrinal exposition of a high order, judiciousness of criticism, and lucidity of arrangement, style and language.

Domitii Ulpiani fragmenta, consisting of 29 titles, were first edited by Tilius (Paris, 1549). Other editions are by Hugo (Berlin, 1834), Böcking (Bonn, 1836), containing fragments of the first book of the *Institutiones* discovered by Endlicher at Vienna in 1835, and in Girard's *Textes de droit romain* (Paris, 1890).

ULRICH, duke of Württemberg (1487–1550), was a son of Henry, count of Montbéliard (d. 1519), younger son of Ulrich V., count of Württemberg. He succeeded his kinsman Eberhard II. as duke of Württemberg in 1498, being declared of age in 1503. He served the German king, Maximilian I., in the war over the succession to the duchy of Bavaria-Landshut in 1504, receiving some additions to Württemberg as a reward; he accompanied Maximilian on his unfinished journey to Rome in 1508; and he marched with the imperial army into France in 1513. Meanwhile in Württemberg Ulrich had become very unpopular. His extravagance had led to a large accumulation of debt, and his subjects were irritated by his oppressive methods of raising money. In 1514 a rising under the name of "poor Conrad" broke out, and was only suppressed after Ulrich had made important concessions to the estates in return for financial aid. The duke's relations with the Swabian league, moreover, were very bad, and trouble soon came from another quarter also. In 1511 Ulrich had married Sabina, a daughter of Albert III., duke of Bavaria-Munich, and niece of the emperor Maximilian. The marriage was a very unhappy one, and having formed an affection for the wife of a knight named Hans von Hutten, a kinsman of Ulrich von Hutten, the duke killed Hans in 1515 during an altercation. Hutten's friends now joined the other elements of discontent. Fleeing from her husband, Sabina won the support of the emperor and of her brother William IV., duke of Bavaria, and Ulrich was twice placed under the imperial ban. After the death of Maximilian in January 1519 the Swabian league interfered in the struggle, and Ulrich was driven from Württemberg, which was afterwards sold by the league to the emperor Charles V.

Ulrich passed some time in Switzerland, France and Germany, occupied with brigand exploits and in service under Francis I. of France; but he never lost sight of the possibility of recovering Württemberg, and about 1523 he announced his conversion to the reformed faith. His opportunity came with the outbreak of the Peasants' War. Posing as the friend of the lower orders and signing himself "Ulrich the peasant," his former oppressions were forgotten and his return was anticipated with joy. Collecting men and money, mainly in France and Switzerland, he invaded Württemberg in February 1525, but the Swiss in his service were recalled owing to the defeat of Francis I. of France at Pavia; the peasantry were unable to give him any serious support, and in a few weeks he was again a fugitive. During his exile Ulrich had formed a friendship with Philip, landgrave of Hesse; and his restoration, undertaken by Philip, is an event of some importance in the political history of the Reformation. In 1526 Philip had declared he was anxious to restore the exiled duke, and about the same time Francis I. and Zwingli had intimated their willingness to assist in a general attack upon the Habsburgs. Many difficulties, however, barred the way, and it was 1534 before Philip was prepared to strike. In January of that year Francis I. had definitely promised assistance; the Swabian league had just been dissolved; and, after a manifesto had been issued by Ulrich and Philip justifying the proposed undertaking, Württemberg was invaded in April 1534. Charles V. and his brother, the German king, Ferdinand I., could send but little assistance to their lieutenants, and on the 13th of May the troops of the Habsburgs were completely defeated at Lauffen. In a few weeks Ulrich was restored, and in June 1534 a treaty was negotiated at Kaaden by which he was recognized as duke by Ferdinand, but was to hold Württemberg under Austrian suzerainty. After some hesitation Ulrich yielded to the solicitations of Philip, and signed the treaty in February 1535.

The duke now lost no time in pressing on the teaching of the reformed doctrines of Luther and Zwingli. Many convents and monasteries were destroyed, and extensive seizures of church property formed a welcome addition to his impoverished exchequer. Taxation, however, was so heavy that he soon lost his temporary popularity. In April 1536 he joined the league of Schmalkalden, though he did not assent to some of the schemes of Philip of Hesse for attacking Charles V. In 1546 his troops fought against the emperor during the war of the league of Schmalkalden, but with disastrous results for Württemberg. The duchy was quickly overrun, and the duke compelled to agree to the treaty of Heilbronn in January 1547. By this treaty Charles, ignoring the desire of Ferdinand to depose Ulrich again, allowed him to retain his duchy, but stipulated that he should pay a large sum of money, surrender certain fortresses, and appear as a suppliant before the emperor at Ulm. Having submitted under compulsion to the *Interim* issued from Augsburg in May 1548, Ulrich died on the 6th of November 1550 at Tübingen, where he was buried. He left a son, Christopher (1515–1568), who succeeded him.

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ULRICI, HERMANN (1806–1884), German philosopher, was born at Pförten, Prussia, on the 23rd of March 1806. He was educated for the law, but gave up his profession on the death of his father, and devoted four years to the study of literature, philosophy and science. In 1834 he was called to a professorship at Halle, where he remained till his death, on the 11th of January 1884. His philosophical standpoint may be characterized as a reaction from the pantheistic tendency of Hegel's idealistic rationalism towards a more pronouncedly theistic position. The Hegelian identity of being and thought is also abandoned and the truth of realism acknowledged, an attempt being made to exhibit idealism and realism as respectively incomplete but mutually complementary systems. Ulrici's later works, while expressing the same views, are largely occupied in proving the existence of God and the soul from the basis of scientific conceptions, and in opposition to the materialistic current of thought then popular in Germany.

His first works were in the sphere of literary criticism; of his treatise *On Shakespeare's Dramatic Art* (1839; editions, 1847, 1868, 1874), the 3rd ed. was translated into English by L. D. Schmitz in 1876. In 1841 he published *Über Princip u. Methode der Hegelschen Philosophie*, a severe criticism of the Hegelian system. This was continued in the *Grundprincip der Philosophie* (1845–1846), which also gives his speculative position. Complementary to this is his *System der Logik* (1852). His later works on the relation of philosophy to science and to the thought of his time were more popular in character. These are *Glauben u. Wissen* (1858), *Gott u. die Natur* (1862; 3rd ed., 1875), *Gott und der Mensch* (2 vols., 1866–1873; 2nd ed., 1874). From 1847 onward Ulrici edited, jointly with the younger Fichte, the *Zeitschrift für Philosophie u. phil. Kritik*. See Fränkel's art. in *Allgemeine deutsche Biog.* (1895) and works there quoted.

ULSTER, EARLS OF. The earldom of Ulster was the first title of honour in Ireland of English creation, and for more than a century was the only one. By many authorities John de Courci (*q.v.*), the conqueror of Ulster, is held to have been the first earl of Ulster; "it is, however, certain," says J.H. Round, "that this title was the invention of a late chronicler, and that it first appears in the *Book of Howth*, where we read of "Sir John Courcey, earl and president of Ulster." The confusion probably arose from the words of a charter, dated the 29th of May 1205, by which King John confirmed to Hugh de Lacy, whom he then created earl of Ulster, a grant of Ulster "as John de Courci held it on the day when Hugh conquered and took him prisoner in the field"; these words referring not to the earldom but to the lands held by de Courci, and possibly also to the authority which he had exercised in the king's name. The earldom therefore dates from this grant to de Lacy in 1205.

Hugh de Lacy, 1st Earl of Ulster (d. 1242 ?), was descended from Walter de Lacy (d. 1085), who fought for William the Conqueror at Hastings. The family came from Lassy in Normandy, and after the Conquest Walter de Lacy obtained extensive grants of land on the Welsh marches. He was the first baron Lacy by tenure, and was probably a brother, certainly a kinsman, of Ilbert de Lacy, from whom were descended Roger de Lacy, justiciar in the reign of King John, and the earls of Lincoln (*q.v.*) of the de Lacy family. Although Walter had three sons, one of whom founded Llanthony Abbey, none of them left

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heirs; but his daughter's son Gilbert took the name of de Lacy and became the fourth baron. Gilbert's son Hugh de Lacy (d. 1186) was one of the barons who accompanied Henry II. to Ireland in 1171; he obtained a grant of Meath, and governed Ireland as vicegerent for the king. By his wife Rose of Monmouth Hugh was father of Walter de Lacy (d. 1241), who succeeded his father as lord of Meath and took a leading part in the conflict of his family with John de Courci in Ireland, and also of Hugh de Lacy, 1st earl of Ulster. The latter was for a time a coadjutor of de Courci in Leinster and Munster, but after 1200 the rivalry between the two developed into war, and in 1203 de Lacy drove de Courci out of Down, and in the following year took him prisoner. He was rewarded by the king with grants of land in Ulster and Connaught, which were confirmed by the charter of the 29th of May 1205, when Hugh was created earl. He returned to Ireland with quasi-viceregal authority, and endeavoured without much success to reduce the O'Neill of Tyrone to submission. In 1207 war broke out between the earl of Ulster and FitzHenry, the justiciar. This brought King John in person to Ireland, where he expelled the earl's brother, Walter de Lacy, from Meath, and compelled the earl himself to fly from Carrickfergus to Scotland. For several years Ulster took part in the wars in France, and he did not return to Ireland till 1221, when he allied himself with O'Neill against the English. In 1226 his lands in Ulster were handed over to his brother Walter, but were restored to him in the following year, after which date he appears to have loyally served the king, being more than once summoned to England to give advice about Irish affairs. He died at Carrickfergus in 1242 or 1243. He left no surviving legitimate children, and on his death the earldom of Ulster reverted to the Crown.

In 1254 the lordship of Ireland was granted by Henry III. to Prince Edward (afterwards Edward I.), who about 1255 transferred "the county of Ulster" to Walter de Burgh, lord of Connaught, in exchange for the rich domain of Kilsilan. De Burgh was henceforth, or at all events within a short time afterwards, styled earl of Ulster, to which title he may have advanced some hereditary claim of a loose order through his mother Egidia, daughter of Walter de Lacy, the first earl of Ulster's brother. The earldom remained in the family of De Burgh until the death of William, 3rd earl of this line, in 1333, when it passed to his daughter Elizabeth, who married Lionel Plantagenet, son of Edward III. Lionel, having inherited in right of his wife the great estates of the family of de Clare as well as those of de Burgh, was created duke of Clarence in 1362. Leaving no male heirs, Lionel was succeeded in the earldom of Ulster by his daughter Philippa, who married Edmund Mortimer, earl of March. The third Mortimer, earl of Ulster, died unmarried in 1425, when his titles were inherited by his sister's son, Richard Plantagenet, duke of York, whose son Edward ascended the throne as Edward IV. in 1461.

Since that date the earldom of Ulster, which then merged in the Crown, has only been held by members of the royal family. It was granted in 1659 to James, duke of York, second son of Charles I., on whose accession as James II. it again merged in the Crown. The next prince to bear the title (1716) was Ernest Augustus, duke of Brunswick-Lüneburg, son of the elector of Hanover, and youngest brother of George I. The title became extinct at his death without heirs in 1728. It was next conferred on Edward Augustus, brother of George III., in 1760, again becoming extinct at his death seven years later. In 1784 Prince Frederick, second son of George III., was created earl of Ulster, and died leaving no children in 1827. Each of these last four earls of Ulster, all being of separate creations, held the title in conjunction with the dukedoms of York and Albany. On the next occasion of its revival it was united with the dukedom of Edinburgh, Prince Alfred Ernest Albert, second son of Queen Victoria, being created duke of Edinburgh, earl of Kent and earl of Ulster in 1866. On the death of the duke of Edinburgh in 1900 the earldom became extinct.

See, for the de Lacy and de Burgh earls of Ulster, *The Chronicle of Florence of Worcester*, edited by T. Forester (London, 1854); *Annals of Ireland by the Four Masters*, edited by J. O'Donovan (7 vols., Dublin, 1851); The *Annals of Loch Cé*, edited by W. M. Hennessy, "Rolls Series" (2 vols., London, 1871); *Calendar of Documents Relating to Ireland*, edited by H. S. Sweetman (5 vols., London, 1875–1886); W. W. Shirley, *Royal and Historical Letters of the Reign of Henry III.*, "Rolls Series" (2 vols., London, 1862–1866); Sir J. T. Gilbert, *History of the Viceroys of Ireland* (Dublin, 1865). For the later history of the earldom see G. E. C., *Complete Peerage*, vol. viii. (London, 1898). (R. J. M.)

ULSTER, a province of Ireland occupying the northern part of the island. It includes the counties Donegal, Londonderry, Antrim, Fermanagh, Tyrone, Cavan, Monaghan, Armagh and Down. Ulster (*Uladh*) was one of the early provincial kingdoms of Ireland, formed, according to the legendary chronicles, at the Milesian conquest of the island ten centuries before Christ, and given to the descendants of Ir, one of the sons of Mileadh. Interprovincial wars frequently altered its boundaries, notably in 332 when the three Collas, sons of Eochaidh Doimhlein, conquered the land between the river Boyne and Lough Neagh, which became a separate kingdom under the name of Uriel (Oriel or Orgial). Its princes maintained themselves until the close of the 16th century. In 1177 John de Courci, with the countenance of Henry II., set out to the conquest of Ulster. His operations were gradually successful, and he became lord deputy of Ireland in 1186 (see above). The nominal reign of the last king of Ulster closed in 1200. In 1585 Lord Deputy Sir John Perrot undertook the shiring of Ulster (excluding the counties Antrim and Down, which had already taken shape); and his work, though of little immediate effect owing to the rising of Hugh O'Neill, served as a basis for the division of the territory at the plantation of Ulster in the reign of James I.

ULTIMATUM (from Lat. *ultimus*, last), a word used in diplomacy to signify the final terms submitted by one of the parties in negotiation for settlement of any subject of disagreement. It is accompanied by an intimation as to how refusal will be regarded. English diplomacy has devised the adroit reservation that refusal will be regarded as an "unfriendly act," a phrase which serves as a warning that the consequences of the rupture of negotiations will be considered from the point of view of forcing a settlement. This opens up a variety of possibilities, such as good offices, mediation, the appointment of a commission of inquiry, arbitration, reprisals, pacific blockade and war.[1]

As regards the alternative of war, the Hague convention relative to the Opening of Hostilities of the 18th of October 1907, provides as follows:—

> "Considering that it is important, in order to ensure the maintenances of pacific relations, that hostilities should not commence without previous warning," it is agreed by the Contracting Powers to "recognize that hostilities between them must not commence without a previous and explicit warning in the form of either a declaration of war, giving reasons, or an ultimatum with a conditional declaration of war."

As reasons for a declaration of war are necessarily in the nature of an ultimatum, the ultimatum may now be regarded as an indispensable formality precedent to the outbreak of hostilities.

Another Hague convention of the same date respecting the limitation of the employment of force for the recovery of contract debts provides as follows:—

> "Being desirous of preventing between nations armed conflicts originating in a pecuniary dispute respecting contract debts claimed from the government of one country by the government of another country as due to its subjects or citizens," the Contracting Powers agree "not to have recourse to armed force for the recovery of contract debts claimed from the government of one country by the government of another country as being due to its subjects or citizens."

This undertaking, however, is not applicable when the debtor state refuses or neglects to reply to an offer of arbitration or, "after accepting the offer, renders the settlement of the *compromis* impossible, or, after the arbitration, fails to comply with the award."

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[1] To these may be added a new unofficial method devised by the Turks in connexion with the Austro-Turkish difficulty over the annexation of Bosnia-Herzegovina, viz. the boycotting of the goods and ships of the natives of the state against which the grievance exists. This is a method open to weaker as against more powerful states, which can have serious coercive and even complicated consequences under the influence of democratic institutions.

Under this convention, in the cases to which it relates, the alternative of the ultimatum is *ipso facto* arbitration, and it is only when the conditions of the convention have been set at naught that other measures may be employed.

ULTRAMARINE, a blue pigment, consisting essentially of a double silicate of aluminium and sodium with some sulphides or sulphates, and occurring in nature as a proximate component of lapis lazuli (*q.v.*). As early at least as the 11th century the art of extracting a blue pigment from lapis lazuli was practised, and from the beginning of the 16th century this pigment began to be imported into Europe from "over the sea," as *azurrum ultramarinum*. As the mineral only yields from 2 to 3% of the pigment, it is not surprising to learn that the pigment used to be weighed up with gold. It was valued chiefly on account of its brilliancy of tone and its inertness in opposition to sunlight, oil, and slaked lime (in fresco-painting). In 1814 Tassaert observed the spontaneous formation of a blue compound, very similar to ultramarine, if not identical with it, in a soda-furnace at St Gobain, which caused the *Société pour l'Encouragement d'Industrie* to offer, in 1824, a prize for the artificial production of the precious colour. Processes were devised by Guimet (1826) and by Christian Gmelin (1828), then professor of chemistry in Tübingen; but while Guimet kept his process a secret Gmelin published his, and thus became the originator of the "artificial ultramarine" industry.

The details of the commercial processes are trade secrets. The raw materials used in the manufacture are: (1) iron-free kaolin, or some other kind of pure clay, which should contain its silica and alumina as nearly as possible in the proportion of $2SiO_2 : Al_2O_3$ demanded by the formula assigned to ideal kaolin (a deficit of silica, however, it appears can be made up for by addition of the calculated weight of finely divided silica); (2) anhydrous sulphate of soda; (3) anhydrous carbonate of soda; (4) sulphur (in the state of powder); and (5) powdered charcoal or relatively ash-free coal, or colophony in lumps. "Ultramarine poor in silica" is obtained by fusing a mixture of soft clay, sodium sulphate, charcoal, soda and sulphur. The product is at first white, but soon turns green ("green ultramarine") when it is mixed with sulphur and heated. The sulphur fires, and a fine blue pigment is obtained. "Ultramarine rich in silica" is generally obtained by heating a mixture of pure clay, very fine white sand, sulphur and charcoal in a muffle-furnace. A blue product is obtained at once, but a red tinge often results. The different ultramarines—green, blue, red and violet—are finely ground and washed with water.

Artificial, like natural, ultramarine has a magnificent blue colour, which is not affected by light nor by contact with oil or lime as used in painting. Hydrochloric acid at once bleaches it with liberation of sulphuretted hydrogen and milk of sulphur. It is remarkable that even a small addition of zinc-white (oxide of zinc) to the reddish varieties especially causes a considerable diminution in the intensity of the colour, while dilution with artificial precipitated sulphate of lime ("annalin") or sulphate of baryta ("blanc fix") acts pretty much as one would expect. Ultramarine being very cheap, it is largely used for wall painting, the printing of paperhangings and calico, &c., and also as a corrective for the yellowish tinge often present in things meant to be white, such as linen, paper, &c. Large quantities are used in the manufacture of paper, and especially for producing that kind of pale blue writing paper which is so popular in Great Britain. The composition of the pigment is quite similar to that of lapis lazuli; but the constitution of both is uncertain.

By treating blue ultramarine with silver nitrate solution, "silver-ultramarine" is obtained as a yellow powder. This compound gives a blue potassium- and lithium-ultramarine when treated with the corresponding chloride, and an ethyl-ultramarine when treated with ethyl iodide. Selenium- and tellurium-ultramarine, in which these elements replace the sulphur, have also been prepared. It has been suggested that ultramarine is a compound of a sodium aluminium silicate and sodium sulphide. Another view is that the colour is due to some comparatively simple substance suspended in a colourless medium.

ULTRAMONTANISM (Lat. *ultra*, beyond, *montes*, the mountains), the name given to a certain school of opinion in the Roman Catholic Church. The expression *ultramontane* was originally no more than a term of locality, characterizing the persons so described as living—or derived from—"beyond the mountains." The "mountains" in this case are the Alps, so that, from the Italian standpoint, Germans and French for instance were "ultramontane." In this sense the word was applied in the later middle ages to the Germans studying at Italian universities and—to take a particular example—to the French cardinals at the election of Clement V. (1305). North of the Alps, however, the term seems never to have been restricted to the sense implying locality; for from the very beginning we find it used as a party appellation to describe those who looked "beyond the mountains" in order to obtain a lead from Rome, who represented the papal point of view and supported the papal policy. Thus, as early as the 11th century, the partisans of Gregory VII. were styled ultramontanes, and from the 15th century onwards the same name was given to the opponents of the Gallican movement in France.

It was not until the 19th century that "ultramontane" and "ultramontanism" came into general use as broad designations covering the characteristics of particular personalities, measures and phenomena within the Roman Catholic Church. At the present time they are applied to a tendency representing a definite form of Catholicism within that Church; and this tendency, in spite of the individual forms it has assumed in different countries, everywhere displays the same essential features and pursues the same ends. It follows, to be sure, from the very nature of Ultramontanism, and from the important position to which it has attained, that the official organs of the Church and all the people interested in the continuance of the actual state of affairs deny that it exists at all as an independent tendency, and seek to identify it with any proper interpretation of Roman Catholicism. Numerous Catholics, on the other hand, well qualified to form a judgment, themselves protest against this obliteration of the dividing line. It is indisputably legitimate to speak of Ultramontanism as a distinct policy, but it is very difficult to define its essential character. For, true to its nature, it has itself drawn up no complete programme of its objects, and, in addition to its avowed aims, its subsidiary effects claim attention. There is something chameleon-like in its appearances; its genuine views are kept in the background from tactical considerations, and first one aspect, then another, comes into prominence. It is evident, therefore, that the request for a definition of Ultramontanism cannot be answered with a concise formula, but that the varied character of its manifestations necessitates a more detailed examination of its peculiar objects.

The indications given by the late Franz Xaver Kraus—himself a Catholic—may well serve for a guide (*Spectator*, ep. 2). He classes as Ultramontane: (1) Whoever places the idea of the Church above that of religion; (2) whoever confounds the pope with the Church; (3) whoever believes that the kingdom of Heaven is of this world, and maintains, with medieval Catholicism, that the power of the keys, conferred on Peter, includes secular jurisdiction over princes and nations; (4) whoever holds that religious conviction can be imposed by material force, or may legitimately be crushed by it; (5) whoever is always ready to sacrifice a clear injunction of his own conscience to the claims of an alien authority.

The first and fundamental characteristic of Ultramontanism is its championship of a logical carrying out of the so-called "papalistic system," the concentration, that is, of all ecclesiastical power in the person of the Roman bishop. This tendency among occupants of the Roman see to exalt themselves above other bishops, and to usurp the part of a superior authority as compared with them, may be traced even in antiquity. No later than the end of the 2nd century Bishop Victor made an attempt to establish this position during the discussions regarding the date of the Easter festival. But he met with a sharp rebuff, and Bishop Stephen fared no better when, in the middle of the 3rd century, he came into collision with Cyprian of Carthage and Firmilian of Caesarea in the dispute concerning heretical baptism. How the Roman bishopric rose in status till it became the papacy, how the individual popes—in spite of these and similar repulses—advanced steadily on their path, how they succeeded in founding their primacy within the Church, and in re-establishing and maintaining that primacy notwithstanding severe defeats and long periods in which their prestige sank to the vanishing point, is told elsewhere (see Papacy). A characteristic peculiarity of the process is that the claims of the Roman see were always in advance of the actual facts and always encountered opposition; though there were many periods—at the height of the middle ages, for instance—when the voices raised in protest were only timid and hesitating. To the curial system, so evolved, and continually fortifying its position in the domains of theology, ecclesiastical law and politics, the episcopal system stands in diametrical opposition. This system admits that the pope represents the unity of the Church, and acknowledges his primacy, but only in the sense that he is *primus inter pares*; while at the same time it claims on behalf of the bishops that, in virtue of the divine ordinance, they possess an inalienable right to a share in the government of the Church (see Episcopacy). This theory of the independence of the episcopate with regard to the Roman bishop was first propounded by Cyprian, in his treatise *De unitate ecclesiae*. In the 15th century it received its classical expression in the resolutions of the ecumenical council at Constance; its principles were developed and amplified by Gallicanism, and, finally, in the 18th century, was restored in a modernized form by "Febronius" (Nikolaus von Hontheim, *q.v.*) and in the Punctation of Ems (see Febronianism). The struggle between these two systems continued well into the 19th century; and, though episcopalism was not infrequently proscribed by the curia, it still survived, and till the year 1870 could boast that no ecumenical council had ventured to condemn it. This was done for the first time, in 1870, at the Vatican Council (*q.v.*), whose decrees, recognizing the universal episcopate and the infallibility of the pope, marked the triumph of that ultramontane doctrine by which they had been long anticipated.

In 1865 Döllinger wrote: "The Ultramontane view can be summarized in a single, concise, and luminous proposition; but out of this proposition are evolved a doctrine and a view that embrace not merely religion and the Church, but science and the state, politics, morals and the social order—in a word, the whole intellectual life of men and nations. The proposition runs: The pope is the supreme, the infallible, and consequently the sole authority in all that concerns religion, the Church, and morality, and each of his utterances on these topics demands unconditional submission—internal no less than external." History, since the Vatican Council, has shown this judgment to have been correct. The Roman Catholic Church, in all countries, has become more and more dependent on the Curia; the bishops have lost their autonomous standing, and their position is little more than that of papal delegates, while all important questions are referred to Rome or settled by the nuncios.

A second peculiarity of Ultramontanism is its confusion of religion with politics; it claims for the Roman Catholic Church the functions of a political power, and asserts that it is the duty of the secular state to carry out its instructions and wishes. Ultramontanism regards the state, not as a divinely established order but, like its ancient prototype, as a profane institution and, for that reason, not co-ordinate with, but subordinate to the Church.

Since the conditions of the age no longer allow the pope to depose a temporal sovereign, the practical application of this conception of the relationship between the spiritual and temporal powers has taken other forms, all of which, however, clearly show that the superiority of the Church over the state is assumed. This may be seen in the attitude of Ultramontanism towards secular law. It assumes that God has conferred on the individual and on society certain rights and competences as inalienable possessions. This "natural law" ranks above all secular law, and all state legislation is binding only in so far as it is in harmony with that law. As to the provisions of this natural law, and the consequences they entail in individual cases, these can be decided only by the Church, *i.e.* the last resort, by the pope. This is to assert the principle of the invalidity of all legislation conflicting with ecclesiastical interests and rules. This was the attitude of Innocent III. when he annulled the English Magna Charta; of Innocent X. when he pronounced the treaty of Westphalia null and void; of Pius IX. when he condemned the Austrian constitution (1868) and the ecclesiastical laws of Prussia so far as they affected the circumstances of the Roman Catholic Church (1875). Thus too, even at the present time, the opinion is very clearly expressed in Ultramontane quarters that, in the event of the state issuing laws contravening those of nature or of the Church, obedience must be refused. The attitude of Ultramontanism, for instance, towards the right claimed and exercised by the state to make laws concerning marriage is wholly negative; for it recognizes no marriage laws except those of the Church, the Church alone being regarded as competent to decide what impediments are a bar to marriage, and to exercise jurisdiction over such cases. Thus Ultramontanism disclaims any moral subjection to secular authority or law, and will recognize the state only in so far as it conforms its rules to those of the Church. An instance of this interference with the duties of the individual citizen towards the state may be found in the fact that, till the year 1904, the Catholics of Italy were prohibited by the pope from taking part in any parliamentary election.

Since Ultramontanism cannot hope to realise its political ambitions unless it succeeds in controlling the intellectual and religious life of Catholic Christendom, it attempts to extend its sphere of influence in all directions over culture, science, education, literature and the forms taken by devotion. This endeavour is the third great characteristic of Ultramontanism. Wherever its operations can be traced, they are dominated by the conviction that all stirrings of independence must be repressed, and any advance beyond the stage of immaturity and nonage checked at the outset. That science must be left free to determine the aims of her investigation, to select and apply her own methods, and to publish the results of her researches without restraint, is a postulate which Ultramontanism either cannot understand or treats with indifference, for it regards as strange and incredible the fundamental law governing all scientific research—that there is for it no higher aim than the discovery of the truth. This ignorance of the very nature of science leads to under-estimation of the elemental force which science possesses; for only thus can we explain the pertinacity with which Ultramontanism, even at the present day, strives to subject her work to its own censorship and control. Nor are its criticisms limited to theology alone: its care extends to philosophy, history and the natural sciences. Even medicine has not escaped its vigilance, as is proved by the prohibition of certain surgical operations. The development of these efforts may be easily traced from decisions of the Congregation of the Index and the Holy Office in Rome. Ultramontanism, too, labours systematically to bring the whole educational organization under ecclesiastical supervision and guidance; and it manifests the greatest repugnance to allowing the future priest to come into touch with the modern spirit. Hence the attempts to train its growing manhood in clerically regulated boarding-schools and to keep it shut out from the external world in clerical seminaries, even in places where there are universities. Again, it works zealously to bring the elementary schools under the sway of the Church. Since it regards the training and instruction of childhood as inseparable, and holds that the former is essentially the work of the Church, it contests the right of the state to compel parents to send their children to the state schools and only to the state schools. In logical sequence to these tenets it seeks to divorce the school from the state—a proceeding which it terms educational freedom, though the underlying motive is to subordinate the school to the Church. In the domain of religion, Ultramontanism tends to foster popular superstitions and to emphasize outward forms as the essence of religious life, for it can only maintain its dominion so long as the common people remain at a low spiritual level. If any one desires to appreciate the intellectual plane—

and the power—of this Ultramontane habit of thought, he will find ample material in the performances of the notorious swindler Leo Taxil under Leo XIII., and in the acceptance of his blasphemous effusions by the highest ranks of the clergy.

In the fourth place, Ultramontanism is the embodiment of intolerance towards other creeds. The general presupposition involved is that a man cannot be saved except within the Catholic Church. Since, however, on the one hand—in virtue of a theory advanced by Pius IX. against the emperor William I. of Germany, in a letter which has since become famous—every Christian, whether he will or no, belongs to that Church by baptism, and is consequently pledged to obey her, and, on the other hand, since the state lies under the obligation to place the "secular arm" at her disposal whenever one of her members wishes to secede, the most far-reaching consequences result. In the past this principle led to the erection of the Inquisition (*q.v.*) and, even at the present day, there exists in the Curia a special congregation charged with its application (see CURIA ROMANA). On the Roman Catholic side the employment of compulsion against heretics has never been acknowledged as a blunder; and this method of silencing opposition has found champions in the bosom of the Church down to the most recent years. But the development of modern culture has rendered these exploits of an unbridled fanaticism impossible, and no government would consent to enforce the once obligatory sentences of ecclesiastical courts. As a result of this situation, the Catholic condemnation of heresy—though as stringent as ever in principle—has assumed less dangerous forms for the heretic. Nevertheless, it proved capable, even in the 19th century, of imposing onerous restrictions on the heterodox, and practical exemplifications of this hostile attitude persist to the present day. The embittering influence of Ultramontanism may be further traced in its attitude towards the baptism of non-Catholics, for it seeks to establish the rule that baptism conferred by Protestants is invalid through defect of form or matter, or even of intention, and that, consequently, the rite must be readministered, at least conditionally, to proselytes joining the Roman Church. Finally, ample scope for the display of tolerance—or intolerance—is found in the mixed marriages between Protestants and Catholics, which, as a result of the modern facilities for intercommunication and the consequent greater mobility of the population, have shown a large increase during the last few decades—in Germany, for instance. Here, again, Ultramontanism has done much to aggravate the pernicious feud between the two creeds, by exacting a promise before marriage from the Roman Catholic party that all the children shall be brought up as members of the Roman Catholic Church (see MARRIAGE: *Canon Law*). A like result has been produced when, in response to Ultramontane agitation, interdicts have been placed on churchyards in which non-Catholics have found their last resting-place.

Lastly, Ultramontanism is the foe of the nationalization of Catholicism. This peculiarity is connected, though not identical, with the above-mentioned tendency towards the Romanization of the Church. Just as in Protestant countries there has often been an amalgamation of evangelical belief with national feeling, to the great gain of both, Catholics demand that Catholicism shall enter into the sphere of their national interests, and that the activities of the Catholic Church should rest on a national basis. These aspirations have been proclaimed with especial emphasis in France, in Germany (*Reformkatholizismus*) and in the United States (*Americanism*; see HECKER, I. T.) but are everywhere met with a blank refusal from the Ultramontane side. For Ultramontanism fears that any infusion of a national element into ecclesiastical life would entail the eventual independence of the people in question from papal control, and lead to developments opposed to its papalistic mode of thought. It endeavours, therefore, to undermine all aspirations of this nature and, its own tendency being essentially international, strives to ensure that national sentiment and national interests shall not find over-zealous champions among the clergy.

The relationship of Ultramontanism to Catholicism is a much-disputed problem. The Ultramontane, indeed, maintains that there is no justification for distinguishing between the two. but the motives underlying this attitude are obvious. For, by representing the prosecution of its party-political objects as a championship of the Catholic Church, Ultramontanism seeks to acquire the support of the official organs of that Church, and the good will of all circles interested in her welfare; while at the same time it strives to discredit any attempt at opposition by branding it as an assault on the orthodox faith. But, even within the pale of the Roman Church, this identification provokes emphatic dissent, and is repudiated by all who are shocked by the effects of a one-sided accentuation of political Catholicism on the inner life of the church, and are reluctant to see the priest playing the part of a political agitator. It was on these grounds that Count May, in January 1904, proposed in the chamber of the Bavarian Reichsrath that the clergy should be deprived of the suffrage. In Germany, again, the last few years have witnessed a growing aversion from Ultramontanism on the part of those Catholics who cannot reconcile its tenets with their patriotic sentiments, and are disinclined to submit to a limitation of their share in the intellectual life of the times, particularly in art, science and literature. It may be admitted that, in many cases, the distinction between Ultramontanism and Catholicism cannot be clearly traced; and it is impossible to draw a sharp line of severance between the two, which could be absolutely valid under all circumstances and in relation to all questions. For there are many almost imperceptible stages of transition from the one to the other; and, for all the principal contentions of Ultramontanism, analogies may be found in the past history of the Catholic Church. Thus, in the middle ages, we find extremely bold pronouncements with respect to the position of the papacy in the universal Church; while political Catholicism had its beginnings in antiquity and found very definite expression, for instance, in the bull *Unam sanctam* of Boniface VIII. Again, the attempt to subordinate all intellectual life to ecclesiastical control was a feature of the medieval Church, and the fundamental attitude of that Church towards heresy was fixed during the same period. But since then much has been altered both in the Church and her secular environment. The state has become independent of the Church, legislates on its own sole authority, and has recognized as falling within its own proper sphere the civilizing agencies and social questions formerly reserved for the Church. Again, education, science, art and literature have been secularized: the printing-press carries knowledge into every house, the number of illiterates diminishes from year to year in every civilized country, and the clergy are no longer the exclusive propagators of culture, but merely one factor among a hundred others. Finally, the Roman Catholic Church has long forfeited the privileged position formerly accorded as her due. The days when she was *the* Christian Church are past: and now the civic rights of a man in a modern state are not curtailed, though he may neglect his duty to the Church or flatly refuse to acknowledge the existence of any such duty. The struggle for religious freedom has suffered no intermission since the beginning of the Reformation; and the result is that to-day its recognition is considered one of the most precious trophies won in the evolution of modern civilization; nor can these changes be reversed, for they stand in the closest connexion and reciprocity one with another, and represent the fruits of centuries of co-operation on the part of the European peoples. But Ultramontanism ignores this latest page of history and treats it as non-existent, aspiring to the erection of a new order of society, similar to that which Rome created—or, at least, endeavoured to create—in the halcyon days of medievalism. For the justification of this enterprise, it is considered sufficient to point out that the several elements of its programme once enjoyed validity within the Church. But Cyprian of Carthage said long ago, *Consuetudo sine veritate vetustas erroris est*; and the bare fact of previous existence is no argument for the re-introduction of obsolete and antiquated institutions and theories. But, under the guise of a restoration on conservative lines, Ultramontanism—notwithstanding the totally different conditions which now obtain—girds itself to work for an ideal of religion and culture in vogue during the middle ages, and at the same time holds itself justified in adopting the extreme point of view with respect to all questions which we have mentioned. Thus Ultramontanism is not to be conceived as a theological movement, but as the programme of a party whose principles are in fundamental opposition to modern culture, modern education, modern tolerance and the modern state—a party which seeks to carry out its campaign against the society of to-day, not by bridging the gulf betwixt creed and creed, but by widening it, by awakening religious fanaticism, and by closing the way to a peaceful co-operation of Catholics and non-Catholics in the highest tasks of culture and human civilization. The hierophants of this Ultramontane system are to be found in the Society of Jesus (See JESUITS). In fact, the terms *jesuitical* and *ultramontane* may, in numerous cases, be regarded as equivalent.

The origin of modern Ultramontanism is preceded and conditioned by the collapse of Catholicism in the period of the French Revolution. Pius VI. and Pius VII. were expelled from Rome, deprived of the papal states, and banished to France. In that country the Church almost completely lost her possessions; in Germany they were at least considerably curtailed; in both the hierarchical organization was shattered, while the Catholic laity surveyed the catastrophe in complete passivity. But from this severe fall the Roman Church recovered with comparative readiness, and the upward movement is contemporaneous with the rise of Ultramontanism. The birth of that system, however, cannot be fixed as a definite event by the day and the hour; nor was it created by any single personality. Rather it was the product of the first post-revolutionary generation. Neither is it merely fortuitous that the reaction proceeded from France itself. For in no other country had hostility to religion attained such a pitch or assumed such grotesque forms; and consequently in no other country did the yearning for religion manifest itself so unequivocally, when bitter experience had demonstrated the necessity of a return to law and order. And in the other states of Europe there existed, more or less, a similar desire for peace and an equal dread of a fresh outbreak of revolutionary violence. In contrast to the struggle for an ideal freedom, which was at first hailed with tempestuous delight only to reveal itself as a dangerous tyranny, men became conscious of the need for a firmly established authority in the reconstruction of society. After the violent upheaval in the political world during the last few decades, the existent—as such—increased in value, and the high estimation in which the old régime was now held led to a policy of restoration. At the same time, the repression of idealism and sentiment during the period of "illumination" was amply revenged, and the barren age of reason gave place to Romanticism. These tendencies in contemporary opinion favoured the renovation of the Roman Catholic Church. But the papacy signalized its reinstation by restoring the Society of Jesus (1814) and re-establishing the index. Even before this, the earliest germs can be traced back into the revolutionary period itself—the movement characterized above had begun working in France on the same lines; and, as it showed great zeal for the increase of the papal authority, it received the support of the Curia. True, the principles of Bonald, Lemaître, Lamennais and Lacordaire, were not carried through in the French Church without opposition; but, about the year 1850, they had become predominant there. In Germany Ultramontanism had to contend with great difficulties; for here ecclesiastical affairs were not in so desperate a case that the most drastic remedies possessed the most powerful attraction; while, in addition, the clergy were too highly educated to be willing to renounce all scientific work. The result was that a series of violent struggles took place between the old Catholicism and the new Ultramontane species (Hermes, Baader, Döllinger, &c.). But even here Ultramontanism gained ground and derived inestimable assistance from the blunders of government after government—witness the conflict of the Prussian administration with Archbishop Droste-Vischering (*q.v.*) of Cologne, 1837. Additional impetus was also lent by the revolution of 1848.

The growth of the Jesuitical influence at Rome—more especially after the return of Pius IX. from exile—implied a more definite protection of Ultramontanism by the papacy. The proclamation of the dogma of the immaculate conception in 1854 was more than the decision of an old and vexed theological problem; it was an act of conformity to a pietistic type especially represented by the Jesuits. The Syllabus of 1864, however, carried with it a recognition of the Ultramontane condemnation of all modern culture (see the articles PIUS IX., and SYLLABUS). Finally, in the Vatican Council, the Jesuits saw another of their favourite theories—that of papal infallibility—elevated to the status of a dogma of the Church (see VATICAN COUNCIL and INFALLIBILITY).

Ultramontanism, again, though essentially averse from all forms of progress, had displayed great dexterity in utilizing the opportunities presented to it by modern life. Where it appeared advisable, it has formed itself into a political party, as for instance, the Centre Party in Germany. It has shown extreme activity in the creation of a press devoted to its interests, and has consolidated its influence by the formation of an extensive league-system. In the episcopacy it has numerous adherents; it has made progress in the universities, and most of the learned and theological reviews are conducted in its spirit.

Whether the powerful position of this movement within the Roman Catholic Church be an advantage for that Church itself cannot be discussed here. The answer to the problem will mainly depend on the estimate which we form of the Society of Jesus and its whole activity. The outstanding event in the latest history of Ultramontanism is the separation between Church and state in France (1904), by which the republic has endeavoured to break the influence of this party. Similarly, the dissolution of the German Reichstag in December 1906 was a weapon directed against Ultramontanism; and, though the elections of 1907 failed to diminish the numbers of the Centre, they rendered possible the formation of a majority, in face of which that system forfeited the influence it had previously possessed.

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A collection of the further literature will be found in Benrath's article "Ultramontanism" in the *Realencyclopädie für protestantische Theologie und Kirche* (3rd ed., 1908, vol. xx. p. 213 seq.). Also, for the history of the rise of Ultramontanism in Germany, see C. Mirbt, *Die katholisch-theologische Fakultät zu Marburg. Ein Beitrag zur Geschichte der katholischen Kirche in Kurhessen und Nassau* (Marburg, 1905). (C. M.)

ULUGH BEG, MIRZA MAHOMMED BEN SHAH ROK (1394–1449), Persian astronomer, son of the shah Rok and grandson of Timur, succeeded his father as prince of Samarkand in 1447, after having for years taken part in the government, and was murdered in 1449 by his eldest son. He erected an observatory at Samarkand, from which were issued tables of the sun, moon and planets, with an interesting introduction, which throws much light on the trigonometry and astronomical methods then in use (*Prolégomènes des tables astronomiques d'Ouloug Beg*, ed. by Sédillot, Paris, 1847, and translated by the same, 1853). The serious errors which he found in the Arabian star catalogues (which were simply copied from Ptolemy, adding the effect of precession to the longitudes) induced him to redetermine the positions of 992 fixed stars, to which he added 27 stars from Al Sûfi's catalogue, which were too far south to be observed at Samarkand.

This catalogue, the first original one since Ptolemy, was edited by Th. Hyde at Oxford in 1665 (*Tabulae longitudinis et latitudinis stellarum fixarum ex observatione Ulugbeighi*), by G. Sharpe in 1767, and in 1843 by F. Baily in vol. xiii. of the *Memoirs* of the Royal Astronomical Society.

See Delambre, *Histoire de l'astronomie du moyen âge*; Poggendorff, *Biographisch-litterarisches.*

ULUNDI (Zulu for "high place"), the royal kraal of Cetywayo, situated in the Mahlabatini district of Zululand, about 3 m. north of the White Umfolosi River, and 115 m. N.N.E. of Durban. The valley of the White Umfolosi here forms an extensive basin called the Emhlabatini, and from the time of Chaka to the overthrow of Cetywayo in 1883 was the exclusive place of residence of the Zulu kings. The basin on the south side of the river is regarded as the cradle of the Zulu race; here all their early chiefs are buried, hence the term Emakosini (*i.e.* at the grave of the chiefs) applied to the district (see Blue Book C. 5143). During Cetywayo's reign a garrison of 3000 was kept at Ulundi. About a mile from the kraal on the 4th of July 1879 a Zulu army some 20,000 strong was totally defeated by Lord Chelmsford. The British force, consisting of the second division and Wood's column, numbered in all 4200 Europeans and some 1000 natives. On the morning of the battle they formed a square, with the mounted troops (about 300) inside. The Zulus attacked with great gallantry but were received with so deadly a fire that they could not come within thirty yards of the rifles. After twenty minutes they broke and fled, and the cavalry followed them till broken ground rendered further pursuit impossible. The British loss was about 100, that of the Zulus 1500. After the fight the royal kraal was burned. On the 1st of September following, at the site of the ruined kraal, Sir Garnet (afterwards Lord) Wolseley announced the partition of Zululand into thirteen petty chieftainships. But on the 29th of January 1883 Cetywayo was reinstalled by the British at Ulundi as chief over two-thirds of his old dominions. Attacked at Ulundi in July 1883 by the rival chief Usibepu, Cetywayo and his 5000 followers fled to the Nkandhla bush. The royal kraal was again destroyed and Ulundi ceased to be a rallying point. The magistracy for the district is situated 5 m. north of the site of Ulundi. (See ZULULAND.)

ULVERSTON, a market town in the North Lonsdale parliamentary division of Lancashire, England, in the Furness district, 9½ m. N.E. from Barrow-in-Furness and 256 m. N.W. by N. from London, on the Furness railway. Pop. of urban district (1901), 10,064. The church of St Mary, founded in 1111, retains the south door of the original building in the Transition style, but the greater portion of the structure is Perpendicular, of the time of Henry VIII. It contains an altar-tomb with recumbent figure of Walter Sandys of Conishead, dated 1588. After the destruction of Furness Abbey, Ulverston succeeded Dalton as the most important town in Furness, but the rapid rise of Barrow surpassed it in modern times. A monument on Hoad Hill commemorates Sir John Barrow, secretary of the admiralty and a native of the town. Conishead Priory, 2 m. south-east, a mansion on the site of a priory founded in the reign of Henry II., is used as a hydropathic establishment. Formerly Ulverston had a considerable trade in linens, checks and ginghams, but it is now dependent on large iron and steel works, chemical works, breweries, tan-yards, and hardware, paper, and wooden hoop manufactories. Through its connexion with Morecambe Bay by a ship canal of 1 m. in length, owned by the Furness railway, it has a shipping trade in iron and slates.

Ulverston, otherwise Vlureston, Olvestonum, occurs in Domesday Book, where Vlurestun is named as a manor in possession of Turulf, who was probably the original Saxon owner. Early in the 12th century the manor passed to Stephen, count of Boulogne, and was given by him to Furness Abbey. In 1196 the abbot granted the vill of Ulverstone with the inhabitants to Gilbert Fitz-Reinfred, who granted it a charter by which he raised it to the rank of a free borough. The lordship became divided, and one-half passed to the Harringtons and finally to Henry Grey, duke of Suffolk, on whose attainder in 1553 it was forfeited to the Crown. The other moiety returned to the abbey about the end of the 14th century, and at the dissolution was surrendered to the Crown. Early in the 17th century the Crown alienated the manor, which is now in the family of Buccleuch. The yearly court-leet and court-baron are still held in October. In 1280 Roger de Lancaster obtained a charter from Edward I. for a weekly market on Thursday and an annual fair of three days beginning on the eve of the nativity (Sept. 7).

UMAÑ, a town of Russia, in the government of Kiev, 120 m. S. of the city of Kiev. Pop. 28,628, many of whom are Jews, and carry on the export of corn, spirits, &c. It has a park (290 acres), planted in 1793 by Count Potocki, and now containing a gardening school. Umañ was founded early in the 17th century as a fort against the Tatar raiders. The Cossacks of the Ukraine, who kept it, revolted against their Polish rulers about 1665, and sustained a fierce siege. In 1674 it was plundered and most of its inhabitants murdered by the Ukrainians and Turks. In 1712 its last occupants were transferred by Peter the Great to the left bank of the Dnieper. But by the end of the 18th century, when it again became the property of the Potockis, it was repeopled and became one of the busiest trading towns of Little Russia. In 1768, when the Cossacks revolted anew against the Poles, they took Umañ and murdered most of its inhabitants.

UMARKOT, a town in Sind, India, 7 m. from a station on the North-Western railway; pop. (1901), 4924. It is the headquarters of the Thar and Parkar district. The Mogul emperor Akbar was born here in 1542, when his father, Humayun, was fleeing to Afghanistan.

UMBALLA, or AMBALA, a city and district of British India, in the Delhi division of the Punjab. The city is 3 m. E. of the river Ghaggar, 902 ft. above the sea. Pop. (1901), 78,638. It has a station on the North-Western railway (1077 m. N.W. of Calcutta), with a branch line to Kalka at the foot of the hills (39 m.), which was continued up to Simla in 1903. Umballa owes its importance to a large military cantonment which was first established in 1843, and is the headquarters of a cavalry brigade belonging to the Northern army. The cantonment, which lies 4 m. south-east of the native town, is well laid out with broad roads shaded by trees. It contains a church, a club-house, several hotels and English shops.

The DISTRICT OF UMBALLA has an area of 1851 sq. m. With one small exception it consists of a level alluvial plain, sloping away gradually from the foot of the Himalayas, and lying between the rivers Jumna and Sutlej. These rivers do not materially affect the district, which has a drainage system consisting of the numerous torrents which pour down from the hills. In the south these torrents run in broad sandy beds scarcely below the surface of the country, and vary from 200 yds. to 1 m. in width, until, at a distance of 20 or 30 m. from the hills, they become comparatively docile streams, with well-defined clay banks. Towards the north the torrents run in deep beds from the point where they debouch from the hills; they also differ from the streams of the south in being free from sand. The principal of these northern streams is the Ghaggar, into which the minor streams empty themselves, some within and some beyond the limits of the district. Whatever surplus water of this river is not swallowed up by irrigation passes on through Patiala state and Sirsa, and is finally lost in the sands of Rajputana. The Ghaggar is the only perennial stream within the district, but dwindles to a tiny rivulet in the dry season, and disappears altogether beyond the border of the district. In 1901 the population was 815,880, showing a decrease of 5·6% in the decade. The principal crops are wheat, maize, pulse, millets, rice, cotton and some sugarcane. There are factories for ginning and pressing cotton, and also for grinding wheat. Two opposite corners of the district are watered by the Sirhind and the Eastern Jumna canals. A portion is crossed by the main line of the North-Western railway and by the Delhi-Umballa-Kalka railway, which have their junction at Umballa city. Umballa is one of the territories previously held by numerous Sikh sirdars, which were attacked by Ranjit Singh during one of his marauding expeditions. This caused the movement of British troops in 1809 which resulted in the treaty with Ranjit Singh, by which he was required to withdraw his army from the left bank of the Sutlej and to relinquish his recent conquests in Sirhind. In June 1849, after the second Sikh War had brought the Punjab under British rule, the chiefs were deprived of all sovereign power and the district took practically its modern form. In March 1869 a grand durbar was held at Umballa on the occasion of the visit of the amir Shere Ali.

UMBELLIFERAE, in botany, an order of polypetalous Dicotyledons belonging to the series Umbelliflorae, which includes also the orders Araliaceae (ivy family) and Cornaceae (dogwood family). It contains 180 genera with about 1400 species, occurring in all parts of the world but chiefly in north temperate regions. It is well represented in the British flora by 35 genera. The plants are annual or perennial herbs, rarely shrubby as sometimes in *Bupleurum*, with generally a very characteristic habit, namely stout erect stems with hollow internodes, alternate pinnately compound exstipulate sheathing leaves and compound umbels of small, generally white, flowers.

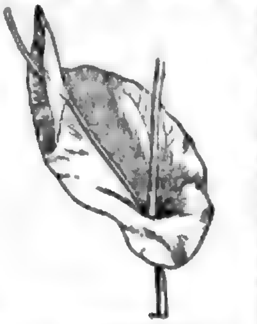


FIG. 1.—Perfoliate leaf of a species of hare's-ear (*Bupleurum rotundifolium*). The two lobes at the base of the leaf are united, so that the stalk appears to come through the leaf.

An example of an annual is the common fool's parsley, *Aethusa Cynapium*; carrot (*Daucus Carota*) is a biennial; others are perennial, persisting by means of tubers or rhizomes—such are hogweed (*Heracleum*), *Angelica*, *Peucedanum*, and others. Some genera have a creeping stem as in *Hydrocotyle* (pennywort), a small herb with a creeping filiform stem and, in the British species, entire leaves. *Bupleurum* has simple, entire, often perfoliate leaves (fig. 1). *Azorella*, a large genus in south temperate regions, has a peculiar caespitose habit, forming dense cushions often several feet in diameter and persisting for many years. *Eryngium*, represented in Britain by sea-holly (*E. maritimum*), is a large genus of rigid often glaucous herbs with spiny-toothed leaves, which in some South American species with narrow parallel-veined blade and broadly sheathing base recall those of a Monocotyledon such as *Agave* or *Bromelia*. In sanicle (*Sanicula*), *Astrantia* and others the leaves are palmately divided; and there is a great variety in the degree of division in the characteristic pinnate leaf, which varies from simply pinnate to a branching of the blade to the fifth or sixth order.

There is also considerable variety in the development of the umbel, which is usually compound but sometimes simple, as generally in *Hydrocotyle* and *Astrantia*, rarely reduced to a single flower as in species of *Hydrocotyle*. In *Eryngium* the flowers are crowded into dense heads subtended by a whorl of rigid bracts. A terminal flower is sometimes present as in carrot, where it is distinguished by its form and dark colour. The presence or absence of bracts and their form when present afford useful diagnostic characters. When present at the base of the primary rays of the umbel they form the *involucre*, and the *involucel* when at the base of a partial umbel. In *Astrantia* the simple umbel is enveloped by a large, often coloured, involucre.

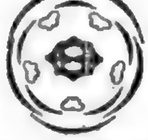
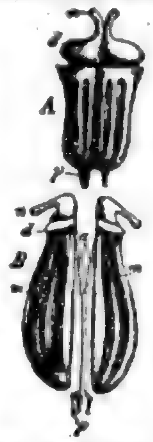


FIG. 2.—Diagram of flower of Umbelliferae.

The small epigynous flowers are usually hermaphrodite and regular, with parts in fives. The sepals are usually very small, often represented only by teeth on the upper edge of the ovary; the petals are usually obovate or obcordate in shape, often with the tip inflexed; the stamens have long slender filaments bent inwards in the bud but ultimately spreading; the two carpels are in the median plane; the two-celled ovary is surmounted by an epigynous glandular disk—the stylopodium—which bears the two styles. Each ovary-cell contains a single pendulous anatropous ovule with a ventral raphe and a single integument. In the development of the flower the stamens appear first, followed by the petals, the sepals and the rudiments of the carpels in succession. The flowers are rendered conspicuous by being massed into more or less dense flat-topped inflorescences. A resemblance to the rayed heads of Compositae is suggested in the frequently larger size of the flowers on the circumference of the umbel which are often sterile and zygomorphic from the larger size of the outer petals. This arrangement allows a large number of flowers to be visited in a short time. The flowers are generally white, sometimes pink or yellow, very rarely blue; they are generally scented, but the whole plant has an odour from the general presence in the tissues of an ethereal oil or resin. The flower is widely open, the petals and stamens radiating from the central disk (fig. 3, *d*), on which honey is secreted, and is thus accessible to quite short-lipped flies. Cross-pollination is rendered necessary by the flowers being generally markedly proterandrous; the stamens throughout the umbel have generally shed their pollen before the stigmas have begun to be functional even in the outer flowers.

The fruit is again very characteristic; a schizocarp which splits down the septum to form two dry one-seeded mericarps which are at first attached to, or pendulous from, an entire or split central axis or *carpophore* (fig. 3). The form of the mericarp affords valuable characters for distinguishing genera. On the outer surface of each are generally 5 ridges (primary ridges), between which are sometimes 4 secondary ridges; oil-cavities, *villae*, are often present in the intervening furrows. The fruits are variously adapted for distribution; they are sometimes thin and flat as in *Heracleum*, when they are easily carried by the wind, or, as in carrot, provided with hooks. The seed contains a small embryo embedded in oily endosperm, which is usually cartilaginous in texture.

The order is divided into 9 tribes depending on the form of the fruit, whether compressed, angled, grooved, constricted, &c., and the presence or absence of *villae*. The 35 British genera include representatives of 7 of the tribes. The following may be mentioned: *Hydrocotyle* (pennywort), *Eryngium* (sea-holly), *Sanicula* (sanicle), *Conium* (hemlock, *q.v.*), *Smyrnium* (Alexanders), *Bupleurum* (hare's-ear), *Apium* (celery, *q.v.*), *Carum* (caraway, *q.v.*), *Conopodium* or *Bunium* (earth-nut, *q.v.*), *Myrrhis* (Cicely), *Chaerophyllum* (chervil), *Foeniculum* (fennel, *q.v.*), *Crithmum* (samphire), *Oenanthe* (water dropwort), *Aethusa* (fool's parsley, *q.v.*), *Angelica* (*q.v.*), *Peucedanum* (hog's fennel, parsnip, *q.v.*), *Heracleum* (hogweed), *Daucus* (carrot). *Petroselinum sativum* is common parsley (*q.v.*).



(From Vines's *Student's Text Book of Botany*, by permission of Swan, Sonnenschein & Co.)

FIG. 3.—*A*, Pistil; *B*, Fruit of the Caraway (*Carum Carui*); enlarged.

d, epigynous disk; *f*, ovary; *n*, stigma; *p*, pedicel. In *B* the two carpels have separated so as to form two mericarps (*m*). Part of the septum constitutes the carpophore (*a*).

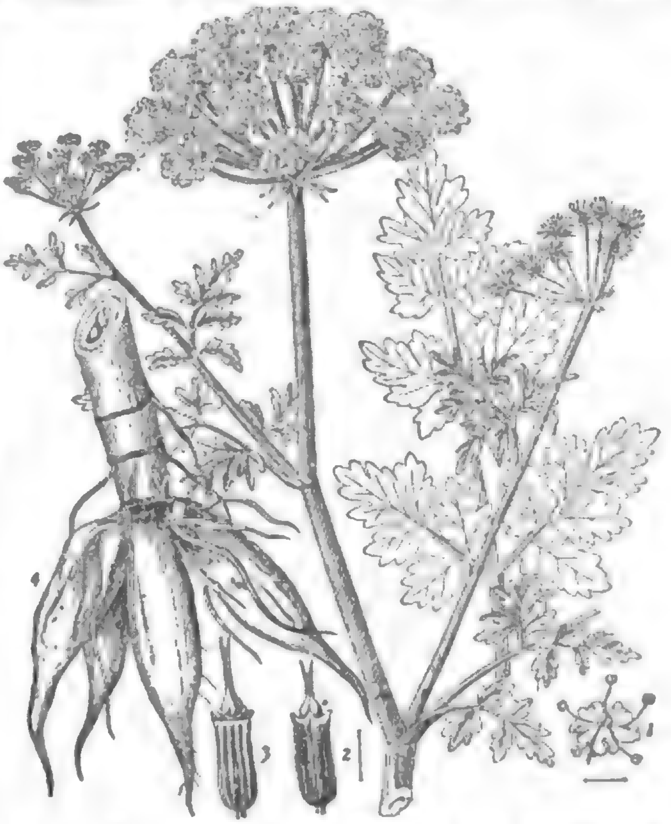


FIG. 4.—Water Dropwort, *Oenanthe crocata*, with thickened root fibres, about half nat. size.

1, Flower; 2 and 3, Side and front view of fruit; enlarged.

UMBER, a brown mineral pigment consisting of hydrated iron and manganese oxides. The finely-powdered mineral is known as *raw umber*; when calcined the beauty of the colour increases and the pigment is known as *burnt umber*. It was probably first obtained from Umbria in Italy, but it occurs in many localities, notably in Cyprus (*Turkey umber*); large quantities of *English umber* are mined in Devonshire and Cornwall. (See Pigments.)

UMBRA (Lat. for shade or shadow), in astronomy, the completely dark portion of the shadow of a heavenly body, filling the space within which the sun is entirely hidden. The body being supposed spherical, the umbra is a cone circumscribing both the sun and the body that casts the shadow. The term is also given to the interior and darkest part of a sunspot. (See Sun; Eclipse.)

UMBRELLA, a portable folding protector from rain (Fr. *parapluie*), the name parasol being given to the smaller and more fanciful article carried by ladies as a sunshade, and the *en-tout-cas* being available for both purposes. Primarily the umbrella (*ombrella*, Ital. dim. from Lat. *umbra*, shade) was a sunshade alone—its original home having been in hot, brilliant climates. In Eastern countries from the earliest times the umbrella was one of the insignia of royalty and power. On the sculptured remains of ancient Nineveh and Egypt there are representations of kings and sometimes of lesser potentates going in procession with an umbrella carried over their heads; and throughout Asia the umbrella had, and still has, something of the same significance. The Mahratta princes of India had among their titles "lord of the umbrella." In 1855 the king of Burma in addressing the governor-general of India termed himself "the monarch who reigns over the great umbrella-wearing chiefs of the Eastern countries." The baldachins erected over ecclesiastical chairs, altars and portals, and the canopies of thrones and pulpits, &c., are in their origin closely related to umbrellas, and have the same symbolic significance. In each of the basilican churches of Rome there still hangs a large umbrella.

Among the Greeks and Romans the umbrella (*σκιάς*, *σκιάδειον*, *umbraculum*, *umbella*) was used by ladies, while the carrying of it by men was regarded as a sign of effeminacy. Probably in these southern climes it never went out of use, and allusions by Montaigne show that in his day its employment as a sunshade was quite common in Italy. The umbrella was not unknown in England in the 17th century, and was already used as a rain protector. Michael Drayton, writing about the beginning of the 17th century, says, speaking of doves:—

> "And, like umbrellas, with their feathers
> Shield you in all sorts of weathers."

Although it was the practice to keep an umbrella in the coffee-houses early in the 18th century, its use cannot have been very familiar, for in 1752 Colonel Wolfe, writing from Paris, mentions the carrying of them there as a defence against both rain and sun, and wonders that they are not introduced into England. The traveller Jonas Hanway, who died in 1786, is credited with having been the first Englishman who habitually carried an umbrella.

The umbrella, as at first used, was based on its Eastern prototype, and was a heavy, ungainly article which did not hold well together. It had a long handle, with ribs of whalebone or cane, very rarely of metal, and stretchers of cane. The jointing of the ribs and stretchers to the stick and to each other was very rough and imperfect. The covering material consisted of oiled silk or cotton, heavy in substance, and liable to stick together in the folds. Gingham soon came to be substituted for the oiled cloth, and in 1848 William Sangster patented the use of alpaca as an umbrella covering material. One of the most notable inventions for combining lightness, strength and elasticity in the ribs of umbrellas was the "Paragon" rib patented by Samuel Fox in 1852. It is formed of a thin strip of steel rolled into a U or trough section, a form which gives great strength for the weight of metal. Umbrella silk is chiefly made at Lyons and Crefeld; much of it is so loaded that it cuts readily at the folds. Textures of pure silk or of silk and alpaca mixed have better wear-resisting properties.

UMBRIA ('Ομβρική), the name of an ancient and a modern district of Italy.

1. The ancient district was bounded in the period of the Roman supremacy by the Ager Gallicus (in a line with Ravenna) on the N., by Etruria (the Tiber) on the W., by the Sabine territory on the S. and by Picenum on the E. The Via Flaminia passed up through it from Ocriculum to Ariminum; along it lay the important towns of Narnia (Narni) Carsulae, Mevania (Bevagna), Forum Flaminii, Nuceria Camellaria (Nocera) and Forum Sempronii; and on the Adriatic coast Fanum Fortunae (Fano) and Pisaurum (Pesaro). To the east lay Interamna (Terni), Spoletium (Spoleto), Fulginium (Foligno—on a branch of the Via Flaminia which left the main road at Varina and rejoined it at Forum Flaminii) and the important town of Camerinum on the side of the Apennines towards Picenum. On the side towards Etruria lay Ameria (Amelia) and Tuder (Todi), both on the direct road from Rome to Perusia,[1] Iguvium, which occupied a very advantageous position close to the main pass through the Apennines, and Hispellum (Spello). Not far off was Assisium (Assisi), whilst far to the north in the mountains lay Sarsina. Under the empire it formed the sixth region of Italy. In earlier times it embraced a far larger area. Herodotus (iv. 49) describes it as extending to the Alps, and the *περίοδος* ascribed to Scylax (a treatise which embodies material of the 4th century B.C. or earlier) makes Umbria conterminous with Samnium. Furthermore, place-names of undoubted Umbrian origin abound in Etruria and are also found in the Po valley. Thus in the early days of Italian history Umbria may be taken as having extended over the greater part of northern and central Italy.

The name Umbria is derived from the Umbri, one of the chief constituent stocks of the Italian nation. The origin and ethnic affinities of the Umbrians are still in some degree a matter of dispute, but their language proves them to have been an Aryan people closely allied with the Oscans and in a remoter degree with the Latins. Archaeological considerations further show with approximate certainty that the Umbri are to be identified with the creators of the Terramara (*q.v.*), and probably also of the Villanova (*q.v.*), culture in northern and central Italy, who at the beginning of the Bronze Age displaced the original Ligurian population by an invasion from the north-east. From the time and starting-point of their migrations, as well as from their type of culture, it may be provisionally inferred that the Umbrians were cognate with the Achaeans of prehistoric Greece. Pliny's statement (iii. 13, 19) that they were the most ancient race of Italy may certainly be rejected.

The process by which the Umbrians were deprived of their predominance in upper and central Italy and restricted to their confines of historic times cannot be traced in any detail. A tradition declares that their easternmost territory in the region of Ancona was wrested from them by the Picentes, a branch of the Sabine stock. It may also be conjectured that they were partly displaced in the valley of the Po by the Gaulish tribes which began to pour across the Alps from about 500 B.C. But their chief enemies were undoubtedly the Etruscans. These invaders, whose encroachments can be determined by archaeological evidence as proceeding from the western seaboard towards the north and east, and as lasting from about 700 to 500 B.C., eventually drove the Umbrians into that upland tract athwart the Apennines to which the name of Umbria belonged in historical times. In the course of this struggle the Etruscans are said to have captured 300 Umbrian towns. Nevertheless the Umbrian element of population does not seem to have been eradicated in the conquered districts. Strabo records a tradition that the Umbrians recovered their ground in the plain of the Po at the expense of the Etruscans, and states that the colonies subsequently founded in this region by the Romans contained large Umbrian contingents. In Etruria proper the persistence of the Umbrian stock is indicated by the survival of numerous Umbrian place-names, and by the record of Umbrian soldiers taking part in Etruscan enterprises, *e.g.* the attack on Cumae in 524 B.C. Indeed it is not unlikely that the bulk of the population in Etruria continued to be of Umbrian origin, and that the Romanization of this country was facilitated by the partial absorption of the Etruscan conquerors into the Umbrian multitude.

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[1] The geographers make this road go round by Vettona (mod. Bettona) between Tuder and Perusia, instead of following the more direct modern line.

Against the Romans the Umbrians never fought any wars of importance, a fact which may be explained partly by the remoteness of their position, but chiefly by the common hostility of the two nations to the Etruscans. After the downfall of the Etruscan power they made a belated attempt to aid their Samnite kinsmen in their decisive struggle against Rome (308 B.C.); but their communications with Samnium were impeded by the foundation of a Roman fortress at Narnia (298 B.C.), and at the great battle of Sentinum (295 B.C.), which was fought in their own territory, the Umbrians are not reported to have lent the Samnites any substantial help. It is perhaps on account of this defection that in 200 B.C. they received from the Romans a portion of the Ager Gallicus reconquered from the Senonian Gauls. They offered no opposition to the construction of the Via Flaminia through the heart of their country, and in the Second Punic War withheld all assistance from Hannibal. In the Social War (90–89 B.C.), they joined the rebels tardily and were among the first to make their peace with Rome. Henceforth the Umbrians no longer played an independent part in Italian history.

The material prosperity of Umbria, in spite of its unfavourable position for commercial intercourse, was relatively great, owing to the fertility of the numerous small valleys which intersect the Apennine system in this region. The chief products of the soil were olives, vines and spelt; the uplands harboured the choicest boars of Italy. In Pliny's time there still existed in Umbria 49 independent communities, and the abundance of inscriptions and the high proportion of recruits furnished to the imperial army attest its continued populousness. Among its most famous natives were the poets Plautus (b. at Sarsina) and Propertius (b. at Assisi).

Of the Umbrians' political and municipal organization little is known. In addition to the city (*tota*) they seem to have had a larger territorial division in the *tribus* (*trifu*, acc.) as we gather from Livy (xxxi. 2, "per Umbriam quam tribum Sapiniam vocant"; cf. xxxiii. 37) and from the Eugubine Tables ("trifor Tarsinates," vi. B. 54). Ancient authors describe the Umbrians as leading effeminate lives, and as closely resembling their Etruscan enemies in their habits (Theopompus, *Fragm.* 142; Pseudo-Scymnus, 366–368). It is almost certain that each race influenced and modified the other to a large extent. There is conclusive proof of strong Etruscan influences in Umbria. For instance, they undoubtedly borrowed their alphabet and the art of writing from the Etruscans. Their writing ran from right to left. The alphabet consisted of nineteen letters. It had no separate symbols for O, G, Q; the aspirates and X were wanting; on the other hand, it possessed forms for Z and V, and had likewise the Etruscan *f* (8). It also had a symbol peculiar to itself for expressing the sound of palatal *k* when followed by either *e* or *i*. The fact that it is only in towns on the side next Etruria, *e.g.* Tuder and Iguvium, that a coinage is found indicates that they borrowed the art of minting from that quarter. The Umbrians counted their day from noon to noon. But whether they borrowed this likewise from the Etruscans we do not know (Pliny ii. 77). In their measuring of land they employed the *vorsus*, a measure common to them and the Oscans (Frontinus, *De Limit.* p. 30), 3⅓ of which went to the Roman *jugerum*.

See Strabo bk. v.; T. E. Peet, *The Stone and Bronze Ages of Italy and Sicily* (Oxford, 1909), pp. 492–510; B. V. Head, *Historia numorum* (Oxford, 1887); B. Nissen, *Italische Landeskunde*; Bücheler, *Umbrica* (1883); R. S. Conway, *Italic Dialects*. (M. O. B. C.)

2. The modern territorial division is situated in the middle of the peninsula, between Tuscany and the Marches on the N. and E., and Rome and the Abruzzi on the S. and W., and comprising the one province of Perugia, with an area of 3748 sq. m.; pop. (1901), 675,352. Umbria and the two provinces of Ancona and Pesaro and Urbino taken together form an area slightly more extensive than that of the sixth region of Augustus. The surface is mountainous, but affords good pasture, and there are numerous fertile valleys. Many treasures of art and architecture are preserved, and Umbria is in this respect one of the most interesting regions of Italy (see PERUGIA). Modern Umbria formed down to 1860 a part of the States of the Church.

Two main lines of railway run through the territory. That from Florence to Rome skirts the borders of the province on the west, running north and south, while the Rome-Ancona runs across the province from north-east to south-west. The cross communication is given by three branch lines. In the north a narrow gauge line from Arezzo to Fossato passes through Gubbio. Perugia, the capital of the province, stands on the line from Terontola to Foligno, while on the extreme south a line passing through Rieti and Aquila, and ultimately reaching Sulmona, starts from Terni on the Rome-Ancona line. (T. As.)

UMFRAVILLE, the name of an English baronial family, derived from Amfreville in Normandy. Members of this family obtained lands in Northumberland, including Redesdale and Prudhoe, from the Norman kings, and a later member, Gilbert de Umfraville (d. 1245), married Matilda, daughter of Malcolm, earl of Angus, and obtained this Scottish earldom. Gilbert's son, Gilbert, earl of Angus (*c.* 1244–1307), took part in the fighting between Henry III. and his barons, and in the Scottish expeditions of Edward I. His son, Robert, earl of Angus (1277–1325), was taken prisoner by the Scots at Bannockburn, but was soon released, though he was deprived of the earldom of Angus and of his Scottish estates. His son and heir, Gilbert de Umfraville (1310–1381), claimed the earldom, which he hoped to gain by helping Edward Baliol to win the Scottish crown, but he failed, and on his death without issue the greater part of his English estates passed to his niece, Eleanor, the wife of Sir Henry Talboys (d. 1370), while others, including Redesdale, Harbottle and Otterbourne, came to his half-brother, Sir Thomas de Umfraville (d. 1386). Sir Thomas's son, another Sir Thomas de Umfraville (1362–1391), left a son, Gilbert de Umfraville (1390–1421), who fought on the Scottish border and in France under his warlike uncle, Sir Robert de Umfraville (d. 1436). Although not related in blood he appears to have inherited the estates in Lincolnshire of the Kyme family, and he was generally known as the earl of Kyme, though the title was never properly conferred upon him. In 1415 he fought at Agincourt; he was afterwards sent as an ambassador to Charles VI. of France, and arranged an alliance between the English and the Burgundians. He was killed at the battle of Baugé on the 22nd of March 1421. His heir was his uncle Sir Robert, who died on the 29th of January 1436, when the male line of the Umfraville family became extinct. The chronicler John Hardyng was for many years in the service of Sir Robert, and in his *Chronicle* he eulogizes various members of the family.

UMPIRE, the term used, like "referee," for a person appointed by consent to settle disputes arising between opposing parties, and particularly one chosen to see that the rules of a game are obeyed. The word itself stands for the Middle English *nompere* or *noumpere*, "a numpere" becoming "an umpire." The earlier form represents the Old French *nompere*, *nonpair*, *i.e.* not equal, odd. The Latin *impar*, unequal, was similarly used in the sense of "arbitrator."

UMRA KHAN, of Jandol (*c.* 1860–1903), a Pathan chief on the north-western frontier of India, who was chiefly responsible for the Chitral Campaign of 1895. He was the younger son of the khan of Jandol; but he killed his elder brother, seized the throne, and made himself a power on the frontier. In 1894 he held undisputed sway over almost the whole of Bajour, when his restless ambition caused him to interfere in the internal affairs of Chitral. He instigated Amir-ul-Mulk, a half-witted brother of the Chitral chief, to murder his brother Nizam-ul-Mulk, and then threw over the fratricide and supported the claims of his uncle Sher Afzul to the throne. The government of India intervened and ordered Umra Khan to leave Chitral. When he refused, the Chitral Expedition was despatched (see CHITRAL); Umra Khan was driven into exile in Afghanistan, and died there in 1903.

UNAO, a town and district of British India, in the Lucknow division of the United Provinces. The town is 10 m. N.E. of Cawnpore, on the Oudh and Rohilkhand railway. Pop. (1901), 13,109.

The DISTRICT OF UNAO has an area of 1792 sq. m. It consists of a flat alluvial plain, lying north of the Ganges. Rich and fertile tracts, studded with groves, alternate with stretches of waste land and plains of barren *usar*, the whole being intersected by small streams, used for irrigation. The Ganges is the only navigable river in the district, while the Sai forms its north-eastern boundary. The temperature varies from about 75° to 103° in the hot season and from 46° to 79° in the cold season. The annual rainfall averages about 35 in. Pop. (1901), 976,639, showing an increase of 2·4% in the decade. The principal crops are barley, wheat, pulses, rice and millets, with some cotton, sugar-cane and poppy. The district is crossed by the main line of the Oudh & Rohilkhand railway.

During the Mutiny of 1857–58 Unao was the scene of several severe engagements between General Havelock's little army and the rebels on his march to relieve Lucknow. On the death of Raja Jasa Singh, one of the leading rebels, and the capture of his two sons, the family estates were confiscated, and the villages either restored to their former owners or given to other landholders for their loyalty.

See *Unao District Gazetteer* (Allahabad, 1903).

UNCLE, the brother of a person's father or mother, also the husband of one's aunt (*i.e.* the sister of a father or mother) The French *oncle*, which appears in Anglo-French as *uncle*, comes from a Late Latin *unculus*, a shortened form of the Latin *avunculus*, a maternal uncle, the brother of one's mother. The word is a diminutive of *avus*, grandfather. The Latin for a paternal uncle is *patruus*. "Aunt" comes through the Old French *aunte*, *ante*, corrupted into the modern *tante*, from Latin *amita*, a father's sister, a paternal aunt, the maternal aunt being called *matertera*.

UNCTION (Lat. *unctio*, anointing, *ungere*, *unguere*, to smear with ointment, to anoint; cf. "ointment," O.Fr. *oignement*, from *oigner*, mod. *oindre*, to anoint), the act of pouring, or rubbing oil, ointment or salve over or on to a person or object. The term is particularly used of the ceremonial practice of anointing with oil or unguents (see ANOINTING). The sacrament of the anointing of the sick in the Roman church is treated under EXTREME UNCTION. The use of the term for religious fervour in speech has degenerated into its common meaning of exaggerated sentiment.

UNDER-CROFT, in architecture, a synonym for crypt (*q.v.*), a vaulted chamber under ground.

UNDERWRITER, one who insures ships and their cargoes from loss and damage, so called from his writing his name under the document or policy of insurance. A request to an underwriter to insure is termed the offering of a "risk," and the word risk in marine insurance is equivalent to the liability of an underwriter under a contract. When the risk is divided up among several underwriters, each signs his name individually, putting opposite thereto the amount for which he accepts liability. Each signature has the effect of making a separate contract, in the terms of the policy, for the amount set opposite the name of the underwriter. (See INSURANCE: *Marine.*)

UNEMPLOYMENT, a modern term for the state of being unemployed among the working-classes. The social question involved is intimately bound up with that of relief of the poor, and its earlier history is outlined in the article CHARITY AND CHARITIES. It is more particularly within the 20th century that the problem of unemployment has become specially insistent, not by reason of its greater intensity—for it is open to considerable doubt whether, comparatively speaking, there was not more unemployment in the organized industrial communities of the early middle ages—but because the greater facilities for publicity, the growth of industrial democracy, the more scientific methods applied to the solution of economic questions, the larger humanitarian spirit of the times all demand that remedies differing considerably from those of the past should at least be tried. In most civilized countries attempts have been made to solve this or that particular phase of the problem by improved methods. There is, however, always a great difficulty in knowing the extent of unemployment even in any one particular country. No census has ever been taken in any country of those of the whole population who were employed and unemployed on any particular day, and even if it were possible to take such a census modern conditions of industry might render its results valueless almost immediately after It would be complicated, too, by having of necessity to include the shiftless and unemployable sections of the population, as well as those on the borderland of employment (those who are worth some sort of wage in times of pressure), while at the same time it would be necessary, to make the census of practical value, to obtain returns of the demand for labour, in order to value the true character of the supply Such statistics are obtainable possibly only in theory, but every country makes an endeavour to obtain statistics of a sort. In England the Board of Trade, for example, has compiled valuable memoranda on the percentages of unemployment in the more important trade union groups of trades, which may be taken as a measure of unemployment in the more highly organized industries, while other memoranda throwing light on the subject deal with the amount of time lost by workpeople through want of employment and other causes; with cyclical trade depressions; the extent to which female labour has displaced adult male labour of late years; seasonal industries and industries carried on by casual labour, emigration and immigration, &c., all intimately bound up with the study of the problem. The statistics issued by the Labour Bureaus of many of the states in the United States are of considerable value, in particular, those of Massachusetts, New Jersey, New York, Connecticut and Wisconsin. Germany, France and Belgium also publish statistics, but like the figures of other countries, they far from represent the actual state of unemployment.

Causes of Unemployment.

The actual causes of unemployment in any one country will always remain to a certain extent controversial, as will the comparative weight to be assigned to each cause. Putting aside the much disputed theories of economists as to the causes of cyclical depressions of trade, there are certain well-observed facts which present themselves in connexion with the question of unemployment, and to each one of them some contributory portion of blame may be assigned. These facts may be classified as (*a*) those over which the worker has no control, and (*b*) those which may be said to lie in the worker himself. Some of those under (*a*), of which it is impossible to give more than the more obvious examples, have, of course, been operating, especially in the United Kingdom, sometimes potently, sometimes slowly and almost unnoticed, over a long range of years. They are seasonal industries and industries carried on by casual labour. There are many industries affected by certain states of the weather or by the changes of the seasons, as the building and allied trades, the furriers' trade, confectionery trades, &c. But more important are those industries which depend largely in times of pressure on casual and unskilled labour, such as port and riverside work of all kinds, construction works and to a certain extent the iron and steel industries. Then there are a number of skilled trades which have about them continually a fringe of casual labour, for which employment is very intermittent.

To quote from the report of the British Royal Commission on the Poor Laws (1909):—

> "The class of under-employed includes not merely the whole of the men in such occupations as dock and wharf labour and market porters, and a waxing and waning share of the lower grades of the building operations, but also a very extensive fringe of men more or less attached to particular industries, and working at them only by way of brief and casual jobs. "To go in" for one half-day, one day, two, three, four or five days out of the five and a half is common to bootmaking, coopering, galvanizing, tank-making, oil pressing, sugar boiling, piano-making, as it is to dock-labouring, stevedoring, crane-lifting, building. Some trades, like that of the London bakers, regularly employ more men on one or two days of the week than on others. In London a large body of men is always required for the Friday night baking when the work in preparation for Saturday and Sunday is, we are told, exceedingly heavy. The usual hours of

working are fifteen or sixteen instead of the ten of other nights and twice as many men are required. These Friday night men, many hundreds in number, pick up odd jobs the rest of the week. At the factory gates every night during the week, a number of men are always hanging about ready to be taken on in an emergency, or to fill the place of any man who, according to a very common custom, has "taken a night off." In busy marketing neighbourhoods, a whole class of butchers' assistants are engaged only for Fridays and Saturdays. Analogous arrangements exist in many other trades. Moreover, in every trade there are men whom the employer takes on only when he has a sudden and temporary press of business. They may be the "glut men" of the customs department or the Christmas hands of the post office. Every tramway undertaking, municipal or commercial, has its reserve of extra drivers, conductors, yard-men, washers, &c., who get a day's work now and then when they are wanted. At Liverpool, and indeed in all large towns, there is a whole class of casual carmen, who are taken on for the job as required."

Then there are the accidental circumstances which incidentally produce unemployment, such as the displacement of labour by the progress of invention and improvement. The example of the distress brought upon the hand-loom weavers by the invention of the power-loom is only one of many, but the process is continually going on. The change, for example, from horse carriages to motor cars has brought much unemployment in its train. Then there is the unemployment due to decaying or declining trades, brought about through a persistent falling off of the demand, or through some change of process or of fashion; the removal of an industry from one place to another, the displacement of adult labour by that of women and boys, the continuous migration of unskilled labour from the country to the towns, and the depression in general trade caused by the occurrence of something unforeseen, as war. Then too, there are to be added the numberless frictions of industrial life, all contributing their quota to unemployment, such as the bankruptcy of an employer, changes in management, the arbitrariness of a foreman, &c. There are also what may be termed the political causes of unemployment, which depend on the commercial policy of the nation, in so far as it adopts Free Trade or Protection.

Remedies for Unemployment.

Labour Exchanges.

Recognizing the existence of the problem of unemployment, and putting aside the possibility of knowing exactly its extent, we have to consider the remedies which have been advanced for its solution. These may be classified as temporary and permanent. Temporary expedients, whether in the nature of voluntary relief by individuals or organized societies, or on the larger scale of municipal or state organized relief works, more properly fall under the description of charity (see CHARITY AND CHARITIES). Two particular methods of permanent remedy, however, are especially favoured. The first of these is the establishment of a system of labour exchanges, national in character if possible, by which it is claimed that machinery would at once be set in motion for assisting that mobility which is so effective for the proper utilization of labour and which, even with the modern facilities for travel, labour so lacks at the present time. Labour exchanges would also, it is argued, facilitate the collection of data for the enumeration and classification of the unemployed. Labour exchanges have been long established in Germany. "There is a network of labour exchanges of various types. The most important . . . are the public and municipal exchanges. There are over 200 such, among the 700 odd exchanges, filling now 150,000 places a month, which report regularly to the imperial statistical officer. Practically there is a public general exchange in every town of over 50,000 inhabitants, and in a very large proportion of the smaller towns. Most of the public labour exchanges date from 1894 to 1896 or received a fresh impulse then" (Report of Commission on Poor Laws, 1909). The causes of the success of the German system of labour exchanges[1] are attributed by the Poor Law Commissioners to (*a*) the high standing given to the movement by the advocacy and practical assistance of all public authorities, town councils, state governments, imperial government, &c.; (*b*) the association through combined committees of employers and employees in the management of the exchanges; (*c*) the unequivocal character of the exchanges as industrial and not relief institutions; (*d*) the excellent arrangements for the use of telephonic, telegraphic and postal facilities by the exchanges, and (*e*) the preferential railway fares for men sent to a situation.

An attempt was made in England to start labour exchanges by the Labour Bureaux (London) Act 1902, which gave metropolitan boroughs power to establish and maintain bureaux, to be paid for out of the general rate. Before this act, however, certain municipalities here and there had made experiments in the way of exchanges, but they were never very successful, for they had no knowledge of what they intended to do; they were not properly staffed; they were hampered by bad rules; they were nearly all started in times of depression, exactly the wrong time to start a labour exchange, the time to start it being when trade is going up. The act of 1902 was a failure because it merely permitted, and did not compel borough councils to establish bureaux, and consequently only a very small part of the metropolis was covered, and there was no interchange of ideas amongst those established. However, a fresh attempt was made to establish exchanges over a greater part of the United Kingdom by the Labour Exchanges Act 1909. The Labour Exchanges Act defines a labour exchange as any office or place used for the purpose of collecting and furnishing information, either by the keeping of registers or otherwise, respecting employers who desire to engage workpeople and workpeople who seek engagement or employment. The act gave the Board of Trade power to establish and maintain labour exchanges in such places as they might think fit, and to collect and furnish information to employers and workpeople. An important provision of the act was the authorization of advances by way of loan towards meeting the expenses of workpeople travelling to places where employment is found for them through a labour exchange. The regulations of the exchanges provide that no person shall suffer any disqualification or be otherwise prejudiced on account of refusing to accept employment found for him through a labour exchange where the ground of refusal is that a trade dispute which affects his trade exists, or that the wages offered are lower than those current in the trade in the district where the employment is found. The act also empowers the Board of Trade to establish advisory committees in connexion with the exchanges and imposes penalties for making false statements for the purpose of obtaining employment or procuring workpeople. For the carrying out of the act the whole of the United Kingdom was mapped out into divisions, with a divisional inspector at the head of each. In all the more important towns of each division exchanges were established, classified according to the population of the town. All the exchanges are in telephonic communication either with each other or with a divisional clearing-house, the divisional clearing-house in turn being in communication with a central clearing-house in London. The advantage of the English system of labour exchanges will be found in the fact that it is a national system, with the support of the state behind it. Unless, as has been proposed, it is made compulsory in all large trades, much of its success will depend on the patronage extended to it by employers, which in its turn must be justified by the efficiency of the service rendered. Patronage by government and municipal authorities, while making an imposing addition to the returns of situations found, will not necessarily be an effective guarantee that the true objects of the exchanges are being fulfilled.

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[1] The German system of labour exchanges is exhaustively dealt with in *Report to the Board of Trade on Agencies and Methods for Dealing with the Unemployed in certain Foreign Countries*, by D. F. Schloss (1904).

The German labour registries are of seven principal types: the private registry office, maintained by ordinary agents for purposes of gain, and occupying itself chiefly with the placing of domestic servants; the travellers' homes and relief stations, which endeavour to find situations for their inmates—their success is not great, as the better elements of the labouring classes avoid them; trade union registries maintained by trade unions to assist their members in obtaining employment; gild labour registries or associations of employers (mainly small employers) for the promotion of the interests of the trade in which they are engaged; agricultural labour registries maintained in different parts of Germany by the chambers of agriculture; employers' labour registries, established as a countermove against the trade union registries—they are chiefly in industries employing large capital, particularly the metal industries; and public labour registries, established either by voluntary associations or by municipalities. These latter have been very successful and have provided the model for the English registries. In Austria labour registries have also been established on the German model by many district and municipal authorities, those of Vienna and Prague being especially successful. Switzerland has a few registries established by public authorities, notably those at Basel, Bern, Schaffhausen and Zurich. In Belgium there are a considerable number of public registries, some established by associations, some philanthropic, some political, some organized by employers, some by employees, some jointly by employers and employed. Some of these registries are in receipt of subventions granted by municipalities, while in a few cases the municipalities themselves have started registries. In France labour registries are of many types. There are the ordinary registry offices, carried on for gain, and requiring a licence from the municipal authorities. They are very numerous and according to returns to the French Labour Department fill over 1,000,000 situations yearly in various occupations. There are also registries maintained by trade gilds, by individual trade unions, by a number of trade unions jointly, by joint associations of employers and employed, by associations of employers, by friendly societies, by philanthropic institutions and by municipalities. These last are being rapidly increased, and will without doubt eventually supersede all the others. In the United States the states of Colorado, Connecticut, Illinois, Kansas, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, Ohio, West Virginia and Wisconsin have established free public employment offices, and in many of the other states the private registries are under strict supervision and licensing.

Insurance against Unemployment.

The second permanent remedy is that of insurance against unemployment. Certain schemes have been tried in Switzerland, notably the voluntary municipal scheme of Berne, the compulsory municipal scheme of St Gall and a trade union scheme at Basel,[1] while there is in Germany a system of insurance against sickness, accident and incapacity (see GERMANY). Much attention has been devoted in England to the possibilities of insurance against unemployment, and in 1910 a scheme was being worked out by the government with a view to its discussion by parliament in 1911. The lines on which such a scheme must work were clearly laid down by Sir H. Llewellyn Smith, the permanent secretary to the Board of Trade, in his presidential address to the Economic Science and Statistics section of the British Association at Sheffield in September 1910.

"The crucial question from a practical point of view," said Sir H. Llewellyn Smith, "is whether it is possible to devise a scheme of insurance which, while nominally covering unemployment due to all causes other than those which can be definitely excluded, shall automatically discriminate as between the classes of unemployment for which insurance is or is not an appropriate remedy. We can advance a step towards answering this crucial question by enumerating some of the essential characteristics of any unemployment insurance scheme which seem to follow directly or by necessary implication from the conditions of the problem as here laid down.

"1. The scheme must be compulsory; otherwise the bad personal risks against which we must always be on our guard would be certain to predominate.

"2. The scheme must be contributory, for only by exacting rigorously as a necessary qualification for benefit that a sufficient number of weeks' contribution shall have been paid by each recipient can we possibly hope to put limits on the exceptionally bad risks.

"3. With the same object in view there must be a maximum limit to the amount of benefit which can be drawn, both absolutely and in relation to the amount of contribution paid; or, in other words, we must in some way or other secure that the number of weeks for which a workman contributes should bear some relation to his claim upon the fund. Armed with this double weapon of a maximum limit to benefit and of a minimum contribution, the operation of the scheme itself will automatically exclude the loafer.

"4. The scheme must avoid encouraging unemployment, and for this purpose it is essential that the rate of unemployment benefit payable shall be relatively low. It would be fatal to any scheme to offer compensation for unemployment at a rate approximating to that of ordinary wages.

"5. For the same reason it is essential to enlist the interest of all those engaged in the insured trades, whether as employers or as workmen, in reducing unemployment, by associating them with the scheme both as regards contribution and management.

"6. As it appears on examination that some trades are more suitable to be dealt with by insurance than others, either because the unemployment in these trades contains a large insurable element, or because it takes the form of total discharge rather than short time, or for other reasons, it follows that, for the scheme to have the best chance of success, it should be based upon the trade group, and should at the outset be partial in operation.

"7. The group of trades to which the scheme is to be applied must, however, be a large one, and must extend throughout the United Kingdom, as it is essential that industrial mobility as between occupations and districts should not be unduly checked.

"8. A state subvention and guarantee will be necessary, in addition to contributions from the trades affected, in order to give the necessary stability and security, and also in order to justify the amount of state control that will be necessary.

"9. The scheme must aim at encouraging the regular employer and workman, and discriminating against casual engagements. Otherwise it will be subject to the criticism of placing an undue burden on the regular for the benefit of the irregular members of the trade.

"10. The scheme must not act as a discouragement to voluntary provision for unemployment, and for that purpose some well-devised plan of co-operation is essential between the state organization and the voluntary associations which at present provide unemployed benefit for their members. Our analysis, therefore, leads us step by step to the contemplation of a national contributory scheme of insurance, universal in its operation within the limits of a large group of trades—a group so far as possible self-contained and carefully selected as favourable for the experiment, the funds being derived from compulsory contributions from all those engaged in these trades, with a subsidy and guarantee from the state, and the rules relating to benefit being so devised as to discriminate effectively against unemployment which is mainly due to personal defects, while giving a substantial allowance to those whose unemployment results from industrial causes beyond the control of the individual. Is such a scheme practicable? This is a question partly actuarial, partly administrative, and partly political. I may say that so far as can be judged from such data as exist (and those data are admittedly imperfect and rest on a somewhat narrow basis) a scheme framed on the lines I have indicated is actuarially possible, at least for such a group of trades as building, engineering and shipbuilding."

In addition to insurance against unemployment by the state, there are various voluntary associations, such as friendly societies and trade unions, which make a feature of grants to their members when out of employment.

In September 1910 the first International Conference on Unemployment was convened in Paris, the subjects of statistics of unemployment, labour registries and state insurance being the chief topics. The outcome of the conference was the formation of a society to study all phases of the problem, and to keep in touch with public and private bodies and the various governments.

AUTHORITIES.—*Report* of Royal Commission on Labour (1894); *Report* of House of Commons Committee on Distress from Want of Employment (1895); *Report* of Royal Commission on Poor Laws (1909); *Report* of the Massachusetts Board to Investigate the Subject of the Unemployed. The following recent books will be found useful. P Alden, *The Unemployed* (1905); W H. Beveridge, *Unemployment. A Problem of Industry* (1909). N. B. Dearle, *Problems of Unemployment in the London Building Trades* (1909); J A. Hobson, *The Problem of the Unemployed* (1904). F. W. Lewis, *State Insurance a Social and Industrial Need* (1909); D. F. Schloss, *Insurance Against Unemployment* (1909); F. I. Taylor, *A Bibliography of Unemployment and the Unemployed* (1909). (T. A. I.)

UNGAVA, an unorganized territory of the Dominion of Canada, including the north-western side of the peninsula of Labrador (*q.v.*), bounded by Hudson Bay on the W. as far S. as East Main River; Hudson Strait and Ungava Bay on the N.; and with indefinite boundaries toward Quebec on the S., and the coast strip of Labrador belonging to Newfoundland on the E. The area is estimated at 354,961 sq. m. Ungava includes much of the lower portion of Labrador, with a rim of recent marine deposits along its western coast, but the interior has the usual character of low rocky hills of Archean rocks, especially granite and gneiss, with a long band of little disturbed iron-bearing rocks, resembling the Animikie, or Upper Huronian of the Lake Superior region. near its eastern

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[1] For a detailed description of these schemes see G. Schanz, *Zur Frage der Arbeitslosen-Versicherung* (Bamberg, 1895); *Neue Beiträge sur Frage der Arbeitslosen-Versicherung* (Berlin, 1897); and *Dritter Beitrag sur Frage der Arbeitslosen-Versicherung und der Bekämpfung der Arbeitslosigkeit* (Berlin, 1901).

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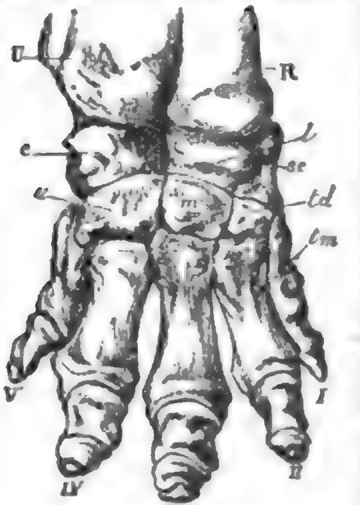
side. Along Hudson Bay shore there is a strip of similar rocks, and a long row of small islands of the same age, with great sheets of trap or diabase forming the tops of the hills. The iron formation is widely spread. There is evidence that Ungava, like the rest of Labrador, has risen several hundred feet since the Ice Age, marine beaches being found up to 700 ft. on the Hudson Bay side; and it is interesting to find seals like those of the adjoining seacoasts in the Seal Lakes 100 m. inland and 800 ft. above the present sea-level. Owing to its northerly position a large part of Ungava is treeless, and belongs to the barren grounds where caribou roam and feed on the so-called caribou moss, a greyish lichen.

UNGULATA, the name of an order of placental mammals in which the terminal joints of the toes are usually encased in solid hoofs or covered with broad hoof-like nails, while the molar (and not unfrequently some or all of the premolar) teeth have broad tuberculated crowns adapted for crushing vegetable substances. The teeth (when all are present) are differentiated into the usual four series; and milk-teeth, not completely discarded till the full stature is attained, are invariably developed. All the existing members of the group are eminently adapted for a terrestrial life, and in the main for a vegetable diet. Though a few may in some circumstances kill living creatures smaller than themselves for food, none are habitually predaceous. In none of the existing, and in but few of the extinct types, are collar-bones, or clavicles, developed; and the scaphoid and lunar bones of the carpus are separate. The typical ungulates are the members of the suborders ARTIODACTYLA and PERISSODACTYLA (*q.v.*), in both of which the bones of the foot articulate with each other by means of groove-and-tongue joints, whence the name of Diplarthra (equivalent to Ungulata Vera), which has been proposed for these two groups collectively, as distinct from the other representatives of the order. The remaining and less typical subordinal groups—sometimes ranked as orders by themselves—include among living animals the Proboscidea, or elephants, and the Hyracoidea, or hyraxes, and among extinct groups the Amblypoda, Ancylopoda, Barypoda, Condylarthra, Litopterna and Toxodontia. The characteristics of these groups will be found under their respective headings, with the exception of the Barypoda and Condylarthra, for which see ARSINOITHERIUM and PHENACODUS.

In the great majority of the Subungulata the bones of the upper and lower rows of the wrist-joint, or carpus, retain the primitive or more typical relation to each other (see fig., and contrast with PERISSODACTYLA, fig. 1); the os magnum of the second row articulating mainly with the lunar of the first, or with the cuneiform, but not with the scaphoid. On the other hand in the Diplarthra, the group to which the vast majority of modern Ungulates belong, the second or lower row has been shifted altogether towards the inner side of the limb, so that the magnum is brought considerably into relation with the scaphoid, and is entirely removed from the cuneiform, as in most existing mammals.



Right Fore Foot of Indian Elephant

U, ulna; *R*, radius; *c*, cuneiform; *l*, lunar; *sc*, scaphoid; *u*, unciform; *m*, magnum; *td*, trapezoid; *tm*, trapezium; *I* to *V*, first to fifth digit.

In the typical Ungulata or Diplarthra, the feet are never plantigrade, and the functional toes do not exceed four—the inner digit being suppressed, at all events in all forms which have existed since the Early Eocene period. The os magnum of the carpus articulates freely with the scaphoid. The allantois is largely developed, and the placenta, so far as known, is nondeciduate, the chorionic villi being either evenly diffused or collected in groups or cotyledons (in Pecora). The testes descend into a scrotum. There is never an os penis. The uterus is bicornuate. The teats are usually few, and inguinal, but may be numerous and abdominal (as in Suina), although they are never solely pectoral. The cerebral hemispheres in existing Ungulates are well convoluted. (R. L.*)

UNICORN (Lat. *unicornis*, for Gr. *μονόκερως*, having one horn; Fr. *licorne*; Ital. *alicorno*), a fabulous beast, usually having the head and body of a horse, the hind legs of an antelope, the tail of a lion (sometimes horse's tail), sometimes the beard of a goat, and as its chief feature a long, sharp, twisted horn, similar to the narwhal's tusk, set in the middle of its forehead. The earliest description is that of Ctesias, who (*Indica opera*, ed. Baehr, p. 254) states that there were in India white wild asses celebrated for their fleetness of foot, having on the forehead a horn a cubit and a half in length, coloured white, red and black; from the horn were made drinking cups which were a preventive of poisoning. Aristotle mentions (*Hist. anim.* ii. 1; *De part. anim.* iii. 2) two one-horned animals, the oryx, a kind of antelope, and "the so-called Indian ass." In Roman times Pliny (*N.H.* viii. 30; xi. 106) mentions the oryx, the Indian ass, and an Indian ox as one-horned; Aelian (*De nat. anim.* iii. 41; iv. 52), quoting Ctesias, adds that India produces also a one-horned horse, and says (xvi. 20) that the *Monoceros* was sometimes called *Carcasonon*, which may be a form of the Arabic *Carcadān*, meaning rhinoceros (see Rev. W. Haughton, "On the Unicorn of the Ancients," in *Annals and Mag. of Natural History* for 1862, p. 363). Strabo (*lib.* xv.) says that in India there were one-horned horses with stag-like heads. The origin of all these statements is probably to be found partly in the rhinoceros, which was well known to the ancients, and partly in the narwhal, specimens of the long tusk of which were probably brought home by travellers. The theory of a one-horned oryx would probably be drawn from the remembrance of a passing glimpse of an antelope in silhouette, or even of one which had broken one horn off short in fighting, and E. Schrader (*Sitzungsberichte d. kgl. preuss. Akad. zu Berlin*, 1892, pp. 573-581, and pl. 5) traces the idea of a one-horned ox to the sculptures of Persepolis and other places, which Ctesias would probably have seen, in which the ox, represented in silhouette, has apparently only one horn. As India became better known, and it was realized that the unicorn was not found there, its place of abode was changed to Africa.

The medieval conception of the unicorn as possessing great strength and fierceness may have been partly due to the fact that in certain passages of the Old Testament (*e.g.* Num. xxiii. 22; Deut. xxxiii. 17; Job xxxix. 9-10) the Hebrew word *R'ēm*, now translated in the Revised Version "wild ox," was translated in the Septuagint *μονόκερως*, in the Vulgate *unicornis* or *rhinoceros*, and in the Authorised Version "unicorn," though in Deut. xxxiii. 17 it obviously refers to a two-horned animal. The early commentators applied to this beast the classical attributes of the *μονόκερως* (*e.g.* Isidore xii. 2, 12 tells how the unicorn has been known to worst the elephant in combat). There is also the passage in Aelian xvi. 20 which says that though as a rule savage and quarrelsome, even with females, the unicorn at mating time becomes very gentle to his mate, which is supposed to have given rise to the medieval idea that the unicorn is subdued to gentleness at the sight of a virgin, and will come and lay his head in her lap, which is the only means by which he can be caught on account of his swiftness and ferocity. This story is illustrated in the tapestry figured in Plate II. Fig. 10 of EMBROIDERY, also on Pisanello's medal of Cecilia Gonzaga (see J. de Foville, *Pisanello et les médailleurs italiens*, 1909, p. 40), on the reverse of which is a young girl with a unicorn lying by her side, the unicorn here being represented as a beautiful long-haired goat, with the long horn in the middle of his brow. The idea was widely spread in the middle ages, and Lauchert (*Geschichte des Physiologus*, 1889) gives instances of its allegorical use, as typical not only of Christ and the Virgin, but also of the softening influence of love upon the fiercest of men, and a symbol of purity. As a decoration of drinking cups it symbolized the ancient belief in the efficacy of the unicorn's horn against poison, which in England remained even in the time of Charles II., though Sir E. Ray Lankester (*Science from an Easy Chair*, London, 1910, p. 127) mentions that a cup made of rhinoceros horn was then handed over to the Royal Society for experiment, with the result of entirely disproving the superstition. In the court ceremonial of France as late as 1789 instruments of "unicorn's" horn were still used for testing the royal food for poison. So-called unicorns' horns, or articles made of unicorn's horn, have always been sought after as "curiosities"; some of them, like the cup mentioned above, were of rhinoceros horn; others, like the horn seen at Windsor by Heutzner, a German traveller, in 1598 (see E. Phipson, *Animal-lore of Shakespeare's Time*, p. 456), were probably narwhals' tusks. Another medieval legend about the unicorn is that when it stooped to drink from a pool its horn, dipping into the water, purified and rendered it sweet. The traditional rivalry of the lion and the unicorn, which is generally considered to date at earliest from the Union of England and Scotland, when the lion and the unicorn appeared as the supporters of the royal arms, is referred to, curiously enough, in Spenser's *Faery Queene*, ii. 5.

In heraldry the unicorn was sometimes used as a device (see HERALDRY, where two English families are enumerated who used the unicorn on their arms), but more frequently as a supporter, and subsists to the present day as the left-hand supporter of the royal arms. This position it assumed at the Union, the Scottish royal arms having previously been supported by two unicorns. The origin of these is uncertain. The unicorn first appears (*c* 1480), as a single supporter, on two gold coins of James III. of Scotland, hence known as "unicorns" and "half-unicorns" (see Lindsay, *Coinage of Scotland*, pp. 135–137 and plate xiii. figs. 22–27). It is represented in a sitting posture, having round its neck a crown, to which is attached a chain and ring, and holding the shield between its front feet. Seton (*Law and Practice of Heraldry in Scotland*, Edinburgh, 1863, p. 274, foot-note) suggests that the unicorn as a supporter may have been introduced into Scotland by the marriage of James I. with Jane Beaufort, the Beauforts as dukes of Somerset having used it as such.[1] However this may be, the unicorn became established by the end of the 15th century. J. A. Smith in "Notes on Melrose Abbey" (*Proceedings of Society of Antiquaries of Scotland*, ii. 257) describes a table dated 1505 on which are sculptured the royal arms supported by two unicorns. The royal arms are also supported by unicorns on the Great Seals of Scotland from the time of Queen Mary onwards (see Anderson, *Diplomata Scotiae*, plate lxxxviii. xc. xci.). At the Union, when the unicorn became a supporter of the royal arms both of England and Scotland, a royal crown was added on the head of the unicorn, in addition to the crown with chain and ring round its neck (see Great Seal of James I. and VI. in Anderson, pl. xciii.), but this crown was removed after the Hanoverian succession. In England after the Union the unicorn became the left-hand supporter, but in Scotland, as late as 1766, it was still put on the right (Seton, p. 442), and Scotland displayed great reluctance to alter this, or to remove the crown from the head of the unicorn. Seton tells us how in 1853 a petition was made in favour, among other things, of retaining the crown on the unicorn, but without success. The rule, however, that the unicorn is to be the left-hand supporter, uncrowned, is still sometimes ignored, and Seton states (1863) that in the case of seals, such as that of the Board of Manufactures, which bear the Scottish arms alone, the two unicorns are still kept as supporters.

AUTHORITIES.—There are many treatises on the unicorn and other fabulous beasts, from the 16th century onwards. Of these, good bibliographies are given by Drexler, *s.v. Monokeros*, in Roscher's *Lexicon*, and by Rev. W. Haughton in *Annals and Magazine of Natural History* for 1862, p. 363, "On the Unicorn of the Ancients."
(C. B. P.)

UNIFORMS. The word "uniform" (Lat. *unus*, one, and *forma*, form), meaning adjectively homogeneous, is specifically used as a substantive for the distinctive naval and military dress, which serves, in its various styles, to give homogeneity to the several services, regiments and ranks. Although in ancient history we occasionally meet with uniformed soldiers, such as the white and crimson Spanish regiments of Hannibal, it was not until the beginning of large standing armies that uniforms were introduced in modern times. Before this, armed bodies were of two sorts, retainers and mercenaries, and while the former often wore their master's livery, the latter were dressed each according to his own taste or means. The absence of uniforms accounts very largely for the significance attached to the colours and standards, which alone formed rallying points for the soldier and his comrades, and thus acquired the sacred character which they have since possessed. A man who left the colours wandered into the terrifying unknown, for there was nothing to distinguish friend and foe. Even if the generals had ordered the men to wear some improvised badge such as a sprig of leaves, or the shirt outside the coat, such badges as these were easily lost or taken off. The next step in advance was a scarf of uniform colour, such as it is supposed was worn by the "green," "yellow" and other similarly-named brigades of the Swedish army under Gustavus Adolphus. This too was easily removed, as in the example of the squire who at Edgehill put on the orange scarf of the parliamentarians and with no more elaborate disguise succeeded in recapturing the lost royal standard from the hands of Essex's own secretary. By this time, in France at least, the general character of the clothes and accoutrements to be worn on various occasions was strictly regulated by orders. But uniformity of clothing was not to be expected so long as the "enlistment" system prevailed and soldiers came and went, were taken in and dismissed, at the beginning and end of every campaign. The beginnings of uniform are therefore to be found in truly national armies, in the *Indelta* of Gustavus, and the English armies of the Great Rebellion. In the earlier years of the latter, though the richer colonels uniformed their men (as, for instance, the marquess of Newcastle's "Whitecoats" and the king's own "Bluecoats"), the rustics and the citizens turned out for war in their ordinary rough clothes, donning armour and sword-belt. But in 1645 the parliament raised an army "all its own" for permanent service, and the colonels became officials rather than proprietors. The "new model" was clothed in the civilian costume of the date—ample coat, waistcoat, breeches, stockings and shoes (in the case of cavalry, boots)—but with the distinctive colour throughout the army of red and with regimental facings of various colours. The breeches were grey. Soon afterwards the helmet disappeared, and its place was taken by a grey broad-brimmed hat. From the coat was evolved the tunic of to-day, and the hat became the cocked hat of a later generation, which has never altogether disappeared, and has indeed reverted to its original form in the now familiar "slouch-hat."

For service in Ireland the red coat was exchanged for one of russet colour, just as scarlet gave way to khaki for Indian service in the 19th century. The cavalry, however, wore buff leather coats and armour long after the infantry had abandoned them; the Austrians (see Plate I., line 1, No. 2), on account of their Turkish wars, retained them longer than any.

Thus the principle ever since followed—uniform coat and variegated facings—was established. Little or nothing of sentiment led to this. By choice or convenience the majority of the corps out of which the new model was formed had come to be dressed in red, with facings according to the colonel's taste, and it is a curious fact that in Austria sixty years afterwards events took the same course. The colonels there uniforming their men as they saw fit, had by tacit consent, probably to obtain "wholesale" prices, agreed upon a serviceable colour (pearl grey), and when in 1707 Prince Eugene procured the issue of uniform regulations, few line regiments had to be reclothed. The preferences of the colonel were exhibited in the colour of the facings (Plate I., line 1, fig. 3). In France, as in England and Austria, the cavalry, as yet rather led by the wealthy classes than officered by the professional, was not uniformed upon an army system until after the infantry. But in 1688 six-sevenths of the French cavalry was uniformed in light grey with red facings; and about half the dragoon regiments had red uniforms and blue facings. Louvois, in creating a standing army, had introduced an infantry uniform as a necessary consequence. The native French regiments had light grey coats, the Swiss red, the German black and the Italian blue, with various facings. The French grey was probably decided upon, like the Austrian grey, as being a good "service" colour, which could be cheaply manufactured (Plate I., line 1, fig. 1). Both these greys, however, refined themselves in course of time into white.

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[1] Willement, *Regal Heraldry*, p. 70, says that it was also so used by Anne Boleyn and by the earls of Hertford.

The hat and the long coat and breeches remained the uniform of line infantry almost everywhere up to the advent of the shako and the coatee about 1790–1820. The gradual evolution of these two garments, from the comfortable civilian clothes of 1690 to the stiff, precise military garments of 1790, can be traced in a few words. The brim of the felt hat was first looped up on one side for convenience, then, for appearance' sake, on the other, and so became the three-cornered cocked hat, fringed with feathers, lace or braid, of Marlborough's wars.[1] Then came the fashion of looping up before and behind, which produced the hat called the "Khevenhüller," or the broadside-on cocked hat. Lastly, came the purely decorative, lace-looped "fore-and-aft" pattern, as worn in many states to-day. But before this came into vogue the cocked hat had practically disappeared from the ordinary ranks of all armies. It may be said that so long as the cocked hat survived in its simple, rank-and-file form, uniforms retained much of their looseness. Though the long skirts that rendered great coats unnecessary were looped back, and the ample cuffs of Marlborough's time were becoming narrower until they were at last sewn down to the sleeve, yet the military costume was in all essentials the civil costume of the time—long coat, hat, sleeved waistcoat, breeches and gaiters.

But other influences were at work. The principal was the introduction into armies of Slavonic irregulars, which tended to restrict line infantry and cavalry to parade drill and to pitched battles in parade order. This, and their complete separation from the civil population, stiffened their costume until it became "soldierly." Frederick the Great, indeed, could not have developed the infantry fire power that he needed if his soldiers had had tight sleeves, but in his old age the evil of sacrificing comfort to smartness attained a height which, except in the 1820–1840 period, was never surpassed. The figure of a Prussian fusilier, Plate I. line 2, No. 1 (in which by mistake a slung sword is shown) shows this process beginning. The stock has made its appearance, soon to stiffen into a cloth collar, under which, as if it were not already tight enough, another stock in due course came to be worn. The flapped cuffs, shown in the British figure No. 5, have become plain round cuffs, above which are embroidery stripes and buttons which at one time laced the flaps of the cuff together and now survive as the "guard-stripe." This may be called the first instance of the dummy adornments, which are so marked in modern full-dress uniforms. Similarly the former cloth turnback on the front of the coat has even in 1756 been cut off, the buttons and embroidered loops that retained it being kept as decorations.

Many of these specially military adornments were borrowed from the national costumes of the irregulars themselves. Their head-gear in particular drove out the cocked hat. The grenadier cap, now a towering bearskin, was its first successful rival, the shako the next. The grenadier cap was, in the first instance, a limp conical cap (identical with the hussar cap), edged with fur and having a tassel at the end. Soon the fur became more prominent in the front, and the tail disappeared. Then the cloth mitre-cap (Plate I., line 1, fig. 6) appeared. This was originally a field-service cap, with ear-flaps and sunshade. But it stiffened about 1775 into a fur cap of the same shape (with which sometimes the old cloth tail is found), and this in turn evolved, through the fuller but still narrow and forward-pointing bearskin of Peninsular days, into the great fur cap of grenadiers and fusiliers of the present time. The mitre-shaped cloth cap survives in a few Russian and Prussian regiments. As early as 1755, as the Prussian figure shows, a conical leather cap with a large brass plate in front had come into existence. This held its ground for some time, and the grenadier cap of to-day in Russia and Prussia is a metal copy of the mitre field-service cap itself. A curious derivative of the low fur cap with a peak in front and a bag-tail behind worn by some 17th- and 18th-century grenadiers is the head-dress of the Russian horse-grenadiers. The peak has become the helmet, the fur a "sausage" across the cap from ear to ear, and the back part of the helmet is covered by the bag-tail.

The Hungarian hussars introduced the jacket and the busby. The latter was originally a conical cap with fur edge, but the fur became higher until there was nothing left of the cap but the ornamental "busby-bag" of to-day. It would appear also as if the hussars brought the shako to western Europe. This is a conical, bell-topped, or cylindrical head-dress of stiff material, commonly leather. Its prototype, the tall cylindrical cap of the 18th-century hussars, was tilted on one side and wound round with a very narrow bag-tail, the last few inches of which, adorned with a tassel, hung down. But the shako itself succeeded, as nothing else succeeded, in being accepted by line infantry and cavalry, and after passing through numerous forms it remains in every army to-day, either as a low rigid cap (Germany, England and Austria), a stiffened or limp képi (France and Italy), or the flat-topped peaked cap which is the most common military head-dress of modern Europe.

All these adjuncts came in the first place from the national costume of imported auxiliaries. So also did the lancer cap, which, originally the Polish czapka, was a cylindrical cap, the upper part of which could be pushed up or down after the fashion of a bellows or accordion, with a square top. The original form is seen in Plate I., line 2, fig. 6, and the stiffened development of it in Plate II., line 1, fig. 5. The British lancer cap (Plate III., line 1, No. 2) has still a full middle portion, but in Austria and Germany this has dwindled to a very narrow neck (Plate IV., line 1, No. 7; Plate VII., line 1, No. 7). The line infantry and cavalry coat, full-skirted in the first instance, retained its original length until about 1780, but from that time onwards (probably in most cases in the interests of the colonel's pocket) it becomes little by little, shorter and scantier (Plate I., line 2, Nos. 4, 5, and Plate II., line 1, No. 1), until at last it is a "coatee," not as long as the present-day tunic (Plate II., line 1, Nos. 2 and 4), or a swallow-tailed coat (Plate II., line 1, figs. 5, 6; line 2, No. 1). This, of course, did away with the protection afforded by the full skirt, and necessitated the introduction of the great coat, which even to-day in some cases is worn, without the tunic, over the "vest" that represents the sleeved waistcoat (Plate III., line 2, No. 6), formerly worn under the long skirted coat. The white breeches and gaiters, retained to the last, gradually gave way to trousers and ankle boots in 1800–1820.

Meanwhile another form of head-dress, which was purely military and owed nothing to Poland or Hungary, came into vogue. This was the helmet, which had disappeared from the infantry about 1650–1670, and the cavalry thirty years afterwards. It took two forms, both of which possessed some of the characteristics of ancient Greek and Roman helmets. These were a small helmet with sausage-shaped ornament from front to back, worn chiefly by British light dragoons and artillery (Plate II., line 1, fig. 3), and the towering crested helmet worn by the French, British and Austrians. The French cuirassiers and dragoons (Plate I., line 2, No. 5) had, and still have, long horsehair tails dependent from the crest. The Austrian infantry helmet, worn with the white coat, similar to, but smaller than, that shown in Plate IV., line 1, No. 1, had no ornament, but the British heavy cavalry helmet (Plate II., line 1, No. 4) resembled that of the French. To-day, besides the French, the Austrian dragoons and Italian heavy cavalry have this form of helmet (Plate IV., line 2, No. 5, and Plate VIII., line 1, No. 3).

It has been said above that the coatee and the shako are the principal novelties in European military costumes of Napoleon's time. To these should be added the replacement of the gaitered breeches by trousers, and the adoption of hussar and lancer uniforms of ever-growing sumptuousness, in which the comfort that had originally belonged to these national irregular costumes was entirely sacrificed. After Waterloo, indeed, all traces of the old-fashioned coat disappeared, and, except for the doubtful gain of tight-fitting "overalls," the soldier was more showy and worse off in comfort and convenience than ever before or since. One or two examples may be quoted. In George IV.'s time the coatees of the lifeguards were so tight that the men were unable to perform their sword exercise, and their crested helmet, surmounted by a "sausage" ornament, was so high that the sword could not be raised for a downward blow. The total height of the lancer cap with its plume (Plate II., line 1, No. 5) was about an arm's length, and prints exist showing British lancers in a cap of which the square top is very nearly as broad as the wearer's shoulders. The hussar furred pelisse, originally worn over a jacket (Plate I., line 1, fig. 4), and so worn by the Austrians to-day, had become a magnificently embroidered and laced garment, always slung and never worn, and the old plain under-jacket had been loaded with buttons and lace, and differed from the pelisse only in the absence of fur. It was the Restoration era, too, that delighted to decorate uniforms with sewn-down imitations of the skirt pockets, turn-back cuffs, &c., of the old coat. This was, in short, the epoch of pure dandyism, and although some of its wilder extravagances were abolished between 1830 and 1850, enough still remained when the British army took the field in the Crimea to bring about a sudden and violent reaction, in which the slovenliest dress was accounted the best. The dress regulations of 1855 introduced the low "Albert" shako and the tunic, abolished the epaulette—an ornament which had grown in the 18th century out of a shoulder cord that kept the belts in place and was decorated at the outer end with a few loose strands or tassels of embroidery—and made other changes which, without bringing back uniform to its original roominess and comfort, destroyed not only the dandyism of George IV.'s time, but also the chastened finery of the Early Victorian uniforms (Plate II., line 2, No. 5).

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[1] In the cavalry an iron-framed skull-cap was often worn under the cocked hat

The tunic, accompanied by a spiked helmet of burgonet shape, had been introduced in Prussia and Russia about 1835. Russia was too poor to allow extravagance in dress, and Russians, clothed as they generally were in their great coats, had little incentive to aim at futile splendour. Both countries, however, and France and Austria likewise, passed through a period of tight, if unadorned, uniforms, before Algeria, Italy, and similar experiences brought about the abandonment of the swallow-tailed coatee. The French adopted the tunic in 1853, the Austrians in 1856, and in both countries the shako became smaller and lighter. From about 1880, when the spiked helmet replaced the low shako in England, no radical changes were made in full dress uniforms, except that the Russian army, abandoning the German pattern uniforms formerly in vogue, adopted a national uniform which is simple, roomy, and exceedingly plain, even in full dress. In 1906–1909, however, this attempt to combine handsomeness and comfort was given up, full dresses being made more decorative, and light green-grey service dresses being introduced. Lastly, since the South African War and the development of infantry fire, the attempt to wear full dress uniform on active service has been practically given up. Great Britain first of all adopted the Indian khaki, and then a drab mixture for "service dress" and returned, after 150 years, to the civilian style of field dress, adopting the "Norfolk jacket" or shooting coat with spinal pleat and roomy pockets. Germany, Italy, the United States and other countries have followed suit, though each has chosen its own shade, and the shades vary from light grey blue in Italy to deep olive drab in the United States. The details of the present-day uniforms in the principal states are given below. It might be stated, as a summary of modern uniforms, that Great Britain has most completely divorced service and full dress, and that in consequence her full dress is handsomer and her service dress plainer than those of any other country. Whether, for European war at any rate, the obliteration of regimental distinctions has not been carried too far, is open to question. The method adopted for the Italian infantry would seem to give enough means of identification, without increasing visibility, and as this method was used by the British in the South African War, it will probably be revived in future wars.

GREAT BRITAIN

The full dress uniforms of the British service in 1910 had not undergone any radical change since the army reorganization of 1881. Many regiments had, however, resumed their original facings instead of the white common to all non-royal English regiments in the last twenty years of the 19th century. But the Scottish regiments maintained their yellow or yellow-buff facings, and the single Irish regiment which is not "royal" (the Connaught Rangers) its green. Rifle regiments had astrakhan busbies, resembling in shape enlarged "glengarry" caps, with plume and lines. Details in all corps have been changed, rendering the uniforms more handsome. In September 1910 it was announced that the cloth helmet would be replaced by a shako.

Cavalry.—Household cavalry and dragoons wear single-breasted tunics with gold buttons, cuffs pointed with Austrian knot collars and shoulder-straps of the facings colour and white piping on the front and the skirt-flaps. The household cavalry wear steel cuirasses in review order, and in undress tight-fitting jackets and blue red-striped overalls. All wear steel or brass helmets, with drooping horsehair plumes, except the Scots Greys (2nd Dragoons), who have a grenadier bearskin with feather plume. All wear blue pantaloons and jack boots, except the household cavalry, who in full dress wear white leather breeches and high jack boots, reaching above the knee. The stripes on the pantaloons are yellow, (white in 2nd and 6th Dragoon Guards), white belts[1] and slings. See Plate III., line 1, fig. 4 and line 2, fig. 3.

Lancers (Plate III., line 1, No. 2) wear double-breasted tunics with gold buttons, and the front or "plastron," the peculiar mark of the lancer, varies in colour with the facings of the regiment. Lancers wear lancer caps (the Polish czapka) with drooping plumes. Pantaloons are blue, with yellow stripes (white in 17th), boots as in the dragoons. Round the waist is a girdle of yellow and red, and the cap is secured to the collar of the tunic by yellow lines.

	Tunic.	Facings.	Helmet.	Plume.
1st Life Guards	Scarlet	Blue	Steel	White
2nd ,, ,,	,,	,,	,,	,,
Royal Horse Guards (Blues)	Blue	Red	,,	Red
1st Dragoon Guards (King's)	Scarlet	Black	Brass	,,
2nd ,, ,,	,,	White	,,	Black
3rd ,, ,,	,,	Yellow	,,	Black and red
4th ,, ,,	,,	Blue	,,	White
5th ,, ,,	,,	Dark green	,,	Red and white
6th ,, ,, (Carabineers)	Blue	White	,,	White
7th ,, ,,	Scarlet	Black	,,	Black and white
1st Royal Dragoons	,,	Blue	Steel	Black
2nd Dragoons (Scots Greys)	,,	,,	(Bearskin cap)	White
6th Inniskilling Dragoons	,,	Primrose	Steel	,,
			Czapka top.	
5th Lancers	Blue	Scarlet	Scarlet	Green
9th ,,	,,	,,	Black	Black and white
12th ,,	,,	,,	Scarlet	Scarlet
16th ,,	Scarlet	Blue	Blue	Black
17th ,,	Blue	White	White	White
21st ,,	,,	Light blue	Light blue	,,
			Busby-bag.	
3rd Hussars	Blue	Nil	Garter blue	White
4th ,,	,,	,,	Yellow	Scarlet
7th ,,	,,	,,	Scarlet	White
8th ,,	,,	,,	,,	White over red
10th ,,	,,	,,	,,	White over black
11th ,,	,,	,,	Crimson	White over crimson
13th ,,	,,	,,	White	White
14th ,,	,,	,,	Yellow	,,
15th ,,	,,	,,	Scarlet	Scarlet
18th ,,	,,	,,	Blue	White over red
19th ,,	,,	,,	White	White
20th ,,	,,	,,	Crimson	Yellow

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[1] The 1st Life Guards have a red line, the 2nd a blue line, in the pouch belt.

The undress cap is in all the above blue, with bands of various colours, amongst which the most noticeable is the white zigzag on a black background of the Scots Greys.

Hussars (Plate I., line 1, figs. 1 and 3) wear a blue jacket, shorter than the ordinary tunic, braided with yellow or gold in front, along the back seams and on the collars and cuffs. They have no shoulder-straps, facings or waist-belt. The 3rd Hussars wear, however, scarlet and the 13th white, collars. The distinctive head-dress is the cylindrical busby with an upright feather plume, lines, and a busby-bag on the right side. The pantaloons are blue, except for the 11th Hussars. who wear crimson. Double stripes on the trousers, yellow (white, 13th). The undress cap is a red peaked cap. Officers' Hessian boots have gold edging and boss.

Infantry.—The uniforms of the four Foot Guard regiments are distinguished by the cuffs, which have slashed flaps and buttons, by the blue shoulder-straps and by the embroidery patches on the collar, cuff-flaps and skirts, which are analogous to the *Garde-Litzen* of continental armies. The only uniform which could be mistaken for it is the Royal Marine Light Infantry's (Plate VIII., line 1, No. 5), which has also slashed flaps, but it has fewer and smaller embroidery patches and plain collars. All the Guard regiments wear scarlet tunics with blue collars, shoulder-straps and cuffs, bearskin caps, blue trousers with red piping (officers, red stripe). The regimental distinctions (Plate III., line 2, fig. 6, and Plate IV., line 1, fig. 2) are: Grenadiers—Buttons equally spaced, white plume, red cap-band. Coldstream—Buttons spaced in twos, red plume, white cap-band. Scots—Buttons in threes, no plume, diced red and white cap-band. Irish—Buttons in fours, green plume, green cap-band. All wear in undress the white jacket, which is the old sleeved waistcoat, and peaked cap.

The uniforms of the line infantry may be classed as Line, Light, Fusilier, Rifle, Lowland and Highland Scottish. The tunic in the first three is red, with pointed cuffs and collars of the facings colour (blue in Royal regiments, white in English and Welsh, yellow in Scottish, green in Irish, except where the older colours have been revived), red shoulder-straps, gold buttons and white piping, blue trousers with red piping. On the shoulder-strap in the case of the rank and file is the regimental title, on the collar the regimental badge. The line infantry have a dark blue helmet (Plate IV., line 1, No. 3), with brass spike and ornaments; the light infantry a dark green helmet of the same pattern;[1] the fusiliers (Plate III., line 2, fig. 7) bear or racoon skin cap with hackle plume. In undress all ranks have a blue (green for light infantry) peaked cap, with a black (royal regiments, scarlet, non-royal Irish, green) band. The rifle regiments (Plate IV., line 1, No. 4) wear very dark green tunics and trousers without coloured cuffs or collars. In the King's Royal Rifles the scarlet piping and collar form a conspicuous distinction. The head-dress of the rifle regiments is an astrakhan cap with plume (red and black, K.R.R.; dark green and black, K.I.R.; black, Rifle Brigade), in undress a dark green peaked cap.

The Lowland and Highland Scottish regiments wear a scarlet (Scottish Rifles, green) "doublet" with gauntlet cuffs (Plate III., line 2, fig. 5 and Plate IV., line 1, fig. 6.) In undress Highland regiments wear the white jacket. Highland regiments wear tartan kilt and plaid and sporran (varying with the regiments), diced hose-tops and white spats, Lowland regiments (also Scottish Rifles, Highland Light Infantry, and all mounted officers) tartan trews. The head-dress of Highland regiments is a "feather bonnet"—a loose fur cap of peculiar shape with hackle. The Highland Light Infantry wear a small shako with a red and white diced band and ball. Lowland regiments (except the Royal Scots Fusiliers) wear the Kilmarnock bonnet (Plate III., line 2, No. 5). The Scottish Rifles have a shako with black drooping plume. The undress cap of all Scottish infantry is the "glengarry."

The full dress of officers is similar to that of the men, but it is more ornamented (see below for badges of rank). In all English and Irish regiments clothed in scarlet a crimson waist-sash is worn by officers. Guards officers on ceremonial occasions wear a gold and crimson sash. On the collar and cuffs there are broad edgings of lace terminating in the case of the cuffs in a small Austrian knot. The rifle Jacket is of hussar pattern with black embroidery and a black pouch belt (Plate IV., line 1, fig. 4). The Highland officer has a special pattern of sword; in full dress the basket-hilted claymore (so-called) or a plainer sword decorated with ribbon, on service a plain cross-hilted sword. He has also a richly decorated dirk, a broad white baldric, and a very full sash over the left shoulder. Lowland officers have also the shoulder belt and claymore, &c.

Royal Artillery.—The Royal Horse Artillery (Plate III., line 2, fig. 1) wears an old-fashioned hussar uniform, consisting of busby with red bag and white plume, a blue jacket with 18 rows of gold braid and scarlet collar. Trousers blue with red stripe. The Royal Field and Royal Garrison Artillery (Plate III., line 2, No. 2) wear a blue tunic with red collar and gold lace (Austrian knot on the sleeve), blue trousers with red stripe, helmet with brass plate and ball ornament, waist-belt and pouch-belt (white for men, gold for officers). The badge is either a grenade or a device of a field gun on its carriage.

	Facings.	Corresponding Corps and their facings in 1815. (S = silver lace.)
Line Infantry, English and Welsh.		
Queen's (R. West Surrey).	Blue	2nd, blue (S).
Buffs (East Kent)	Buff yellow	3rd, buff (S).
King's Own (R. Lancaster)	Blue	4th, blue.
Royal Warwickshire	„	6th, yellow (S).
King's Liverpool	„	8th, blue.
Norfolk	Yellow	9th, yellow (S).
Lincolnshire	White	10th, yellow (S).
Devonshire	Lincoln green	11th, green.
Suffolk	Yellow	12th, yellow.
Prince of Wales's Own (West Yorks)	Buff yellow	14th, buff (S).
East Yorkshire	White	15th, yellow (S).
Bedfordshire	„	16th, yellow (S).
Leicestershire	„	17th, white (S).
Princess of Wales's Own (Yorkshire Regt.)	Grass green	19th, grass green.
Cheshire	Buff yellow	22nd, buff yellow.
South Wales Borderers	Grass green	24th, grass green (S).
Gloucestershire	White	28th, yellow (S). 61st, yellow (S).
Worcestershire	„	29th, yellow (S). 36th, gosling green.
East Lancashire	„	30th, pale yellow (S). 59th, white (S).
East Surrey	„	31st, buffs (S). 70th, black.
West Riding (Duke of Wellington's)	Scarlet	33rd, red (S); 76th red (S).
Border	White	34th, yellow (S). 55th, green.
Royal Sussex	Blue	35th, orange (S). 107th, (?).
Hampshire	Yellow	37th, yellow (S). 67th, yellow (S).
South Staffordshire	White	38th, yellow (S). 80th, yellow.
Dorsetshire	Grass green	39th, grass green. 54th, green (S).
Prince of Wales's Volunteers (S. Lancashire)	White	40th, buff yellow. 82nd, yellow (S).
Welsh	„	41st, red (S). 69th, green.
Essex	„	44th, yellow (S). 56th, purple (S).
Sherwood Foresters (Notts and Derby)	„	45th, dark green (S).
Loyal North Lancashire	„	47th, white (S). 81st, buff (S).
Northamptonshire	„	48th, buff. 58th, black.
Princess Charlotte of Wales's Royal Berkshire	Blue	49th, green. 66th, gosling grn. (S).
Queen's Own R. West Kent	„	50th, black (S). 97th, blue (S).
Duke of Cambridge's Own Middlesex	Lemon yellow	57th, yellow. 77th, yellow (S).
Wiltshire (Duke of Edinburgh's Own)	Buff yellow	62nd, buff (S). 99th, pale yellow.
Manchester	White	63rd, dark green (S). 96th, buff (S).
Prince of Wales's North Staffordshire	„	64th, black. 98th, buff.
York and Lancashire	„	65th, white; 84th, yellow (S).
Line Infantry, Irish.		
Royal Irish Regt.	Blue	18th, blue.
Connaught Rangers	Green	88th, yellow (S). 94th, green.
Leinster Regt. (R. Canadian)	Blue	(100th and 109th late H.East India Co.'s troops).
Light Infantry.		
Prince Albert's Somersetshire	Blue	13th, yellow (S).
Duke of Cornwall's	White	32nd, white; 42nd, pale yellow (S).
Oxfordshire and Bucks	„	43rd, white (S). 52nd, buff (S).

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[1] To be replaced by a shako.

	Facings.	Corresponding Corps and their facings in 1815. (S = silver lace.)
Light Infantry—continued.		
Yorkshire (King's Own) .	Blue	51st, grass green (105th H.E. India Co.'s troops).
Shropshire (the King's) . .	"	53rd, red; 85th, yellow (S).
Durham	Dark green	68th, bottle green (S) (106th H.E. India Co.'s troops).
Highland	Buff yellow	71st, buff (S); 74th, white.
Fusiliers.		
Northumberland . . .	Gosling green	5th, gosling green (S).
Royal (City of London) . .	Blue	7th, blue.
Lancashire	White	20th, yellow (S).
Royal Scots	Blue	21st, blue.
Royal Welsh	"	23rd, blue.
Royal Irish	"	27th, buff (108th late H. East India Co.'s troops).
Royal Inniskilling . . .	"	87th, green; 89th black.
Royal Munster	"	(101st and 104th late H. East India Co.'s troops).
Royal Dublin	"	(102nd and 103rd, late H. East India Co.'s troops).
Rifles.		
Cameronians (Scottish Rifles)	Dark green	(Formerly 26th and 90th line).
King's Royal.	Red	60th Rifles, red.
Royal Irish.	Dark green	(Formerly 83rd and 86th line).
Rifle Brigade	Black	95th Rifles, black.
Line Infantry, Lowland Scottish.		
Royal Scots Lothian . .	Blue	1st, blue.
King's Own Scottish Borderers.	"	25th, blue.
Highlanders.		
Black Watch (Royal Hrs.)	"	42nd, blue; 73rd, dark green.
Seaforth	Buff yellow	72nd, yellow (S).
Gordon	Yellow	75th, yellow; 92nd yellow (S).
Queen's Own Cameron Hrs. .	Blue	79th, dark green.
Princess Louise's (Argyll and Sutherland Hrs.) . . .	Yellow	91st, yellow (S). 93rd, yellow (S).

Royal Engineers (Plate IV., line 1, No. 1).—Scarlet tunic with garter, blue cuffs and collar, yellow shoulder-cords and piping, blue trousers with red stripe, helmet with royal arms on plate, and spike. Waist-belt white for men, gold-laced russia leather for officers, who wear also a pouch-belt of russia leather with a wavy gold lion in the centre.

Army Service Corps (Plate III., line 2, No. 4).—Blue tunic with white facings and white piping. Helmet with ball and plate, trousers blue with double white stripe. Officers, gold belts. *Royal Army Medical Corps*, blue uniform with magenta facings; *Army Veterinary Corps*, blue with maroon facings; *Army Pay Corps*, blue with yellow facings; *Army Ordnance Corps*, blue with red facings. *The West India Regiment* (negroes) wear a red sleeveless jacket over a white smock, baggy dark blue trousers, and a round cap with white puggaree.

The distinguishing mark of the *staff* officer in full dress is the aiguillette and the cocked hat with upright or drooping plume; in undress and service dress the red gorget patches on the collar. The full-dress uniforms of a *field marshal* and a *general officer* are shown in Plate III., line 1, Nos. 5 and 6.

Badges of Rank.—All officers have twisted gold shoulder-cords (except Foot Guards, who wear a blue cloth shoulder-strap with lace edges); on these cords badges of rank are worn as follows: 2nd lieutenant, lieutenant and captain, 1, 2 and 3 stars; major, crown; lieutenant-colonel, crown and star; colonel, crown and 2 stars; brigadier-general, crossed swords; generals, sword and baton crossed, and (major-general) star; (lieutenant-general), crown; (general), crown and star; field marshal, crossed batons in a laurel wreath with crown above. In service dress (khaki), however, the badges are worn in worsted on a slashed flap of the sleeve, coupled with rings of braid (1 for a 2nd lieutenant or lieutenant, 2 for a captain, &c.). Non-commissioned officers wear chevrons (point downwards) on the upper right arm; lance-corporal or acting bombardier, 1; corporal, 2; sergeant, 3; colour-sergeant, 3 chevrons and crossed colours; staff-sergeant, 4 chevrons. On the lower part of the left arm chevrons (point up) are worn as "good conduct" badges. A sergeant-major is dressed as an officer, except that he has a crown on the lower part of the right sleeve). There are also badges of proficiency such as crossed rifles for marksmen, a spur for rough-riders, a fleur-de-lys for scouts, &c.

Regimental Badges.—The grenade in various forms is worn by the Royal Artillery, the Grenadier Guards and the Fusilier regiments. The figure of Britannia was awarded to the (9th) Norfolk regiment for gallantry at Almanza, 1707. The White Horse of Hanover was given to some regiments for service against the Jacobites. The Lion of England was awarded by William III. to the King's Own (Royal Lancaster) Regiment for services against the troops of James II. The Queen's (Royal West Surrey) Regiment wear a Paschal Lamb, the badge of Catherine of Braganza, queen of Charles II. The Dragon of Wales figures among the badges of all the Welsh regiments. Several regiments wear a castle and key in memory of services at Gibraltar, others have a tiger for services in India and still more a sphinx for Egyptian campaigns. The most general of all badges—though not the most generally worn—is the "stripped" rose. Nearly all corps possess several badges, which are combined in various ways.

The special interest of these badges is that they are peculiar to the British army. Although a badge of the branch (infantry, cavalry, &c.) is common, no other army wears distinctive regimental devices.

A few details of general practice may be added. All cavalry wear a pouch-belt over the left shoulder. The crimson infantry sash is worn by officers round the waist and by sergeants across the body and over the right shoulder. All officers and sergeants who do not wear the sash, to whatever branch they belong, have a pouch-belt, the pattern, of course varying. Ankle boots (and sometimes leggings with them) are worn by dismounted men. Swords, except in the case of Scottish infantry, are worn suspended by slings from a belt (the belt in infantry, rifles and hussars being worn under the tunic or sash). On foreign service the uniform is varied according to circumstances, the most usual change being from the full dress head-dress to the white helmet.

The full dress of the territorial army varies greatly, sometimes conforming exactly to the uniform of the corresponding regular units, sometimes keeping to its original "Rifle" character in grey or green of various shades. The latter conform to the rules of the dress of "Rifles" (*e.g* wear pouch-belts instead of sashes), and the former, though in many cases the silver lace and ornaments of the old volunteer force are retained, to those for the regulars, the distinguishing mark in all cases being the letter "T" on the shoulder or collar. The yeomanry cavalry is variously attired, some old regiments possessing rich old-fashioned hussar uniforms, others of recent formation wearing "service" colours only. Some regiments are dressed as dragoons, but the great majority are hussars. The infantry and artillery of the Honourable Artillery Company of London are dressed somewhat after the fashion of the Grenadier Guards and the Royal Horse Artillery.

Undress Uniforms.—In "walking-out" order most troops wear the tunic, Household Cavalry and Dragoons with waist-belts and sword-slings, lancers with girdle (R.F.A. and Army Service Corps also wear girdles in walking-out order), infantry and all other branches except hussars with waist-belt. Sergeants of infantry wear the sash and side-arms, the latter privilege being accorded also to corporals of the guards regiments. White gloves are worn by sergeants. Since the general introduction of khaki service dress, undress uniforms of red, blue, &c., have mostly disappeared, but the blue serge "jumper" is still retained. Officers of infantry (except in hussars and Rifles) have undress frock coats of various patterns. With these the "Sam Browne" equipment brown leather waist-belt, frog and the sash and slings are worn, but with the jumper and service frock, braces. Field officers have an edging of braid on the peak of the undress caps, staff and general officers an oak-leaf design.

Service Dress.—This, since the conclusion of the Boer War, is universally khaki serge, of shooting-coat pattern, with a spinal pleat and four large pockets; all buttons and badges are in bronze. It has a double collar. A peaked cap, breeches or trousers, and puttees of the same colour are worn with it. The universal pattern great-coat and macintosh are also khaki coloured. The guards and staff officers, however, wear a light grey overcoat.

Mess Dress, for officers, after undergoing various modifications, now almost universally consists of a jacket with roll collar, waistcoat, and overalls and patent leather Wellington boots, the colours following in the main those of the full dress.

It remains to mention a few of the many regimental distinctions, trifling in themselves yet of the greatest importance as fostering regimental pride and as recalling specially gallant services in the old wars. The officers of the 7th Hussars and the Oxfordshire and Buckinghamshire Light Infantry wear linen collars with their undress uniforms. The Royal Welsh Fusiliers have a bow of black velvet (called a "flash," this being an obsolete slang word for "wig") sewn to the back of the collar—a survival of the old-fashioned method of tying the hair in a club queue. The officers of certain regiments, in memory of severe losses, wear a black line in their gold lace. To commemorate Culloden the sergeants of the Somersetshire Light Infantry wear their sashes over the left shoulder as officers used to do. Until after the South African War the only fusilier regiment that wore plumed busbies was the Northumberland Fusiliers; now, however, all fusiliers wear a hackle (in the order of regiments shown in the table: red and white; white; primrose; white; white; grey; green; white and green; blue and green). The (28th) Gloucestershire regiment wears two badges on the helmet, to commemorate its having fought facing both ways, ranks back to back, at Alexandria in 1801.

Indian Native Army.—The uniforms of the Indian army vary infinitely in details, owing to the different methods of tying the turban, &c., practised by different castes and tribes, and to the strictly regimental system of clothing and equipping the soldier. But the infantry, except the Gurkha Rifles, have tunics of similar pattern, viz. long skirted, without collars, and (if scarlet) with round cuffs, flaps and broad edgings on the front of the tunic of the facings colour. The trousers are dark blue and wide, and spats are worn with them (Plate VI., line 2, No. 2). Gurkhas (Plate VI., line 2, No. 3 are dressed as Rifles, except that their head-dress is a round cap. The pattern of cavalry uniform, which is generally followed whatever the colours and regimental distinctions, is shown on Plate VI., line 2, No. 1.

In the main the dress of the native cavalry is dark blue. Five of the regiments wear red, the three Madras corps French grey, the Hyderabad and one other green, and only three drab. One regiment, the 1st, wears a yellow uniform, being perhaps the only one so clothed in the world.

Native artillery units wear blue with red facings, native engineer units, red with blue facings. The Queen's Own Corps of Guides wears drab with red facings.

The greater part of the infantry wears, in full dress, scarlet, the various facings following no discoverable system, although certain groups of regiments have a regular colour scheme.

A large number of regiments are clothed in drab, and there are Gurkha and other rifles in green; the remarkable Baluchi uniforms (green and drab with baggy red trousers) are unique in the British Empire.

The regiments of the *Australian Commonwealth*, with certain exceptions, wear khaki or drab with white facings and emu plume in the cavalry and green facings in the infantry. The same principle is carried out in other services, the intelligence corps having pale blue, the signal corps royal purple, the medical chocolate and the veterinary maroon facings. The artillery, engineers and army service corps are dressed as the corresponding branches of the home army. All the *Canadian* forces are uniformed very similarly to the British army. The 6th Dragoon Guards and the 13th Hussars are the models for the cavalry, and line, rifle, highland and fusilier uniforms are all represented, the dark rifle uniform predominating. In *South Africa*, as in Australia, khaki has become almost universal.

FRANCE

The Revolutionary simplification of the varied uniforms of the *Ancien Régime* has endured to the present day. Even in the various waves of flamboyant military fashions they have remained simple in the sense that all troops of an arm or branch were dressed practically alike, with none of the regimental differences that England, deferring to tradition, and Germany, systematizing the *ordre de bataille* to the last detail, preserved and introduced.

The line infantry wears a single-breasted blue tunic with red collar, a small red flap on the cuff, red epaulettes and gold buttons. The number of the regiment appears on a blue collar patch. The cap is a madder-red képi, with blue band, brass grenade, tricolour cockade and a ball. The trousers are loose, madder-red, and worn either with shoes and gaiters or with high ankle boots. The men usually march in the blue double-breasted greatcoat, under which is worn the plain *veste* (Plate V., line 2, No. 3). With this is worn a képi without ornaments and having the number in front. The officers wear a tunic of a different blue, almost black; otherwise, except for rank badges, it is similar to the men's; epaulettes and braid, gold. The officers' full dress képi has a golden ball and the trousers have a black stripe (Plate V., line 1, No. 1).

The chasseur battalions (Plate V., line 2, No. 4) wear the same pattern of tunic as the line, but the collar and cuffs are self-coloured, the epaulettes green, the trousers grey-blue with yellow piping, képi dark blue with yellow edgings and green ball, buttons, &c., silver. Chasseur officers are dressed as the men (with the usual officer's blue-black tunic), but have a drooping green plume. The Alpine battalions wear a plain dark blue jumper and soft cap (*béret*) or tam-o'-shanter. Under the jumper, which is usually half-open, they wear a light blue shawl round the waist. The trousers are wide, dark blue knickerbockers, and puttees are worn with them.

The Zouaves (Plate V., line 2, No. 2) wear dark blue red-trimmed jackets and waistcoats, with a light blue cummerbund, baggy red trousers with blue piping and dark blue or white spats. The head-dress is a red tasselled cap (*chéchia*). The "false pockets" round which the braid circles on the front of the jacket are red for the 1st, white for the 2nd, yellow for the 3rd and blue for the 4th Zouaves. Zouave officers have the ordinary officer's tunic, with blue-black collar and gold ornaments, but wear it unbuttoned (showing a red cummerbund) and without epaulettes. The cuff is pointed and slit almost to the elbow, the edges of the slit being gold laced according to rank and having a scarlet lining. Only the service képi is worn. The red trousers have the usual black stripe, and are cut very wide.

The Turcos are dressed similarly to the Zouaves, but with light blue jackets and waistcoats, light blue or white trousers, red cummerbund and yellow braid; the four regiments are distinguished among themselves in the same way as the four Zouave units. Their officers have a light blue tunic with yellow collar, Zouave cuff, red trousers with light blue stripe; képi red, with light blue band.

The Foreign Legion is dressed as line infantry, with certain minor distinctions. The colonial (formerly marine) infantry wears a double-breasted tunic with gold buttons, blue grey trousers and dark blue képi with red piping, plain collar and cuffs. The full dress cap badge is an anchor.

Cavalry.—Cuirassiers (Plate V., line 1, No. 3) wear dark blue tunics with red collars and cuff-flaps, silver ornaments and steel cuirasses, steel helmet with brass ornaments, black horsehair tail, red "shaving-brush" at the front of this tail and another shaving-brush, of colour varying with the squadron, &c., on the left side of the helmet. The trousers are red (officers with dark blue stripes, men with blue piping). The number is borne on a blue collar patch. The officers wear silver, the men red, epaulettes. Undress cap as infantry, silver-laced for officers.

Dragoons wear blue tunics (the black-braided "dolman," shown on Plate V., line 1, No. 6, is gradually passing out of the service) with white collars and cuff-flaps, silver buttons, &c., helmet as for cuirassiers, but without the "shaving-brush" at the front of the horsehair tail, trousers red with dark blue stripe. The men wear shoulder-cords instead of epaulettes, and the officers only wear their silver epaulettes on ceremonial duties. The number appears on a blue collar patch. Undress cap as for cuirassiers.

Chasseurs à cheval (Plate V., line 2, No. 1) wear a light blue tunic or dolman (the latter black-braided) with silver buttons, red collars and cuff-flaps. The trousers are red with light blue piping (two broad and one narrow light blue stripes between for officers). The full dress head-dress is a light blue shako, with dark green plume in full dress, coloured ball in other orders. The badge on the shako is a brass bugle. The képi is red with light blue band and piping (silver braid for officers). Number on the collar.

Hussars are dressed as *chasseurs à cheval*, but with white braiding on the dolman instead of black, and self-coloured collar. The badge on the shako is an Austrian knot.

The *Chasseurs d' Afrique* wear the half-open *veste*, which is light blue with yellow collar and edgings. The cuff is slit in the Zouave style, the visible lining being yellow. A red cummerbund is worn. The shako is almost invariably worn with a white cover and neck curtain. The trousers are red. Officers as the corresponding chasseur officers in France, but with yellow instead of red collars, &c.

The native Algerian cavalry, the *Spahis*, wear national costume—red jacket with black braiding, red cummerbund, light blue wide trousers, and red morocco boots. Above this they wear a flowing red mantle of thick cloth, and over this mantle the ample white burnous, which covers the head and shoulders. Their French officers wear a red tunic, with self-coloured collar and cuffs, gold buttons and epaulettes, number with crescent in gold on the collar, gold rings on cuff according to rank, trousers as for the hussars, &c., in France.

Artillery.—The rank and file wear blue tunics or dolmans (more usually, however, the *veste*). The dolman has black braiding but a red shoulder-cord, and has red collar, with black patch and number, and red pointed cuffs; buttons, &c., gold. The trousers are dark blue, with two broad and one narrow red stripe. The képi is dark blue, with dark blue band and red ornaments, the full dress cap having a badge, in red, of crossed guns and grenade. Artillery officers wear a black-braided dolman (blue-black) with gold shoulder-cord and Austrian knot. Their képi has the artillery badge in brass, gold braid, and a red plume. Plate V., line 1, No. 5 shows an artillery officer serving on the general staff.

Engineers, dark blue tunic with gold buttons, black red-edged collar patches bearing the number in red, black red-edged flap on cuffs; red epaulettes, trousers and képi as for artillery. Engineer officers have the same tunic as infantry, without facings, and the engineer badge (a cuirass and helmet) on the full dress képi.

Train (Army Service Corps), blue-grey dolman, black-braided, with red collar, black braid on the cuff, and red shoulder-cord; infantry képi, officers as officers of the *chasseurs à cheval* but with (silver) Austrian knot on the sleeve, and red plume. Medical officers have dark blue dolman, red trousers with black stripe, and red collars and cuffs. Their distinctive marks are a whole red képi (with gold braid), a white armlet with the red cross, Aesculapius' staff on the collar, gold-laced shoulder-strap, and a curious pouch-belt which is entirely wrapped in a red cloth cover that buttons over it.

Generals wear in full dress the uniform shown in Plate V., line 1, No. 4, with some distinctions of rank. In undress they wear a dark blue jacket with black braiding, the black Austrian knot on the sleeve carrying the silver stars of rank; trousers red with black stripe; képi red, with a blue band covered by gold, oak leaf lace. General staff officers (see Plate V., line 1, No. 5) wear their regimental uniform, with gold or silver aiguillettes, and on the collar, instead of the regimental number, the thunderbolt badge of the staff, the badge or number being removed also from the képi. Their special distinctions are the armlet and the plume, which vary according to the staff to which the officer belongs.

Badges of Rank.—General officers (on the epaulette or on the Austrian knot), one silver star for general of brigade, two for general of division. Other officers (rings on the cuff and képi band, or strands of braid on the Austrian knot), 1 for sub-lieutenant, 2 for lieutenant, 3 for captain, 4 for commandant, 5 (3 gold and 2 silver) for lieutenant-colonel, 5 for colonel (Plate V., line 1, figs. 1 and 5). Epaulettes: sub-lieutenant, 1 with fringe on right shoulder and 1 scale on left; lieutenant, fringed on left and scale on right shoulder; captain, both fringed; commandant, as sub-lieutenant but with thicker fringe; lieutenant-colonel and colonel, both with thick fringes (in the case of the lieutenant-colonel the body is silver). The vertical braids of the képi also vary according to rank. Field officers as a rule wear in full dress "shaving brush" plumes instead of a ball.

Under-Officers.—The badge is a stripe crossing the lower half of the sleeve diagonally; lance-corporals 1, corporals 2 worsted stripes; sergeants 1, sergeant-majors 2 gold or silver stripes. The "adjutant," who corresponds to the British sergeant-major, has a ring of lace, like an officer's, but narrower.

GERMANY

The infantry of the Prussian Guard wear single-breasted dark Prussian blue tunics with red piping on front and skirt flaps, or gold buttons (1st and 5th Foot Guards and Guard Fusiliers silver), white belts (3rd or "Fusilier" battalions and the Guard Fusiliers black), red collars and cuffs, spiked helmets with, in full dress, white plumes (Guard Fusiliers black). Guard distinctions throughout Germany take the form of "guard-stripes," collar stripes of embroidery, and similar stripes forming false buttonholes round the buttons on the cuff, whether these are of the "Brandenburg" (plain flap with 3 buttons), "French" (slashed flap with 3 buttons), or "Swedish" (round cuff with buttons along the top edge) pattern.

The 1st to 4th Foot Guards have two guard-stripes on the collar, Swedish cuff with stripes, and white, red, yellow and light blue (the ordinary German indicative sequence) shoulder-straps. The Guard Fusiliers have the same uniform with yellow shoulder-straps and plume and belt as stated above. The 1st to 4th Grenadier Guards have double guard-stripes, red "Brandenburg" cuffs with blue flaps and embroidered stripes, shoulder-straps coloured in the same order as the Foot Guards. The 5th Foot Guards and 5th Grenadier Guards (of later formation) wear only a single guard-stripe; these return to white shoulder-straps in the sequence, and both have the blue flap and stripes. Service cap as in the line. For gala wear the 3rd battalion of the 1st Foot Guards, and all battalions of the 1st Grenadier Guards, wear the old mitre cap, once of cloth, but now become rigid and consisting of a metal front plate and a stiff red cap behind it.

The line infantry (other than Bavarians, Saxons, Württembergers, &c.) wear blue tunic with gold buttons, red piping, and red collar. The cuffs, also red, are of the "Brandenburg" pattern, plain round with a small red flap. The shoulder straps bear the number, or cipher. The head-dress is a small black leather helmet with brass Prussian eagle badge and spike. The trousers are dark grey with red piping, the equipment of black leather, the boots of Wellington pattern (the trousers being tucked into them). The greatcoat is grey with shoulder-straps as on tunic and a collar patch of the cuff-flap colour. The service cap is a round cap without peak, dark blue with red band and piping, and two cockades, "national" and "imperial." Exceptions to these rules are: Prussian grenadiers (Nos. 1 to 12) wear black horsehair plumes and white belts, Mecklenburg grenadiers No. 89, Queen's Fusiliers No. 86, Brunswick regiment No. 92, 145th Prussian regiment, black plumes.

The Prussian and quasi-Prussian portions of the army follow a clear rule as to the badge of the army corps. The infantry of each corps has shoulder-straps of uniform colour, and when a regiment changes its corps it changes its shoulder-strap. There is a further distinguishing mark on the cuff-flap:—

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Shoulder-strap	White	White	Red	Red	Yellow	Yellow	Lt. blue	Lt. blue
Cuff-flap piping . . .	White	Nil	White	Nil	White	Nil	White	Nil
	IX.	X.	XI.	XV.	XVI.	XVII.	XVIII.	XX.[1]
Shoulder-strap	White	White	Red	Red	Yellow	Yellow	Lt. blue	Lt. blue
Cuff-flap piping . . .	Yellow	Lt. blue	Yellow	Lt. blue	Yellow	Lt. blue	Yellow	Lt. blue

Except in regiments (such as the guards of the smaller states now numbered in the line of the army, and a few others) where the blue flap and guard-stripes are worn, the greater part of the Prussian regiments wear the historic red flap; but there came a time when the system of indicating regimental variations had to be expanded, and thereafter (from No. 145 inclusive onwards) red and white flaps were given alternately to new regiments, in such a way that there was one "white" regiment in each corps. The I. corps on the Russian frontier, being further reinforced, received one regiment with a yellow (150th) and one with a light blue flap (151st). "Guard" distinctions are worn by the Mecklenburg Grenadiers, No. 89, double guard-stripe on collar, blue cuff-flap with red piping and embroidery by the 7th Prussian Grenadiers, single guard-stripe and blue flap with embroidery (edged with V. corps colour); by the 1st, 2nd, 3rd and 8th Prussian Grenadiers and by the 80th Fusiliers (formerly the elector of Hesse's bodyguard), single guard-stripe and embroidery on the ordinary red cuff-flap.

The infantry of Hesse-Darmstadt, Württemberg and Baden are similarly uniformed to those of Prussia, the distinctions being easily described. The five "Grand Ducal Hessian" regiments (115–118 and 168) have not the corps (XVIII.) distinction, and have both shoulder-straps and cuff-flap of the same colour (red, white, light blue, yellow and red), the senior regiment, 115 (bodyguard regiment), having double guard-stripe on the collar and guard patches on the flap. A very marked distinction is in the buttons, which are invariably silver, and in the helmet badge, which is a lion rampant. The first three regiments wear a black plume.

Of the Württemberg infantry (XIII. corps), the 119th and 123rd regiments (guards) wear the double guard-stripe, and the "Swedish" cuff, also plumed helmets. The remainder have red shoulder-straps and red cuff-flaps edged with light blue, like the XV. army corps, and the only conspicuous distinction is the royal arms instead of the eagle on the helmet. The 120th also wears the grenadier plume.

Of the Baden regiments, the 109th and 110th (guards and grenadiers) have white plumes and white shoulder-straps, the 109th having the Swedish cuff with patches, the double guard stripe, and silver buttons. The remainder have yellow, red, light blue and green shoulder-straps; there is no edging to the flap. The only distinguishing mark for these is the Baden device (a griffin and a shield) on the helmet.

The Saxon infantry, though assimilated to the Prussian in most respects, is distinguished by various well-marked peculiarities. All shoulder-straps are self-coloured and edged with red. All Saxon regiments have either the "Swedish" or more usually the so-called "German" plain round cuff (red), with two buttons on back seam. The guard and grenadier regiments, 100th and 101st, have black plumes, double guard-stripes and "Swedish" cuffs. The helmet has an eight-pointed brass star. The 108th is a rifle regiment, and wears a green tunic with black red-edged collar and cuffs, dark grey trousers and a shako with black plume looped to one side in the Austrian fashion. The service cap of this corps is green with black piping and band. A peculiarity of the Saxons is that the bottom edges of the tunics are edged with red, as well as the front, and the skirt flaps are very short.

The Bavarian infantry has retained its historic light blue uniform, though in most details the Prussian model has been accepted. Tunic and trousers are light blue with red piping, red cuffs, collars and shoulder-straps. The Bavarian bodyguard regiment has red collar with double guard-stripe, red Swedish cuff with stripes, red shoulder-straps and silver buttons, but no plume. The line has gold buttons and appointments and "Brandenburg" cuffs, flaps edged according to the usual sequence (I. corps white, II. none, III. yellow). The service cap is light blue with red band and piping. Belts black.

Jägers and *Schützen*.—The Jäger uniform is bright green, with red collars, piping and Swedish cuffs (Prussian Guard, double guard-stripe and cuff-stripes), gold buttons, trousers as for line, and a small shako with drooping black plume. The Mecklenburg battalion No. 14, however, has light green collars, cuffs and shoulder-straps edged with red, and double guard-stripe and cuff-stripes. The Guard Schützen battalion (originally a French-speaking corps from Neuchâtel) has black collars and cuffs, edged with red shoulder-straps, double guard-stripe and green red-edged "French" (*i.e.* slashed) cuff-flaps with stripes; and the Jäger battalions of the XII. and XVIII. corps have exactly the same uniform as the Saxon Schützen regiment already mentioned, silver buttons being substituted for gold. The Bavarian Jäger battalions have light blue uniforms with green facings, Swedish cuff, and shako. In all these the field cap is of the colour of the uniform, the band of the colour of the collar, the piping as on the tunic.

Cavalry.—The heavy cavalry consists of the Prussian *Gardes du Corps* and Guard Cuirassiers, the eight line cuirassier regiments, and the Saxon and Bavarian "heavy cavalry." In most of these cuirasses of black or bright iron or of brass (with or without breast decorations), and even cuirass-shaped remnants of the old buff coat, in richly decorated leather, are worn on ceremonial occasions. The head-dress is a helmet of burgonet shape. The ordinary full dress of Prussian cuirassiers is a white long-skirted tunic (called a *Koller*) with white shoulder-straps and collars, edged along the collar and down the front (which is hooked, not buttoned) with broad braid (white, with lines of the regimental colour). The Swedish cuffs, edged with similar braid, are of the regimental colour, of which colour there is also a patch on the collar and piping round the shoulder-straps and back seams. In full dress white trousers, otherwise dark grey trousers with red piping, are worn. The undress tunic is dark blue of the ordinary buttoned pattern, but with braided cuffs, white shoulder-strap and collar-patch and braid as in full dress. The field cap is of the tunic colour with band of the regimental colour. The belts are white. High jack-boots are worn. The guard regiments have double guard-stripe and cuff-stripes.

The Saxon heavy cavalry wears light blue braided cuirassier tunics, with brass scales instead of shoulder-straps, white piping, brass helmets with the Saxon star device, Swedish cuffs cut gauntlet-wise, white or light blue trousers, light blue cap, and white belts. In the 1st Guard regiment the collar and cuffs are white, the braid light blue and white, the helmet ornament a silver lion, the cap-

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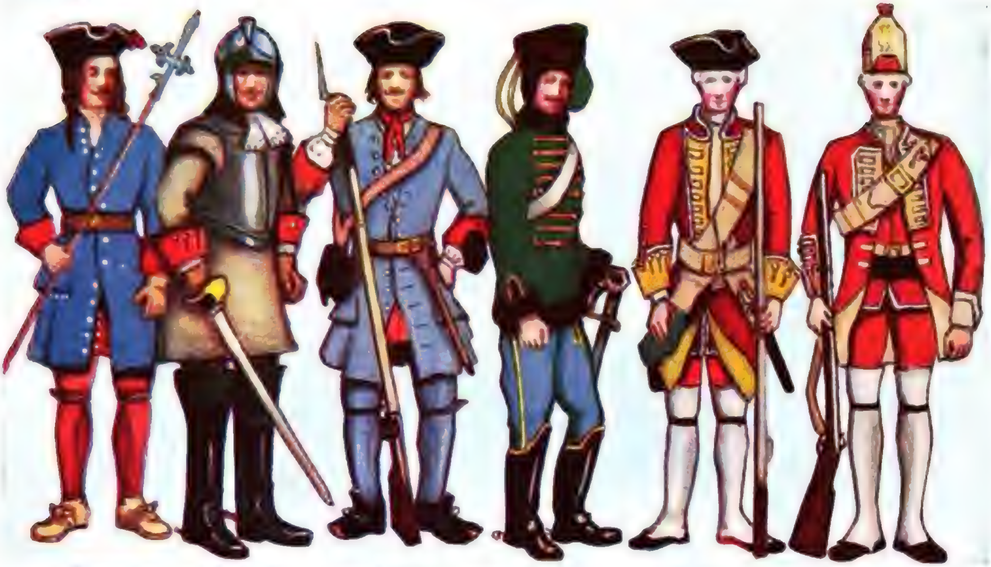
[1] Not yet formed.

UNIFORMS

1690-1751



France:
Sergeant,
Alsace Regt., 1690

Austria:
Cuirassier,
1705

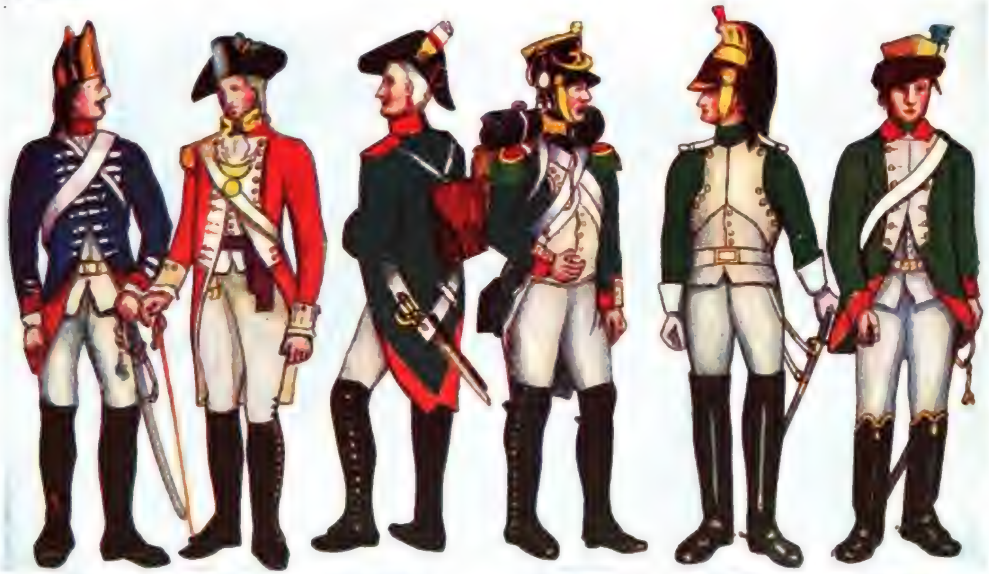
Austria:
Württemberg
Regt., 1710

Hungary:
Nádasdy
Hussars, 1762

England:
34th Foot,
1742

England:
Grenadier,
4th Foot, 1751

1756-1800



Prussia:
Hesse-Cassel
Regt., 1756

England:
40th Foot,
1790

France:
Revolutionary
Infantry, 1795

France:
Voltigeur,
51st Regt., 1806

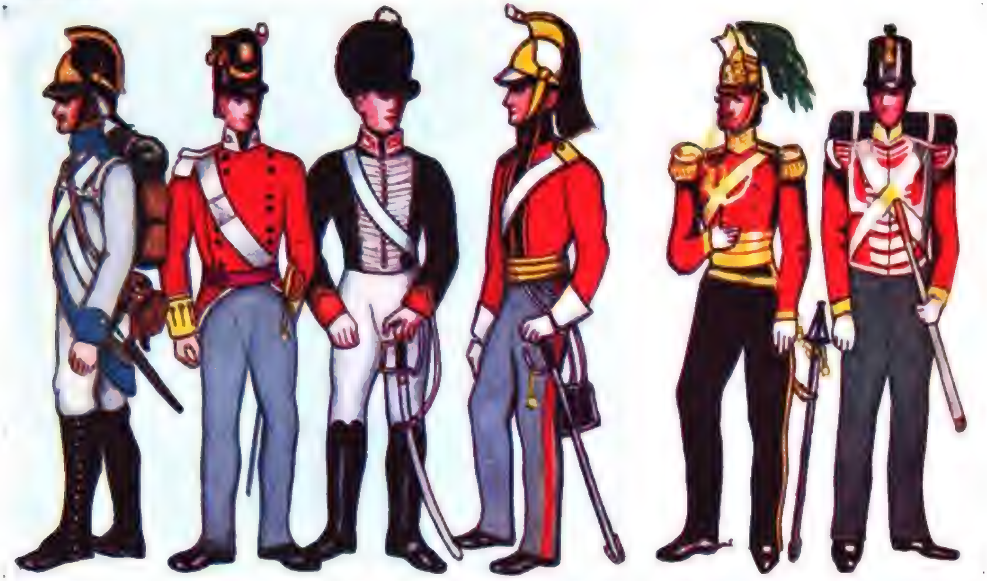
France:
Guard
Dragoon, 1806

Austria:
Uhlan,
1800

PLATE II

UNIFORMS

1805-1845



Austria: Deutschmeister Regt., 1805

England: 9th Foot, 1812

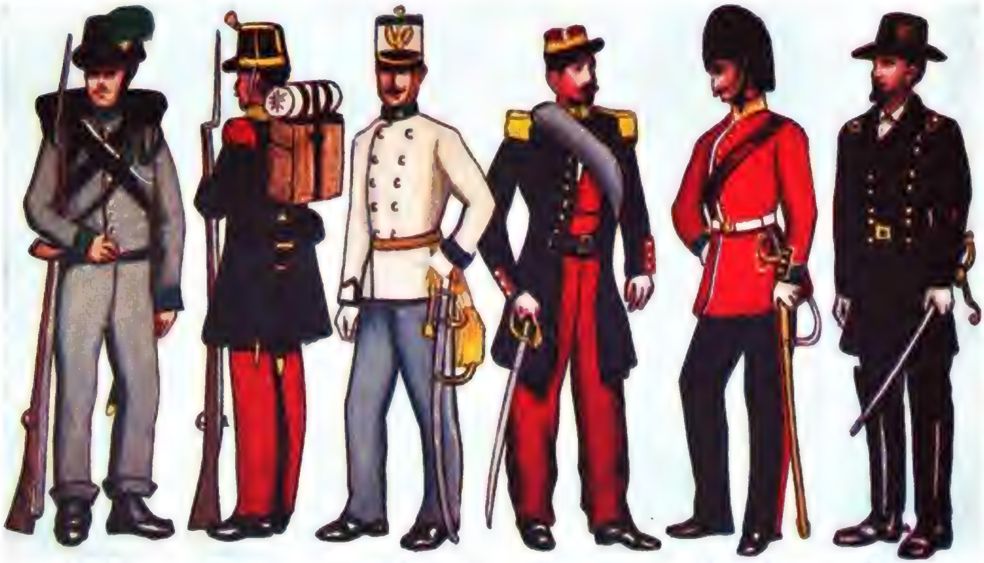
England: Royal Horse Artillery, 1815

England: 1st Royal Dragoons, 1815

England: 17th Lancers, Officer, 1845

England: 90th Light Infantry, 1845

1848-1865



Austria: Jäger, 1848

France: Line Infantry, 1852

Austria-Hungary: Gyulai Regt., 1856

France: Infantry Officer, 1859

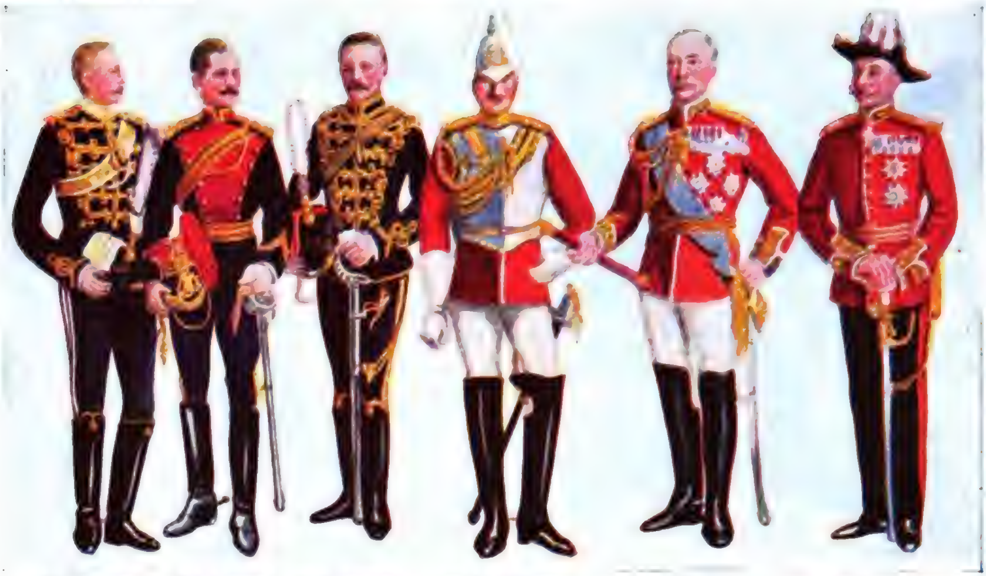
England: Scots Fusilier Guards, Officer, 1865

U. S. A.: General Officer, 1864

UNIFORMS

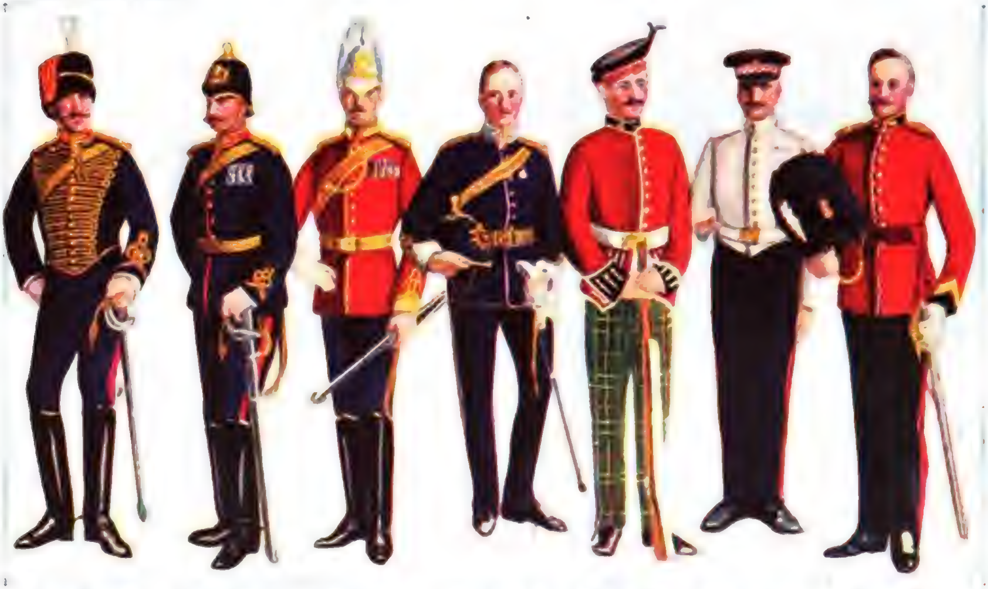
PLATE III

GREAT BRITAIN



13th Hussars, Officer
12th Lancers, Officer
10th Hussars, Officer
2nd Life Guards, Officer
Field Marshal
Major-General

GREAT BRITAIN



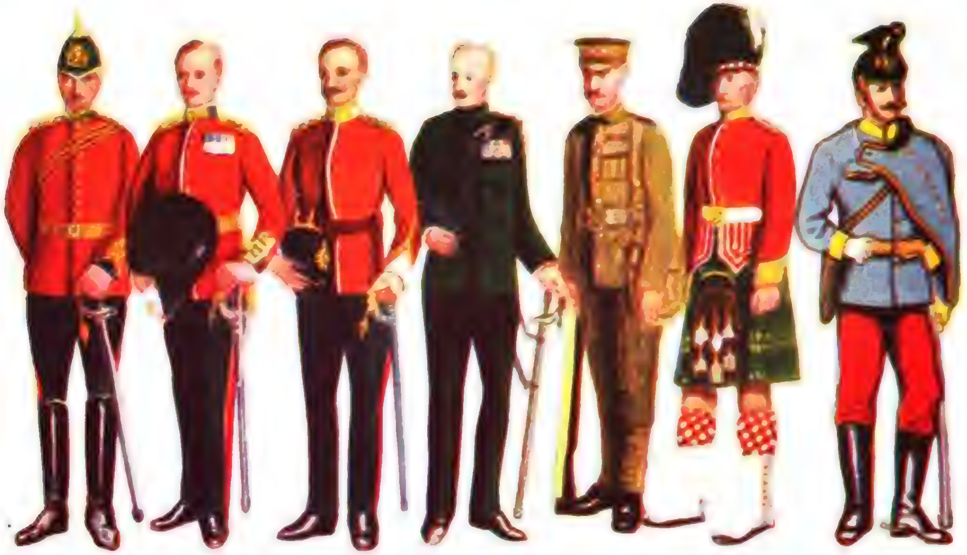
Royal Horse Artillery, Officer
Royal Field Artillery, Officer
6th Inniskilling Dragoons, Officer
Army Service Corps, Officer
King's Own Scottish Borderers
Scots Guards, Undress
Royal Fusiliers, Officer

PLATE IV

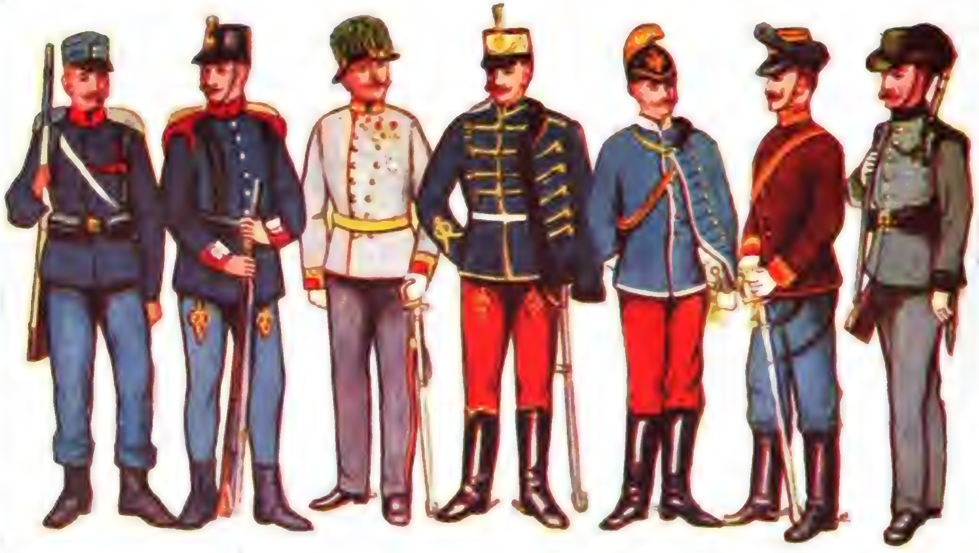
UNIFORMS

GREAT BRITAIN

AUSTRIA-HUNGARY


Royal Engineers, Officer
Grenadier Guards, Officer
Welsh Regiment, Officer
Rifle Brigade, Officer
King's Own (Royal Lancaster), Service Dress
Argyll and Sutherland Highlanders
1st Uhlans

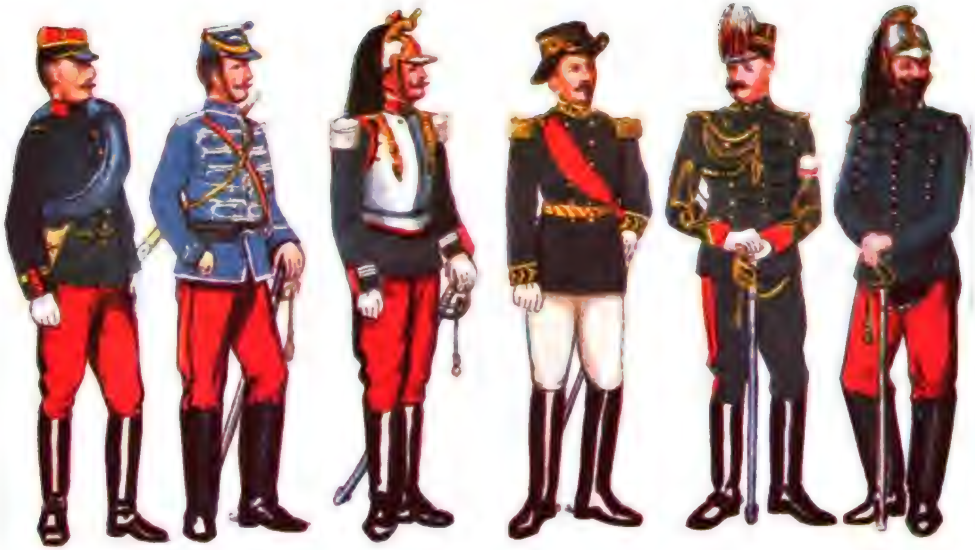
AUSTRIA-HUNGARY


Austrian 18th Infantry
Hungarian 82nd Infantry
General
9th Hussars
15th Dragoons, Officer
Artillery Colonel
Jäger

UNIFORMS

PLATE V

FRANCE



Infantry of the Line, Lieutenant

Hussar

Cuirassiers, Captain

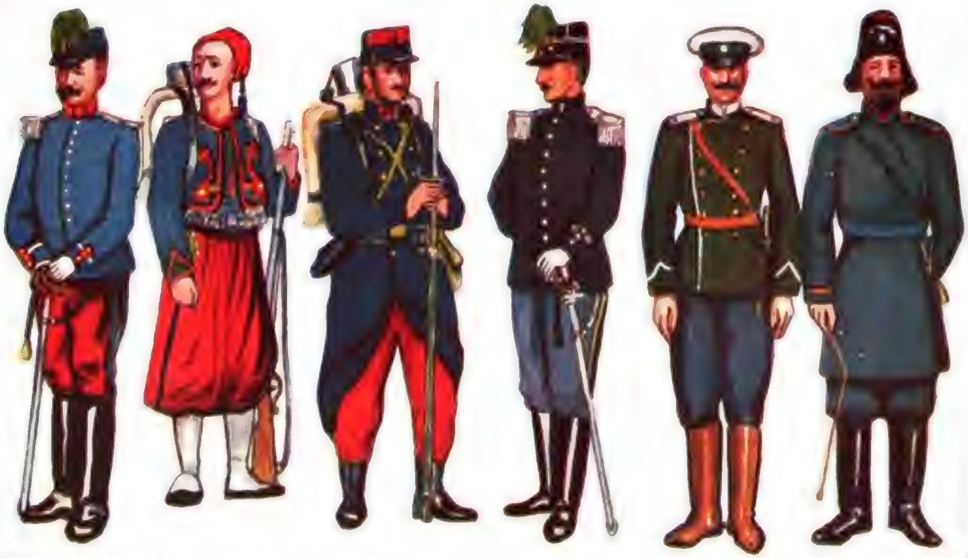
General of Brigade, Full Dress

Artillery (Lieut. on General Staff)

Dragoons

FRANCE

RUSSIA



Chasseurs à Cheval, Sub-Lieut.

3rd Zouaves

Line Infantry, Marching Order

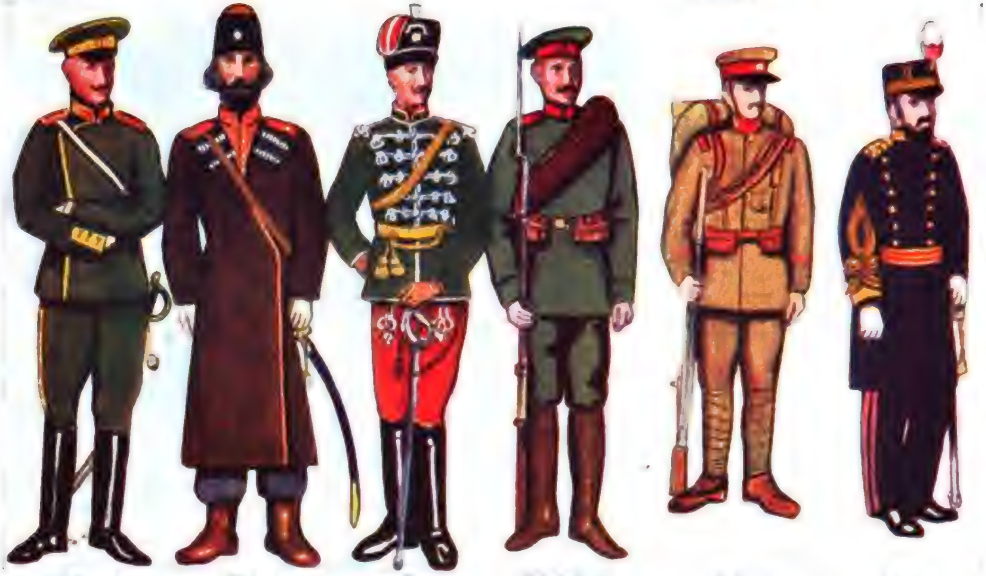
Chasseurs à Pied, Lieutenant

21st Dragoons, Officer

Don Cossack

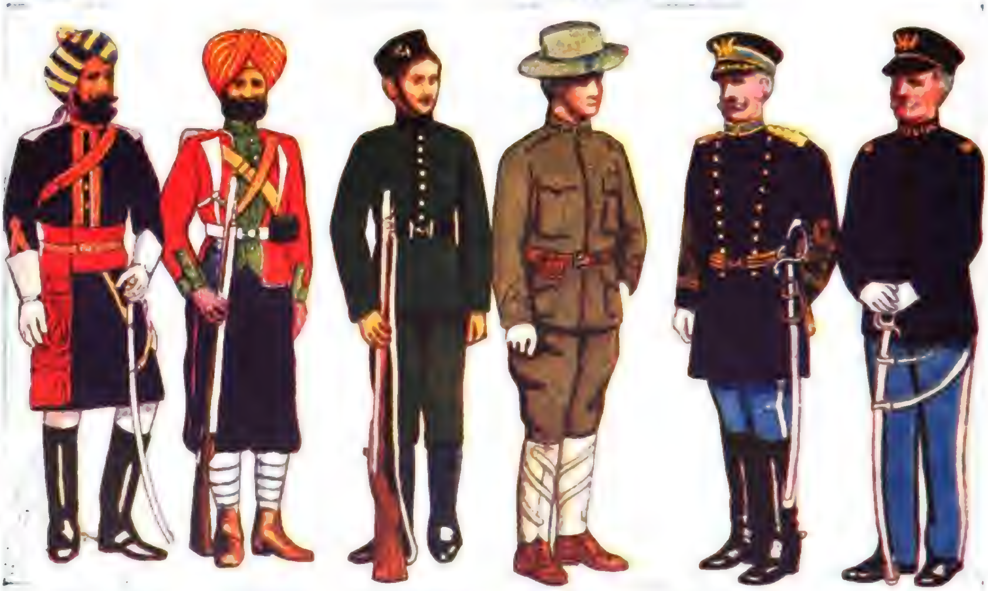
UNIFORMS

RUSSIA **JAPAN**



Lithuanian Guards, Officer — Kuban Cossack — Grodno Hussars, Officer — 17th Infantry of the Line — Infantry, Service dress — General Officer, Full dress

INDIA **UNITED STATES**

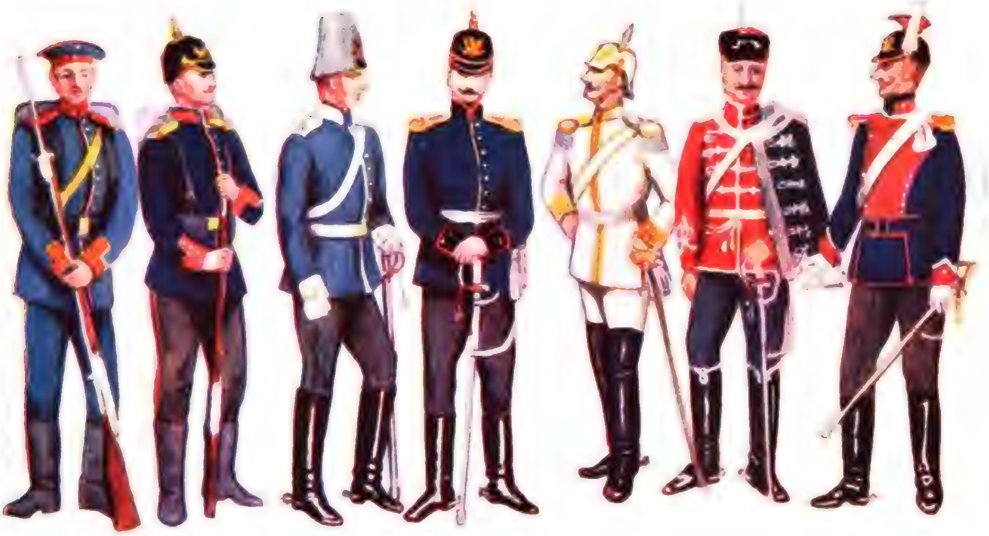


16th Cavalry — Ludhiana Sikhs — 2nd Gurkhas — Infantry, Service dress — Lieut.-Colonel, Infantry, Full dress — Captain, Infantry, Undress

UNIFORMS

PLATE VII

GERMANY



Bavaria: Infantry (III Corps)

Prussia: Infantry (V Corps)

Prussia: 9th Dragoons

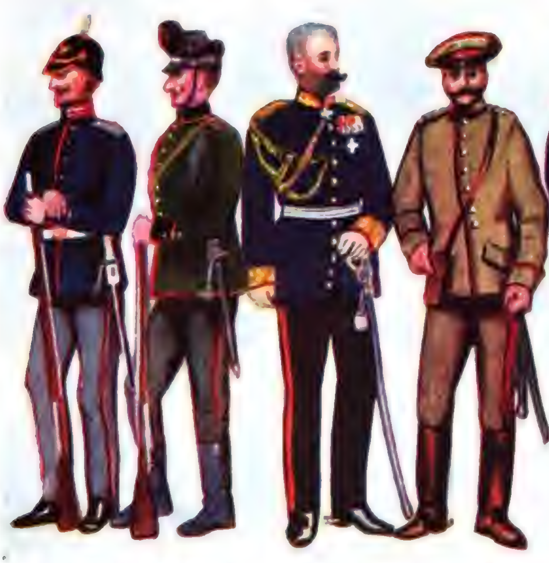
Prussia: Captain, Field Artillery

Prussia: Major, 7th Cuirassiers

Prussia: Officer, 3d Zieten Hussars

Prussia: 14th Uhlans

GERMANY



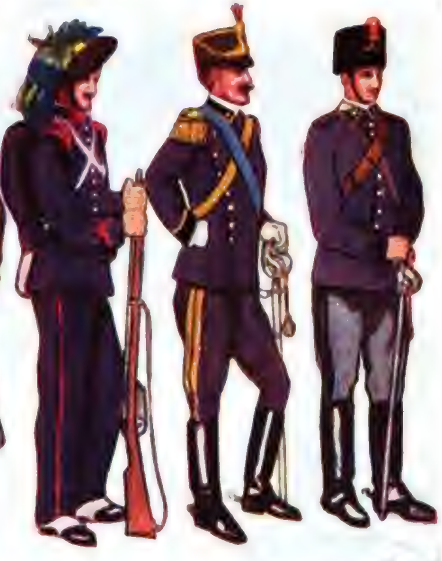
Prussia: 4th Grenadier Guards

Saxony: Jäger

Prussia: General

General Staff, Service Dress

ITALY.



Bersaglieri, Marching Order

Field Artillery Officer

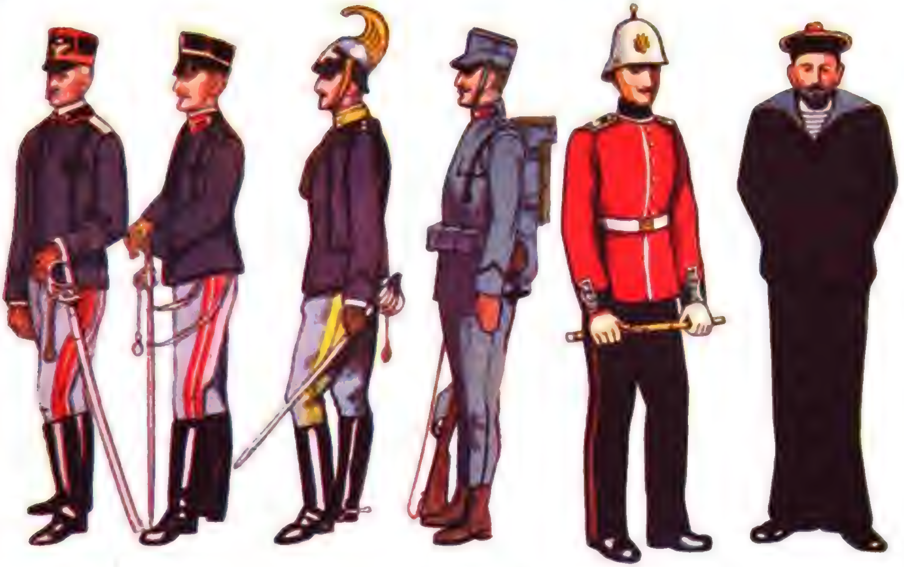
Cavallegieri (12th Regt.)

PLATE VIII

UNIFORMS

ITALY

NAVIES



Major-General

Infantry Officer, Undress (Pistoia Brigade)

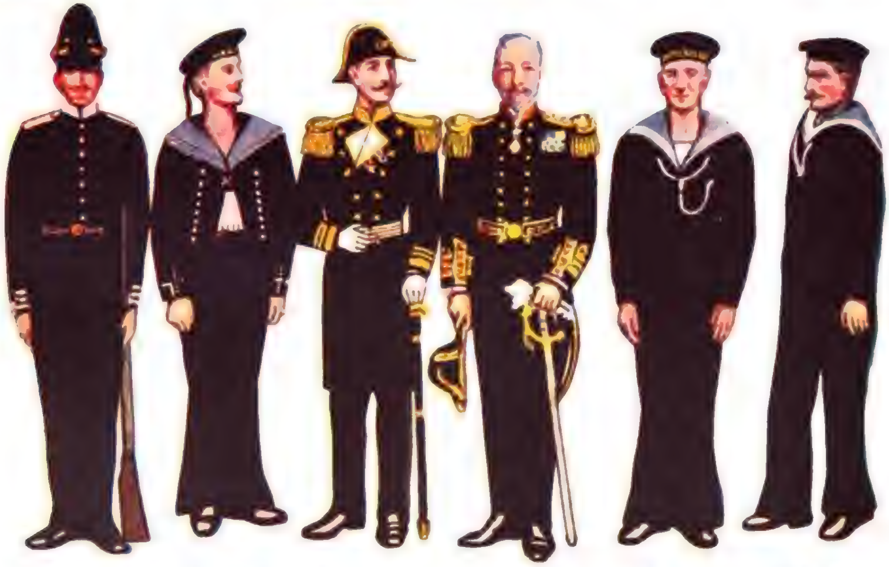
Line Cavalry, Officer; Undress (4th Genoa Regt.)

Infantry, Service Dress (Aosta Brigade)

England: Marine Light Infantry

France: Sailor

NAVIES



Germany: Marine

Germany: Sailor

Germany: Vice-Admiral

England: Vice-Admiral

England: Sailor

U. S. A.: Sailor

band white; in the 2nd Carabineers collar and cuffs black, braid black and white, helmet ornament a brass spike, cap-band black. The Bavarian heavy cavalry is dressed in dragoon fashion—light blue tunic, red facings, light blue collar edging, light blue trousers with red stripe, helmet with white plume. 1st regiment has silver buttons, the 2nd gold.

	Helmet.	Facings.	Blue Tunic Facings.	Buttons.
G. du Corps	Brass with silver eagle (or spike)	Red	Red	Silver
G. Cuirassiers	"	Blue	Blue	"
1 "	Steel with brass spike	Black	Black	"
2 "	"	Dark red	Dark red	"
3 "	"	Light blue	Light blue	"
4 "	"	Red	Red	"
5 "	"	Pink	Pink	Gold
6 "	Brass with silver spike	Dark blue	Poppy-red	"
7 "	Steel with brass spike	Yellow	Yellow	"
8 "	"	Green	Green	"

The line dragoon regiments, other than those of Oldenburg, Mecklenburg, Baden, Württemberg, and Grand Ducal Hesse (Saxony and Bavaria have no dragoons) wear light blue tunics with collars, shoulder-straps (with number), piping and cuffs of the regimental colour. The cuffs are Swedish. The trousers are blue-black without stripe. The helmet is black leather, very similar to the infantry helmet, with black horsehair plume. The regimental distinctions follow a regular scheme thus:—

Regiment.	1	2	3	4	5	6	7	8
Facing . . .	Scarlet	Black	Pink	Yellow	Scarlet	Black	Pink	Yellow
Collar edging	Lt. blue	Lt. blue	Lt. blue	Lt. blue	Lt. blue	Lt. blue	Lt. blue	Lt. blue
Buttons and ornaments.	Gold	Gold	Silver	Silver	Silver	Silver	Gold	Gold
Regiment.	9	10	11	12	13	14	15	16
Facing . . .	White	White	Crimson	Crimson	Scarlet	Black	Pink	Yellow
Collar edging	Lt. blue	Lt. blue	Lt. blue	Lt. blue	White	White	White	White
Buttons and ornaments.	Gold	Silver	Gold	Silver	Gold	Gold	Silver	Silver

The 17th and 18th (Mecklenburg) have respectively scarlet facings and gold buttons, and black facings with silver buttons. They have the double guard-stripe and cuff stripes. The 19th (Oldenburg) have the ordinary uniform with black facings and silver buttons, but white shoulder-straps.

The Baden regiments (20, 21 and 22) have light blue uniforms with scarlet, yellow and black facings, light blue, light blue and red edgings, and silver buttons. They have white plumes instead of black, and the Baden device on the helmet. The Hessian regiments (23 and 24) have dark green tunics; the 23rd have double guard-stripe, cuff stripes and scarlet facings; the 24th the ordinary tunic with white facings, and both silver buttons. The Württembergers (25 and 26) have white and yellow facings respectively, collar edging light blue, buttons gold and silver respectively; the 25th regiment has double guard-stripe and cuff stripes, and white plume. Belts are white throughout, except in the Hessian units, which have black.

The Prussian Guard Dragoons have light blue uniforms and red facings, double guard-stripes, and cuff stripes. Buttons gold in the 1st, silver in the 2nd. White plumes.

The uniforms of the eight Bavarian regiments of *Chevaulegers* resemble those of dragoons. They wear the black dragoon helmet and white plumes, dark green tunics, trousers and undress cap, and white belts. They also have the dragoon cuffs. But they have the double-breasted lancer tunic with front and piping of the regimental colour; crimson 1st and 2nd; pink 3rd and 6th; scarlet 4th and 5th; white 7th and 8th; the first of each pair having gold, the second silver ornaments.

The Lancers (*Ulanen*) wear the usual lancer uniform of czapka, double-breasted tunic with plastron, and girdle. The trousers are dark grey, the plume white. The girdle is of the uniform colour edged with the facings colour The cuff is the so-called "Polish," a round, slightly pointed cuff with a button (and where appropriate a guard-stripe) in the middle of the pointed portion. The collar is edged with the uniform colour. Regimental distinctions in the line are as shown in table at the top of next column.

Guard Ulans: dark blue tunic with double guard-stripe and cuff stripes, and dark grey trousers; 1st, red facings, and piping, white turnback (piped red), white czapka; 2nd, scarlet facings and czapka; 3rd, yellow facings and czapka.

17th, 18th and 21st (Saxon), light blue tunics and trousers, crimson facings, double guard-stripes and cuff stripes, brass scales, white piping. Czapkas white, crimson, light blue. Undress caps white. 19th and 20th (Württemberg), dark blue uniforms, dark grey trousers, facings and czapkas scarlet in 19th, yellow in 20th. 19th double guard-stripe and cuff stripe. Ornaments silver. 1st and 2nd Bavarian Ulans, dark green tunics and trousers, crimson facings and czapkas, white belts instead of girdles; 1st gold, 2nd silver ornaments.

	1	2	3	4	5	6	7	8
Facings and piping . .	Scarlet	Scarlet	Scarlet	Scarlet	Scarlet	Scarlet	Scarlet	Scarlet
Czapka and ground of scale . . .	White	Scarlet	Yellow	Lt. blue	White	Scarlet	Yellow	Lt. blue
Ornaments .	Gold	Gold	Gold	Gold	Silver	Silver	Silver	Silver
	9	10	11	12	13	14	15	16
Facings and piping . .	White	Crimson	Yellow	Lt. blue*	White	Crimson	Yellow	Lt. blue*
Czapka and ground of scale . . .	White	Crimson	Yellow	Lt. blue	White	Crimson	Yellow	Lt. blue
Ornaments .	Gold	Gold	Gold	Gold	Silver	Silver	Silver	Silver

* These two regiments have white piping.

The Hussars are very richly dressed, many having the slung pelisse. The front cuffs, back seams and collar are braided. The busby is low and slightly conical, the busby-bag hanging over towards the back on the left side. On the front of the busby are various decorations. Round the waist is a white girdle intertwined with the colours of the state to which the regiment belongs. A plain shoulder cord is worn. The trousers are dark grey with lace stripe. The Hessian boots have embroidered top and boss. The five senior regiments preserve the unusual colours indicative of their irregular origin. The remainder are clothed in dark and light blue, or green. All wear a white (gold or silver officers) pouch-belt, white plumes. The undress cap is of the colour of the tunic, with various bands.

	Uniform.	Busby-bag.	Lace and Braid.	Pelisse.
Guard	Scarlet	Scarlet	Gold	Dark blue
1	Black	Red	Silver	Black
2	"	White	"	"
3	Dull vermilion	Vermilion	"	Dark blue
4	Brown	Yellow	Gold	—
5	Dark red	Dark red	Silver	—
7	Dark blue	Red	Gold	—
8	"	Light blue	Silver	Dark blue
14	"	Red	"	—
15	"	Yellow	"	Dark blue
9	Light blue	Light blue	Gold	—
12	"	White	Silver	Light blue
13	"	Red	"	—
16	"	Yellow	"	Light blue
6	Dark green	Red	Gold	—
10	"	Pink	"	—
11	"	Red	Silver	—

The 17th Brunswick Hussars, preserving the memory of the Black Brunswickers of the Napoleonic wars, have black uniforms (no pelisse), with gold lace and red busby-bag. The 18th and 19th (Saxon) Hussars have light blue tunics and trousers (no pelisse), with gold and silver lace and red and crimson busby-bags respectively. No information is available as to the 20th Hussars, formed in November 1910.

The *Jägers zu Pferd* (mounted rifles) have a green-grey tunic and trousers of cuirassier cut, with green collars, Swedish cuffs, shoulder-straps, and piping, green-grey cap, brown belts and a black helmet of cuirassier pattern. The buttons are silver. The broad cuirassier braid on collar, front and cuffs is green, with white lines in the 1st, red in the 2nd, yellow 3rd, light blue 4th (the normal sequence), black 5th. The edgings of the shoulder-straps are similarly white, red, &c. The "staff orderlies" wear the same uniform, with certain deviations, in particular yellow and green braid, gold buttons, and white undress cap.

The machine gun detachments wear a grey uniform with red Swedish cuffs (guard-stripes and cuff stripes in the Guard corps), collar, shoulder-strap and piping. The head-dress is the Jäger shako, and the whole uniform is of Jäger type, so much so that the 2nd Guard detachment has the black collar and "French" cuff of the *Gardeschützen*.

The field artillery has the dark blue tunic with red piping, black collar and Swedish cuffs, gold appointments, and dark grey trousers without stripe. The helmet has a ball ornament. The cap is blue with black band. The Guard regiments have double guard-stripes and cuff stripes and a white plume—shoulder-straps, white for 1st, red for 2nd, yellow for 3rd, light blue for 4th regiment. In the field artillery at large the shoulder-straps are of the corps colour.

The Bavarian, two Württemberg, one Baden and two Hessian regiments have white or black (Bavarians red) plumes, otherwise as for a "red" Prussian corps. The Mecklenburg artillery has silver buttons. The Saxon field artillery uniform is altogether different, consisting of green tunics with red collars and Swedish cuffs, gold appointments, red edgings, and black plume (horse artillery have a brass scale). Prussian and Bavarian field artillery have white belts, others black.

The foot artillery, which has white shoulder-straps, is distinguished from the field by the black Brandenburg cuff with plain blue flap (Guard Swedish cuff, guard-stripes, &c.) and by a red trouser piping. The Saxon foot artillery is distinguished from the field by the ball ornament instead of plume, and the "German" cuff. Belts black (Guard and Bavarians white). Bavarian foot artillery as Prussian, but with a spiked helmet and black cuff-flap, red-edged.

The pioneers have the same uniform as artillery, but with silver buttons and appointments. The shoulder-straps are red, the helmet is spiked (Guards, black plume). The cuffs are black, red-edged, Swedish. Saxon pioneers as field artillery, but with "German" cuff. The "communication troops" wear similar uniforms with special badges, some having the Jäger shako. The *Train* (army service corps) has dark blue dragoon uniforms with light blue facings and black plumes; Saxons, however, have light blue with black facings. Medical officers and hospital corps wear blue uniforms with blue collars and cuffs and red edgings; stretcher bearers, &c., blue with magenta facings and silver buttons, &c.

Rank Badges (*a*).—Non-commissioned officers: lance-corporal a button on each side of the collar. Corporals and sergeants gold or silver lace on the collar and cuffs, small patches of the national colours on the collar patches of the greatcoat. Sergeants are distinguished from corporals by a button to the collar. There are numerous minor distinctions on the sword knots, lance pennons, hussar girdles, &c. Sergeant-majors have a narrow ring of lace on the cuff in addition to the broad under-officer's ring; and on the greatcoat patch two small national patches. Aspirant officers wear the uniform of their non-commissioned rank with some of the officer's distinctions. (*b*) Officers: The distinctive mark of the commissioned officer is the shoulder-piece (epaulette or cord). The epaulette is almost always silver and is worn as a "scale," *i.e.* without fringe, by captains and subalterns, with a fine fringe by field officers and with a thick fringe by general officers. The ranks within each class are distinguished by small stars on the circle of the epaulette, lieutenant, major, and major-general, no star; first lieutenant, lieutenant-colonel and lieutenant-general, one star; captain, colonel and general, two stars. A colonel-general has three stars and a field-marshal crossed batons. The number or cipher is also worn by all regimental officers. The body of the epaulette is usually of the same colour as the shoulder-strap of the rank and file. The shoulder cord for captains and subalterns is made up of straight strips of silver lace, that for field officers is of twisted silver cords, that of general officers is composed of two gold cords and one of silver and colours intertwined. In all these, lines of the national colours are interwoven with the silver. Badges, numbers, &c., as on the epaulette. A silver waist-sash (staff officers and adjutants shoulder-sash) is worn by all combatant officers (except hussars, who have girdles). An interesting survival of earlier uniforms is found in the full dress of general officers. The tunic buttons below the waist, and while on the left shoulder there is only a narrow silver cord, on the right the thick cord of gold, silver and coloured silks is extended to form an aiguillette. The aiguillette is also worn on the right shoulder by staff officers and some others. A universal custom, which is also a survival, is for all ranks to wear sword-knots, even with the bayonet.

The new service dress is a loose-fitting "field-grey" uniform, except in *Jägers*, machine-gun detachments and *Jägers zu Pferd*, who wear grey-green field dress.

AUSTRIA-HUNGARY

The infantry uniforms, since the abandonment of the historic white after 1866, have been of a very quiet shade of dark blue, and the facings colours are more varied than those of any other army. The "German," that is Austrian, infantry wears in full dress a dark blue single-breasted tunic, light blue trousers, and a black leather shako with double eagle and a metal ball ornament. The equipment is black. On the shoulders are straps terminating in rolls or "wings," all of the regimental colour, as are the collar and the ("German") cuffs. In marching or service dress the tunic is replaced by a hooked jacket or blouse with plain cuffs, no shoulder-straps, and only collar patches of the regimental colour. The trousers are turned up over or tucked into a high ankle boot. The field cap is of cloth, cylindrical, with flaps buttoning in front. Hungarian infantry wears the same tunic but has a silver or white embroidered device in front of the cuff. The trousers are tight pantaloons, with a yellow piping and "Austrian"—really Hungarian—knots. Officers of infantry have no shoulder cords or straps. The full dress shako and the collar are ornamented with braid or lace according to rank. A yellow waist-sash is worn. Hungarian officers are dressed as Austrian except for the tunic cuff ornament. In other respects both the tunic and the blouse are similar to the men's. Jägers wear a broad-brimmed felt hat with cock's feather plume on the left. The tunic, trousers and cap are green-grey; the buttons gold; cuffs, collar, shoulder ornament and piping in full dress, and collar patch and piping in undress, green. Officers wear the waist-sash and double green stripes on the trousers. All officers in undress wear plain dark grey trousers and dark grey cylindrical cloth cap, both in the line and the Jägers.

	Austrian.		Hungarian.	
Facings.	White or silver buttons, &c.	Gold or brass buttons, &c.	White buttons, &c.	Gold buttons, &c.
Black	58th	14th	38th	26th
Dark brown	17th	55th	78th	68th
Maroon	7th	93rd	83rd	12th
Dark red	18th	1st	53rd	52nd
Amaranth red	95th	90th	—	86th
Bordeaux red	88th	89th	—	—
Cherry red	77th	73rd	23rd	43rd
Madder red	74th	15th	34th	44th
Crimson	81st	84th	82nd	96th
Scarlet	80th	45th	9th	37th
Vermilion	20th	35th	67th	71st
Pink	36th	57th	66th	65th
Rose	97th	13th	6th	5th
White	92nd	94th	—	—
Sea green	87th	21st	25th	70th
Apple green	54th	9th	79th	85th
Bright green	10th	91st	50th	46th
Grass green	28th	8th	62nd	61st
Seaweed green	—	102nd	—	—
Grey green	47th	56th	60th	48th
Pike grey	49th	30th	69th	76th
Ash grey	24th	11th	33rd	51st
Orange	42nd	59th	63rd	64th
Imperial yellow	22nd	27th	31st	2nd
Sulphur	41st	99th	101st	16th
Sky blue	8th	4th	19th	32nd
Pale blue	75th	40th	29th	72nd
Pearl	98th	100th	—	—

Dragoons wear light blue jackets with collar and cuffs of regimental colour and narrow white or gold shoulder cord, red trousers, black crested helmets (gilded crests for officers), and slung pelisse exactly similar to the jacket except that the collar and cuffs are of black fur. The jacket is not merely an ornament, but is frequently worn, serving as a tunic. The field cap of the rank and file is red, shaped as for infantry, but without peak. Belts brown. The facings are—dark red 1st and 3rd, black 2nd and 6th, grass green 4th and 9th, imperial yellow 5th and 12th, sulphur yellow 7th and 10th, scarlet 8th and 11th, madder red 13th and 14th, white 15th. Silver buttons 1, 2, 4, 5, 6, 7, 11, 13, gold 3, 8, 9, 10, 14, 15.

Hussars wear dark or light blue jackets and pelisses, the former braided, the latter braided and edged with black fur. The trousers are red with gold "Austrian" knots and piping (all hussars are Hungarian) and the boots have the usual hussar braid. The head-dress is a shako with black "shaving-brush" plume. Regimental distinctions are as follows:—

	Shako.	Silver.	Gold.		Shako.	Silver.	Gold.
Uniform Dk. blue	White	9th	3rd	Uniform Lt. blue	White	12th	2nd
	Dark blue	13th	1st		Light blue	7th	10th
	Madder red	5th	8th		Madder red	4th	14th
	Ash grey	11th	15th		Ash grey	16th	6th

Lancers (*Uhlans*, who do not carry lances) wear the lancer cap (*czapka*) with black plume looped back, and old ornaments, light blue double-breasted lancer tunics (slung on the shoulder as pelisses) with madder red cuffs and piping—but no "plastron"—black for collar and gold shoulder cord. The jacket is plain, light blue, with breast and skirt pockets and flaps edged red, red collar and cuffs, no shoulder cord. The trousers are red. Regimental distinctions—top of the *czapka*, imperial yellow 1st and 6th, dark green 2nd and 7th, madder 3rd and 8th, white 4th, light blue 5th, cherry 11th, dark blue 12th and 13th. Gold buttons 1st, 2nd, 3rd, 4th, 5th and 12th, silver 6th, 7th, 8th, 11th and 13th.

All cavalry officers wear gold or silver pouch-belts; in undress dark grey trousers and cap are worn. Men's undress cap as for dragoons. All cavalry men carry the carbine slung and have brown belts.

Artillery wear maroon tunics, light blue trousers, red collars, cuffs, shoulder-straps and wings, light blue cap, shako with black plume looped back. Fortress artillery have a red stripe in the trousers, technical artillery are dressed as field, but with dark grey trousers and cap and without plume. Buttons gold. On the jacket the whole collar is red. Officers wear pouch-belts as cavalry, and in undress the usual grey trousers and cap.

Engineers have an infantry uniform, but in the Jäger colours, grey and green. Train (A.S.C.) as artillery, but with light blue facings and red trousers with cap. Their shako has no plume.

The staff wears a dark green tunic, short-waisted, double-breasted and piped all round with red. The collar and cuffs are red (cuffs black for general staff), buttons and lace usually gold. The trousers are dark grey, piped red (in some cases with stripes of yellow and red) The general staff wears the waist-sash; the adjutant-general's branch, aides-de-camp, &c., the same sash over the shoulder (as indeed all adjutants wear it in Germany and Austria). The cocked hat is small and has a green feather plume. General officers ordinarily wear dark grey trousers with double red stripe, pearl-grey tunics, cocked hats and waist-sash; their collars and cuffs are red. Inspector-generals of artillery and engineers wear the colours of their arm (brown and Jäger grey). In court dress, however, Austrian generals wear the old white tunic and red, gold-laced trousers; Hungarian generals an elaborate red hussar dress, with a white pelisse.

Rank is shown by stars and lace on the collar. Lance-corporal, corporal and sergeant have 1, 2 and 3 worsted stars; second lieutenant, first lieutenant and captain 1, 2, and 3 gold or silver stars; major, lieutenant-colonel and colonel 1, 2 and 3 stars on a gold-laced collar; major-general, lieutenant field-marshal and general (or *Feldzeugmeister*) 1, 2 or 3 stars on laced collar.

Russia

The figures in Plates V and VI represent the uniforms of 1905. Since that time the attempt to combine bright colours with the looseness and comfort of service dress has been abandoned, and the troops have received a more handsome full dress and a grey-green field dress. Little information as to the details of the new uniforms has been published. The ordinary infantry uniform was a double-breasted hooked tunic of dark green cloth, dark green trousers and cap (in full dress a round fur cap). With a few exceptions, details of facings, &c., followed well-marked rules. The number of the regiment appeared on the cap, that of the division on the shoulder-strap. The two regiments of the 1st brigade in each division wore red shoulder-straps, the two of the 2nd brigade blue. The 1st regiment had a red cap band and red collar patches, the 2nd blue, the 3rd white and the 4th green. It is not known how far this has been modified of late years. Regiments with royal colonels-in-chief wear ciphers on the shoulder-strap, and some have double guard-stripes on the collar. In winter a heavy grey-brown greatcoat is worn, usually with a loose sheepskin lining and a fur-lined hood. The grenadiers are distinguished by yellow shoulder-straps (with a narrow edging of red, blue, white and yellow, according to the division). The Guards wear closely fitting tunics, with guard-stripes on the collars and cuff-flaps. In the 1st Guard division the shoulder-straps and piping are red and white, in the 2nd red and red, in the 3rd yellow and yellow respectively. The cuff-flaps are red in 1st, and 2nd, yellow in 3rd division. The colour of the collars and cuffs varies according to the order of regiment within the division. The Pavlovsky regiment wears, instead of the fur cap, the old mitre-cap in brass and stiff red cloth.

Rifles wear the universal pattern uniform with plain cap-band and collar and crimson shoulder-straps. The Finland rifles have light blue instead of crimson, and the Guard rifles have double guard-stripes and stripes on the cuff-flap (or Swedish cuff).

Line dragoons wear a dark green silver or gold buttoned tunic, double-breasted, grey-blue trousers and knee boots. The cap, which was peaked, and had a dark green band, was, in 1905, red for the 1st, blue for the 2nd, and white for the 3rd regiment of each division, the same colours appearing on the collar patches, piping and shoulder-straps. The regimental number (or colonel-in-chief's cipher) appears on the shoulder-strap. The fur cap is in shape a truncated cone, the body of the cap being of the colour of the facings and the sides of fur. A few regiments had special distinctions.

The cuirassiers (guards) wear in full dress white cuirassier uniforms with brass helmets and eagles, and in field order dark green tunics and white caps. The trousers are grey-blue with red stripe. The Horse Grenadiers wear dark green lancer tunic with red facings, double guard-stripe and cuff-stripe, red girdles and dark grey trousers with red stripes. They wear epaulettes and the curious grenadier cap mentioned above. The Guard Dragoons are dressed as the Horse Grenadiers, but with the dragoon busby and red shoulder-straps. The Guard Lancers wear a lancer uniform resembling the German, blue with scarlet facings, lancer caps and grey-blue trousers. The top of the czapka is scarlet and yellow for the respective regiments. The Emperor's Hussars wear scarlet tunics and blue trousers, and the Grodno Hussars dark green tunics and crimson trousers (see Plate VI., line 1, fig. 3), with busby, red busby-bag and white plume; girdles scarlet and blue and green and white, and braid yellow and white respectively.

The artillery tunic, trousers and cap are dark green, the piping and shoulder-strap red. The Guard Artillery has black collar and cuffs, red-edged. The engineers are distinguished from artillery by their having silver buttons and appointments instead of gold.

The greater part of the Cossacks wear a long, loose caftan. This, in the Don, Ural and Astrakhan contingents is dark blue, in the rest, except as mentioned below, dark green. Cossacks wear no spurs, but use a whip. As for the facings, the Don regiments have plain, and the other blue regiments crimson and yellow shoulder-straps respectively, and the green regiments have red, yellow or light blue. The head-dress is a conical lambskin cap, with cloth top, or a blue or green cap with band of the regimental colour. The Caucasus regiments, however, wear a more distinctly national uniform, consisting of a dark brown, collarless caftan, cut away below the throat to show a waistcoat, scarlet for Kuban and blue for Terek regiments (Plate VI., line 1, No. 2). The shoulder-straps are of the colour of this waistcoat. The Caucasus regiments always wear the full head-dress and never the field cap. The Guard Cossacks have short tunics (scarlet, light blue and dark red) with guard-stripes on collar and cuffs, and caps of the same colours. These wear spurs besides carrying whips. The Cossacks of the tsar's escort wear a scarlet caftan edged with gold braid, white waistcoat and dark blue trousers. The Cossack artillery wears green uniforms of Cossack cut, with red facings.

Badges of rank are as follows: Non-commissioned officers, one, two or three stripes of braid across the shoulder-strap; sergeant-major, a stripe of gold lace across the shoulder-strap. In and above the rank of corporal, gold lace is worn on the collar and cuffs as in Germany. Officers wear broad cloth (red, blue, &c.) shoulder-straps nearly covered by strips of silver or gold lace; on these appear the number or cipher and stars of rank—subalterns one, two and three, second captains four and senior captains none. In these ranks the cloth of the shoulder-strap shows in one narrow strip through the lace. In the field ranks, the cloth, covered by three bars of lace, shows two strips and the same sequence is followed: lieutenant-colonel, three stars; colonel, none. In general officers' uniforms the lace entirely covers the cloth, and the stars number two for a major-general, three for lieutenant-general and none for a full general.

Italy

The universal colour in full dress and undress coats is a dark, flat blue, faintly tinged with purple. Generals, cavalry and infantry (except *Bersaglieri*) wear blue-grey trousers and silver ornaments; staff officers, artillery and engineers dark blue trousers and gold ornaments.

The coat, whether tunic or frock, has a stand and fall collar, on the corners of which invariably figures a five-pointed silver or white star. The cuffs are slightly pointed, except for cavalry. The full-dress head-dress is a low cloth shako, the undress throughout a képi. Generals wear only the képi. The tunic, double-breasted for officers and single-breasted for rank and file, is cut very short, and has little piping. Officers have plain blue shoulder-straps with stars showing rank. A white collar is worn under the coat collar by all ranks. Officers have a blue frock, with black braid and plain cuffs.

Infantry have silver buttons and (rank and file) red-edged shoulder-straps and shoulder wings, blue-grey trousers with red piping (officers, double stripe). The shako is blue with red piping (officers, silver braid), silver device and cockade; the képi (in the rank and file pointed back and front and pressed down at the sides) is similar in colour, &c., to the men's shako. The belts are black. The Grenadier brigade alone has red collars and cuffs, all others are self-coloured (red edge to cuff). The greatcoat is light blue-grey, single-breasted and unadorned except for shoulder wings. White or holland gaiters are worn with the blue uniform. The brigades are distinguished by gorget patches of the brigade colours, upon which the star is worn. Officers wear a shoulder sash of light blue, and in full dress silver epaulettes.

Cavalry.—Line cavalry have light coloured collars, cuffs and shoulder-strap edges, silver buttons, and blue-grey trousers with double back stripe (officers, of the facings colour). Regimental distinctions are given in the table. The full head-dress is a singularly handsome helmet, partly black, partly bright steel, with a tall swan-neck crest (see Plate VIII., line 1, fig. 3) and on the front a broad white cross. The undress cap is a képi with piping as in table. On the men's shoulder-straps is a silver grenade. The lancers (*Lanzieri*) have coat and trousers as line cavalry with regimental distinctions given below. On the men's shoulder-straps are crossed lances. The head-dress is a fur cap, adorned with crossed lances and chain in silver. It has also a cockade and a small upright plume. The crossed lances appear also on the képi. The light horse (*Cavallegieri*) have a similar coat and trousers, except that the collar has a flame-shaped patch. Shoulder-strap, full head-dress and képi as for lancers, with a bugle instead of lances. All cavalry have brown bandoliers over the left shoulder.

Artillery, gold buttons, dark blue trousers, with yellow piping (officers, double yellow stripe). Officers' tunics have black yellow-edged collars and cuffs, men's a black yellow-edged collar patch, and yellow edgings on the collars, shoulder-straps and cuff. The badge of the field artillery on shako, képi and men's shoulder-straps is gold crossed guns; that of the horse and mountain, a gold grenade; fortress artillery are dressed practically as field. The shako has gold badge and short upright plume (horse artillery long black plume, looped back on the right side); the képi piping is yellow. Gold epaulettes and light blue sash are worn by officers, and in the horse artillery a pouch-belt as well. *Engineers* have the artillery uniform, but with red piping, &c. instead of yellow, and badge of crossed axes. The departmental corps wear, as a rule, black facings with light blue piping, differing amongst themselves in details.

The famous *Bersaglieri* (light infantry) have the infantry tunic and frock with gold buttons, &c. (officers in full dress, epaulettes), dark blue trousers with crimson stripe. Officers have crimson cuffs, all ranks a blue red-edged collar, with crimson flame patch. The distinctive feature is the dark, wide-brimmed, slouch hat with a large drooping cock's feather plume. The Alpine infantry (*Alpini*) have a black felt hat with silver device and eagle feather, tunic, trousers and képi with green instead of red piping throughout. Officers wear black collar with green flame patch and green cuffs.

	Collar.	Cuff.	Piping.
Line.			
1 Nice	Crimson	Crimson	Crimson
2 Piedmont	Red	Red	Red
3 Savoy	Black, red edged	Black	"
4 Genoa	Yellow	Yellow	Yellow
Lancers.			
5 Novara	White	Black	As collar
6 Aosta	Red		
7 Milan	Crimson		
8 Montebello	Green		
9 Florence	Orange		
10 Victor Emmanuel II.	Yellow		

	Collar.	Flame patch.	Cuff.	Piping.
Light Horse.				
11 Foggia	Red	Black	Red	Red
12 Saluzzo	Yellow	"	Black	Yellow
13 Monferrato	Black	Crimson	"	Crimson
14 Alessandria	"	Orange	"	Orange
15 Lodi	Red	Black	"	Red
16 Lucca	White	"	"	White
17 Caserta	Black	Red	Red	Red
18 Piacenza	Green	Black	Black	Green
19 Guides	Lt. blue	White	Lt. blue	White
20 Rome	Black	"	Black	"
21 Padua	Crimson	Black	"	Crimson
22 Catania	Orange	"	"	Orange
23 Humbert I.	White	Lt. blue	White	White
24 Vicenza	"	Red	"	Red

General officers have a single-breasted tunic with black velvet collar and cuffs laced with silver, red piping, silver shoulder-straps, and silver buttons. Frock, trousers, &c., as shown on Plate VIII., line 1, No. 1. Staff officers wear light blue collar and cuffs, dark blue trousers with gold stripe and shako somewhat as for artillery officers. They wear the usual light blue shoulder sash, but over the left, instead of, as in the army at large, over the right shoulder.

The new service dress is blue-grey, regimental distinctions as on the officer's frock and képi in all arms. Infantry equipment is shown on Plate VIII., line 1, No. 4. The cavalry head-dress is a round grey helmet

Rank Badges.—Non-commissioned officers: Red or silver chevrons above the cuff, and small distinctions on the shako. Officers: On the shoulder-strap, 1, 2 and 3 silver stars for subalterns and captains, the same with narrow silver edging round the strap for field officers, 1, 2 or 3 gold stars on a silver shoulder-strap for general officers; on the shako, silver or gold rings round the upper part, on the képi rings round the lower part of the cap, 1, 2 or 3 for company officers, 1 broader ring and 1, 2 or 3 for field officers. On the general's képi there is a red, silver-embroidered band with 1, 2 or 3 rings above.

UNITED STATES

The uniforms, though recent changes have largely deprived them of their character, still in some respects follow the French fashion upon which they were originally modelled. The helmet, worn until 1899, indeed showed no trace of French influence—it was simply a mere showy parade head-dress. The French képi, worn during and after the Civil War, has been abolished and replaced by a cap which, like the full-dress cap now worn, bears some resemblance to the Japanese cap. But the long-skirted blue tunic, the general's "chapeau," the sergeant's and corporal's long pointed chevrons still survive to recall the old uniforms, and one or two of the innovations, the rank badges on the sleeve, are also French.

Infantry Officers.—Full dress: universal pattern tunic (dark blue, double-breasted with thick gold shoulder cord) with light blue, gold-laced collar, light blue trousers with white stripe, badges of rank and branch on sleeve. Universal pattern full-dress peaked cap (stiff blue cloth, gold-edged band, and eagle badge, with light blue band). Undress: universal pattern frock (dark blue, single-breasted, braided black and hooked; across the shoulder, flat loops edged with gold lace and bearing rank badges); shoulder loop light blue; plain collar with U.S. and branch badge in gold; trousers as in full dress. Sword belt under the frock, slings brown leather. Cap, of the same shape as full-dress cap but with plain black braid band. A white undress of similar pattern is worn in hot climates. Service dress (olive drab or light khaki). Coat, single-breasted, four pockets, stand and fall collar, bronze buttons and ornaments. Brown waistbelt and braces, somewhat similar to British "Sam Browne," but with sword slings. Peaked cap, plain olive drab or khaki, with bronze eagle badge. Slouch hat, grey, with gold and black twisted cord.

Evening dress and mess dress. blue, with shoulder cords and rank-marks as in full dress, blue trousers. Greatcoat, universal pattern, khaki with horn buttons; rank-marks in black braid on the sleeve, branch badge in bronze.

Cavalry officers as infantry, but with yellow collar, cap-band and trousers stripes as full dress and branch badge.

Artillery officers as infantry, but with red collar, cap-band and trousers stripes, and branch badge.

Engineer officers as infantry, but branch badge, red ground with white edges on full-dress collar and cap. Full-dress trousers, dark blue with red, white-edged stripe, undress, light blue with red stripe. In full dress engineer officers have the special distinction of wearing red skirt-flaps with white line and gold edge. *Signal Corps*, as infantry, but with branch badge and salmon collar, cap-band, &c. Signal officers, alone in the army, wear a pouch-belt: this is of black leather—crimson leather for the chief of the corps—with gold appointments. *Ordnance Corps*, as infantry, but dark blue red-edged trousers stripes, &c., and branch badge. *Medical*, as infantry, but with magenta stripes, &c., and branch badge.

Generals and Staff Officers.—Major-generals (and with a third star lieutenant-generals), dark blue double-breasted tunic with buttons in threes, and cuffs and collar of black velvet ornamented with oak-leaf gold embroidery, above the cuffs two silver stars; gold epaulettes and aiguillette, wide yellow waist-sash; dark blue trousers with two gold stripes: slings, and waist-belt if worn, crimson leather with gold stripes. "Chapeau" or cocked hat (French pattern) black felt with black feather edging and gold ornament; full-dress cap, universal pattern, with black velvet band, embroidered on band and peak as on full-dress cuffs. Undress: blue frock, double-breasted, with buttons in threes, "stand and fall" collar with U.S. in gold; rank marks on shoulder loops; plain dark blue trousers, universal pattern undress caps with oak-leaves on the peak only. White undress uniform is similar. Brigadier-generals, as major-generals with the following distinctions: one star on the sleeve or shoulder-loop, narrow yellow sash, buttons in pairs, plain black strap instead of crimson waist-belt (with, however, crimson and gold slings). Service dress and overcoats (all general officers) universal pattern: on the slouch hat a gold cord instead of black and gold. Evening and mess dress, universal pattern, with cuffs, collar and epaulettes as in full dress. Certain general officers who are chiefs of departments wear some of the distinctions of their branch; thus the adjutant-general, the quartermaster-general, &c., wear the branch badge below the stars, the chief of engineers the scarlet engineer skirt flap, the chief of artillery a crimson waist-sash instead of yellow. In undress these officers have a ground of their branch colour instead of dark blue on the shoulder loops. *Staff officers* are in the main uniformed in the same way as those of infantry, but wear dark blue trousers (in full dress a gold stripe), black and gold belts and slings, branch badge on sleeve, and full-dress collars, full-dress cap-bands and undress shoulder loops of the branch colour.

Branch and Line Badges.—General staff, a silver star, decorated with eagle device; inspector-general's department, sword and "fasces" crossed in wreath, gold, adjutant-general's department, gold shield with U.S. arms; quartermaster-general's department, sword and key crossed, surmounted by eagle, over a wheel, gold; ordnance, grenade; commissary or subsistence, silver crescent; infantry, gold crossed rifles; cavalry, gold crossed swords, artillery, gold crossed guns; engineers, silver castle, signal corps, crossed flags and torch; medical, winged Aesculapius staff. Aides-de-camp wear a shield like the adjutant-general's but in red, white and blue enamel and surmounted by an eagle; adjutants, quartermasters, commissaries, &c., of the combatant arms wear a shield, sword and key, crescent, &c., under the guns, swords, &c., of the regiment or corps.

Branch and Arm Colours.—Infantry, light blue; cavalry, yellow; artillery, red; engineers, red with white edge, signal corps, salmon with white edge; quartermaster's department, yellow ochre; ordnance, blue with crimson edge; other staffs and departments, light blue; medical, magenta, general staff, dark blue.

Badges of Rank.—Officers general, lieutenant-general, major-general; brigadier-general, stars 4, 3, 2, and 1 respectively, in all orders of dress. Other officers, in undress, silver on a shoulder loop of coloured cloth according to branch, colonel, spread eagle, lieutenant-colonel, pair of oak-leaf sprigs; major as lieutenant-colonel but in gold, captain, two pairs of bars, 1st lieutenant, one pair of bars, 2nd lieutenant, no badge: in full dress, evening dress and greatcoat, colonel fivefold, lieutenant-colonel fourfold, major threefold, captain twofold, 1st lieutenant single Austrian knot of narrow gold braid, 2nd lieutenant no Austrian knot. Field officers have black leather waist-belt and slings completely covered with gold braid, and also oak-leaf embroidery on the peak of the full-dress cap. Captains and lieutenants have similar belts, but with four gold braids only; in the infantry, cavalry, artillery and engineers the intervening spaces ("lights") are coloured light blue, yellow, &c., while in other cases the black leather is allowed to appear.

Enlisted men are dressed similarly to officers, with the following differences: tunic with dark blue cuffs, collar and shoulder-straps. The collar is edged top and bottom, the shoulder-straps all round and the cuffs along the top edge wth yellow for cavalry, light blue for infantry, &c. The badge of the branch in brass is on the collar. Lines are worn (aiguillette fashion) as an additional decoration; these are of the branch colours. The trousers are light blue, with, in full dress, stripes of branch colours. The white undress, service dress and greatcoat are similar to those for officers, with certain distinctions in detail. The full-dress cap is of the officers' pattern, but the band is dark blue, edged with the branch or arm colour above and below, and the badge is brass in a white metal wreath. The slouch hat has a cord of the branch colours. Rank marks of non-commissioned officers are long, graceful chevrons (inherited from France) pointing upwards, 1, 2 and 3 for lance-corporals, corporals and sergeants, 3 with diamond star, &c., for "first sergeants" and corresponding ranks, 3 with the lower ends connected by bars or arcs of the chevron material for sergeant-majors and staff-sergeants. In full dress these chevrons are of the colour of the branch facings, in service dress of khaki embroidery.

Naval Uniforms.—The full-dress coat of British naval officers is a dark blue double-breasted swallow-tailed coat with gold buttons, lace and epaulettes, a white gold-edged slashed-flap on the sleeve with rings of lace showing rank. Dark blue trousers with gold stripes, and black silk cocked hat. The undress coats are frock coat, which may be worn with epaulettes, and double-breasted jumper, both having plain cuffs with rings of gold lace. The undress cap is a peaked cap with gold badge. Certain petty officers wear blue jumpers, the rest and the sailors wear sailors' dress (Plate VIII., line 2, No. 5). White is worn in the tropics, with white pith helmets in the case of officers and broad-brimmed straw hats in that of the sailors. Royal Marine Artillery and Royal Marine Light Infantry are dressed as artillery and infantry of the army, with certain distinctions; they may always be recognized by the badge of a globe within a laurel wreath. (Plate VIII., line 1, No. 5.)

Officers' Rank Marks.—(*a*) On the epaulette: Batons in laurel wreath and crown, admiral of the fleet; crown, sword and baton crossed, and 1, 2, 3 stars, rear-admiral, vice-admiral, admiral; anchor and crown, with 0, 1, 2, stars, commander, junior captain, senior captain; anchor and star, senior lieutenant; anchor, junior lieutenant; anchor on fringeless epaulette, sub-lieutenant. (*b*) On the sleeve (in all orders of dress except white, and greatcoat): flag officers, broad gold ring with 1, 2, 3, 4 narrow rings (the uppermost with a curl) for rear-admiral, vice-admiral, &c.; other officers, 1, 2, 2 with narrower ring between, 3 and 4 for sub-lieutenant, junior lieutenant, senior lieutenant, commander and captain. (*c*) Shoulder straps in greatcoat and white undress, blue strap with bars and curl as on sleeve in other orders, except flag officers, who have gold-laced shoulder-strap with rank marks as on epaulette. Non-combatant branches have not the "curl," and between the gold bars or rings there are "lights" or stripes of various colours according to branch. The Royal Naval Reserve officers have similar rank mark, but, instead of bars of plain lace, a thin twist of gold embroidery, and an oval badge surrounding the anchor on the epaulettes.

The uniforms of other navies are very similar to those of the British. The old-fashioned jacket worn over the sailor blouse, and the conspicuous white lapels of the full-dress coat, are the principal peculiarities of the German navy. The Spanish naval officer has red lapels. A very marked peculiarity of the Austrian navy is that the officers, dressed in all other respects similarly to the naval officers of other countries, have the military tunic. The marines, where they exist, conform to the infantry of the respective land forces in most respects; the German marines, however, wear the Jäger shako, and navy-blue uniforms with white collars and cuffs. (Plate VIII., line 2, No. 1.)

See Colonel C. Walton, *British Army*; and British regimental histories; Ottenfeld and Teuber, *Oesterreichs Armee*; Richard Knötel, *Uniformen-Kunde*; R. Nevill, *British Military Prints*; Lienhardt and Humbert, *Les Uniformes de l'Armée Française*; British Dress Regulations, 1822, 1834, 1846, 1855–64, 1874, 1883, 1891 and 1904; Lavisse, *Sac au Dos*, and Moritz Ruhl's handbooks of the German, Austrian, Russian, Italian and French army uniforms of the present day. The particulars given of the United States army uniforms have been obtained, by the kind permission of the United States Embassy, from official plates. (C. F. A.)

UNION (known locally as Union Hill and officially as Town of Union), a town of Hudson county, New Jersey, U.S.A., on the Hudson river, adjoining West Hoboken and Weehawken, and opposite New York City. Pop. (1900), 15,187, of whom 5179 were foreign-born; (1910 U.S. census) 21,023. In the foreign element Germans predominate. The town is served by the railways passing through Weehawken and Hoboken. The principal manufactures are silk goods, shirts and malt liquors. In 1905 the factory products were valued at $3,512,451. Originally a part of the township of North Bergen, Union was incorporated as a separated township in 1861, and as a town, under the name Town of Union, in 1864. Town of Union must not be confused with Union township (pop. in 1910, 3419), Union county, incorporated in 1808; Union township (1910, 2756), Bergen county, incorporated in 1852; Union township (1910, 982), Ocean county, incorporated in 1846; and Union township (1910, 930), Hunterdon county, incorporated in 1853. Union township, Camden county, became Gloucester City in 1868, and Union township, Hudson county, became West New York in 1898.

UNION, a town and the county-seat of Union county, South Carolina, U.S.A., about 66 m. N.W. of Columbia. Pop. (1900) 5400, of whom 1701 were negroes; (U.S. census 1910) 5623. Union is served by the Southern and the Union & Glenn Springs railways; the latter connects at Pride, 16 m. distant, with the Seaboard Air Line. The city is situated in the Piedmont region near the foot of the Blue Ridge Mountains. It is the seat of Clifford Seminary for Young Women (opened, 1881; chartered, 1883), and has a Carnegie library. Union is in a rich cotton-growing, farming and fruit-growing region, and deposits of gold, magnetic iron ore, marble and granite are found. The town has several large cotton mills and a large knitting mill. Union was settled about 1755 and was incorporated as a town in 1872.

UNION LEAGUE OF AMERICA, THE, sometimes called the Loyal League, an organization for political purposes of Northern whites, later of Southern blacks, which originated in Ohio in 1862 when the Confederate military successes and political disaffection in the Northern states made the outlook for the North seem doubtful. Within one year it had spread over eighteen Northern states and among the Unionists of the South. The order raised troops, paid their expenses, sent supplies to the field and distributed political literature. At the close of the war it worked for radical reconstruction of the Southern states, punishment of the Southern leaders, confiscation of property and negro suffrage. The Southern Unionists hoped to make it the nucleus of a new political party, but this was frustrated by the admission of the blacks for political purposes, after which the Southern whites generally deserted the League. After the Freedmen's Bureau agents and other Northern whites obtained command of the League in the South it became simply a machine to control the votes of the blacks. The League ceased to be important in the North, though headquarters were in New York City. Each Southern state had its grand council and each county one or more councils. A constitution and an elaborate ritual were adopted, making it an oath-bound secret order, whose members were sworn to support one another on all occasions, to vote in elections only for negroes or Northern men, and to overthrow the Southern "white oligarchy." No ex-Confederate and few Southern Unionists were permitted to join. At each meeting the members were taught from a catechism prepared by Radical members of Congress that they must beware of their white neighbours as their worst enemies, that the Democratic party, to which the Southern whites belonged, had opposed emancipation and was still opposed to any rights for the negro. In order to prevent moral control of the negroes by former masters, the League, by an "exodus order," required all negroes who were still living with their former masters to find other homes. The negroes were taught the equality of men and the right of the negro to his master's property. The votes of blacks, during reconstruction, were controlled by the few white Radical leaders. No negro could safely break away and vote independently. Negroes who voted with the mass of the Southern whites were persecuted, beaten or (as in a few cases) killed. The League died out about 1870, but not before it had succeeded, with the Freedmen's Bureau and other forces, in permanently arraying the blacks and whites into opposing political parties. (W. L. F.)

UNIONTOWN, a borough and the county-seat of Fayette county, Pennsylvania, U.S.A., about 40 m. S. by E. of Pittsburg. Pop. (1900) 7344 (449 foreign-born); (1910) 13,344. Uniontown is served by the Pennsylvania and the Baltimore & Ohio railways. Coal, iron and natural gas are found in the neighbouring region. The manufactures include glass products, iron, steel, enamel, radiators, coke, flour and bricks.

The original village was surveyed and laid out in 1776 on land owned by Henry Beeson, and the borough was incorporated in 1796. From 1827 to 1832 Uniontown was the seat of Madison College, formed from Union Academy (founded 1808); in 1832 the college was merged with Allegheny College, of Meadville, Pa. In 1866 the buildings were turned over to the Soldiers' Orphans' School (now at Jumonville, a suburb), which occupied them until 1875. In the south-eastern part of the county is the district known as Great Meadows, here George Washington built Fort Necessity in 1754, and General Edward Braddock died and was buried here after his defeat by the French and Indians in 1755.

UNITARIANISM, a system of Christian thought and religious observance, based, as opposed to orthodox Trinitarianism, on the unipersonality of the Godhead, *i.e.* that the Godhead exists in the person of the Father alone. Unitarians carry their history up to the Apostolic age, claim for their doctrine a prevalence during the ante-Nicene period, and by help of Arian communities and individual thinkers trace a continuity of their views to the present time. However this may be, it is certain that the Reformation of the 16th century was in every European country attended by an outbreak more or less serious of anti-Trinitarian opinion. Suppressed as a rule in individual cases, this type of doctrine ultimately became the badge of separate religious communities, in Poland (extinct), in Hungary (still flourishing), and at a much later date in England. Along with the fundamental doctrine, certain characteristics have always marked its professors; namely, a large degree of toleration, a minimizing of essentials, a repugnance to formulated creed, an historical study of Scripture. Martin Cellarius (1499–1564) a friend of Luther, is usually regarded as the first literary pioneer (1527) of the movement, the anti-Trinitarian position of Ludwig Haetzer (*q.v.*) was not disclosed till after his execution (1529) for anabaptism. Both by his writings (from 1531) and by his fate (1553) Servetus (*q v.*) stimulated thought in this direction. The *Dialogues* (1563) of Bernardino Ochino, while defending the Trinity, stated objections and difficulties with a force which captivated many. In his 27th Dialogue Ochino points to Hungary as a possible home of religious liberty. It was in Poland and Hungary that religious communities, definitely anti-Trinitarian, were first formed and tolerated.

Poland.—Scattered expressions of anti-Trinitarian opinion appear here early. At the age of 80, Catherine, wife of Melchior Vogel or Weygel, was burned at Cracow (1539) for apostasy; whether her views embraced more than deism is not clear. The first synod of the Reformed Church was held in 1555, at the second (1556), Gregory Pauli and Peter Gonesius avowed anti-Trinitarian and anabaptist views. The arrival of Blandrata (*q.v*) in 1558 furnished the party with a leader. In 1565 the diet of Piotrkow excluded anti-Trinitarians from the existing synod; henceforward they held their own synods as the Minor Church. Known by various other names (of which Arian was the most common), at no time in its history did this body adopt for itself any designation save Christian. Originally Arian (though excluding any worship of Christ) and anabaptist, the Minor Church was (by 1588) brought round to his own views by Fausto Sozzini, who had settled in Poland in 1579 (see Socinus). In 1602 James Sienynski established at Raków a college and a printing-press, from which the *Racovian Catechism* was issued in 1605. In 1610 a Catholic reaction began, led by Jesuits. The establishment at Raków was suppressed in 1638, two lads having pelted a crucifix outside the town. Twenty years later the Polish Diet gave anti-Trinitarians the option of conformity or exile. The Minor Church included many Polish magnates, but their adoption of the views of Sozzini, which precluded Christians from magisterial office, rendered them politically powerless. The execution of the decree, hastened by a year, took place in 1660. Some conformed; a large number made their way to Holland (where the Remonstrants admitted them to membership on the basis of the Apostles' Creed); others to the German frontier; a contingent settled in Transylvania, not joining the Unitarian Church, but maintaining a distinct organization at Kolozsvár till 1793. At Amsterdam was published (1665–1669) the *Bibliotheca fratrum polonorum*, embracing the works of Hans Krell, their leading theologian, of Jonas Schlichting, their chief commentator, of Sozzini and of Johann Ludwig Wolzogen; the title-page of this collection, bearing the words *quos Unitarios vocant*, introduced this term to Western Europe.

Transylvania and Hungary.—No distinct trace of anti-Trinitarian opinion precedes the appearance of Blandrata at the Transylvanian court in 1563. His influence was exerted on Francis Dávid (1510–1579), who was successively Catholic, Lutheran, Calvinist and anti-Trinitarian. In 1564 Dávid was elected by the Calvinists as "bishop of the Hungarian churches in Transylvania," and appointed court preacher to John Sigismund, prince of Transylvania. His discussion of the Trinity began (1565) with doubts of the personality of the Holy Ghost. His antagonist in public disputations was the Calvinist leader, Peter Juhász (Melius); his supporter was Blandrata. John Sigismund, adopting his court-preacher's views, issued (1568) an edict of religious liberty at the Torda Diet, which allowed Dávid (retaining his existing title) to transfer his episcopate from the Calvinists to the anti-Trinitarians, Kolozsvár being evacuated by all but his followers. In 1571, John Sigismund was succeeded by Stephen Báthory, a Catholic, and trouble began. Under the influence of John Sommer, rector of the Kolozsvár gymnasium, Dávid (about 1572) abandoned the worship of Christ. The attempted accommodation by Sozzini only precipitated matters; tried as an innovator, Dávid died in prison at Déva (1579). The cultus of Christ became an established usage of the Church; it is recognized in the 1837 edition of the official hymnal, but removed in the edition of 1865. On the other hand, in 1621 a new sect arose, the *Sabbatarii*, with strong Judaic tendencies; though excluded from toleration they maintained an existence till 1848. The term *unitarius* (said to have been introduced by Melius, in discussions of 1569–1571) makes its first documentary appearance in a decree of the Lécsfalva Diet (1600), it was not officially adopted by the Church till 1638. Of the line of twenty-three bishops the most distinguished were George Enyedi (1592–1597), whose *Explicationes* obtained European vogue, and Michael Lombard Szentabrahámi (1737–1758), who rallied the forces of his Church, broken by persecution and deprivation of property, and gave them their existing constitution. His *Summa universae theologiae secundum Unitarios* (1787), Socinian with Arminian modifications, was accepted by Joseph II. as the official manifesto of doctrine, and so remains, though no subscription to it has ever been required The official title is the Hungarian Unitarian Church, with a membership of over 60,000, most of them in Transylvania, especially among the Szekler population, a few in Hungary, their bishop has a seat in the Hungarian parliament. At Kolozsvár, the seat of the consistory, is the principal college; others are at Torda and at Székely-Keresztúr. Till 1818 the continued existence of this body was unknown to English Unitarians; relations have since become intimate; since 1860 a succession of students have finished their theological education at Manchester College, Oxford, others at the Unitarian Home Missionary College.

England.—Between 1548 (John Assheton) and 1612 we have a thin line of anti-Trinitarians, either executed or saved by recantation. Those burned were George van Parris (1551), Flemish surgeon; Patrick Pakingham (1555), fellmonger; Matthew Hamont (1579), ploughwright; John Lewes (1583); Peter Cole (1587), tanner; Francis Kett (1589), physician and author; Bartholomew Legate (1612), cloth-dealer, last of the Smithfield victims; and the twice-burned fanatic Edward Wightman (1612). In all these cases the virus seems to have come from Holland; the last two executions followed the rash dedication to James I. of the Latin version of the *Racovian Catechism* (1609). The vogue of Socinian views, which for a time affected men like Falkland and Chillingworth, led to the abortive fourth canon of 1640 against Socinian books. The ordinance of 1648 made denial of the Trinity capital, but it was a dead letter, Cromwell intervening in the cases of Paul Best (1590–1657) and John Biddle (1616–1662). In 1650 John Knowles was an Arian lay-preacher at Chester. In 1652–1654 and 1658–1662 Biddle held a Socinian conventicle in London; in addition to his own writings he reprinted (1651) and translated (1652) the *Racovian Catechism*, and the *Life of Socinus* (1653). His disciple Thomas Firmin (1632–1697), mercer and philanthropist, and friend of Tillotson, was weaned to Sabellian views by Stephen Nye (1648–1719), a clergyman. Firmin promoted a remarkable series of controversial tracts (1690–1699).

The term "Unitarian" first emerges in 1682, and appears in the title of the *Brief History* (1687). It was construed in a broad sense to cover all who, with whatever differences, held the unipersonality of the Divine Being. Firmin had later a project of Unitarian societies "within the Church"; the first preacher to describe himself as Unitarian was Thomas Emlyn (1663–1741) who gathered a London congregation in 1705. This was contrary to the Toleration Act of 1689, which excluded all who should preach or write against the Trinity. It is noteworthy that in England the Socinian controversy, initiated by Biddle, preceded the Arian controversy initiated by Samuel Clarke's *Scripture Doctrine* of the Trinity (1712). Arian or semi-Arian views had much vogue during the 18th century, both in the Church and in dissent. The free atmosphere of dissenting academies (colleges) favoured new ideas. The effect of the Salters' Hall conference (1719), called for by the alleged heresy of James Peirce (1673–1726) of Exeter, was to leave dissenting congregations to determine their own orthodoxy; the General Baptists had already (1700) condoned defections from the common doctrine. In 1689 Presbyterians and Independents had coalesced, agreeing to drop both names and to support a common fund. The union in the London fund was ruptured in 1693; in course of time differences in the administration of the two funds led to the attaching of the Presbyterian name to theological liberals, though many of the older Unitarian chapels were Independent foundations, and at least half of the Presbyterian chapels (of 1690–1710) are now in the hands of Congregationalists. Leaders in the advocacy of a purely humanitarian christology came largely from the Independents, *e.g.* Nathaniel Lardner (1684–1768), Caleb Fleming (1698–1779), Joseph Priestley (1733–1804), Thomas Belsham (1750–1829).

The formation of a distinct Unitarian denomination dates from the secession (1773) of Theophilus Lindsey (1723–1808) from the Anglican Church, on the failure of the Feathers petition to parliament (1772) for relief from subscription. Lindsey's secession had been preceded in Ireland by that of William Robertson, D. D. (1705–1783), who has been called "the father of Unitarian nonconformity." It was followed by other clerical secessions, mostly of men who left the ministry, and Lindsey's hope of a Unitarian movement from the Anglican Church was disappointed. By degrees his type of theology superseded Arianism in a considerable number of dissenting congregations. The Toleration Act was amended (1779) by substituting belief in Scripture for belief in the Anglican (doctrinal) articles; in 1813 the penal acts against deniers of the Trinity were repealed In 1825 the British and Foreign Unitarian Association was formed as an amalgamation of three older societies, for literature (1791), mission work (1806) and civil rights (1818). Attacks were made on properties held by Unitarians, but created prior to 1813. The Wolverhampton Chapel case began in 1817, the more important Hewley Fund case in 1830; both were decided against the Unitarians in 1842. Appeal to parliament resulted in the Dissenters' Chapels Act (1844), which secures that, so far as trusts do not specify doctrines, twenty-five years tenure legitimates existing usage.

The drier Priestley-Belsham type of Unitarianism, bound up with a determinist philosophy, was gradually modified by the influence of Channing (see below), whose works were reprinted in numerous editions and owed a wide circulation to the efforts of Robert Spears (1825–1899). Another American influence, potent in reducing the rigid though limited supernaturalism of Belsham and his successors, was that of Theodore Parker (1810–1860). At home the teaching of James Martineau (1805–1900), resisted at first, was at length powerfully felt, seconded as it was by the influence of John James Tayler (1797–1869) and John Hamilton Thom (1808–1894). The body has produced some remarkable scholars, *e.g.* John Kenrick (1788–1877), James Yates (1789–1871), Samuel Sharpe (1799–1881), but few very popular preachers, though George Harris (1794—1859) is an exception. Its year-book specifies 406 congregations in England and Wales. For the education of its ministry it supports Manchester College at Oxford (which deduces its ancestry from the academy of Richard Frankland, begun 1670), the Unitarian Home Missionary College (founded in Manchester in 1854 by John Relly Beard, D.D., and William Gaskell), and the Presbyterian College, Carmarthen.

English Unitarian periodical literature begins with Priestley's *Theological Repository* (1769–1788), and includes the *Monthly Repository* (1806–1838), The *Christian Reformer* (1834–1863), the *Prospective Review* (1845–1854), the *National Review* (1855–1864), the *Theological Review* (1864–1879), and now the *Hibbert Journal*, one of the enterprises of the Hibbert Trust, founded by Robert Hibbert (1770–1849) and originally designated the Anti-Trinitarian Fund. This came into operation in 1853, awards scholarships and fellowships, supported (1878–1894) an annual lectureship, and has maintained (from 1894) a chair of ecclesiastical history at Manchester College. The general activities of the body are conducted partly by its association (Essex Street, Strand), partly by its (triennial) National Conference, established 1882. It has two weekly papers, the *Inquirer* and the *Christian Life*.

Scotland.—Much has been made of the execution (1697) at Edinburgh of the student Thomas Aikenhead, convicted of blaspheming the Trinity. The works of John Taylor, D.D. (1694–1761) on original sin and atonement had much influence in the east of Scotland, as we learn from Robert Burns; and such men as William Dalrymple, D.D. (1723–1814) and William M'Gill, D.D. (1732–1807), along with other "moderates," were under suspicion of similar heresies. Overt Unitarianism has never had much vogue in Scotland. The only congregation of old foundation is at Edinburgh, founded in 1776 by a secession from one of the "fellowship societies" formed by James Fraser, of Brea (1639–1699). The mission enterprises of Richard Wright (1764–1836) and George Harris (1794–1859) produced results of no great permanence. There are now seven congregations. The Scottish Unitarian Association was founded in 1813, mainly by Thomas Southwood Smith, M.D., the sanitary reformer. The McQuaker Trust was founded (1889) for propagandist purposes.

Ireland.—Controversy respecting the Trinity was excited in Ireland by the prosecution at Dublin (1703) of Thomas Emlyn (see above), resulting in fine and imprisonment, for rejecting the deity of Christ. In 1705 the Belfast Society was founded for theological discussion by Presbyterian ministers in the north, with the result of creating a body of opinion adverse to subscription to the Westminster standards. Toleration of dissent, withheld in Ireland till 1719, was then granted without the requirement of any doctrinal subscription. Next year a movement against subscription was begun in the General Synod of Ulster, culminating (1725) in the placing of the advocates of non-subscription, headed by John Abernethy, D.D., of Antrim, into a presbytery by themselves. This Antrim presbytery was excluded (1726) from jurisdiction, though not from communion. During the next hundred years its members exercised great influence on their brethren of the synod; but the counter-influence of the mission of the Scottish Seceders (from 1742) produced a reaction. The Antrim Presbytery gradually became Arian, the same type of theology affected more or less the Southern Association, known since 1806 as the Synod of Munster. From 1783 ten of the fourteen presbyteries in the General Synod had made subscription optional, the synod's code of 1824 left "soundness in the faith" to be ascertained by subscription or by examination. Against this compromise Henry Cooke, D.D. (1788–1868), directed all his powers, and was ultimately (1829) successful in defeating his Arian opponent, Henry Montgomery, LL.D. (1788–1865). Montgomery led a secession which formed (1830) the Remonstrant Synod, comprising three presbyteries. In 1910 the Antrim Presbytery, Remonstrant Synod and Synod of Munster were united as the General Synod of the non-subscribing Presbyterian Church of Ireland. They have 38 congregations and some mission stations. Till 1889 they maintained two theological chairs in Belfast, where John Scott Porter (1801–1880) was a pioneer in biblical criticism; they now send their students to England for their theological education, though in certain respects their views and practices are more conservative than those of their English brethren.

Irish Unitarian periodical literature began in 1832 with the *Bible Christian*, followed by the *Irish Unitarian Magazine*, the *Christian Unitarian*, the *Disciple* and now the *Non-subscribing Presbyterian*. See generally R. Wallace's *Antitrinitarian Biog.* (1850); G. Bonet-Maury's *Early Sources of Eng. Unit. Christianity*, trans. E. P. Hall (1884); A. Gordon's *Heads of Eng. Unit. Hist.* (1895). (A. Go.*)

United States.—Unitarianism in the United States followed essentially the same development as in England, and passed through the stages of Arminianism, Arianism, anti-tritheism, to rationalism and a modernism based on a large-minded acceptance of the results of the comparative study of all religions. In the early 18th century Arminianism presented itself in New England, and sporadically elsewhere; this tendency was largely accelerated by the reaction from the excesses of the "Great Awakening" under Jonathan Edwards and George Whitefield. Before the War of Independence Arianism showed itself in individual instances, and French influences were widespread in the direction of deism, though they were not organized into any definite utterance by religious bodies.

As early as the middle of the 18th century Harvard College represented the most advanced thought of the time, and a score or more of clergymen in New England were preaching what was essentially Unitarianism. The most prominent of these men was Jonathan Mayhew (1720–1766), pastor of the West Church in Boston from 1747 to 1766. He preached the strict unity of God, the subordinate nature of Christ, and salvation by character. Charles Chauncy (1705–1787), pastor of the First Church from 1727 until his death, the chief opponent of Edwards in the great revival, was both a Unitarian and a Universalist. Ebenezer Gay (1696–1787) of Hingham, Samuel West (1730–1807) of New Bedford, Thomas Barnard (1748–1814) of Newbury, John Prince (1751–1836) and William Bentley (1758–1819) of Salem, Aaron Bancroft (1755–1836) of Worcester, and several others, were Unitarians.

The first official acceptance of the Unitarian faith on the part of a congregation was by King's Chapel in Boston, which settled James Freeman (1759–1853) in 1782, and revised the Prayer Book into a mild Unitarian liturgy, in 1785. The Rev. William Hazlitt (father of the essayist and critic), visiting the United States in 1783–1785, published the fact that there were Unitarians in Philadelphia, Boston, Charleston, Pittsburg, Hallowell, on Cape Cod and elsewhere. Unitarian congregations were organized at Portland and Saco in 1792 by Thomas Oxnard, in 1800 the First Church in Plymouth accepted the more liberal faith. Joseph Priestley came to the United States in 1794, and organized a Unitarian Church at Northumberland, Pennsylvania, the same year, and one at Philadelphia in 1796. His writings had a considerable influence.

Thus from 1725 to 1825 a more tolerant and rational belief was developing in New England, and to some extent elsewhere. The first distinctive manifestation of the change was the inauguration of Henry Ware (1764–1845) as professor of divinity at Harvard College, in 1805. In the same year appeared Unitarian books by John Sherman (1772–1828) and Hosea Ballou (1771–1852), and another in 1810 by Noah Worcester (1758–1837). At the opening of the 19th century, with one exception, all the churches of Boston were occupied by Unitarian preachers, and various periodicals and organizations expressed their opinions. Churches were established in New York, Baltimore, Washington, Charleston and elsewhere during this period.

William Ellery Channing was settled over the Federal Street Congregational Church, Boston, 1803; and in a few years he became the leader of the Unitarian movement. At first mystical rather than rationalistic in his theology, he took part with the "Catholic Christians," as they called themselves, who aimed at bringing Christianity into harmony with the progressive spirit of the time. His essays on *The System of Exclusion and Denunciation in Religion* (1815), and *Objections to Unitarian Christianity Considered* (1819), made him a defender of Unitarianism. His sermon on "Unitarian Christianity," preached at Baltimore in 1819, at the ordination of Jared Sparks, and that at New York in 1821, on "Unitarian Christianity most favourable to Piety," made him its interpreter. The result was a growing division in the Congregational churches, which was emphasized in 1825 by the formation of the American Unitarian Association at Boston. It was organized "to diffuse the knowledge and promote the interests of pure Christianity"; and it published tracts and books, supported poor churches, sent out missionaries into every part of the country, and established new churches in nearly all the states. Essentially non-sectarian, with little missionary zeal, the Unitarian movement has grown slowly; and its influence has been chiefly exercised through general culture and the better literature of the country. Many of its clergymen have been trained in other denominations; but the Harvard Divinity School was distinctly Unitarian from its formation, in 1816, to 1870, when it became an unsectarian department of the university. The Meadville (Pa.) Theological School was founded in 1844; and the Unitarian Theological School at Berkeley, California, in 1904.

Unitarian thought in the United States has passed through three periods. The first, from 1800 to 1835, was formative, mainly influenced by English philosophy, semi-supernatural, imperfectly rationalistic, devoted to philanthropy and practical Christianity. Dr Channing was its distinguished exponent. The second, from 1835 to 1885, profoundly influenced by German idealism, was increasingly rationalistic, though its theology was largely flavoured by mysticism. In 1865 the National Unitarian Conference was organized, and adopted a distinctly Christian platform, affirming that its members were "disciples of the Lord Jesus Christ." The more rationalistic minority thereupon formed the Free Religious Association, "to encourage the scientific study of theology and to increase fellowship in the spirit." The Western Unitarian Association accepted the same position, and based its "fellowship on no dogmatic tests," but affirmed a desire "to establish truth, righteousness and love in the world." This period of controversy, and of vigorous theological development, practically came to an end soon after 1885; and its cessation was assured by the action of the national conference at Saratoga in 1894, when it was affirmed by a nearly unanimous vote: "These churches accept the religion of Jesus, holding, in accordance with his teaching, that practical religion is summed up in love to God and love to man. The conference recognizes the fact that its constituency is Congregational in tradition and polity. Therefore it declares that nothing in this constitution is to be construed as an authoritative test; and we cordially invite to our working fellowship any who, while differing from us in belief, are in general sympathy with our spirit and our practical aims." The leaders of this period were Emerson, with his idealism, and Theodore Parker, with his acceptance of Christianity as absolute religion.

The third period, beginning about 1885, has been one of rationalism, recognition of universal religion, large acceptance of the scientific method and ideas and an ethical attempt to realize the higher affirmations of Christianity. It has been marked by harmony and unity to a degree perhaps found in no other religious body, by steady growth in the number of churches and by a widening fellowship with all other progressive phases of modern religion. This last phase has been shown in the organization of "The International Council of Unitarian and other Liberal Religious Thinkers and Workers," at Boston on the 25th of May 1900, "to open communication with those in all lands who are striving to unite pure religion and perfect liberty, and to increase fellowship and co-operation among them." This council has held biennial sessions in London, Amsterdam, Geneva and Boston. During the period since 1885 the influence of Emerson has become predominant, modified by the more scientific preaching of Minot J. Savage, who has found his guides in Darwin and Spencer.

Beyond its own borders the body has obtained recognition through the public work of such men as Henry Whitney Bellows and Edward Everett Hale, the remarkable influence of James Freeman Clarke and the popular power of Robert Collyer. The number of Unitarian churches in the United States in 1909 was 461, with 541 ministers. The church membership, really nominal, may be estimated at 100,000. The periodicals are *The Christian Register*, weekly, Boston; *Unity*, weekly, Chicago; *The Unitarian*, monthly, New York; *Old and New*, monthly, Des Moines; *Pacific Unitarian*, San Francisco.

See Joseph Henry Allen, *Our Liberal Movement in Theology* (Boston, 1882), and *Sequel to our Liberal Movement* (Boston, 1897); John White Chadwick, *Old and New Unitarian Belief* (Boston, 1894), and specially *William Ellery Channing* (1903); *Unitarianism: its Origin and History, a course of Sixteen Lectures* (Boston, 1895); George Willis Cooke, *Unitarianism in America: a History of its Origin and Development* (Boston, 1902); and *Unitarian Year Book* (Boston). (G. W. C.*)

UNITED BRETHREN IN CHRIST,[1] an American religious sect which originated in the last part of the 18th century under the leadership of Philip William Otterbein (1726–1813), pastor of the Second Reformed Church in Baltimore, and Martin Boehm (1725–1812), a Pennsylvanian Mennonite of Swiss descent. Otterbein and Boehm licensed some of their followers to preach and did a great work, especially through class-meetings of a Wesleyan type;[2] in 1789 they held a formal conference at Baltimore, and in 1800, at a conference near Frederick City, Maryland, the Church was organized under its present name, and Otterbein and Boehm were chosen its first bishops or superintendents. The ecclesiastical polity of the Church is Wesleyan and its theology is Arminian: there is no hard-and-fast rule about baptism. Bishops are elected for four years. The first delegated general conference met at Mount Pleasant, Pennsylvania, in 1815, and adopted a confession of faith, rules of order and a book of discipline, which were revised in 1885–1889, when women were first admitted to ordination, and when the Conservatives, protesting against the new constitution, withdrew and formed the body now commonly known as the United Brethren in Christ "of the Old Constitution."

The Liberal branch had 3732 organizations in 1906 with a total membership of 274,649. This body carries on missions in West Africa (since 1855), Japan, China, the Philippines and Porto Rico. It has a publishing house (1834) and Bonebrake Theological Seminary (1871) at Dayton, Ohio; and supports Otterbein University (1847) at Westerville, O.; Westfield College (1865) at Westfield, Illinois; Leander Clark College (1857) at Toledo, Iowa; York College (1890) at York, Nebraska; Philomath College (1867) at Philomath, Oregon; Lebanon Valley College (1867) at Annville, Pa.; Campbell College (1864) at Holton, Kansas, and Central University (1907) at Indianapolis, Indiana.

The "Old Constitution" body had 572 organizations in 1906 with a total membership of 21,401. It has a publishing house at Huntington, Indiana.

See D. Berger, *History of the Church of the United Brethren* (1897), and his sketch (1894) in vol xii. of the "American Church History Series"; E. L. Shuey, *Handbook of the United Brethren in Christ* (1893); W. J. Shuey, *Year-Book of the United Brethren in Christ* (from 1867); and A. W. Drury, *Life of Philip William Otterbein* (1884).

UNITED FREE CHURCH OF SCOTLAND, a religious organization, representing the union made in 1900 between the Free Church of Scotland (except a dissentient section who separated off and retained the name of Free Church) and the United Presbyterian Church. (See Free Church of Scotland and United Presbyterian Church.)

The first moderator was Dr Rainy (*q.v.*). The Free Church brought into the union 1077 congregations, the United Presbyterians 599; the revenue of the former amounted to £706,546, of the latter to £361,743. The missionaries of both churches joined the union, and the United Church was then equipped with missions in various parts of India, in Manchuria, in Africa (Lovedale, Livingstonia, &c.), in Melanesia and in the West Indies. The formula which was adopted allowed for development of doctrine, the candidate stating that he believes "in the doctrine of this Church, set forth in the Confession of Faith," the Church being thus set above the confession. The Church has three divinity halls, at Glasgow, Edinburgh and Aberdeen, served by seventeen professors and five lecturers.

The minority of the Free Church who had refused to join the union lost no time in testing the legality of the act of the majority in entering it. Their summons, dated the 14th of December 1900, claimed that in uniting with the United Presbyterian Church, which did not hold the principles of the Free Church, the majority had forfeited the right to the property of the Free Church, which must be judged to belong to the minority who remained faithful to the principles of the Free Church and were that Church. In the Scottish courts the case was decided in favour of the union by Lord Low on the 9th of August 1901, and by the second division of the Court of Session on the 4th of July 1902, it being held in both trials that the old Free Church had a right within limits to change its views and to do by its Assembly what had been done. The proceedings before the House of Lords on appeal were protracted by the death of one of the judges, which involved the necessity of a second hearing, and it was not till the 1st of August 1904 that the verdict was pronounced. By a majority of five to two the House of Lords reversed the decision of the Court of Session, allowed the appeal, and found the minority entitled to the funds and property of the Free Church. It was held that the majority of an independent church, adopting new standards of doctrine or ceasing to hold essential or fundamental doctrines of the church, forfeit the right to the property, which remains with the minority holding the church's original doctrine: also that the establishment principle was a fundamental doctrine of the Free Church, and that by entering a union on terms leaving that doctrine an open question, the majority had violated the conditions on which the property of the Free Church was held. On the plea that by the Declaratory Act of 1892 the Free Church had abandoned its doctrinal position, argument was heard, but the House of Lords did not decide.

Few legal decisions have occasioned so great consternation or such serious practical difficulties. At first sight it deprived the Free Church section of the United Church of all its material goods—churches, manses, colleges and missions, even of the provision for the old age of the clergy. It appeared to divert large amounts of church property from the uses for which it had been provided, and to hand it over to a body with which the United Church was deeply out of sympathy and which could have little prospect of making effective use of it. A conference held in September between representatives of the United Free and of the (now distinct) Free Church, in order to come to some working arrangement in view of the decision, found that no basis for such an agreement could be arrived at. Nothing remained but to invoke the intervention of parliament to put an end to an impossible situation. A convocation of ministers and elders of the United Free Church, held on the 15th of December, decided that the union should go on, and resolved to "take every lawful means of appealing to the nation and to parliament to rescue the funds and buildings of the Church for the sacred purposes for which they had been provided." The Free Church could not refuse to consent to this, and in December a commission was appointed, consisting of Lord Elgin, Lord Kinnear and Sir Ralph Anstruther, to inquire into matters connected with the two churches, while the question of interim possession was referred to Sir John Cheyne, as commissioner, for inquiry and action. The commission sat in public, and after hearing evidence on both sides, issued their report in April 1905. They reported that the state of feeling on one side and on the other had made their work difficult. They had concluded however that the Free Church was unable in many respects to carry out the purposes of the trusts, which, under the verdict of the House of Lords, was a condition of their holding the property, and that there was a case for parliamentary interference. They recommended that an executive commission should be set up by act of parliament, in which the whole property of the Free Church, as at the date of the union, should be vested, and which should allocate it to the United Free Church, where the Free Church was unable to carry out the trust purposes. The commission was to entertain suggestions which might be made to them for friendly arrangements.

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[1] The sect is not to be confused with the Moravian Brethren (*q.v.*), whose official name, *Unitas Fratrum*, is commonly rendered in English "United Brethren."

[2] Otterbein was an intimate friend of Francis Asbury and was greatly influenced by him.

The Churches (Scotland) Act, which gave effect to these recommendations, was passed on the 11th of August 1905. It contained (see SCOTLAND, CHURCH OF) a clause (No. 5) providing for the relaxation of subscription in the Established Church, parliament thus interesting itself in the affairs of all Presbyterian churches. The commissioners were those on whose report the act was formed, with the addition of two others. In October 1906 the commission intimated that the Assembly Hall, with the New College Buildings and the High Church, were to be the property of the United Free Church, the Free Church receiving the offices in Edinburgh, and a tenement to be converted into a college, while the library was to be vested in the United Free Church, but open to members of both churches. After having occupied class-rooms in the university for two sessions, and held an assembly (1905) in another hall, the United Free Church in 1906 again occupied in its own right the historic buildings of the Free Church. All the foreign missions and all the continental stations were adjudged to the United Free Church. The allocation of churches and manses was a slow business, but in 1908 over 100 churches had been assigned to the Free Church. Some of the dispossessed United Free Church congregations, most of them in the Highlands, found shelter for a time in the parish churches; but it was early decided that in spite of the objection against the erection of more church buildings in districts where many were now standing empty, 60 new churches and manses should at once be built at a cost of about £150,000. (A. M.*)

UNITED KINGDOM OF GREAT BRITAIN AND IRELAND,[1] the official title, since the 1st of January 1801, of the political unity composed of England and Wales, Scotland and Ireland. "Great Britain" was employed as a formal designation from the time of the union of the kingdoms of England and Scotland in 1707. Although the name (which apparently had its origin in Britannia Major, the name given to the island to distinguish it from Britannia Minor or Brittany) had, in earlier times, been often used both by English and by foreign writers, especially for rhetorical and poetical purposes, it was not till after the accession of James I. that it became a recognized part of the royal style. Its adoption was due to the king himself, who was anxious to give expression to the fact that he was sovereign of the undivided island, and not only of England or Scotland. As early as 1559 the Scottish congregation had formally proposed the union of the two crowns, and the adoption of the name of Great Britain for the common country (Teulet, *Mém. Caille à M. de la Mothe*, Dec. 20). But in England the innovation at first met with great opposition. Various objections, sentimental and practical, were urged against it in parliament; and the judges, when appealed to by the king, declared that the adoption of the title would invalidate all legal processes. At length, on the 20th of October 1604, the king, weary of the discussion, cut the knot by assuming the title by royal proclamation, and in due course the inscription "J. D. G. Mag. Brit. F. et H. Rex" appeared on his coins. In November 1604 we find the king instructing the lords commissioners of the Gunpowder Plot to try and discover if the prisoner was the author of a most "cruel pasquil" against him for assuming the name of Britain.

For further details see *Calendar of State Papers, Domestic Series*; and J. Spedding, *Letters and Life of Lord Bacon*, vol iii. (London, 1861–1874).

England and Wales, Scotland and Ireland are politically united under a parliament (*q.v.*), consisting of the king, the House of Lords[2] and the House of Commons,[3] the prerogatives of the Crown being exercised through responsible ministers. The executive government is carried on under the supervision of the ministers of state (see MINISTRY), the more important of whom are united in the cabinet (*q.v.*). The first minister of the Crown or prime minister (*q.v.*) is appointed by the king, and having made choice of his colleagues, recommends them for appointment. (See the separate articles on the various offices. For the judiciary system, see COURT; APPEAL; &c.)

The table at the foot of this column shows the imperial revenue and expenditure, with the amount of revenue per head of population of the United Kingdom for various years. The financial year now ends on the 31st of March of the year following that quoted. The figures before 1907 did not include the revenue assigned to local purposes. The deficit in 1909 was due to delay in passing the Finance Act.

Year.	Total Revenue.	Total Expenditure.	Proportion of Revenue per head.
	£	£	£ s. d.
1861	70,283,674	72,792,059	2 8 10
1871	69,945,220	69,548,539	2 4 5
1881	81,872,354	80,938,990	2 7 1
1891	89,489,112	87,732,855	2 6 2
1901	130,384,684	183,592,264	3 2 10
1902	142,997,999	195,522,213	3 12 11
1903	151,551,698	184,483,708	3 11 6
1904	141,545,597	146,961,136	3 6 2
1905	143,370,404	141,956,497	3 6 4
1906	143,977,575	140,511,955	3 5 11
1907	156,537,690	151,812,094	3 6 5
1908	151,578,295	152,292,395	3 5 0
1909	131,696,456	157,944,611	2 18 5

Year ending March 31st.

	1891.	1896.	1901.	1906.	1910.
	£	£	£	£	£
Funded debt	579,472,082	589,146,878	551,182,153	634,047,429	614,868,547
Terminable annuities	66,550,579	49,183,748	60,154,800	43,459,548	35,876,861
Unfunded debt	36,140,079	9,975,800	78,133,000	65,713,000	62,500,000
Other capital liabilities*	1,317,719	3,979,940	14,464,396	45,770,210	49,218,217
Total gross liabilities of the state	683,480,459	652,286,366	703,934,349	788,990,187	762,463,625
Assets—					
Suez Canal shares	3,532,040†	22,627,000‡	25,806,000‡	31,080,000‡	35,295,000
Other assets	1,740,397	939,354	712,760	2,586,799	4,118,352
Exchequer balances at banks of England and Ireland	6,370,897	8,975,201	5,596,918	10,451,487	2,831,248

* These are in respect of sums borrowed under certain acts. † Nominal value.
‡ Estimated market value on the 31st of March each year.

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[1] See also BRITAIN; BRITISH EMPIRE; ENGLAND; IRELAND; SCOTLAND; WALES; &c.

[2] See PEERAGE. [3] See REPRESENTATION and PARLIAMENT.

In separate articles throughout this Encyclopaedia the main subjects of interest in connexion with British institutions are fully dealt with; and it is only necessary here to give such details as are needed to supplement those given under the subject-heading. See AGRICULTURE; NAVY (also SHIP and SHIP-BUILDING); EDUCATION; ENGLISH FINANCE; ENGLISH HISTORY; CIVIL SERVICE; NATIONAL DEBT; POLICE; POOR LAW; &c. A separate section, however, is devoted to the army, the constitution of which in 1910 is described; the history is given under ARMY.

National Debt (*q.v.*).—The table on the preceding page shows the position of the national debt at quinquennial intervals during 1891–1910.

Area and Population.—The United Kingdom has an area of 120,651 sq. m., and at the census of 1891 had a population of 37,732,922 and in 1901 of 41,458,721. If the islands in British seas are included, the area is increased to 120,953 sq. m., and the population to 41,609,091. The main divisions are as follows:—

	Area sq. m.	Population.	
		1891.	1901.
England and Wales . . .	58,324	29,002,525	32,527,843
Scotland	29,796	4,025,647	4,472,103
Ireland	32,531	4,704,750	4,458,775
Islands in the British seas .	302	147,842	150,370

Vital Statistics.—The following table institutes a comparison between the birth-rates per thousand of the population in the United Kingdom and certain other countries, at intervals (so far as possible) of five years, adding the figures for other years in specific years when there was a marked fluctuation:—

	1881.	1886.	1891.	1896.	1901.	1905,	1906.
Russia in Europe *	47·8 (1882, 50·4)	46·5	48·8	49·7	47·9	—	—
Hungary	42·9	45·6	42·3	40·5	37·8	—	36·0
Austria	37·5 (1882, 38·9)	38·1	38·3	38·0	36·6	33·7	—
Germany	37·0	37·0	37·0	36·3	35·7	33·0	—
Japan	25·6	27·3 (1889, 30·2)	26·7	30·0	32·7	30·6	—
Holland	35·0	34·6	33·7	32·7	32·3	—	30·4
Denmark	32·2	32·4	31·0 (1892, 29·6)	30·5	29·7	—	28·5
Switzerland	29·8	27·8	28·2	28·1	29·1	27·4	—
UNITED KINGDOM	32·5	31·5 (1890, 29·2)	30·4	29·0	28·0	—	26·8
England	33·9	32·8 (1890, 30·2)	31·4	29·6	28·5	—	27·1
Scotland	33·7	32·9 (1890, 30·4)	31·2 (1894, 29·9)	30·4	29·5	—	27·9
Ireland	24·5	23·2 (1890, 22·3)	23·1 (1892, 22·5)	23·7	22·7	—	23·6
Norway	30·6	31·2	30·9	30·2	29·6	—	26·5
Sweden	29·1	29·8	28·3	27·2	27·0	—	25·7
Belgium	31·8	29·9	30·0	29·0	29·4	—	25·7
France	24·9	23·9	22·6	22·5	22·0	—	20·6

The number of births in the United Kingdom in 1909 was 1,146,118, giving a rate per thousand of 25·5.

* Not including Finland.

The death-rate is similarly treated:—

	1881.	1886.	1891.	1896.	1901.	1905,	1906.
Denmark . . .	18·3	18·1	20·0	15·7	15·8	—	13·5
Norway . . .	17·0	16·2	17·5	15·1	14·9	—	13·7
Sweden . . .	17·7	16·6	16·8	15·6	16·1	—	14·4
Holland . . .	21·5	21·8	20·7	17·2	17·2	—	14·8
UNITED KINGDOM.	18·7	19·2	20·0	16·9	17·1	—	15·6
England . . .	18·9	19·5	20·2	17·1	16·9	—	15·4
Scotland . . .	19·3	18·9	20·7	16·6	17·9	—	16·0
Ireland . . .	17·5	17·8	18·4	16·7	17·8	—	17·0
Belgium . . .	21·2	21·3	21·2	17·5	17·2	—	16·4
Switzerland . .	22·4	20·7	20·6	17·8	18·0	17·9	—
Germany . . .	25·5	26·2	23·4	20·8	20·7	19·8	—
France	22·0	22·5	22·9	20·0	20·1	—	19·9
Japan	18·7	24·4	21·0	21·4	20·4	22·0	—
Hungary . . .	34·4	31·7	33·1	28·9	25·4	—	24·8
Austria . . .	30·5	29·5	28·1	26·3	24·0	25·0	—
Russia in Europe*.	33·2	31·2	34·6	32·8	32·1	—	—

* Not including Finland.

The deaths in the United Kingdom in 1909 numbered 667,765, the rate per thousand being 14·8.

The number of marriages (*a*) and the proportion of persons married per thousand of the population (*b*) are thus shown:—

Year.	England and Wales.		Scotland.		Ireland.		United Kingdom.	
	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)
1896	242,764	15·7	30,270	14·2	23,055	10·2	296,089	15·0
1901	259,400	15·9	31,387	14·0	22,564	10·2	313,351	15·1
1906	269,734	15·6	33,123	14·0	22,557	10·3	325,414	14·9
1909	260,259	14·6	30,092	12·3	22,769	10·4	313,120	13·9

Emigration.—The following table shows the number of passengers, distinguishing English and Welsh, Scottish and Irish, who left the United Kingdom for extra-European countries in 1895, 1900 and 1905, and the total for 1909, and in certain other years in which the numbers show marked fluctuations:—

Year.	English and Welsh.	Scottish.	Irish.	Total.
1895	112,538	18,294	54,349	185,181
1898	90,679	15,570	34,395	140,644
1900	102,448	20,472	45,905	168,825
1904	175,733	37,445	58,285	271,435
1905	170,408	41,510	50,159	262,077
1906	219,765	53,162	52,210	325,137

In 1909 the total number to British dominions was 163,594 and the total number to other extra-European countries was 125,167.

Occupations.—The following table shows the occupations of the people (excluding children under ten years of age) as distinguished in five great orders, according to the census of 1901:—

	England and Wales.	Scotland.	Ireland.
Professional .	804,427	101,061	131,035
Domestic . .	1,994,197	201,230	219,418
Commercial .	1,858,454	245,715	97,889
Agricultural .	1,152,495	237,311	876,062
Industrial .	7,534,994	1,197,495	639,413

Agriculture.—The following table illustrates broadly the difference in the position of agriculture in Great Britain and in Ireland:—

Percentage to total area of area—	Great Britain.		Ireland.	
	1890.	1909.	1890.	1909.
Cultivated	57·7	56·6	73·1	70·3
Under grain crops	14·1	12·4	7·3	6·1
Under green crops	5·8	5·4	5·8	5·0
Under grasses and other crops .	8·5	7·9	5·9	11·2
In permanent pasture . . .	28·2	30·2	53·4	43·1

Minerals and Mining.—The mineral production of the United Kingdom reached a total value in 1890 of £100,802,657 and in 1909 of £119,394,486, with a maximum during that period of £160,605,154 in 1900 and a minimum of £73,024,066 in 1893. These figures include pig-iron produced from foreign ores. About 73% represents the value of the coal output. The figures for the more important minerals are as follows:—

Description of Minerals.	1900.	1909.	Value, 1909.
	Tons.	Tons.	£
Coal	225,181,300	263,774,312	106,274,900
Iron ore	14,025,208	14,979,979	3,089,777
Clay and shale	14,049,694	14,067,810	1,718,056
Sandstone	5,019,874	4,600,084	1,339,106
Slate	585,859	402,184	1,007,013
Limestone (not chalk)	11,905,477	11,811,122	1,226,967
Igneous rocks	4,634,301	6,283,297	1,235,046
Oil shale	2,282,221	2,967,057	815,937
Tin ore (dressed)	6,800	8,289	617,376
Salt	1,861,347	1,822,744	548,896

Gold ore, manganese ore and uranium ore are produced in small quantities, and the list of minerals worked in the United Kingdom also includes chalk, lead, alum, phosphate of lime, chert and flint, gravel and sand, zinc ore, gypsum, arsenic, copper, barytes, wolfram and strontium sulphate.

Metals were obtained from the ores as follows:—

Description of Metal.	1900.	1909.	
	Quantity.	Quantity.	Value (average market price).
			£
Iron	4,666,942 tons	4,802,163 tons	15,559,253
Tin	4,268 „	5,199 „	695,546
Lead	24,364 „	22,463 „	298,945
Zinc	9,066 „	3,818 „	87,146
Copper	765 „	435 „	27,162
Gold	14,004 oz.	1,210 oz.	4,400
Silver	190,850 „	142,146 „	14,030

The total number of persons employed in and about all the mines of the United Kingdom in 1901 was 839,178, and in 1909 1,126,372.

The workers were thus distributed between the three kingdoms and the principality in 1905:—

	Coal Mines, &c.	Metalliferous Mines (*a*).	Quarries (*b*).
England	606,206	19,561	60,725
Wales	137,124	7,333	17,277
Scotland	114,294	974	12,187
Ireland	749	733	4,464

The total figures given above include (*a*) 550 and (*b*) 166 workers in the Isle of Man; and the figures quoted for production include that of the isle.

Coal.

The production of coal in Great Britain, though marked by fluctuation, has, on the whole, largely increased, and in 1901 the output was 42% greater than that of 1881. The maximum quantity extracted in any one year between 1890 and 1910 was 267,830,962 tons in 1907, and the minimum 164,325,795 in 1893. The maximum estimated value, however, was £121,652,596 for the 225,181,300 tons raised in 1900; the value in 1907 being £120,527,378.

	1900.	1909.
England.	Tons.	Tons.
Cumberland	2,022,327	2,309,370
Derby	15,243,031	16,869,347
Durham	34,800,719	41,240,612
Gloucester	1,578,386	1,486,526
Lancashire	24,842,208	23,705,387
Leicester	2,106,343	2,661,606
Monmouth	9,818,829	13,204,357
Northumberland	11,514,521	14,013,135
Nottingham	8,626,177	11,106,702
Somerset	1,046,792	1,140,818
Stafford	14,222,743	13,517,101
Warwick	2,957,490	4,447,978
York	28,247,249	35,896,623
Wales.		
Carmarthen	1,333,880	1,950,429
Denbigh	2,447,092	2,556,612
Glamorgan	27,686,758	34,461,631

In the chief coal-producing counties of England and Wales the quantity raised in 1900 and in 1909 will be found in the table at the foot of preceding column.

Thus it appears that of the coal raised in England the county of Durham contributes about 22%, Yorkshire 17%, Lancashire 16%, Stafford and Derbyshire each about 9%, and Northumberland 7%; while of the coal raised in Wales 85% is contributed by the county of Glamorgan; and that the coal production of England and Wales together constitutes, in quantity and value, 85% of the whole production of the United Kingdom.

The export of coal greatly increased on the whole during the period 1890–1909. The following table shows this; the figures for 1893 are given as the lowest during the period. The tonnage of coke and patent fuel is included in the totals:—

Year.	Tons.	Year.	Tons.
1890	30,442,839	1900	46,098,228
1893	29,031,955	1905	49,359,272
1895	33,101,452	1909	65,694,267

The chief receiving countries are, in order, Germany, France, Italy, Sweden, Spain, Russian Empire, Denmark, Egypt, Holland, Argentina, Norway and Brazil.

Iron.

The annual output of iron ore in the United Kingdom has on the whole decreased since 1882. In that year it reached a maximum of 18,031,957 tons; it then fell off to 13,098,341 tons in 1887, rose in the two years following to nearly 15,000,000, fell to little over 11,000,000 in 1892–1893, rose fairly steadily to 14,461,330 in 1899, stood in 1900 at 14,028,208 tons of a value of £4,224,400, and then showed a further fall and rise, until in 1905 the tonnage was 14,590,703, and the value £3,482,184.

The iron ore raised in the various countries, and in the most productive counties, is here shown:—

	1900.	1909.
	Tons.	Tons.
England	13,072,118	14,176,658
Cumberland[1]	1,103,430	1,246,228
Lancashire[1]	630,361	312,367
Leicester	750,708	514,896
Lincoln	1,924,898	2,037,363
Northampton	1,622,539	2,875,659
Stafford[2]	1,084,797	902,565
York	5,550,677	6,234,589
Wales	7,418	38,043
Scotland[2]	849,031	697,276
Ireland	99,641	68,002

The number of furnaces in blast (fractions showing the proportion of the year furnaces were in blast) was: in England 298$\frac{4}{12}$, Wales 19$\frac{4}{12}$; Scotland 85$\frac{5}{12}$, total 403$\frac{4}{12}$. The total number of existing furnaces in 1900 was: in England 456, Wales 42, Scotland 106; total 604; so that 33% of the number stood unused. In 1905 furnaces in blast numbered: England 244$\frac{4}{12}$, Wales 13$\frac{4}{12}$, Scotland 87$\frac{4}{12}$: total 345$\frac{4}{12}$: and those existing: in England 412, Wales 31, Scotland 101; total 544: and the percentage unused was thus 36.

In 1888 the imports of iron ore amounted to 3,562,071 tons, in 1898 to 5,468,396 tons, in 1899 to 7,054,578 tons, in 1900 to 6,297,953 tons, in 1901 to 5,548,888 tons and in 1909 to 6,361,571 tons, of which the bulk was imported from Spain. The amount of pig-iron obtained found its minimum, during the period 1890–1910, of 6,976,990 tons in 1893, and its maximum of 10,183,860 in 1906, and in 1905 the quantity produced from foreign ores (4,847,899 tons) for the first time exceeded that produced from British ores (4,760,187).

Lead.

The quantity of lead ore produced within the United Kingdom has decreased. It is now less than one-half of the output of about 1877, and the value has decreased more than proportionately. In the period 1890–1908 the maximum annual production of metallic lead from British ore was 33,590 tons in 1890, valued at £440,826; the production fluctuated somewhat, but generally fell, to the minimum of 17,704 tons in 1902 (value £198,875). The most productive counties are Flint, Durham and Derby; the ore obtained in the Isle of Man is increased in value by the silver it contains.

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[1] These counties supply the richest ore in the United Kingdom.

[2] In these cases the greater proportion of ore is from mines also producing coal.

Tin.

The annual output of tin ore, which in 1878 amounted to 15,045 tons, valued at £530,737, fell to 12,898 tons in 1881, though the value in that year rose to £697,444. During the years 1882–1892 the average output was over 14,000 tons, and its average value about £770,000, but in 1893 a decline began in the output (not however accompanied closely by a decline in the value), slightly relieved about 1905.

Year.	Tin Ore.	Value.
	Tons.	£
1893	13,689	637,053
1900	6,800	523,604
1905	7,201	574,183
1909	5,193	617,376

Tin ore is obtained almost exclusively in Cornwall.

Copper.

Like others of the less important mining industries, copper mining in the United Kingdom has declined. In 1881 the output of ore amounted to 52,556 tons, in 1891 to 9158 tons, in 1893 to 5576 tons, in 1905 to 7153 tons, valued at £32,696 and yielding 716 tons of metal by smelting. The total tonnage of ore included 5757 tons from England (chiefly from Cornwall) and 1146 from Ireland (Wicklow, &c.). Copper precipitate is taken from water pumped up from old copper mines on Parys Mountain in Anglesey.

Zinc.

Zinc ore is obtained chiefly from mines in Cumberland, Wales and the Isle of Man. In 1881 the output reached 35,527 tons, valued at £110,043; in 1891 the output was only 22,216 tons, but its value was £113,445. In 1897 the quantity was 19,278 tons, and the value £69,134; but in 1898 the price had risen so that the output of 23,552 tons was worth £117,784. In 1900 the output of 24,675 tons was worth £97,606; and in 1905 that of 23,909 tons was worth £139,806.

Gold.

During the period 1890–1905 gold mines were worked continuously in Merionethshire. Notices of the discovery of gold elsewhere (as in the Forest of Dean, Argyllshire and Ireland) have appeared from time to time.

The principal fluctuations in production were as follows:—

Year.	Ore.	Gold.	Value.
	Tons.	Oz.	£
1890	575	206	675
1891	14,117	4,008	13,700
1893	4,489	2,309	8,691
1895	13,266	6,600	18,520
1898	703	395	1,229
1900	20,802	14,004	52,147
1902	29,953	4,181	14,570
1904	23,203	19,655	73,925
1905	15,981	5,797	21,222
1908	—	915	3,311

It should be noted also that from imported cupreous iron pyrites, copper, gold and silver are extracted at some fifteen metal extraction works in Great Britain. From 386,858 tons of burnt ore in 1900 there were obtained 13,925 tons of copper, 1777 oz. of gold and 309,486 oz. of silver; and in 1905 the figures were: ore, 402,863 tons; copper, 14,502 tons; gold, 1850 oz.; silver, 322,291 oz.

Cotton.

Textile Industries.—The most important of the textile industries of Great Britain is cotton manufacture. The quantities of raw cotton imported, exported and retained for consumption for various years during the period 1890–1910 were as follows:—

Year.	Imported.	Exported.	Retained.
	lb	lb	lb
1890	1,793,495,200	214,641,840	1,578,853,360
1893	1,416,780,064	224,621,488	1,192,158,576
1895	1,757,042,672	203,284,592	1,553,758,080
1898	2,128,548,352	203,072,464	1,925,475,888
1900	1,760,206,672	215,747,168	1,544,459,504
1905	2,203,595,520	283,177,888	1,920,417,632
1907	2,386,901,104	330,352,064	2,056,549,040
1909	2,188,761,456	268,633,456	1,920,128,000

During the same period the minimum and maximum amount of raw cotton (in lb) imported into the United Kingdom from the principal countries whence it is exported was as follows: United States of America (1893), 1,055,855,360; (1898), 1,805,353,424; Egypt (1890), 181,266,176; (1907), 423,052,448; British possessions in the East Indies (1898), 27,349,728; (1890), 238,746,704; (1909), 75,621,168; Brazil (1899), 5,464,592; (1906), 54,362,000; Peru (1891), 6,175,344; (1909), 24,413,648. In 1905 there were imported 7,941,920 lb from Chile (only 195,328 in 1909); 6,033,104 lb from Canada (this also fluctuates greatly; 1,801,072 in 1909); 1,241,408 lb from British West Africa (4,985,232 in 1909); 1,126,720 lb from the British West Indies and Guiana (3,022,208 in 1908).

According to the census returns of 1901 there were 546,065 persons employed in cotton factories, 199,920 male and 346,145 female. Of the total number of workpeople, 529,131 were employed in England and Wales, 14,805 in Scotland and 212 in Ireland. In 1907 the total had risen to 576,820 (217,742 males and 359,078 females).

Wool.

The extent of the woollen and worsted manufactures of the United Kingdom is indicated by the following table showing the imports and exports of wool and the quantity retained for use in various years (1890–1905):—

Year.	Imports.	Exports of imported Wool.	Retained.
	lb	lb	lb
1890	633,028,131	340,712,303	292,315,828
1895	775,379,063	404,935,226	370,443,837
1898	699,555,048	283,317,748	416,237,300
1900	558,950,528	196,207,261	362,743,267
1905	620,350,885	277,864,215	342,486,670
1907	764,286,625	313,519,282	450,767,343
1909	808,710,087	390,695,182	418,014,905

During the same period the minimum and maximum amount of wool (in lb) imported into the United Kingdom was as follows: Australia (1904), 220,483,961; (1895), 417,163,078; New Zealand (1890), 95,632,598; (1909), 176,457,150; British possessions in South Africa (1900), 32,219,369; (1909), 115,896,598; South America (1890), 11,173,692; (1908), 78,938,157; British possessions in the East Indies (1901), 24,069,571; (1909), 56,238,633; France (1890), 10,873,788; (1902), 27,770,790; Turkish Empire (1908), 5,705,671; (1897), 25,727,462.

In the woollen and worsted industries 239,954 persons were employed according to the census of 1901, of whom 99,425 were males and 140,529 females. Of the total number 209,700 were employed in England and Wales, 24,906 in Scotland and 5348 in Ireland.

The numbers of persons employed in the other principal textile industries in 1901 was as follows:—

	England and Wales.	Scotland.	Ireland.	United Kingdom.		Total.
				Males.	Females.	
Flax . . .	4,493	23,570	71,464	29,226	70,301	99,527
Hemp, jute, &c. . . .	2,750	39,200	639	11,618	30,971	42,589
Silk . . .	34,847	2,424	209	11,058	26,422	37,480
Hosiery . .	48,374	11,957	611	15,067	45,875	60,942

Commerce.—British commerce received an enormous development after the first quarter of the 19th century. In 1826 the aggregate value of the imports into and exports from the United Kingdom amounted to no more than £88,758,678; while the total rose to £110,559,538 in 1836 and to £205,625,831 in 1846. In 1856 the aggregate of imports and exports had risen to £311,764,507, in 1866 to £534,195,956 and in 1876 to £631,931,305. Thus the commercial transactions of the United Kingdom with foreign states and British colonies increased more than sevenfold in the course of fifty years.

An important fact in connexion with the foreign commerce of the United Kingdom is that there has been a steady increase in imports, but there has been no corresponding steady increase in exports of British produce and manufactures. Many industries, which formerly were mainly in British hands, have been developed on the continent of Europe, in America, and to some extent in the East. The movement began in 1872. Up to that time the exports of British home produce had kept on increasing with the imports, although at a lesser rate, and far inferior in aggregate value; but a change took place in the latter year. While the imports continued their upward course, gradually rising from £354,693,624 in 1872 to £375,154,703 in 1876, the exports of British produce fell from £256,257,347 in 1872 to £200,639,204 in 1876. The decline in exports, regular and steady throughout the period, and with a tendency to become more pronounced every year, affected all the principal articles of British

Country.		1890.	1895.	1900.	1905.	1909.
I.—BRITISH POSSESSIONS—		£	£	£	£	£
India and Ceylon	Imports	37,856,598	31,076,761	32,861,217	40,540,341	40,095,633
	Exports	38,254,769	27,519,909	32,885,147	45,796,432	46,617,909
Straits Settlements, Malaysia and Hong Kong	Imports	6,412,865	5,404,887	8,092,057	7,222,215	8,948,582
	Exports	5,766,059	4,077,436	6,162,526	7,162,908	7,455,726
Africa	Imports	11,290,022	12,522,366	9,703,086	14,755,353	13,130,724
	Exports	10,744,904	13,325,089	16,725,092	21,338,292	20,181,408
Canada and Newfoundland	Imports	12,444,489	13,400,570	22,240,325	26,204,205	27,674,340
	Exports	8,272,743	6,594,903	9,659,138	14,267,967	18,750,970
West Indies, Bermudas, Honduras and Guiana	Imports	2,992,472	2,831,343	2,483,648	2,717,318	2,969,772
	Exports	4,262,669	3,230,189	2,954,477	3,324,665	3,777,244
Australia	Imports	20,992,185	24,954,779	23,800,820	26,968,977	32,655,709
	Exports	21,750,705	15,867,979	23,545,565	19,476,463	27,207,430
New Zealand	Imports	8,347,430	8,383,058	11,615,881	13,391,222	17,730,556
	Exports	3,705,428	3,443,688	5,899,292	6,994,806	8,081,422
Other	Imports	1,720,583	1,952,431	2,287,537	3,731,132	2,800,939
	Exports	3,826,012	3,095,184	4,252,072	4,351,367	4,246,362
II. FOREIGN COUNTRIES—						
France	Imports	44,828,148	47,470,583	53,618,656	53,072,900	50,690,785
	Exports	24,710,803	20,324,998	25,877,453	23,232,663	31,515,320
Germany	Imports	26,073,331	26,992,559	31,181,667	35,799,758	40,115,450
	Exports	30,516,281	32,736,651	38,542,790	42,742,300	47,168,852
Belgium	Imports	17,383,776	17,545,169	23,502,603	27,751,288	29,217,560
	Exports	13,594,966	11,934,653	14,846,307	14,818,923	19,284,791
Holland	Imports	25,900,924	28,419,944	31,381,023	35,481,059	37,371,702
	Exports	16,445,992	11,272,258	14,931,090	14,516,887	16,303,884
Denmark, Faeroe, Iceland, Greenland	Imports	7,753,389	9,799,328	13,187,757	15,606,991	19,427,483
	Exports	2,928,006	3,135,122	4,724,121	4,609,671	5,705,415
Norway	Imports	—	3,831,727	5,756,018	5,954,870	6,574,319
	Exports	—	2,532,050	3,910,982	3,712,532	3,835,436
Sweden	Imports	—	8,784,256	10,635,060	9,827,993	9,245,303
	Exports	—	4,036,729	6,495,223	6,016,332	7,114,071
Austria-Hungary	Imports	1,728,337	1,221,783	1,375,245	1,488,604	1,208,499
	Exports	1,694,318	2,149,552	3,157,716	2,603,223	4,333,269
Rumania	Imports	4,447,159	2,118,505	1,396,639	1,689,513	3,395,474
	Exports	1,350,497	944,034	616,287	1,305,658	1,749,996
Greece	Imports	1,962,798	1,241,406	2,227,212	1,328,234	1,613,174
	Exports	1,235,126	860,193	1,104,196	1,251,642	1,513,744
Italy	Imports	3,093,918	3,132,720	3,417,790	3,324,595	3,634,073
	Exports	8,523,209	6,211,337	9,444,498	9,787,306	13,274,704
Spain	Imports	12,508,533	11,314,518	15,882,346	13,858,631	13,362,959
	Exports	5,702,804	4,052,806	6,333,857	4,841,774	5,352,017
Portugal	Imports	2,942,194	2,491,926	3,241,367	2,929,634	2,912,994
	Exports	2,612,638	1,865,973	2,529,305	2,826,257	2,777,201
Russian Empire	Imports	23,750,868	24,736,919	21,983,952	33,366,234	36,897,746
	Exports	8,846,054	10,686,333	16,360,475	14,884,050	18,325,844
Turkey	Imports	8,368,851 [1]	5,630,240	5,657,627	5,491,443	5,085,435
	Exports	7,340,868 [1]	5,566,187	5,372,956	6,979,147	7,789,432
Japan	Imports	1,024,993	1,143,382	1,540,526	1,860,313	4,232,716
	Exports	4,187,373	4,772,829	9,933,925	9,796,900	8,018,821
China	Imports	4,830,850 [2]	3,343,865 [2]	2,359,821	2,340,346 [3]	3,725,502
	Exports	6,763,221 [2]	5,363,536 [2]	5,634,313	13,298,828 [3]	8,558,275
Netherlands—India	Imports	1,223,037	874,313	287,454	2,129,479	2,436,518
	Exports	1,675,054	1,988,479	2,881,601	3,558,562	3,768,264
Egypt	Imports	8,368,851	9,524,507	12,585,578	14,976,188	19,872,288
	Exports	3,459,991	3,414,556	6,159,468	8,069,668	8,142,325
U.S.A.	Imports	97,283,349	86,548,860	138,789,261	115,573,051	118,269,777
	Exports	46,340,012	44,067,703	37,343,955	47,282,088	59,254,166
Mexico and Central American States	Imports	1,863,284	1,443,345	1,144,590	2,138,574	2,595,356
	Exports	3,050,051	3,035,097	3,149,652	3,022,074	3,179,577
Brazil	Imports	4,350,675	3,614,155	5,946,547	8,109,208	11,271,890
	Exports	7,795,073	7,643,739	6,156,600	6,916,617	8,809,226
Argentina	Imports	4,129,802	9,084,497	13,080,466	25,034,325	32,528,446
	Exports	8,530,427	5,480,848	7,438,238	13,383,835	19,202,496
Chile	Imports	3,473,348	3,436,142	4,828,371	6,068,031	6,607,415
	Exports	3,365,824	3,454,332	3,535,736	4,782,382	5,054,144
Other countries in Asia	Imports	376,969	344,895	373,344	611,096	1,043,280
	Exports	516,846	720,350	684,440	699,556	1,214,041
Africa	Imports	2,345,843	1,683,319	2,503,823	2,901,281	4,538,518
	Exports	3,262,462	3,052,023	4,686,727	6,063,114	7,783,508
South America	Imports	2,080,466	2,437,294	2,355,801	3,897,595	5,657,201
	Exports	5,674,325	4,489,592	4,088,731	5,129,351	6,137,748
Other countries	Imports	3,206,713	3,447,034	3,190,888	6,289,947	4,260,790
	Exports	6,605,220	3,901,551	6,370,943	8,352,264	7,440,065
Total for British possessions	Imports	100,279,852	100,405,592	113,074,557	134,530,683	146,908,244
	Exports	94,522,469	76,138,896	102,083,109	122,712,920	136,318,471
Total for foreign countries	Imports	324,530,783	321,038,151	413,434,242	437,151,191	477,796,713
	Exports	233,729,649	209,693,511	252,290,645	284,883,607	333,206,695
Grand total	Imports	420,691,997	416,689,658	523,075,163	565,019,917	624,704,957
	Exports	328,252,118	285,832,407	354,373,754	407,596,527	469,525,166

[1] Including Cyprus in this year.

[2] Including Korea.

[3] Excluding Wei-hai-wei.

home produce just enumerated. The value of the cotton manufactures exported sank from £80,164,155 in 1872 to £67,641,268 in 1876; woollen fabrics from £38,493,411 to £23,020,719; iron and steel from £35,996,167 to £20,737,410; coals from £10,442,321 to £8,904,463; machinery from £8,201,112 to £7,210,426; and linen manufactures from £10,956,761 to £7,070,149. The decline during the four years, it will be seen, was greatest in all textile manufactures, and least in coal and machinery.

The table[1] on p. 602 shows the subsequent movement in value of imports from other countries to the United Kingdom, and of exports to other countries from the United Kingdom, at quinquennial intervals; bullion and specie being excluded.

As regards fluctuations not revealed by the above figures, it may be mentioned that the highest total figures for any one year during the period covered are those for 1907, viz. imports £645,807,942; exports £517,977,167. As to minima within the period, the lowest totals for British possessions were: imports £91,851,534 in 1893, and exports, the figure quoted for 1895; for foreign countries, imports £312,836,644 in 1893, and exports £195,133,239 in 1894; grand totals, imports £404,688,178 in 1893, and exports £273,785,867 in 1894. It may be added that the maximal import figures for France within the period are those of 1906 (£53,871,661), for Germany those of 1909, and for the United States those of 1901 (£141,015,465). For exports to the United States the figures for 1909 were highest, to France those of 1007 (£33,507,544) and to Germany those of 1907 (£56,729,988).

The following table presents the value of the chief groups and articles of importation into the United Kingdom:—

	1895.	1900.	1905.	1909.
	£	£	£	£
Grain and flour	53,077,981	62,992,082	70,057,290	83,107,421
Meat	33,334,171	46,782,579	49,431,748	47,623,428
Other principal articles of food and drink—				
Butter	14,235,230	17,450,435	21,586,622	22,424,962
Sugar	17,684,413	19,256,439	19,471,811	21,691,894
Tea	10,242,999	10,686,910	9,302,713	11,617,031
Wine	5,448,088	5,192,909	4,072,199	3,746,489
Coffee	3,778,305	2,544,726	2,578,327	2,075,516
Fish (preserved)	2,289,260	2,895,330	2,493,876	2,509,573
Cocoa and chocolate	1,610,483	2,398,248	2,227,141	903,464
Principal fruits—				
Apples	960,273	1,224,657	2,065,193	2,007,911
Oranges	1,925,415	2,120,790	1,949,496	2,522,491
Bananas	—	548,956	1,770,256	1,752,190
Tobacco	3,353,916	4,799,417	3,721,920	4,986,663
Raw materials—				
Cotton	30,522,016	41,117,308	52,370,878	60,295,049
Wool	28,494,249	24,073,917	26,648,737	35,041,766
Oils, &c.	18,497,573	23,564,644	23,600,927	31,039,883
Wood and timber	16,372,181	27,875,913	23,274,020	23,591,579
Textile materials excluding cotton and wool	11,378,608	11,553,114	14,511,978	12,127,707
Caoutchouc	3,760,178	6,986,133	9,643,153	14,138,204
Hides and skins	7,360,070	8,465,660	8,084,793	11,617,756
Metallic ores excluding iron	4,575,929	5,575,272	7,610,990	8,327,193
Iron ore, &c.	3,027,196	5,750,947	5,525,575	5,076,131
Manufactured articles—				
Yarns and textile fabrics	—	—	39,688,418	29,651,658
Metal, excluding iron and steel	11,196,315	21,844,683	21,840,696	24,346,328
Leather	11,035,870	11,823,132	11,037,983	11,617,130
Chemicals	8,714,360	8,628,279	9,624,638	10,596,593
Iron and steel (not machinery)	—	7,314,696	8,589,405	7,971,594
Paper	2,845,730	4,412,440	5,256,065	5,647,437
Machinery	—	3,475,887	4,537,871	4,438,336

Certain omissions are necessary in this table owing to alterations in classification of the returns.

The value of the chief articles and groups of export of home produce are similarly shown:—

	1895.	1900.	1905.	1909.
	£	£	£	£
Cotton yarn and manufactures	63,746,463	69,750,279	92,010,985	93,444,799
Iron and steel and manufactures	19,428,383[2]	31,623,353[2]	31,826,438	38,192,142
Woollen yarn and manufactures	29,094,568	24 259,766	29,916,807	30,917,807
Coal	14,600,326	36,409,614	24,859,129	37,129,978
Machinery	15,150,522	19 619 784	23,260,326	28,057,643
Chemicals	11,463,304	13,154,344	14,536,857	16,783,019
Textiles (not cotton or wool)	11,986,718	12,191,069	13,204,899	12,441,525
Metal manufactures (not iron)	5,048,588	6,473,197	8,920,533	8,708,945
Clothing	5,615,594	6,499,086	6,021,242	9,824,125
Leather and leather goods	3,833,980	3,875,683	5,660,494	4,242,356
Ships	—	8,587,710	5,431,298	5,927,114

The proportion of imports and exports per head of population of the United Kingdom was:—

Year.	Total Imports.	Exports of British Produce.
	£ s. d.	£ s. d.
1890	11 4 6	7 0 7
1895	10 12 6	5 15 4
1900	12 14 3	7 1 6
1905	13 1 5	7 12 7
1906	13 18 5	8 12 0
1907	14 12 6	9 13 3
1908	13 6 3	8 9 4
1909	13 17 7	8 8 1

The tables on p. 604 show the value of unregistered imports of gold and silver bullion and specie from British possessions and from foreign countries into the United Kingdom, specifying the most important countries individually.

Shipping.—The table at foot of p. 604 shows the tonnage of vessels entered from and cleared to British possessions and foreign countries at the principal ports of the United Kingdom.

For the purpose of showing the relative importance of British and Irish ports falling below the list, the following figures may be quoted for 1909 only: Methil, entered 824,375 tons, cleared 1,105,048 tons; Harwich, entered 792,980, cleared 776,595; Grangemouth, entered 988,007, cleared 1,064,217; Burntisland, entered 609,722, cleared 815,507; Bristol, entered 858,933, cleared 615,266; Goole, entered 815,177, cleared 817,226; Hartlepool, entered 934,836, cleared 730,141; Newhaven, entered 385,313, cleared 376,083; Folkestone, entered 364,524, cleared 359,697; Belfast, entered 490,513, cleared 165,670; Borrowstounness (Bo'ness), entered 301,549, cleared 292,194; Dublin, entered 219,081, cleared 80,868; Cork, entered 146,724, cleared 7413; Maryport and Workington, entered 118,388, cleared 67,494. The figures for Plymouth have included vessels which call "off" the port to embark passengers, &c., by tender only since 1907; for 1909 they were: entered, 1,455,605; cleared, 1,292,244.

The table at the commencement of page 605 shows the total tonnage of vessels entered from and cleared to British possessions and foreign countries at ports in the United Kingdom, and also the nationality of vessels under British and the principal foreign flags.

Out of the following totals steam vessels had an aggregate tonnage of 30,604,578 entered and 31,080,481 cleared in 1890, and 64,327,508 entered and 64,968,655 cleared in 1909. The total tonnage of vessels entered and cleared coastwise was as follows: (1890), 47,738,612 entered,

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[1] Adapted from the *Statistical Abstract for the United Kingdom*, where it is specified that the value of new ships and boats, with their machinery, was not included in exports before 1899.

[2] Owing to an alteration in classification these figures are not strictly comparable with those for 1905.

GOLD.

	1890.	1895.	1900.	1905.	1909.
	£	£	£	£	£
From British possessions	5,368,424	17,618,466	11,350,591	38,567,895	40,464,212
South Africa	1,876,677	8,353,913	378,626	21,286,374	32,912,428
India	443,079	1,929,590	3,637,978	6,850,360	2,170,957
Australia	1,398,627	5,324,498	6,182,718	3,440,037	2,613,002
Foreign countries	18,199,625	18,390,863	14,840,282	4,949,335	14,227,617
Total	23,568,049	36,009,329	26,190,873	43,517,230	54,691,829

SILVER.

	1890.	1895.	1900.	1905.	1909.
	£	£	£	£	£
From British possessions	350,094	282,269	264,676	412,756	667,619
Foreign countries	10,035,565	10,384,063	13,057,624	12,579,258	11,147,270
United States of America	4,057,709	8,082,925	11,459,612	9,784,828	9,971,396
Total	10,385,659	10,666,332	13,322,300	12,992,014	11,814,889

42,317,876, cleared; (1895), 54,304,703 entered, 47,263,791 cleared; (1900), 55,828,569 entered, 54,425,666 cleared; (1905), 60,066,919 entered, 58,670,971 cleared; (1909), 60,566,043 entered, 60,060,979 cleared.

The number and gross tonnage of the registered sailing and steam vessels belonging to the United Kingdom were as follows at the end of each of the years named:—

Year.	Sailing Vessels.		Steam Vessels.	
	Number.	Gross Tonnage.	Number.	Gross Tonnage.
1890	14,181	3,055,136	7,410	8,095,370
1895	12,617	3,040,194	8,386	9,952,211
1900	10,773	2,247,228	9,209	11,816,924
1905	10,059	1,796,826	10,552	14,883,594
1909	9,392	1,407,469	11,797	16,994,732

These figures show not only that steamers have been rapidly taking the place of sailing vessels, but also that large steamers are preferred to small, their average tonnage having increased from 1092 tons in 1895 to 1440 in 1909.

		1890.	1895.	1900.	1905.	1909.
		Tons.	Tons.	Tons.	Tons.	Tons.
London	Entered	7,708,705	8,435,676	9,580,854	10,814,115	11,605,698
	Cleared	5,772,062	6,110,325	7,479,008	7,913,115	8,622,316
Liverpool and Birkenhead	Entered	5,782,351	5,598,341	6,001,563	7,806,844	7,747,994
	Cleared	5,159,450	4,883,199	5,778,114	6,932,687	6,593,094
Cardiff	Entered	3,173,699	3,739,856	5,132,523	4,337,720	5,771,476
	Cleared	5,641,511	6,500,510	7,636,717	7,476,879	8,888,756
Tyne Ports [1 & 2]	Entered	3,401,216	3,292,624	3,897,142	4,058,618	5,700,405
	Cleared	5,010,098	4,822,648	4,894,157	5,158,899	6,899,023
Southampton	Entered	888,352	1,420,531	1,613,913	2,087,277	4,279,052
	Cleared	813,133	1,328,393	1,395,486	1,888,030	4,108,063
Hull	Entered	1,997,138	2,150,654	2,666,598	2,546,064	3,517,953
	Cleared	1,655,996	1,612,385	2,274,137	2,102,160	3,164,156
Glasgow	Entered	1,121,700	1,184,537	1,454,860	1,635,609	1,917,144
	Cleared	1,697,662	1,911,739	2,229,574	2,836,462	3,160,916
Newport	Entered	920,560	871,886	1,092,068	1,250,192	1,548,258
	Cleared	1,316,430	1,374,237	1,511,383	1,773,161	2,105,509
Dover	Entered	789,846	742,940	973,074	2,928,741	1,636,530
	Cleared	767,724	734,334	964,476	2,944,774	1,631,751
Middlesbrough	Entered	833,562	953,985	1,096,130	1,227,017	1,728,385
	Cleared	623,967	875,059	882,156	1,092,958	1,586,148
Blyth [2]	Entered	—	—	974,285	1,094,168	1,292,353
	Cleared	—	—	1,525,727	1,623,003	1,836,503
Sunderland	Entered	725,859	730,396	800,027	981,606	1,357,201
	Cleared	956,266	1,002,552	1,163,310	1,344,999	1,676,777
Swansea [3]	Entered	565,644	580,481	1,018,148	635,458	1,020,480
	Cleared	858,215	931,588	1,427,903	1,335,134	1,719,654
Leith	Entered	706,491	887,842	1,055,291	1,124,281	1,344,898
	Cleared	626,573	750,257	982,309	1,085,734	1,314,361
Grimsby	Entered	663,513	763,892	931,238	1,094,531	1,289,476
	Cleared	689,165	829,837	960,236	1,074,495	1,334,566
Manchester	Entered	—	317,625	787,497	1,133,003	1,275,937
	Cleared	—	288,001	595,757	970,620	1,067,835

Railways.—The first ordinary roads deserving the name of highways were made about 1660, and canal-building began in the middle of the following century; but though roads and canals aided materially in raising the commercial and industrial activity of the nation, their fostering agency was very slight compared with that of railways, of which England is the birthplace. The first line of railway for regular passenger service, that from Stockton to Darlington, 14 m. in length, was opened on the 27th of September 1825. The first really important railway was the line from Manchester to Liverpool, opened on the 15th of September 1830, when William Huskisson, M.P., was accidentally killed. It took three years to get the bill for the London-Birmingham railway, which was passed at last in the session of 1833, obtaining the royal assent on the 8th of May. The first sod of the great line was cut at Chalk Farm, London, on the 1st of June 1834. Enormous engineering difficulties had to be overcome, originating not so much from the nature of the ground as from intense public prejudice against the new mode of locomotion. It took over four years to construct the railway from London to Birmingham, at a cost exceeding £4,000,000. Even friends of the railway presaged that such outlay could not by any possibility be remunerative; but the contrary became evident from the moment the line was opened on the 17th of September 1838. All the great railway systems of England sprang into existence within less than ten years after the opening of the London-Birmingham line. Out of this railway grew one of the largest companies; the London & North-Western; while the most extensive system as regards mileage, the Great Western, originated in a line from Paddington, London, to Bristol, for which an act of parliament was obtained in 1835, and which was opened in 1841. In 1836 a bill passed the legislature erecting the "Great North of England" Railway Company, from which was developed the North-Eastern system. A few years later other acts were passed, sanctioning the "Midland Counties" and the "North Midland" lines, from which the present Midland system grew.

The total length of railways conveying passengers in the United Kingdom at the end of the year 1825 was 40 m., constructed at a cost of £120,000. Five years later, at the end of 1830, there were not more than 95 m., built at a cost of £840,925, but at the end of 1835 there were 293 m., costing £5,648,531. Thus, in the first five years of railway construction, from 1825 to 1830, the mileage doubled; while in the second five years, from 1830 to 1835, it trebled. It quintupled in the next five-yearly period, till the end of 1840, when the total length of miles of railway in the kingdom had come to be 1435, built at a cost of £41,391,634, as represented by the paid-up capital of the various companies. The next five years saw nearly another doubling of length of lines, for at the end of 1845 there were 2441 m. of railway created by a paid-up capital of £88,481,376.

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[1] Newcastle, North Shields, South Shields.
[2] Blyth was included with North Shields till 1897.
[3] Swansea included Port Talbot till 1904.

		1890.	1895.	1900.	1905.	1909
		Tons.	Tons.	Tons.	Tons.	Tons.
Total	Entered	36,835,712	40,001,691	49,913,223	55,623,974	66,309,519
	Cleared	37,448,157	40,537,483	50,182,439	56,416,760	66,958,163
British	Entered	26,777,955	29,175,282	32,135,745	35,200,869	39,661,660
	Cleared	27,195,157	29,516,644	32,147,060	35,762,218	40 102,311
German	Entered	2,161,536	1,940,358	2,966,426	4,298,769	6,766,591
	Cleared	2,230,419	1,948,264	3,060,782	4,346,284	6,754,026
Norwegian . . .	Entered	2,477,936	2,604,049	3,839,602	3,392,216	4,315,870
	Cleared	2,522,865	2,660,795	3,821,969	3,387,152	4,308,221
Swedish	Entered	783,045	990,728	1,788,844	2,114,028	2,456,144
	Cleared	792,767	1,003,634	1,808,354	2,117,717	2,478,534
Danish	Entered	901,819	961,730	1,735,288	2,106,717	2,889,986
	Cleared	952,183	990,006	1,759,509	2,123,830	2,886,731
Dutch	Entered	952,695	1,150,098	1,600,317	1,949,161	2,272,075
	Cleared	948,196	1,156,936	1,613,450	1,957,107	2,294,584
French	Entered	834,039	929,250	1,417,128	1,574,395	1,640,466
	Cleared	852,935	909,493	1,405,247	1,587,762	1,663,197
Spanish	Entered	631,629	645,210	1,309,915	1,462,488	1,477,199
	Cleared	644,431	682,184	1,399,332	1,471,300	1,499,319
Belgian	Entered	449,470	551,513	804,472	936,918	1,355,135
	Cleared	423,639	537,969	797,134	920,597	1,357,668
U.S.A.	Entered	146,721	323,700	282,152	664,360	274,241
	Cleared	145,212	332,825	277,400	675,096	280,464

Not far from a fresh trebling took place in the course of the next quinquennial period, and at the end of 1850 there were 6621 m. of railways, constructed at the cost of £240,270,745.

The construction of railways (especially in England) was undertaken originally by a vast number of small companies, each under separate acts of parliament. But it was soon discovered that there could be neither harmonious nor profitable working of a great many systems, and this led to a series of amalgamations (see under ENGLAND; IRELAND; SCOTLAND).

The number of passengers carried per mile in 1832 was 4860, but before ten more years were past the number of passengers had not only increased in proportion with the opening of new lines, but more than doubled per mile, and, instead of being under 5000, had in 1842 come to be near 12,000. In 1861 the number of passengers carried per mile of railway was 15,988; in 1876 it was 31,928; and in 1900 it was over 52,000.

The two following tables illustrate the further development of railways in the United Kingdom:—

Year.	Mileage.	Paid-up Capital.	Number of Passengers.*	Traffic Receipts.		Percentage of Working Expenses to Receipts.
				Total.	Per Mile.	
		£		£	£	
1860	10,433	348,130,127	163,435,678	27,766,622	2,661	47
1865	13,298	455,478,143	251,862,715	35,890,116	2,701	48
1870	15,537	529,908,673	336,545,397	43,417,070	2,794	48
1875	16,658	630,223,494	506,975,234	58,982,753	3,541	54
1880	17,933	728,316,848	603,885,025	62,961,767	3,511	51
1885	19,169	815,858,055	697,213,031	66,644,967	3,477	53
1890	20,073	897,472,026	817,744,046	76,548,347	3,813	54
1895	21,174	1,001,110,221	929,770,909	81,396,047	3,844	56
1900	21,855	1,176,001,890	1,142,276,686	98,854,552	4,523	62
1905	22,847	1,272,601,000	1,199,022,102	105,131,709	4,601	62
1909	23,280	1,314,406,000	1,265,081,000	110,682,266	4,754	62

* Excluding season-ticket holders, whose number in 1880 was 502,174; in 1900, 1,749,804; and in England and Wales alone, in 1880, 449,823; in 1900, 1,610,754.

In the next table further details are given for 1909:—

		1909.		
		England and Wales.	Scotland.	Ireland.
Mileage of	Double or more lines . .	10,746	1,580	670
	Single lines	5,299	2,264	2,721
		£	£	£
Traffic Receipts	Passenger traffic . . .	43,919,702	5,080,603	2,204,756
	Total goods traffic . . .	50,647,426	6,836,920	1,992,859
	Including—			
	Minerals	24,837,682	3,286,074	281,634
	General merchandise .	24,885,494	3,299,588	1,392,600
Working expenditure		65,169,619	7,200,173	2,667,796
Net receipts		37,979,313	5,489,579	1,667,572

In 1909 the percentage of working expenses to total receipts was 63 in England and Wales, 57 in Scotland and 62 in Ireland.

Tramways.—An act passed in 1870 to facilitate the construction of tramways throughout the country marks the beginning of their modern development. It led to the laying down of "street railways" in many large towns. According to a return laid before the House of Commons in the session of 1878, the total length of tramways authorized by parliament up to the 30th of June 1877 was 363 m., and the total length opened for traffic 213 m., comprising 125 m. of double lines and 88 m. of single lines. On the 30th of June 1900 there were in the United Kingdom 70 tramway undertakings with 585 m. of line belonging to local authorities, while 107 with 592 m. of line belonged to other than local authorities. The capital expenditure on the former amounted to £10,203,604, on the latter to £11,532,384.

The development of tramway enterprise in the United Kingdom, as shown by the mileage open, the paid-up capital, gross receipts, working expenses and number of passengers carried, has been as follows:—

Years ending June 30.	Miles open.	Paid-up Capital.	Gross Receipts.	Working Expenses.	Passengers carried during year.
		£	£	£	
1890	948	13,502,026	3,214,743	2,402,800	526,369,328
1895	982	14,111,521	3,733,690	2,878,490	661,760,461
1900	1177	20,582,692	5,445,629	4,075,352	1,065,374,347
1905	2117	51,501,410	9,917,026	6,565,049	2,068,913,226
1909	2526	70,345,155	12,641,437	8,045,658	2,659,981,136

AUTHORITIES.—The following publications relating to the United Kingdom are issued annually in London (unless otherwise stated): *Finance Accounts*; *Financial Estimates*; *Return showing Revenue and Expenditure (England, Scotland and Ireland)*; *National Debt Accounts*; *National Debt during 60 Years*; *Local Taxation Returns*; *Army Estimates*; *Army Accounts*; *Army List* (quarterly); *Navy Estimates*; *Navy List* (quarterly); *Royal Commission on Agriculture, Reports* (1896). *Mineral Statistics*; *Reports of Inspectors of Mines*; *Reports on Factories and Workshops*; *Reports of Inspectors of Fisheries*; *Return of Fish conveyed inland by rail*; *Statement of the Trade of the United Kingdom*; *Statement of the Shipping and Navigation of the United Kingdom*; *Report of the Postmaster-General*. Vital statistics: *Reports* of the registrars-general respectively for England, for Scotland (Edinburgh), for Ireland (Dublin); *Census Reports* (decennial, 1901, &c.), ditto: Education: *Reports of the Board of Education for England and Wales*; *Report of the Commissioners of National Education in Ireland*; *Report of the Committee of Council on Education in Scotland*; *Electoral Statistics* (London, 1905); *Statistical Tables relating to Emigration and Immigration*; *Judicial Statistics* of England and Wales, of Scotland, of Ireland; *Local Government Reports*, ditto; *Statistical Abstract for the United Kingdom*, in which the most important statistics are summarized for each of the fifteen years preceding the year of issue. Among books may be mentioned the following: Sir W. R. Anson, *The Law and Custom of the Constitution* (2 vols., 2nd ed., Oxford, 1892–1896); W. J. Ashley (edited by), *British Industries* (London, 1902), E. G. Boutmy, *Le Développement de la constitution et de la société politique en Angleterre* (2nd ed., Paris, 1897). Of this there is an English translation (from 1st ed.)

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British Military Forces.

The forces of the British Crown may be classed as (*a*) the regular, or general service, army, together with the Indian army; and (*b*) the home territorial force; while there are also certain forces controlled by the governments of the various self-governing dominions. The home government raises, pays and controls the regular army, its reserves, the territorial force, and some few details such as the militia of the smaller possessions, Indian native battalions employed on imperial service out of India, &c. But the cost of that portion of the regular army which is in India is borne by the Indian government, which is not the case with the regulars serving in other colonies or in the dominions. Consequently the Indian government, unlike the colonial governments, can within limits dispose of the British paid regulars within its sphere.

Regular Army.—The duties of the regular army are to garrison India and overseas colonies, to garrison Great Britain and Ireland, and to find expeditionary forces of greater or less strength for war in Europe or elsewhere. The principles upon which the reorganization of 1905–1908 was based are: (*a*) that in peace the army at home must be maintained at such an effective standard that all necessary drafts for the army abroad shall be forthcoming, without undue depletion of the army at home; (*b*) the home army on mobilization for service should be brought up to war strength by the recall of reservists in sufficient, but not too great, numbers; (*c*) the wastage of a campaign shall be made good by drafts partly from the remaining army reserve, but above all from the militia, now converted into the special reserve; and (*d*) the volunteers and yeomanry, reorganized into the territorial force, shall be responsible, with little regular help, for the defence of the home country, thus freeing the regular army at home for general service. The first of these conditions entirely, the second largely, and even indirectly the third and fourth depend upon the recruiting, establishments and terms of service of the regular army. These last are a compromise between the opposite needs of short service, producing large reserves, and long service, which minimizes the sea-transport of drafts; they are also influenced by the state of the labour market at any given moment, as recruiting is voluntary. To enable the authorities to deal with these conditions, the secretary of state for war may without special legislation vary the terms of enlistment, not only in general but also for the various arms and branches.

After the South African War, several different terms were tried for the line infantry and cavalry, but these experiments proved that the terms formerly prevailing, viz. 7 years with the colours and 5 in the reserve, were the most convenient. In the Horse and Field Artillery the term is 6 and 6, in the Household Cavalry and the Garrison Artillery 8 and 4, and in the Foot Guards 3 and 9. Engineers and other specialists are recruited on various terms. A certain number, again varying from year to year, almost from month to month, are allowed to engage for the full 12 years with the colours (long service). Thus in 1907–1908, 1551 men were serving on a 12-year colour engagement, 24,856 on a term of 7 years colours and 5 reserve, 3589 on a 6 and 6 term, 3449 on 3 and 9 engagement, 4529 for other terms, out of a total of 37,974 recruits or soldiers signing fresh engagements.

The following figures show the inflow of recruits:—

Yea..	Recruits offering.	Recruits approved.	Percentage approved.	Percentage of Recruits to Strength of Army.
Oct. 1903–Oct. 1904	89,824	42,041	46·8	14·6
Oct. 1904–Oct. 1905	81,045	35,551	43·9	13·05
Oct. 1905–Oct. 1906	83,155	36,380	43·5	14
Oct. 1906–Oct. 1907	72,855	34,710	47·6	14·25
Oct. 1907–Oct. 1908	77,526	37,222	47·9	14·05
Oct. 1908–Oct. 1909	75,630	33,766	44·7	13·6

The army consists of about 250,000 officers and men of the regular forces on full pay, distributed (October 1909) as follows:—

	Strength.	Establishment.
Staff and departments, &c.	3,293	3,392
On regimental strength:—		
Home	128,412	130,714
India	77,866	76,009
Colonies	47,127	44,981
Total	253,004	253,405

By units, it is composed of 3 regiments of Household Cavalry, 7 regiments of Dragoon Guards, 3 of Dragoons, 6 of Lancers and 12 of Hussars (total cavalry, 31 regiments); 4 regiments of Foot Guards of 9 battalions, 51 English and Welsh, 10 Scottish and 8 Irish line infantry and rifle regiments (total infantry, 149 battalions); the Royal Regiment of Artillery, divided into Royal Horse and Field Artillery, and Royal Garrison Artillery—the R.H.A. consisting of 28 batteries, the R.F.A. of 150 batteries, the R.G.A. of 100 companies (told off to garrisons, siege train and heavy field batteries) and 8 batteries mountain guns; the Corps of Royal Engineers, organized into mounted field troops, field companies, fortress, telegraph, railway, searchlight, balloon, wireless companies and bridging train; the Army Service Corps, divided into transport, supply, mechanical-transport and other companies and sections; the Royal Army Medical Corps of 35 companies; the Army Ordnance Corps; the Army Veterinary Corps; Army Post Office Corps (formed on mobilization only) and Army Pay Corps.

In addition, there are the following colonial troops under the home government:—West India Regiment, 2 battalions; Royal Malta Artillery, 2 garrison companies; West African Frontier Force, 2 batteries, 1 garrison company, 1 battalion M.I., 6 battalions infantry; and King's African Rifles (East Africa), 5 battalions, besides the Indian troops in imperial services.

The army reserve, formed of men who have served with the colours, consists of four classes. Sections A, B and C consist of men who are fulfilling the reserve portion of their original twelve years' liability. Section A, which receives extra allowances, is liable to be called up in a minor emergency; section B is the general reserve; section C, also part of the general reserve, consists of men who have been sent to the reserve prematurely; section D (which is often suspended) consists of men who at the expiry of their twelve years' engagement undertake a further four years' reserve liability.

Strength and Ages of the Army Reserve (Oct. 1, 1909).

Section.	A.	B & C.	D.	Total.
Infantry	4,051	70,998	9,608	84,657
Cavalry	—	8,894	1,229	10,123
R.H. & F.A.	604	13,849	1,571	16,024
R.G.A.	—	7,748	642	8,189
R.E.	415	4,200	406	5,021
Others	427	9,356	558	10,341
	5,497	115,045	14,014	134,556
Under 30.	98,146		201	98,347
30–35	21,730		10,758	32,488
Over 35	666		3,055	3,721
	120,542		14,014	134,556

The special reserve, converted from the militia, consists of infantry, field and garrison artillery, the Irish Horse (late Yeomanry), engineers, and a few A.S.C. and R.A.M.C. Its object is to make good on mobilization deficiencies (so far as they may exist after the calling in of the army reserve) in the expeditionary or regular forces, and to repair the losses of a campaign. It also acts as a feeder to the regular army. Its establishment and strength on the 1st of October 1909 were 90,664 and 69,954 respectively, without counting in the latter figure 6172 militia and militia reserve men not then absorbed into the new organization.

The war organization of the home establishment, with its general and special reserves, aimed at the mobilization and despatch overseas of 6 army divisions, each of 12 battalions in 3 brigades; 9 field batteries in 3 brigades, a brigade of 3 field howitzer batteries, and a heavy battery, each with the appropriate ammunition columns; 2 field companies and 1 telegraph company R.E.; 2 companies mounted infantry; and ambulances, columns and parks. In addition to these 6 divisions, there are "army troops" at the disposal of the commander-in-chief, consisting of two mixed "mounted brigades" (cavalry, mounted infantry, and horse artillery) serving as the "protective cavalry," and of various technical troops, such as balloon companies and bridging train. The "strategical" cavalry is a division of 4 brigades (12 regiments or 36 squadrons), with 2 brigades (4 batteries) of horse artillery, 4 "field troops" and wireless company R.E., and ambulances and supply columns. The peace organization of the regular forces at home conforms to the prospective war organization. In addition to the field army itself, various lines of communication troops are sent abroad on mobilization. These number some 20,000 men, the field army about 135,000, with 492 field guns, 7561 other vehicles and 60,769 horses and mules.

But the first condition of employing all the home regulars abroad is perfect security at home. Thus the pivot of the Haldane system is the organization of the *Territorial Force* as a completely self-contained army. The higher organization—which the volunteers (*q.v.*) and yeomanry (*q.v.*) never possessed—varies only slightly from that in vogue in the regular army. The second line army consists of 14 mixed mounted brigades as protective cavalry and 14 army divisions of much the same combatant strength as the regular divisions, the only important variation being that the artillery consists of 4-gun instead of 6-gun batteries. In addition to the divisions and mounted brigades there are "army troops," of which the most important component is the cyclist battalions, recruited in the different coast counties and specially organized as a first line of opposition to an invader. Affiliated to the territorial force are officers' training corps, cadets, "veteran reserves," and some of the other organizations mentioned below, the Haldane scheme having as its express object the utilization of every sort of contribution to national defence, whether combatant or non-combatant, on a voluntary basis.

The conditions of enlistment and reserve in the territorial force are a four years' engagement (former yeomen and volunteers being however allowed to extend for one year at a time if they desire to do so), within each year a consecutive training in camp of 14-18 days and a number of "drills" (attendances at company and battalion parades) that varies with the branch and the year of service. The minimum is practically always exceeded, and trebled or quadrupled in the case of the more enthusiastic men, and the chief difficulty with which the officers responsible for training have to contend is the fact that no man can be compelled to attend on any particular occasion. Attendance at the camp training, in so far as the claims of men's civil employment do not infringe upon it, is compulsory, and takes place at one time for all—generally the first half of August.

The army troops, divisions and mounted brigades consist of 56 regiments of yeomanry; 14 batteries and 14 ammunition columns R.H.A., 151 batteries and 55 ammunition columns R.F.A., 3 mountain batteries and ammunition column, and 14 heavy batteries and ammunition columns R.G.A.; 28 field companies, 29 telegraph companies, railway battalion, &c., R.E.; 204 battalions infantry (including 10 of cyclists, the Honourable Artillery Company, and certain corps of the Officers' Training Corps training as territorials); 60 units A.S.C.; 56 field ambulances, 23 general hospitals and 2 sanitary companies R.A.M.C. Told off to the defended seaports are 16 groups of garrison artillery companies and 58 fortress and electric light companies R.E.

Establishment and Strength (April 1, 1910)

Arm or Branch.	Establishment.		Strength.	
	Officers.	Men.	Officers.	Men.
Yeomanry	1,345	24,766	1,193	24,219
R.H. & F.A.	1,211	32,945	1,015	29,658
R.G.A.	450	11,455	406	9,356
R.E.	571	14,660	525	12,896
Infantry	5,679	195,297	5,064	173,670
A.S.C.	322	8,562	277	7,577
R.A.M.C.	1,438	13,664	1,151	11,849
A.V.C.	198	14	95	—
Total	11,214	301,363	9,726[1]	269,225

The Territorial Force is enlisted to serve at home, but individuals and whole corps may volunteer for service abroad in war if called upon. A register is kept of those who accept this liability beforehand, and about 6000 officers and men had joined it in April 1910.

The force is trained, commanded and inspected exclusively by the military authorities, the regular army finding the higher commanders and staffs. But in accordance both with the growing tendency to separate command and administration and with the desire to enlist local sympathies and utilize local resources, "associations," partly of civilian, partly of military members, were formed in every county and charged by statute with all matters relating to the enlistment, service and discharge of the county's quota in the force, finance (other than pay, &c. in camp), buildings, ownership of regimental property, &c. To these duties of county associations are added that of supervising and administering cadet corps of all sorts (other than officers' training corps), and that of providing the extra horses required on mobilization, not only by the territorial force, but by the expeditionary force as well.

There are several groups of more or less military character which are for various reasons outside war office control. These are: (*a*) boys' brigades—the Church Lads' Brigade, the London Diocesan Brigade, the Jewish Lads' Brigade, &c.; (*b*) the Legion of Frontiersmen, an organization intended to enroll for "irregular" service men with colonial or frontier experience; (*c*) rifle clubs, which exist solely for rifle practice, and have no military liabilities; (*d*) boy scouts, an organization founded in 1908 by Lieut.-General Sir R. S. S. Baden-Powell.

Command and Administration.—The secretary of state for war is the head of the army council, which comprises the heads of departments and is the chief executive authority. These departments (see STAFF) are: the general staff; the adjutant-general's department; the quartermaster-general's department; the department of the master-general of the ordnance; the civil member's department; and the finance member's department. In addition to these departments, whose heads form the army council itself, there is the very important department of the inspector-general of the forces, whose duties are to ensure by inspection the maintenance of military efficiency and an adequate standard of instruction, &c. This department is thus in the main a complement of the general staff branch. In 1910 the commander-in-chief in the Mediterranean was appointed inspector-general of the overseas forces other than those in India, and the inspector-general in London supervises therefore only the forces in the home establishment. There are, therefore, three single authorities of high rank for the great divisions of the army—the two inspectors-general and the commander-in-chief in India.

The United Kingdom is subdivided into 7 commands and 12 districts, the commands under a lieutenant-general or general as commander-in-chief and the districts under brigadier-generals. The commands are the eastern, southern, western, northern, Scottish, Irish and the Aldershot. London is organized as a separate district under a major-general. In the colonial establishment the principal commands are the Mediterranean (including Egypt) and the South African. Except in South Africa, there are no imperial troops quartered in the self-governing colonies.

Since 1904–1905 command and administration have been separated and general officers commanding in chief relieved of administrative details by the appointment to their staffs of major-generals in charge of administration (see STAFF and OFFICERS).

Finance.—The army estimates for 1910–1911 show a total sum of £27,760,000 required for the home and colonial establishments, made up as follows (after deducting appropriations in aid):—

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[1] Does not include unattached list of officers, 853, or 736 R.A.M.C. officers not available until mobilization.

Regular Army, Pay and Allowances	£8,733,000
Special Reserve	833,000
Territorial Force	2,660,000
Medical Services	452,000
Educational Establishments	147,000
Quartering, Transport, Remounts	1,589,000
Supplies, Clothing	4,397,000
Stores and Ordnance Establishment	533,000
Armament and Engineer Stores	1,482,000
Works, Buildings and Land, &c.	2,598,000
War Office and Miscellaneous	503,000
Pensions, &c.	3,833,000
	£27,760,000

The pay of the soldiers has increased since the South African War. Without allowances of any kind, it was in 1910 as follows: Warrant officer, 5s. to 6s. per day; quartermaster-sergeants, colour-sergeants, &c., 3s. 4d. to 4s. 6d.; sergeants, 2s. 4d. to 3s. 4d.; corporals, 1s. 8d. to 2s. 8d.; lance-corporals, 1s. 3d. to 1s. 9d.; privates 1s. 1d. to 1s. 9d.; boys, 8d. In addition, all receive a messing allowance of 3d. per day, 2d. for upkeep of kit, and most receive "service" or "proficiency" pay at 3d.–6d a day; and engineers, A.S.C. and R.A.M.C. specialist pay at various rates. Officers' pay, without allowances, is for second lieutenants 5s. 3d. to 7s. 8d.; lieutenants, 6s. 5d. to 8s. 10d.; captains, 11s. 7d. to 15s.; majors, 13s. 7d. to 18s. 6d.; and lieutenant-colonels, 18s. to 24s. 9d.

Indian Army.—The forces in India consist of the British army on the Indian establishment and the Indian native army with its dependent local militias, feudatories, contingents, &c. In addition there is a force of European and Eurasian volunteers, drawn largely from railway employés. The Indian army consists of 138 battalions of infantry, 10 regiments of cavalry, 16 mountain batteries, 1 garrison artillery company, 32 sapper and miner companies (2 railways companies included). The proportion between British and Indian troops observed since the Mutiny is roughly one British to two native, the Indian army being about 162,000 men. In addition the native army includes supply and transport corps, the medical service, and the veterinary service, officered in the higher ranks by officers of the A.S.C., R.A.M,C. and A.V.C. respectively.

The Indian army is recruited from Mahommedans and Hindus of various tribes and sects, and with some exceptions (chiefly in the Madras infantry) companies, sometimes regiments, are composed exclusively of men of one class. The official *F.S. Pocket Book* 1908 gives the following particulars: *Mahommedans* (Pathans of the frontier tribes, Hazaras Baluchis, Moplahs, Punjabi Mahommedans, &c.), 350 infantry companies, 76 squadrons (35% of the army). *Hindus* (Sikhs, Gurkhas, Rajputs, Jats, Dogras, Mahrattas, Tamils, Brahmans, Bhils, Garhwalis, &c.), 727 companies, 79 squadrons (63·3%).

Enlistment is entirely voluntary, and the army enjoys the highest prestige. Service is for three years, but in practice the native soldier makes the army his career and he is allowed to extend up to 32 years. The native cavalry is almost entirely *Silahdar*, in which the trooper mounts and clothes himself, and practically serves without pay. In the infantry, too, the old system of paying men and requiring them to equip, clothe and feed themselves, is in vogue to some extent. There is a reserve of the native army, numbering some 35,000 men. But it is rather a draft to replace wastage than a means of bringing the army up to a war footing in the European way. Indeed, a cardinal principle of the Indian forces, British and native alike, is that the units are maintained in peace at full war effective, often a little above their field strength. Part of the army, nearest the north-west frontier, has even its transport practically in readiness to move at once. The command is in the hands of British officers assisted by native officers, promoted from the ranks. The number of native officers in a unit is equal to that of the British officers.

Besides the regular native army there are: (*a*) various frontier and other levies, such as the Khyber Rifles and the Waziristan Militia; (*b*) selected contingents from the armies of the native princes, inspected by British officers, numbering about 20,000 and styled "imperial service troops"; (*c*) the volunteers, about 32,000 strong; and (*d*) the military police.

The general organization of the forces is into two armies, the northern and the southern, with headquarters at Rawal Pindi and Poona respectively.

Administration.—Under the governor-general in council the commander-in-chief (himself a member of the council) is the executive authority. Under him in the army department, now divided into higher committees and the headquarter staff, the latter comprising (since the abolition of the military staff department under Lord Kitchener's reorganization) the divisions of the chief of the general staff, the adjutant-general and the quartermaster-general. India has her own staff college at Quetta, and can manufacture rifles, ammunition and field artillery equipment except the actual guns.

The cost of the Indian army, and of the British forces on the Indian establishment, borne by the Indian government in 1909 was £20,558,000.

Regulars only.	Northern Army.	Southern Army.	Total.
British	40,608	34,143	74,751
Indian Army, white	1,534	1,512	3,046
" " native	85,189	76,772	161,961
Total	86,723	78,284	165,007
Total	127,331	112,427	239,758

Forces of the Dominions and Colonies.—Lord Kitchener and Sir John French in 1909–1910 paid visits of inspection to Australia and Canada in connexion with the reorganization by the local governments of their military forces, and a beginning was made of a common organization of the forces of the empire in the colonial military conference of 1909. Without infringement of local autonomy and local conditions, a common system of drill, equipment, training and staff administration was agreed on as essential, and to that end the general staff in London was to evolve into an "imperial general staff." The object to be attained as laid down was twofold; (*a*) complete organization of the territorial forces of each dominion or colony; (*b*) evolution of contingents of colonial general-service troops with which the dominion governments might assist the army of Great Britain in wars outside the immediate borders of each dominion. (See BRITISH EMPIRE; AUSTRALIA; CANADA.)

UNITED METHODIST CHURCH, or UNITED METHODISTS, and English Nonconformist community formed in 1907 by the union of the Methodist New Connexion (1797), the Bible Christians (1815), and the United Methodist Free Churches (1857). The act of parliament which enabled this amalgamation received the royal assent on the 26th of July 1907, and authorized the union "to deal with real and personal property belonging to the said three churches or denominations, to provide for the vesting of the said property in trust for the United Church so formed and for the assimilation of the trusts thereof, and for other purposes." The union was completed on the 16th of September 1907 in Wesley's Chapel, City Road, London. The Church gives power of speech and vote in its meetings to every member of 18 years of age and upwards. Its principal courts are constituted of an equal number of ministers and laymen. The Church had theological colleges at Manchester and Sheffield, boys' schools at Shebbear, in Devonshire, and at Harrogate, and a girls' school at Bideford. It issues a weekly and two monthly journals. In 1908 its statistics showed 2343 chapels with accommodation for 714,793 persons, 848 ministers and 5621 local preachers, 165,463 church members and 332,756 Sunday scholars; there were 55 foreign missionaries, and about 30,000 church members and probationers in the foreign field.

UNITED METHODIST FREE CHURCHES, an English Nonconformist community merged since 1907 in the United Methodist Church (*q.v.*). The organization was itself formed in 1857 by the amalgamation of the "Wesleyan Association" (which had in 1836 largely absorbed the Protestant Methodists of 1828) and the "Wesleyan Reformers" (dating from 1849, when a number of Wesleyan Methodist ministers were expelled on a charge of insubordination).

UNITED PRESBYTERIAN CHURCH (of Scotland). This Presbyterian organization, merged since 1900 in the United Free Church of Scotland (see above), was formed in 1847 by the union of the United Secession and Relief Churches.

The general causes which led to the first great secession from the Church of Scotland, as by law established in 1688, are indicated in the article SCOTLAND, CHURCH OF. Its immediate occasion rose out of an act of assembly of 1732, which abolished the last remnant of popular election by enacting that, in cases where patrons

United Secession Church.

might neglect or decline to exercise their right of presentation the minister was to be chosen, not by the congregation, but only by the elders and Protestant heritors. The act itself had been passed by the assembly, although the presbyteries to which it had been previously submitted as an overture had disapproved of it by a large majority; and in accordance with a previous act (1730), which had taken away even the right of complaint, the protests of the dissentient majority were refused. In the following October Ebenezer Erskine (*q.v.*), minister of Stirling, preached a synod sermon, in the course of which he took occasion to refer to the act in question as in his opinion unscriptural and unconstitutional.[1] Some of his expressions were objected to by members of synod, and it was resolved that he should be censured for them. This judgment, on appeal, was affirmed by the assembly in May 1733, whereupon Erskine protested to the effect that he held himself still at liberty to teach the same truths and to testify against the same or similar evils on every proper occasion. This protest, in which he was joined by William Wilson (1690–1741), Alexander Moncrieff (1695–1761) and James Fisher (1697–1775), ministers at Perth, Abernethy and Kinclaven respectively, was regarded by the assembly as contumacious, and the commission of assembly was ordered to procure its retractation or to proceed to higher censures. In November accordingly the protesting ministers were severed from their charges, their churches declared vacant, and all ministers of the Church prohibited from employing them in any ministerial function. They replied by protesting that they still adhered to the principles of the Church, though now obliged to "make a secession from the prevailing party in ecclesiastical courts."

In December 1733 they constituted themselves into a presbytery, but for some time their meetings were devoted almost entirely to prayer and religious conferences. In 1734 they published their first "testimony," with a statement of the grounds of their secession, which made prominent reference to the doctrinal laxity of previous general assemblies. In 1736 they proceeded to exercise "judicial powers" as a church court, published a "judicial testimony," and began to organize churches in various parts of the country. Having been joined by four other ministers, including the well-known Ralph Erskine, they appointed Wilson professor of divinity. For these acts proceedings were again instituted against them in the assembly, with the result that, having disowned the authority of that body in an "act of declinature," there were in 1740 all deposed and ordered to be ejected from their churches. Meanwhile the members of the "Associate Presbytery" and its adherents steadily increased, until in 1745 there were forty-five congregations under its jurisdiction, and it was reconstituted into an "Associate Synod." A violent controversy arose the same year respecting the religious clause of the oath taken by burgesses in Edinburgh, Glasgow and Perth ("I profess and allow with my heart the true religion presently professed within this realm and authorized by the laws thereof"), and resulted in April 1747 in a "breach," when two bodies were formed, each claiming to be the "Associate Synod"; those who condemned the swearing of the burgess oath as sinful came to be popularly known as "Antiburghers," while the other party, who contended that abstinence from it should not be made a term of communion, were designated "Burghers." The Antiburghers not only refused to hold further friendly conference with the others, but ultimately went so far as to pass sentences of deposition and the greater excommunication on the Erskines and other ministers who held the opposing view. The Associate (Antiburgher) Synod held its first meeting in Edinburgh in the house of Adam Gib (*q.v.*) on the 10th of April 1747. It grew with considerable rapidity, and in 1788 had ninety-four settled charges in Great Britain and nineteen in Ireland, besides a presbytery in America. For purposes of organization it was formed in that year into four provincial synods, and took the name of "The General Associate Synod." The "new light" controversies as to the province of the civil magistrate in matters of religion led to the publication of a revised testimony in the "voluntary" sense in 1804, and in consequence Thomas M'Crie (1772–1835), with three other brethren, withdrew to form the Constitutional Associate Presbytery. The Associate (Burgher) Synod held its first meeting at Stirling on the 16th of June 1747. The number of congregations under its charge rapidly increased, and within thirty years there were presbyteries in connexion with it in Ireland and North America, as well as throughout Scotland. In 1782 the American presbyteries took the designation of the Associate Reformed Church in America. About the year 1795 the "voluntary" controversy respecting the power of the civil magistrate in matters of religion arose within this synod also, and a large majority was found to have adopted "new light" views. This led in 1799 to the secession of the "Associate Presbytery," which in 1805 took the designation of the Associate Synod or Original Burgher Synod.[2] In 1820 the General Associate or Antiburgher Synod (to the number of 129 congregations[3]) united with the 154 congregations of the Associate or Burgher Synod. The body thus constituted, "The United Secession Church," had increased by 1847 to 400 congregations.

Relief Church.

The Presbytery of Relief was constituted in 1761 by three ministers of the Church of Scotland, one of whom was Thomas Gillespie (*q.v.*), who had been deposed by the assembly in 1752 for refusing to take part in the intrusion of unacceptable ministers. The number of congregations under its charge increased with considerable rapidity, and a Relief Synod was formed in 1773, which in 1847 had under its jurisdiction 136 congregations. The Relief Church issued no distinctive "testimonies," and a certain breadth of view was shown in the formal declaration of their terms of communion, first made in 1773, which allowed occasional communion with those of the Episcopal and Independent persuasion who are "visible saints." A Relief theological hall was instituted in 1824.

United Presbyterian Church.

In 1847 a union was formed between all the congregations of the United Secession Church and 118 out of 136 of the Relief Churches, in what now became the United Presbyterian Church. It was the first Presbyterian body to relax the stringency of subscription, the Synod passing a declaratory act on the subject in 1879. On such points as that of the six days' creation it was made clear that freedom was allowed; but when Mr David Macrae of Gourock claimed that it should also be allowed on the question of eternal punishment, he was at once declared to be no longer a minister of the church. He left behind him many who sympathized with his position, and in the remaining part of the 19th century the United Presbyterian Church came fully to share the forward movement of thought of the other Scottish churches. Doctrinally there was little difference between the United Presbyterian Church and the Free Church of Scotland, and between 1863 and 1873 negotiations were carried on for a union, which however were fruitless. But in 1896 the United Presbyterian Church again made advances, which were promptly met, and on the 31st of October 1900 the United Free Church of Scotland came into existence.

UNITED PROVINCES OF AGRA AND OUDH (formerly known as the North-Western Provinces and Oudh), a province of British India, lying between 23° 52′ and 31° 18′ N., and between 77° 3′ and 84° 39′ E. The province, including native states, has a total area of 112,243 sq. m. It is bounded N. by Tibet; N.E. by Nepal; E. by Bengal; S. by Chota Nagpur, Rewa, the Bundelkhand states, and the Central Provinces; and on the W. by Gwalior, Rajputana and the Punjab.

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[1] The passing of the act was certainly unconstitutional; it was rescinded in 1734, "because not made according to former acts."

[2] The majority of this synod joined the Church of Scotland in 1839. The small minority which still retained the name joined the Original Seceders in 1842, the resultant body assuming the designation of United Original Seceders. A small majority (twenty-seven ministers in all) of the Synod of United Original Seceders joined the Free Church in 1852.

[3] A dissentient remnant (eight congregations) of the General Associate Synod united with the Constitutional Associate Presbytery in 1827, the resultant body being called the Associate Synod of Original Seceders.

Physical Aspects.—The province occupies, roughly speaking, the upper basin of the Ganges and the Jumna, corresponding to the Hindostan proper of the Mahommedan chroniclers. A large semi-circular tract, comprising the valleys of the Gogra and the Gumti, has long been separated from the remainder of the great plain as the kingdom of Oudh; and though since 1877 it has been under the administrative charge of a lieutenant-governor, it retains certain features of its former status as a chief-commissionership. The province includes the whole upper portion of the wide Gangetic basin, from the Himalayas and the Punjab plain to the Vindhyan plateau, and the low-lying ricefields of Behar. Taken as a whole, the lieutenant-governorship consists of the richest wheat-bearing country in India, irrigated both naturally by the rivers which take their rise in the northern mountains, and artificially by the magnificent system of canals which owe their origin to British enterprise. It is studded with villages, interspersed at greater distances with commercial towns. Except during the hot season, when the crops are off the fields, the general aspect in normal years is that of a verdant and well-tilled but very monotonous plain, only merging into hilly or mountainous country at the extreme edges of the basin on the south and north. The course of the great rivers marks the prevailing slope of the land, which falls away from the Himalayas, the Rajputana uplands, and the Vindhyan plateau south-eastwards towards the Bay of Bengal. The chief natural features of the province are thus determined by the main streams, whose alluvial deposits first formed the central portion of the United Provinces; while the currents afterwards cut deep channels through the detritus they brought down from the ring of hills or uplands.

The extreme or north-western Himalayan region comprises the native state of Garhwal, with the British districts of Dehra Dun, Naini Tal, Almora and Garhwal. The economic value of this mountainous tract is almost confined to the export of forest produce. South of the Himalayas, from which it is separated by valleys or *duns*, is the Siwalik range, which slopes down to the fruitful plain of the Doab (two rivers), a large irregular horn-shaped tongue of land enclosed between the Ganges and Jumna. The great boundary rivers flow through low-lying valleys fertilized by their overflow or percolation, while a high bank leads up to the central upland, which, though naturally dry and unproductive except where irrigated by wells, has been transformed by various canal systems. This favoured region may be regarded as the granary of upper India. North of the Ganges, and enclosed between that river and the Himalayas and Oudh, lies the triangular plain of Rohilkhand. This tract presents the same general features as the Gangetic valley, varied by the damp and pestilential submontane region of the *tarai* on the north-east, at the foot of the Kumaon hills. South of the Jumna is the poor and backward region of Bundelkhand, comprising the districts of Jalaun, Jhansi, Hamirpur and Banda. The soil is generally rocky and unfertile, and the population impoverished, scanty and ignorant. The southernmost portion of Bundelkhand is much cut up by spurs of sandstone and granite hills, running down from the Vindhyan system; but the northern half near the Jumna has a somewhat richer soil, and comes nearer in character to the plain of Doab. Below the junction of the Ganges and the Jumna at Allahabad the country begins to assume the appearance of the Bengal plains, and once more expands northwards to the foot of the Nepal Himalayas. This tract consists of three portions, separated by the Ganges and the Gogra. The division south of the Ganges comprises portions of Allahabad, Benares and Ghazipur, together with the whole of Mirzapur, and in general features somewhat resembles Bundelkhand, but the lowlands along the river bank are more fertile. The triangular tract between the Ganges and the Gogra and the boundary of Oudh is the most fertile corner of the Gangetic plain, and contains the densest population. The trans-Gogra region presents a wilder, submontane appearance.

Oudh forms the central portion of the great Gangetic plain, sloping downwards from the Nepal Himalayas in the north-east to the Ganges on the south-west. For 60 m. along the northern border of Gonda and Bahraich districts the boundary extends close up to the lower slopes of the Himalayas, embracing the damp and unhealthy submontane region known as the *tarai*. To the westward of this the northern boundary recedes a little from the mountain tract, and the *tarai* in this portion of the range has been for the most part ceded to Nepal. With the exception of a belt of government forest along the northern frontier, the rest of the province consists of a fertile and densely peopled plain. The greatest elevation (600 ft.) is attained in the jungle-clad plateau of Khairagarh in Kheri district, while the extreme south-east frontier is only 230 ft. above sea-level. Four great rivers traverse or skirt the plain of Oudh in converging courses—the Ganges, the Gumti, the Gogra and the Rapti. Numerous smaller channels seam the whole face of the country carrying off the surplus drainage in the rains, but drying up in the hot season. All the larger rivers, except the Gumti, as well as most of the smaller streams, have beds hardly sunk below the general level; and in time of floods they burst through their banks and carve out new channels. Numerous shallow ponds or *jhils* mark the former beds of the shifting rivers. These *jhils* have great value, not only as preservatives against inundation, but also as reservoirs for irrigation. The soil of Oudh consists of a rich alluvial deposit, the detritus of the Himalayan system washed down into the Ganges valley. Usually a light loam, it passes here and there into pure clay, or degenerates occasionally into barren sand. The uncultivable land consists chiefly of extensive *usar* plains, found in the southern and western districts, and covered by the deleterious saline efflorescence known as *reh*. Oudh possesses no valuable minerals. Salt was extensively manufactured during native rule, but the British government has prohibited this industry for fiscal reasons. Nodular limestone (*kankar*) occurs in considerable deposits, and is used as road metal.

The villages lie thickly scattered, consisting of low thatched cottages, and surrounded by patches of garden land, or groves of banyan, *pipal* and *pakar* trees. The dense foliage of the mango marks the site of almost every little homestead, no less an area than 1000 sq. m. being covered by these valuable fruit-trees. Tamarinds overhang the huts of the poorer classes, while the seat of a wealthy family may be recognized by clumps of bamboo. Plantains, guavas, jack-fruit, limes and oranges add further beauty to the village plots. The flora of the government reserved forests is rich and varied. The *sal* tree yields the most important timber; the finest logs are cut in the Khairagarh jungles and floated down the Gogra to Bahramghat, where they are sawn. The hard wood of the *shisham* is also valuable; and several other timber-trees afford materials for furniture or roofing shingle. Among the scattered jungles in various parts of the province, the *mahua* tree is prized alike for its edible flowers, its fruits and its timber. The *jhils* supply the villages with wild rice, the roots and seeds of the lotus, and the *singhara* water-nut. The fauna comprises most of the animals and birds common to the Gangetic plain; but the wild elephant is now practically unknown, except when a stray specimen loses its way at the foot of the hills. Tigers are now only found in any numbers in the wilds of Khairagarh. Leopards still haunt the cane-brakes and thickets along the banks of the rivers; and *nilgai* and antelopes abound. Game birds consist of teal and wild duck, snipe, jungle fowl and peacock.

Rivers.—The Ganges and its affluents, the Jumna, the Ramganga and the Gogra, rise in the Himalayas, and meet within the province. In addition there are the following secondary streams: the Kalinadi and the Hindan flow through the Doab; the Chambal intersects the trans-Jumna tract; in Bundelkhand the principal streams are the Betwa and the Ken; the Ramgana, rising in Garhwal, pursues a tortuous course through Rohilkhand; the Gumti flows past Lucknow and Jaunpur to join the Ganges; the trans-Gogra region is divided into two nearly equal parts by the Rapti. These rivers are constantly modifying the adjacent lands. A small obstruction may divert the stream from one side to the other. The deep stream corrodes and cuts down the high ground; but meanwhile alluvial flats are gradually piled up in the shallows. The tributary streams get choked at the mouth and assist the process of deposition. The deposit is greatest when the floods of the rainy season are subsiding.

Climate.—The climate as a whole is hot and dry. The Himalayan districts of course are cool, and have a much greater rainfall than the plains. They are succeeded by a broad submontane belt, the *tarai*, which is rendered moist by the mountain torrents, and is covered by forest from end to end. This region bears the reputation of being the most unhealthy in all India, and in many parts only the acclimatized aborigines can withstand its deadly malaria. The plain country is generally warm and dry, the heat becoming more oppressive as the general level of the country sinks towards Allahabad and Benares, or among the hills of Bundelkhand. There are three seasons. The cold changes gradually to the hot; the hot season gives way abruptly to the rains; and the rains again change gradually into the cold season. In point of humidity and temperature the province lies half-way between Bengal and the Punjab. The rainfall varies from 30 to 44 in. in the plains, increasing gradually towards the Himalaya. The temperature in the hot season ranges from 86° to 115° F., and even higher, in the shade.

Minerals.—Owing to the loamy nature of the soil, few minerals of any kind are found. Iron and coal exist in the southern hills. A little coal was extracted from Mirzapur in 1896, but the enterprise was dropped. Iron, copper, sapphires, &c., are said to be obtainable in the Himalaya. It has been suggested that the oily water known as *telya pani* indicates the presence of petroleum.

Agriculture.—Out of a total area of 104,075 sq. m. in the British districts of the province, over 54,000 sq. m. are under cultivation. The course of tillage comprises two principal harvests: the *kharif*, or autumn crops, sown in June and reaped in October or November; and the *rabi*, or spring crops, sown in October or November, and reaped in March or April. The great agricultural staple is wheat, but millets and rice are also largely cultivated. Speaking broadly, rice and oilseeds predominate in the eastern and sub-Himalayan

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districts, millets and cotton in Bundelkhand and wheat in the greater part of the Gangetic plain. The pulses *mung*, *urd* and *moth* are grown generally in the autumn alone, or in combination with millets; and gram, alone or in combination with wheat and barley, is an important spring crop. Sugar-cane, indigo, poppy and tobacco are locally important; and a little tea is grown in the submontane districts of Almora Garhwal and Dehra Dun.

Land Tenure.—Owing to historical reasons, the system of land tenure is not uniform. In the Benares division, which was the first portion to come under British administration, the land revenue was permanently fixed in 1795, on the same principles that had been previously adopted in Bengal; and there a special class of tenants, as well as the landlords, enjoy a privileged status. Throughout the rest of the province of Agra, almost all of which was acquired between 1801 and 1803, temporary settlements are in force, usually for a term of thirty years, the revenue being assessed at one-half of the "assets" or estimated rental value. The settlement is made with the landholders or *zamindars*, who are frequently a group of persons holding distinct shares in the land, and may be themselves petty cultivators. No proprietary rights superior to those of the actual landowners are recognized. The only privileged class of tenants are those possessing "occupancy" rights, as defined by statute. These rights, which are heritable but not transferable, protect the tenant against eviction, except for default in payment of rent, while the rent may not be enhanced except by mutual agreement or by order of a revenue court. "Occupancy" rights are acquired by continuous cultivation for ten years, but the cultivation need not be of the same holding. All other tenants are merely tenants-at-will. In Oudh, after the convulsion of the Mutiny, all rights in land were confiscated at a stroke, and the new system adopted was in the nature of a treaty between the state and the *talukdars*, or great landlords. These *talukdars* had not all the same origin. Many were Rajput chiefs, ruling over their tribesmen by ancient hereditary right; while others were officials or court favourites, who had acquired power and property during the long period of native misrule. On all the same status was now conferred—a status that has no analogy in the rest of India. By *sanad* (or patent) and by legislation the *talukdars* were declared to possess permanent, heritable and transferable rights, with the special privilege of alienation, either in lifetime or by will, notwithstanding the limits imposed by Hindu or Mahommedan law. In addition most of them follow the rule of primogeniture, while a power of entail has recently been granted. The estates of *talukdars* extend over more than half the total area of Oudh. No "occupancy" rights based on continuous cultivation are recognized in Oudh, but similar rights, here known as "sub-proprietary," were granted to all those who had possessed them within thirty years before annexation. On the other hand, there are no tenants-at-right in Oudh. Any person admitted to the cultivation of land is entitled to hold it for seven years at the same rent, which may not be advanced by more than 6¼% at the end of the term.

Manufactures.—The principal manufactures are those of sugar, indigo and coarse cotton cloth. Ornamental metal-work is made at Benares. Among the factories on the English model are the Elgin and Muir cotton mills at Cawnpore, the Cawnpore tanneries and leather factories, the Shahjahanpur rum distillery, and breweries at Mussoorie and Naini Tal. There are also woollen and jute mills, iron and brass foundries, lac factories and oil-mills. The manufacture of synthetic indigo by German chemists has greatly affected the growth and manufacture of indigo, the indigo factories decreasing in 1904–1905 from 402 to 252.

Trade.—The export trade is chiefly confined to agricultural produce. The principal staples include wheat, oilseeds, raw cotton, indigo, sugar, molasses, timber and forest produce, dry-stuffs, ghee, opium and tobacco. The imports consist mainly of English piece-goods, metal-work, manufactured wares, salt and European goods. The chief centres of trade are Cawnpore, Allahabad, Mirzapur, Benares, Meerut and Moradabad.

Irrigation.—The Doab is intersected by canals drawn from the great rivers. The major productive works are the upper and lower Ganges, the eastern Jumna, and the Agra canals. The greatest work in the province, and one of the greatest irrigation works in the world, is the upper Ganges canal, which is taken from the river where it leaves the hills, some 2 m. above Hardwar. In the first 20 m. of its course this gigantic canal crosses four great torrents, which bring down immense volumes of water in the rainy season. The first two are carried in massive aqueducts over the canal, the third is passed through the canal by a level-crossing, regulated by drop-gates, and the canal is taken over the fourth by an aqueduct. The total length of the main canal is 213 m., navigable throughout, and designed to irrigate 1,500,000 acres. The lower Ganges canal is taken from the river at Narora, 149 m. below Hardwar. After crossing in 55 m. four great drainage lines, it cuts into the Cawnpore, and 7 m. lower down into the Etawah, branches of the upper Ganges canal. These branches are now below the point of intersection, part of the lower Ganges canal system. The irrigating capacity of this canal is 1,250,000 acres.

Railways.—The province is well supplied with railways. The main line of the East Indian runs throughout south of the Ganges, which is bridged at Benares and Cawnpore. North of the river the Oudh & Rohilkhand system connects with Bengal and with the Punjab. From Allahabad, Cawnpore and Agra trade finds an outlet to the sea at Bombay as well as at Calcutta.

Administration.—The administration is conducted by a lieutenant-governor, with five secretaries and five under-secretaries. There is no executive council; but the board of revenue, consisting of two members, exercises important executive duties, and is also the highest court of appeal in revenue and rent cases. For legislative purposes the lieutenant-governor has a council, first constituted in 1886, and enlarged in 1909. It now consists of 48 members, of whom 28 are nominated, and the remainder are elected by local bodies, landholders, Mahommedans, &c. In Agra the chartered high court sitting at Allahabad, and in Oudh the court of the judicial commissioner, sitting at Lucknow, have final jurisdiction in both civil and criminal cases, subject to appeal to the privy council. The former is composed of a chief justice and six puisne judges appointed by the Crown; the latter of a judicial commissioner and two additional judicial commissioners. For ordinary purposes of administration the provinces are divided into nine divisions, each under a commissioner, and into 48 districts, each under a collector or deputy commissioner. Two native states are attached to the United Provinces—Rampur and Garhwal.

Population.—Out of a total population in 1901 of 47,691,782 no fewer than 40,691,818, or over 85% were Hindus, and 6,731,034 or 14% Mahommedans. The total number of persons belonging to all the other religions—Sikhs, Jains, Buddhists, Parsees, Christians, Jews, Aryas and Brahmos—was only 268,930, or less than 0·6%. While nearly fifty languages in all are spoken in the provinces, out of every 10,000 people 4527 speak Western Hindi, 3125 Eastern Hindi, 2109 Bihari and 211 Central Pahari.

History.—If the present limits be slightly extended in either direction so as to include Delhi and Patna, the United Provinces would contain the area on which almost the whole drama of Indian history has been played. Here lay the scene, known as *Madhya Desa* or "middle country," of the second period of Aryan colonization, when the two great epics, the *Mahabhārata* and *Ramayana*, were probably composed, and when the religion of Brahmanism took form. Here Buddha was born, preached and died. Here arose the successive dynasties of Asoka, of the Guptas, and of Harshavardhana, which for a thousand years exercised imperial sway over the greater part of India. Here is Ajodhya, the home of Rama, the most popular of Hindu demigods; and also Benares and Muttra, the most sacred of Hindu shrines. Here too were the Mahommedan capitals—Delhi, Agra, Allahabad, Jaunpur and Lucknow. Here finally, at the crisis of the Mutiny, British dominion was permanently established in India.

The political vicissitudes through which this tract of country passed in earlier times are described under INDIA: *History*. It will be sufficient here to trace the steps by which it passed under British rule. In 1765, after the battle of Buxar, when the nawab of Oudh had been decisively defeated and Shah Alam, the Mogul emperor, was a suppliant in the British camp, Lord Clive was content to claim no acquisition of territory. The whole of Oudh was restored to the Nawab, and Shah Alam received as an imperial apanage the province of Allahabad and Kora in the lower Doab, with a British garrison in the fort of Allahabad. Warren Hastings augmented the territory of Oudh by lending the nawab a British army to conquer Rohilkhand, and by making over to him Allahabad and Kora on the ground that Shah Alam had placed himself in the power of the Mahrattas. At the same time he received from Oudh the sovereignty over the province of Benares. Subsequently no great change took place until the arrival of Lord Wellesley, who acquired a very large accession of territory in two instalments. In 1801 he obtained from the nawab of Oudh the cession of Rohilkhand, the lower Doab, and the Gorakhpur division, thus enclosing Oudh on all sides except the north. In 1804, as the result of Lord Lake's victories in the Mahratta War, the rest of the Doab and part of Bundelkhand, together with

Agra and the guardianship of the old and blind emperor, Shah Alam, at Delhi, were obtained from Sindia. In 1815 the Kumaon division was acquired after the Gurkha War, and a further portion of Bundelkhand from the peshwa in 1817. These new acquisitions, known as the ceded and conquered provinces, continued to be administered by the governor-general as part of Bengal. In 1833 an act of parliament was passed to constitute a new presidency, with its capital at Agra. But this scheme was never fully carried out, and in 1835 another statute authorized the appointment of a lieutenant-governor for the North-Western Provinces, as they were then styled. They included the Delhi territory, transferred after the Mutiny to the Punjab; and also (after 1853) the Saugor and Nerbudda territories, which in 1861 became part of the Central Provinces. Meanwhile Oudh remained under its nawab, who was permitted to assume the title of king in 1819. All protests against gross misgovernment during many years having proved useless, Oudh was annexed in 1856 and constituted a separate chief commissionership. Then followed the Mutiny, when all signs of British rule were for a time swept away throughout the greater part of the two provinces. The lieutenant-governor died when shut up in the fort at Agra, and Oudh was only reconquered after several campaigns lasting for eighteen months.

In 1877 the offices of lieutenant-governor of the North-Western Provinces and chief commissioner of Oudh were combined in the same person; and in 1902, when the new name of United Provinces was introduced, the title of chief commissioner was dropped, though Oudh still retains some marks of its former independence.

See *Gazetteer of the United Provinces* (2 vols., Calcutta, 1908); and Theodore Morison, *The Industrial Organization of an Indian Province* (1906).

UNITED STATES, THE, the short title usually given to the great federal republic which had its origin in the revolt of the British colonies in North America, when, in the Declaration of Independence, they described themselves as "The Thirteen United States of America." Officially the name is "The United States of America," but "The United States" (used as a singular and not a plural) has become accepted as the name of the country; and pre-eminent usage has now made its citizens "Americans," in distinction from the other inhabitants of North and South America.

Boundaries and Area.

The area of the United States, as here considered, exclusive of Alaska and outlying possessions, occupies a belt nearly twenty degrees of middle latitude in width, and crosses North America from the Atlantic to the Pacific. The southern boundary is naturally defined on the east by the Gulf of Mexico; its western extension crosses obliquely over the western highlands, along an irregular line determined by aggressive Americans of Anglo-Saxon stock against Americans of Spanish stock. The northern boundary, after an arbitrary beginning, finds a natural extension along the Great Lakes, and thence continues along the 49th parallel of north latitude to the Pacific (see *Bulletin* 171, U.S. Geological Survey). The area thus included is 3,026,789 sq. m.[1]

I.—PHYSICAL GEOGRAPHY

Coast.—The Atlantic coast of the United States is, with minor exceptions, low; the Pacific coast is, with as few exceptions, hilly or mountainous. The Atlantic coast owes its oblique N.E.-S.W. trend to crustal deformations which in very early geological time gave a beginning to what later came to be the Appalachian mountain system; but this system had its climax of deformation so long ago (probably in Permian time) that it has since then been very generally reduced to moderate or low relief, and owes its present altitude either to renewed elevations along the earlier lines or to the survival of the most resistant rocks as residual mountains. The oblique trend of the coast would be even more pronounced but for a comparatively modern crustal movement, causing a depression in the north-east, with a resulting encroachment of the sea upon the land, and an elevation in the south-west, with a resulting advance of the land upon the sea. The Pacific coast has been defined chiefly by relatively recent crustal deformations, and hence still preserves a greater relief than that of the Atlantic. The minor features of each coast will be mentioned in connexion with the land districts of which the coast-line is only the border.

General Topography and Drainage.—The low Atlantic coast and the hilly or mountainous Pacific coast foreshadow the leading features in the distribution of mountains within the United States. The Appalachian system, originally forest-covered, on the eastern side of the continent, is relatively low and narrow; it is bordered on the south-east and south by an important coastal plain. The Cordilleran system on the western side of the continent is lofty, broad and complicated, with heavy forests near the north-west coast, but elsewhere with trees only on the higher ranges below the Alpine region, and with treeless or desert intermont valleys, plateaus and basins, very arid in the south-west. Between the two mountain systems extends a great central area of plains, stretching from the Gulf of Mexico northward, far beyond the national boundary, to the Arctic Ocean. The rivers that drain the Atlantic slope of the Appalachians are comparatively short; those that drain the Pacific slope include only two, the Columbia and the Colorado, which rise far inland, near the easternmost members of the Cordilleran system, and flow through plateaus and intermont basins to the ocean. The central plains are divided by a hardly perceptible height of land into a Canadian and a United States portion; from the latter the great Mississippi system discharges southward to the Gulf of Mexico. The upper Mississippi and some of the Ohio basin is the prairie region, with trees originally only along the watercourses; the uplands towards the Appalachians were included in the great eastern forested area; the western part of the plains has so dry a climate that its herbage is scanty, and in the south it is barren. The lacustrine system of the St Lawrence flows eastward from a relatively narrow drainage area.

Relation of General Topography to Settlement.—The aboriginal occupants of the greater part of North America were comparatively few in number, and except in Mexico were not advanced beyond the savage state. The geological processes that placed a much narrower ocean between North America and western Europe than between North America and eastern Asia secured to the New World the good fortune of being colonized by the leading peoples of the occidental Old World, instead of by the less developed races of the Orient. The transoceanic invasion progressed slowly through the 17th and 18th centuries, delayed by the head winds of a rough ocean which was crossed only in slow sailing vessels, and by the rough "backwoods" of the Appalachians, which retarded the penetration of wagon roads and canals into the interior. The invasion was wonderfully accelerated through the 19th century, when the vast area of the treeless prairies beyond the Appalachians was offered to the settler, and when steam transportation on sea and land replaced sailing vessels and wagons. The frontier was then swiftly carried across the eastern half of the central plains, but found a second delay in its advance occasioned by the dry climate of the western plains. It was chiefly the mineral wealth of the Cordilleran region, first developed on the far Pacific slope, and later in many parts of the inner mountain ranges, that urged pioneers across the dry plains into the apparently inhospitable mountain region; there the adventurous new-comers rapidly worked out one mining district after another, exhausting and abandoning the smaller "camps" to early decay and rushing in feverish excitement to new-found river fields, but establishing important centres of varied industries in the more important mining districts. It was not until the settlers learned to adapt themselves to the methods of wide-range cattle raising and of farming by irrigation that the greater value of the far western interior was recognized as a permanent home for an agricultural population.

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[1] The following are the states of the Union (recognized abbreviations being given in brackets): Alabama (Ala.), Arizona (Ariz.), Arkansas (Ark.), California (Cal.), Colorado (Col.), Connecticut (Conn.), Delaware (Del.), Florida (Fla.), Georgia (Ga.), Idaho, Illinois (Ill.), Indiana (Ind.), Iowa (Ia.), Kansas (Kan.), Kentucky (Ky.), Louisiana (La.), Maine (Me.), Maryland (Md.), Massachusetts (Mass.), Michigan (Mich.), Minnesota (Minn.), Mississippi (Miss.), Missouri (Mo.), Montana (Mont.), Nebraska (Neb.), Nevada (Nev.), New Hampshire (N.H.), New Jersey (N.J.), New Mexico (N. Mex.), New York (N.Y.), North Carolina (N.C.), North Dakota (N. Dak.), Ohio (O.), Oklahoma (Okla.), Oregon (Oreg.), Pennsylvania (Pa.), Rhode Island (R.I.), South Carolina (S.C.), South Dakota (S. Dak.), Tennessee (Tenn.), Texas (Tex.), Utah, Vermont (Vt.), Virginia Va.), West Virginia (W. Va.), Washington (Wash.), Wisconsin (Wis.), Wyoming (Wyo.); together with the District of Columbia (D.C.).

The purchase of "Louisiana"—a great area west of the Mississippi river—from the French in 1803 has sometimes been said to be the cause of the westward expansion of the United States, but the Louisiana purchase has been better interpreted as the occasion for the expansion rather than its cause; for, as Lewis Evans of Philadelphia long ago recognized (1749), whoever gained possession of the Ohio Valley—the chief eastern part of the central plains—would inevitably become the masters of the continent.

Physiographic Subdivisions.—The area of the United States may be roughly divided into the Appalachian belt, the Cordilleras and the central plains, as already indicated. These large divisions need physiographic subdivision, which will now be made, following the guide of "structure, process and stage"; that is, each subdivision or province will be defined as part of the earth's crust in which some similarity of geological structure prevails, and upon which some process or processes of surface sculpture have worked long enough to reach a certain stage in the cycle of physiographic development.

The Appalachians.—The physiographic description of the Appalachian mountain system offers an especially good opportunity for the application of the genetic method based on "structure, process and stage." This mountain system consists essentially of two belts: one on the south-east, chiefly of ancient and greatly deformed crystalline rocks, the other on the north-west, a heavy series of folded Palaeozoic strata; and with these it will be convenient to associate a third belt, farther north-west, consisting of the same Palaeozoic strata lying essentially horizontal and constituting the Appalachian plateau. The crystalline belt represents, at least in part, the ancient highlands from whose ruins the sandstones, shales and limestones of the stratified series were formed, partly as marine, partly as fluviatile deposits. The deformation of the Appalachians was accomplished in two chief periods of compressive deformation, one in early Palaeozoic, the other about the close of Palaeozoic time, and both undoubtedly of long duration; the second one extended its effects farther north-west than the first. These were followed by a period of minor tilting and faulting in early Mesozoic, by a moderate upwarping in Tertiary, and by a moderate uplift in post-Tertiary time. The later small movements are of importance because they are related to the existing topography with which we are here concerned. Each of the disturbances altered the attitude of the mass with respect to the general base-level of the ocean surface; each movement therefore introduced a new cycle of erosion, which was interrupted by a later movement and the beginning of a later cycle.

Thus interpreted, the Appalachian forms of to-day may be ascribed to three cycles of erosion: a nearly complete Mesozoic cycle, in which most of the previously folded and faulted mountain masses were reduced in Cretaceous time to a peneplain or lowland of small relief, surmounted, however, in the north-east and in the south-west by monadnocks of the most resistant rocks, standing singly or in groups; an incomplete Tertiary cycle, initiated by the moderate Tertiary upwarping of the Mesozoic peneplain, and of sufficient length to develop mature valleys in the more resistant rocks of the crystalline belt or in the horizontal strata of the plateau, and to develop late mature or old valleys in the weaker rocks of the stratified belt, where the harder strata were left standing up in ridges; and a brief post-Tertiary cycle, initiated by an uplift of moderate amount and in progress long enough only to erode narrow and relatively immature valleys. Glacial action complicated the work of the latest cycle in the northern part of the system. In view of all this it is possible to refer nearly every element of Appalachian form to its appropriate cycle and stage of development. The more resistant rocks, even though dissected by Tertiary erosion, retain in their summit uplands an indication of the widespread peneplain of Cretaceous time, now standing at the altitude given to it by the Tertiary upwarping and post-Tertiary uplift; and the most resistant rocks surmount the Cretaceous peneplain as unconsumed monadnocks of the Mesozoic cycle. On the other hand, the weaker rocks are more or less completely reduced to lowlands by Tertiary erosion, and are now trenched by the narrow and shallow valleys of the short post-Tertiary cycle. Evidently, therefore, the Appalachians as we now see them are not the still surviving remnants of the mountains of late Palaeozoic deformation; they owe their present height chiefly to the Tertiary upwarping and uplifting, and their form to the normal processes of sculpture which, having become nearly quiescent at the close of the Mesozoic cycle, became active again in Tertiary and later times.

The belts of structure and the cycles of erosion thus briefly described are recognizable with more or less continuity from the Gulf of St Lawrence 1500 m. south-westward to Alabama, where the deformed mountain structures pass out of sight under nearly horizontal strata of the Gulf coastal plain. But the dimensions of the several belts and the strength of the relief developed by their later erosion varies greatly along the system. In a north-eastern section, practically all of New England is occupied by the older crystalline belt; the corresponding northern part of the stratified belt in the St Lawrence and Champlain-Hudson valleys on the inland side of New England is comparatively free from the ridge-making rocks which abound farther south; and here the plateau member is wanting, being replaced, as it were, by the Adirondacks, an outlier of the Laurentian highlands of Canada which immediately succeeds the deformed stratified belt west of Lake Champlain. In a middle section of the system, from the Hudson river in southern New York to the James river in southern Virginia, the crystalline belt is narrowed, as if by the depression of its south-eastern part beneath the Atlantic Ocean or beneath the strata of the Atlantic coastal plain which now represents the ocean; but the stratified belt is here broadly developed in a remarkable series of ridges and valleys determined by the action of erosion on the many alternations of strong and weak folded strata; and the plateau assumes full strength southward from the monoclinal Mohawk valley which separates it from the Adirondacks. The linear ridges of this middle section are often called the Alleghany Mountains. In a south-western section the crystalline belt again assumes importance in breadth and height, and the plateau member maintains the strength that it had in the middle section, but the intermediate stratified belt again has fewer ridges, because of the infrequence here of ridge-making strata as compared to their frequency in the middle section.

The Middle Appalachians.

The middle section of the Appalachians, rather arbitrarily limited by the Hudson and the James rivers, may be described first because it contains the best representation of the three longitudinal belts of which the mountain system as a whole is composed. The mountain-making compression of the heavy series of Palaeozoic strata has here produced a marvellous series of rock folds with gently undulating axes, trending north-east and south-west through a belt 70 or 80 m. wide; no less wonderful is the form that has been produced by the processes of sculpture. The peculiar configuration of the ridges may be apprehended as follows: The pattern of the folded strata on the low-lying Cretaceous peneplain must have resembled the pattern of the curved grain of wood on a planed board. When the peneplain was uplifted the weaker strata were worn down almost to a lowland of a second generation, while the resistant sandstones, of which there are three chief members, retained a great part of their new-gained altitude in the form of long, narrow, even-crested ridges, well deserving of the name of Endless Mountains given them by the Indians, but here and there bending sharply in peculiar zigzags which give this Alleghany section of the mountains an unusual individuality. The post-Tertiary uplift, giving the present altitude of 1000 or 1500 ft. in Pennsylvania, and of 2500 or 3500 ft. in Virginia, has not significantly altered the forms thus produced; it has only incited the rivers to intrench themselves 100 or more feet beneath the lowlands of Tertiary erosion. The watercourses to-day are, as a rule, longitudinal, following the strike of the weaker strata in paths that they appear to have gained by spontaneous adjustment during the long Mesozoic cycle; but now and again they cross from one longitudinal valley to another by a transverse course, and there they have cut down sharp notches or "water-gaps" in the hard strata that elsewhere stand up in the long even-crested ridges.

The transition from the strongly folded structure of the Alleghany ridges and valleys to the nearly horizontal structure of the Appalachian plateau is promptly made; and with the change of structure comes an appropriate change of form. The horizontal strata of the plateau present equal ease or difficulty of erosion in any direction; the streams and the submature valleys of the plateau therefore ramify in every direction, thus presenting a pattern that has been called insequent, because it follows no apparent control. Further mention of the plateau is made in a later section.

The crystalline belt of the middle Appalachians, 60 or 80 m wide, is to-day of moderate height because the Tertiary upwarping was there of moderate amount. The height is greatest along the inner or north-western border of the belt, and here a sub-mountainous topography has been produced by normal dissection, chiefly in the Tertiary cycle; the valleys being narrow because the rocks are resistant. The relief is strong enough to make occupation difficult; the slopes are forested; the uplands are cleared and well occupied by farms and villages, but many of the valleys are wooded glens. With continued decrease of altitude south-eastward, the crystalline belt dips under the coastal plain, near a line marked by the Delaware river from Trenton to Philadelphia in Pennsylvania, and thence south-south-westward through Maryland and Virginia past the cities of Baltimore, Washington and Richmond.

The Pennsylvania portion of the crystalline belt is narrow, as has been said, because of encroachment upon it by the inward overlap of the coastal plain; it is low because of small Tertiary uplift; but, still more, it is discontinuous, because of the inclusion of certain belts of weak non-crystalline rock; here the rolling uplands are worn down to lowland belts, the longest of which reaches from the southern corner of New York, across New Jersey, Pennsylvania and Maryland, into central Virginia.

Drainage.

The middle section of the Appalachians is further distinguished from the north-eastern and south-western sections by the arrangement of its drainage: its chief rivers rise in the plateau belt and flow across the ridges and valleys of the stratified belt and through the uplands of the crystalline belt to the sea. The rivers which most perfectly exemplify this habit are the Delaware, Susquehanna and Potomac; the Hudson, the north-eastern boundary of the middle section, is peculiar in having headwaters in the Adirondacks as well as in the Catskills (northern part of the plateau); the James, forming the south-western boundary of the section, rises in the inner valleys of the stratified belt, instead of in the plateau. The generally transverse course of these rivers has given rise to the suggestion that they are of antecedent origin; but there are many objections to this over-simple, Gordian explanation. The south-east course of the middle-section rivers is the result of many changes from the initial drainage; the Mesozoic and Tertiary upwarpings were probably very influential in determining the present general courses.

For the most part the rivers follow open valleys along belts of weak strata; but they frequently pass through sharp-cut notches in the narrow ridges of the stratified belt—the Delaware water-gap is one of the deepest of these notches; and in the harder rocks of the crystalline belt they have eroded steep-walled gorges, of which the finest is that of the Hudson, because of the greater height and breadth of the crystalline highlands there than at points where the other rivers cross it. The rivers are shallow and more or less broken by rapids in the notches; rapids occur also near the outer border of the crystalline belt, as if the rivers there had been lately incited to downward erosion by an uplift of the region, and had not yet had time to regrade their courses. This is well shown in the falls of the Potomac a few miles above Washington; in the rapids of the lower Susquehanna; and in the falls of the Schuylkill, a branch which joins the Delaware at Philadelphia, where the water-power has long been used in extensive factories. Hence rivers in the Appalachians are not navigable; it is only farther down-stream, where the rivers have been converted into estuaries and bays—such as Chesapeake and Delaware bays—by a slight depression of the coastal plain belt, that they serve the purposes of navigation. But the Hudson is strikingly exceptional in this respect; it possesses a deep and navigable tide-water channel all through its gorge in the highlands, a feature which has usually been explained as the result of depression of the land, but may also be explained by glacial erosion without change of land-level; a feature which, in connexion with the Mohawk Valley, has been absolutely determinative of the metropolitan rank reached by New York City at the Hudson mouth.

The North-eastern Appalachians.

The community of characteristics that is suggested by the association of six north-eastern states under the name "New England" is in large measure warranted by the inclusion of all these states within the broadened crystalline belt of the north-eastern Appalachians, which is here 150 m. wide. The uplands which prevail through the centre of this area at altitudes of about 1000 ft. rise to 1500 or 2000 ft. in the north-west, before descent is made to the lowlands of the stratified belt (St Lawrence-Champlain-Hudson valleys, described later on as part of the Great Appalachian valley), and at the same time the rising uplands are diversified with monadnocks of increasing number and height and by mature valleys cut to greater and greater depths; thus the interior of New England is moderately mountainous. When the central uplands are followed south-east or south to the coast, their altitude and their relief over the valleys gradually decrease; and thus the surface gradually passes under the sea. The lower coastal parts, from their accessibility and their smaller relief, are more densely populated; the higher and more rugged interior is still largely forested and thinly settled; there are large tracts of unbroken forest in northern Maine, hardly 150 m. from the coast. In spite of these contrasts, no physiographic line can be drawn between the higher and more rugged interior and the lower coastal border; one merges into the other. New England is a unit, though a diversified unit.

The Appalachian trends (N.E.–S.W.) that are so prominent in the stratified belt of the middle Appalachians, and are fairly well marked in the crystalline belt of New Jersey and Pennsylvania, are prevailingly absent in New England. They may be seen on the western border, in the Hoosac range along the boundary of Massachusetts and New York; in the linear series of the Green Mountain summits (Mt Mansfield, 4364 ft., Killington Peak, 4241 ft.) and their (west) piedmont ridges farther north in Vermont; and in the ridges of northern Maine: these are all in sympathy with Appalachian structure; so also are certain open valleys, as the Berkshire (limestone) Valley in western Massachusetts and the corresponding Rutland (limestone and marble) Valley in western Vermont; and more particularly the long Connecticut Valley from northern New Hampshire across Massachusetts to the sea at the southern border of Connecticut, the populous southern third of which is broadly eroded along a belt of red Triassic sandstones with trap ridges. But in general the dissection of the New England upland is as irregular as is the distribution of the surmounting monadnocks. The type of this class of forms is Mt Monadnock in south-western New Hampshire, a fine example of an isolated residual mass rising from an upland some 1500 ft. in altitude and reaching a summit height of 3186 ft. A still larger example is seen in Mt Katahdin (5200 ft.) in north-central Maine, the greatest of several similar isolated mountains that are scattered over the interior uplands without apparent system. The White Mountains of northern New Hampshire may be treated as a complex group of monadnocks, all of subdued forms, except for a few cliffs at the head of cirque-like valleys, with Mt Washington, the highest of the dome-like or low pyramidal summits, reaching 6293 ft., and thirteen other summits over 5000 ft. The absence of range-like continuity is here emphasized by the occurrence of several low passes or "notches" leading directly through the group; the best-known being Crawford's Notch (1900 ft.).

Drainage.

In consequence of the general south-eastward slope of the highlands and uplands of New England, the divide between the Atlantic rivers and those which flow northward and westward into the lowland of the stratified belt in Canada and New York is generally close to the boundary of these two physiographic districts. The chief rivers all flow south or south-east: they are the Connecticut, Merrimack, Kennebec, Penobscot and St John, the last being shared with the province of New Brunswick.

The drainage of New England is unlike that of the middle and south-western Appalachians in the occurrence of numerous lakes and falls. These irregular features are wanting south of the limits of Pleistocene glaciation; there the rivers have had time, in the latest cycle of erosion into which they have entered, to establish themselves in a continuous flow, and as a rule to wear down their courses to a smoothly graded slope. In New England also a well-established drainage undoubtedly prevailed in preglacial times; but partly in consequence of the irregular scouring of the rock floor, and even more because of the very irregular deposition of unstratified and stratified drift in the valleys, the drainage is now in great disorder. Many lakes of moderate size and irregular outline have been formed where drift deposits formed barriers across former river courses; the lake outlets are more or less displaced from former river paths. Smaller lakes were formed by the deposition of washed drift around the longest-lasting ice remnants; when the ice finally melted away, the hollows that it left came to be occupied by ponds and lakes. In Maine lakes of both classes are numerous; the largest is Moosehead Lake, about 35 m. long and of a very irregular shore line.

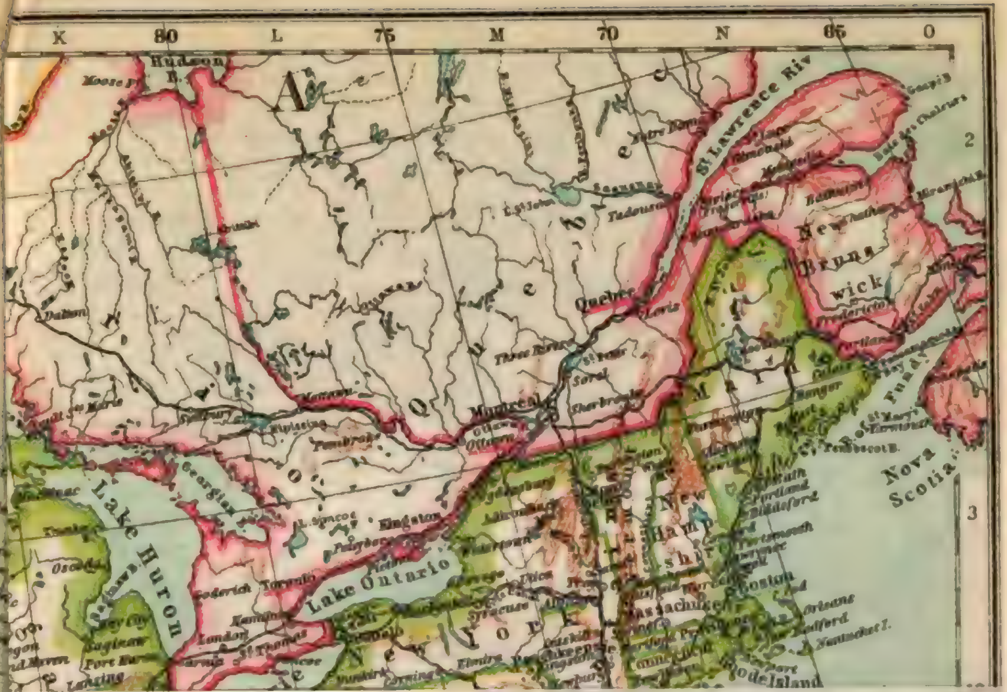
Coast.

The features of a coast can be appreciated only when it is perceived that they result from the descent of the land surface beneath the sea and from the work of the sea upon the shore line thus determined; and it is for this reason that throughout this article the coastal features are described in connexion with the districts of which they are the border. The maturely dissected and recently glaciated uplands of New England are now somewhat depressed with respect to sea-level, so that the sea enters the valleys, forming bays and estuaries, while the interfluve uplands and hills stand forth in headlands and islands. Narragansett Bay, with the associated headlands and islands on the south coast, is one of the best examples. Where drift deposits border the sea, the shore line has been cut back or built forward in beaches of submature expression, often enclosing extensive tidal marshes; but the great part of the shore line is rocky, and there the change from initial pattern due to submergence is as yet small. Hence the coast as a whole is irregular, with numerous embayments, peninsulas and islands; and in Maine this irregularity reaches a disadvantageous climax.

The South-western Appalachians.

As in the north-east, so in the south-west, the crystalline belt widens and gains in height, but while New England is an indivisible unit, the southern crystalline belt must be subdivided into a higher mountain belt on the north-west, 60 m. wide where broadest, and a lower piedmont belt on the south-east, 100 m. wide, from southern Virginia to South Carolina. This subdivision is already necessary in Maryland, where the mountain belt is represented by the Blue Ridge, which is rather a narrow upland belt than a ridge proper where the Potomac cuts across it; while the piedmont belt, relieved by occasional monadnocks stretches from the eastern base of the Blue Ridge to the coastal plain, into which it merges. Farther south, the mountain belt widens and attains its greatest development, a true highland district in North Carolina, where it includes several strong mountain groups. Here Mt Mitchell rises to 6711 ft., the highest of the Appalachians, and about thirty other summits exceed 6000 ft., while the valleys are usually at altitudes of about 2000 ft. Although the relief is strong, the mountain forms are rounded rather than rugged; few of the summits deserve or receive the name of peaks; some are called domes, from their broadly rounded tops, others are known as balds, because the widespread forest cover is replaced over their heads by a grassy cap.

The height and massiveness of the mountains decrease to the south-west, where the piedmont belt sweeps westward around them in western Georgia and eastern Alabama. Some of the residual mountains hereabouts are reduced to a mere skeleton or framework by the retrogressive penetration of widening valleys between wasting spurs; the very type of vanishing forms. Certain districts within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Georgian B.
Lake Ontario
Kingston
Toronto
Goderich
London
St Thomas
Port Huron
Saginaw
Bay City
Lansing
Lake Simcoe
Syracuse
Utica
Elmira
Albany
New Brunswick
Fredericton
Nova Scotia
Maine
Bangor
Portland
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the mountains, apparently consisting of less resistant crystalline rocks, have been reduced to basin-like peneplains in the same time that served only to grade the slopes and subdue the summits of the neighbouring mountains of more resistant rocks; the best example of this kind is the Asheville peneplain in North Carolina, measuring about 40 by 20 m. across; but in consequence of later elevation, its general surface, now standing at an altitude of 2500 ft., is maturely dissected by the French Broad river and its many branches in valleys 300 ft. deep; the basin floor is no longer a plain, but a hilly district in the midst of the mountains; Asheville on its southern border is a noted health resort.

The rivers of the mountain belt, normally dividing and subdividing in apparently insequent fashion between the hills and spurs, generally follow open valleys; there are few waterfalls, the streams being as a rule fairly well graded, though their current is rapid and their channels are set with coarse waste. The valley floors always join at accordant levels, as is the habit among normally subdued mountains; they thus contrast with glaciated mountains such as the Alps and the Canadian Rockies, where the laterals habitually open as "hanging valleys" in the side slope of the main valleys. It is a peculiar feature of the drainage in North Carolina that the headwaters lie to the east of the highest mountains, and that the chief rivers flow north-westward through the mountains to the broad valley lowland of the stratified belt and then through the plateau, as the members of the Mississippi system. It is probable that these rivers follow in a general way courses of much more ancient origin than those of the Atlantic rivers in the middle Appalachians.

The piedmont belt may be described as a maturely dissected peneplain over much of its extent; it is indeed one of the best examples of that class of forms. Its uplands are of fairly accordant altitude, which gradually decreases from 500 to 1000 ft. near the mountain belt to half that height along the coastal plain border. The uplands are here and there surmounted by residual monadnocks in the form of low domes and knobs; these increase in height and number towards the mountain belt, and decrease towards the coastal plain: Stone Mountain, near Atlanta, Georgia, a dome of granite surmounting the schists of the uplands, is a striking example of this class of forms. The chief rivers flow south-eastward in rather irregular courses through valleys from 200 to 500 ft. deep; the small branches ramify indefinitely in typical insequent arrangement; the streams are nearly everywhere well graded; rapids are rare and lakes are unknown.

The boundary between the mountains and the piedmont belt is called the Blue Ridge all along its length; and although the name is fairly appropriate in northern Virginia, it is not deserved in the Carolinas, where the "ridge" is only an escarpment descending abruptly 1000 or 1500 ft. from the valleys of the mountain belt to the rolling uplands of the piedmont belt; and as such it is a form of unusual occurrence. It is not defined by rock structure, but appears to result from the retrogressive erosion of the shorter Atlantic rivers, whereby the highlands, drained by much longer rivers, are undercut. The piedmont belt merges south-eastward into the coastal plain, the altitudes of the piedmont uplands and of the coastal plain hills being about the same along their line of junction. Many of the rivers, elsewhere well graded, have rapids as they pass from the harder rocks of the piedmont to the semi-consolidated strata of the coastal plain.

The Great Valley.

There is one feature of the Appalachians that has greater continuity than any other; this is the Great Valley. It is determined structurally by a belt of topographically weak limestones and shales (or slates) next inland from the crystalline uplands; hence, whatever the direction of the rivers which drain the belt, it has been worn down by Tertiary erosion to a continuous lowland from the Gulf of St Lawrence to central Alabama. Through all this distance of 1500 m. the lowland is nowhere interrupted by a transverse ridge, although longitudinal ridges of moderate height occasionally diversify its surface. In the middle section, as already stated, the Great Valley is somewhat open on the east, by reason of the small height and broad interruptions of the narrow crystalline belt, on the west it is limited by the complex series of Alleghany ridges and valleys; in the north-east section the valley is strongly enclosed on the east by the New England uplands, and on the west by the Adirondacks and Catskills (see below); in the south-west section the valley broadens from the North Carolina highlands on the south-east almost to the Cumberland plateau on the north-west, for here also the ridge-making formations weaken, although they do not entirely disappear.

The Atlantic Coastal Plain.

A striking contrast between New England and the rest of the Appalachians is found in the descent of the New England uplands to an immediate frontage on the sea; while to the south of New York harbour the remainder of the Appalachians are set back from the sea by the interposition of a coastal plain, one of the most characteristic examples of this class of forms anywhere to be found. As in all such cases, the plain consists of marine (with some estuarine and fluviatile) stratified deposits, more or less indurated, which were laid down when the land stood lower and the sea had its shore line farther inland than to-day. An uplift, increasing to the south, revealed part of the shallow sea bottom in the widening coastal plain, from its narrow beginning at New York harbour to its greatest breadth of 110 or 120 m. in Georgia: there it turns westward and is continued in the Gulf coastal plain, described farther on. The coastal plain, however, is the result, not of a single recent uplift, but of movements dating back to Tertiary time and continued with many oscillations to the present; nor is its surface smooth and unbroken, for erosion began upon the inner part of the plain long before the outer border was revealed. Indeed, the original interior border of the plain has been well stripped from its inland overlap; the higher-standing inner part of the plain is now maturely dissected, with a relief of 200 to 500 ft., by rivers extended seaward from the older land and by their innumerable branches, which are often of insequent arrangement; while the seaward border, latest uplifted, is prevailingly low and smooth, with a hardly perceptible seaward slope of but a few feet in a mile; and the shallow sea deepens very gradually for many miles off shore.

South Carolina and Georgia furnish the broadest and most typical section of this important physiographic province: here the more sandy and hilly interior parts are largely occupied by pine forests, which furnish much hard or yellow pine lumber, tar and turpentine. Farther seaward, where the relief is less and the soils are richer, the surface is cleared and cotton is an important crop.

A section of the coastal plain, from North Carolina to southern New Jersey, resembles the plain farther south in general form and quality of soils, but besides being narrower, it is further characterized by several embayments or arms of the sea, caused by a slight depression of the land after mature valleys had been eroded in the plain. The coastal lowland between the sea arms is so flat that, although distinctly above sea-level, vegetation hinders drainage and extensive swamps or "pocossins" occur. Dismal Swamp, on the border of North Carolina and Virginia, is the largest example.

The small triangular section of the coastal plain in New Jersey north of Delaware Bay deserves separate treatment because of the development there of a peculiar topographic feature, which throws light on the occurrence of the islands off the New England coast, described in the next paragraph. The feature referred to results from the occurrence here of a weak basal formation of clay overlaid by more resistant sandy strata; the clay belt has been stripped for a score or more of miles from its original inland overlap, and worn down in a longitudinal inner lowland, while the sandy belt retains a significant altitude of 200 or 300 ft. overlooking the inner lowland in a well-defined slope dissected by many inland-flowing streams, and descending from its broad crest very gently seaward, thus giving rise to what has been called a "belted coastal plain," in which the relief is arranged longitudinally and the upland member, with its very unsymmetrical slopes, has sometimes been called a "cuesta." This is a form of relief frequently occurring elsewhere, as in the Niagara cuesta of the Great Lake district of the northern United States and in the Cotswold and Chiltern hills of England, typical examples of the cuesta class. The Delaware river, unlike its southern analogues, which pursue a relatively direct course to the sea, turns south-westward along the inner lowland for some 50 m.

There is good reason for believing that at least along the southern border of New England a narrow coastal plain was for a time added to the continental border; and that, as in the New Jersey section, the plain was here stripped from a significant breadth of inland overlap and worn down so as to form an inner lowland enclosed by a longitudinal upland or cuesta; and that when this stage was reached a submergence, of the kind which has produced the many embayments of the New England coast, drowned the outer part of the plain and the inner lowland, leaving only the higher parts of the cuesta as islands. Thus Long Island (fronting Connecticut, but belonging to New York state), Block Island (part of the small state of Rhode Island), Martha's Vineyard and Nantucket (parts of Massachusetts) may be best explained. Heavy terminal moraines and outwashed fluviatile plains have been laid on the cuesta remnants, increasing their height as much as 100 ft. and burying their seaward slope with gravel and sand. Moreover, the sea has worked on the shore line thus originated, reducing the size of the more exposed islands farther east, and even consuming some islands which are now represented by the Nantucket shoals.

The Appalachian Plateau.

The same Palaeozoic formations that are folded in the belt of the Alleghany ridges lie nearly horizontal in the plateau district next north-west. The exposed strata are in large part resistant sandstones. While they have suffered active dissection by streams during the later cycles of erosion, the hilltops have retained so considerable an altitude that the district is known as a plateau; it might be better described as a dissected plateau, inasmuch as its uplands are not continuous but are nearly everywhere interrupted by ramifying insequent valleys. The unity and continuity of the district, expressed in the name Appalachian plateau, is seldom recognized in local usage. Its north-eastern part in eastern New York is known as the Catskill Mountains; here it reaches truly mountainous heights in great dome-like masses of full-bodied form, with two summits rising a little over 4000 ft. The border of this part of the plateau descends eastward by a single strong escarpment to the Hudson valley, from which the mountains present a fine appearance, and northward by two escarpments (the second being called the "Helderberg Mountains") to the Mohawk Valley, north of which rise the

Adirondacks; but to the south west the dissected highland continues into Pennsylvania and Virginia, where it is commonly known as the Alleghany plateau. A curious feature appears in northern Pennsylvania: here the lateral pressure of the Palaeozoic mountain-making forces extended its effects through a belt about fifty miles wider than the folded belt of the Hudson Valley, thus compressing into great rock waves a part of the heavy stratified series which in New York lies horizontal and forms the Catskills; hence one sees, in passing south-west from the horizontal to the folded strata, a beautiful illustration of the manner in which land sculpture is controlled by land structure. Altitudes of 1200 ft. prevail in Pennsylvania and increase in Virginia; then the altitude falls to about 1000 ft. in Kentucky and Tennessee, where the name Cumberland plateau is used for the highest portion, and to still less in northern Alabama, where the plateau, like the mountain belt, disappears under the Gulf coastal plain. Through all this distance of 1000 m. the border of the plateau on the south-east is an abrupt escarpment, eroded where the folded structure of the mountain belt reveals a series of weaker strata; but in the north-west the plateau suffers only a gradual decrease of height and of relief, until the prairie plains are reached in central Ohio and southern Indiana and Illinois, about 150 m. inland from the escarpment. Two qualifications must, however, be added. In certain parts of the plateau there are narrow anticlinal uplifts, an outlying effect of mountain-making compression; here a ridge rises if the exposed strata are resistant, as in Chestnut ridge of western Pennsylvania; but here a valley is excavated if the exposed strata are weak, as in Sequatchie Valley, a long narrow trough which cuts off a strip of the plateau from its greater body in Tennessee. Again, in Kentucky and Tennessee, there is a double alternation of sandstone and limestone in the plateau-making strata; and as the skyline of the plateau bevels across these formations, there are west-facing escarpments, made ragged by mature dissection, as one passes from the topographically strong sandstone to the topographically weak limestone.

In the north-east (New York and Pennsylvania) the higher parts of the plateau are drained by the Delaware and Susquehanna rivers directly to the Atlantic; farther west and south-west, the plateau is drained to the Ohio river and its branches. The submature or mature dissection of the plateau by its branching insequent streams results in giving it an excess of sloping surface, usually too steep for farming, and hence left for tree growth.

The Superior Oldland.—An outlying upland of the Laurentian highlands of Canada projects into the United States west and south of Lake Superior. Although composed chiefly of crystalline rocks, which are commonly associated with a rugged landscape, and although possessing a greatly deformed structure, which must at some ancient period have been associated with strong relief, the upland as a whole is gently rolling, and the inter-stream surfaces are prevailing plateau-like in their evenness, with altitudes of 1400 to 1600 ft. in their higher areas. In this province, therefore, we find a part of one of those ancient mountain regions, initiated by crustal deformation, but reduced by long continued erosion to a peneplain of modern relief, with occasional surmounting monadnocks of moderate height not completely consumed during the peneplanation of the rest of the surface. The erosion of the region must have been far advanced, perhaps practically completed, in very ancient times, for the even surface of the peneplain is overlapped by fossiliferous marine strata of early geological date (Cambrian), and this shows that a depression of the region beneath an ancient sea took place after a long existence as dry land. The extent of the submergence and the area over which the Palaeozoic strata were deposited are unknown; for in consequence of renewed elevation without deformation, erosion in later periods has stripped off an undetermined amount of the covering strata. The valleys by which the uplands are here and there trenched to moderate depth appear to be, in part at least, the work of streams that have been superposed upon the peneplain through the now removed cover of stratified rocks. Glaciation has strongly scoured away the deeply-weathered soils that presumably existed here in preglacial time, revealing firm and rugged ledges in the low hills and swells of the ground, and spreading an irregular drift cover over the lower parts, whereby the drainage is often much disordered, here being detained in lakes and swamps ("muskegs") and there rushing down rocky rapids. The region is therefore generally unattractive to the farmer, but it is inviting to the lumberman and the miner.

The Adirondack Mountains.—This rugged district of northern New York may be treated as an outlier in the United States of the Laurentian highlands of Canada, from which it is separated by the St Lawrence Valley. It is of greater altitude (Mt Marcy 5344 ft.) and of much greater relief than the Superior Oldland; its heights decrease gradually to the north, west and south, where it is unconformably overlapped by Palaeozoic strata like those of Minnesota and Wisconsin, it is of more broken structure and form on the east, where the disturbances of the Appalachian system have developed ridges and valleys of linear trends, which are wanting or but faintly seen elsewhere. (See ADIRONDACKS.)

Region of the Great Lakes.—The Palaeozoic strata, already mentioned as lapping on the southern slope of the Superior Oldland and around the western side of the Adirondacks are but parts of a great area of similar strata, hundreds of feet in thickness, which decline gently southward from the great oldland of the Laurentian highlands of eastern Canada. The strata are the deposits of an ancient sea, which in the earlier stage of geological investigation was thought to be part of the primeval ocean, while the Laurentian highlands were taken to be the first land that rose from the primeval waters. Inasmuch, however, as the floor on which the overlapping strata rest is, like the rest of the Laurentian and Superior Oldland, a worn-down mountain region, and as the lowest member of the sedimentary series usually contains pebbles of the oldland rocks, the better interpretation of the relation between the two is that the visible oldland area of to-day is but a small part of the primeval continent, the remainder of which is still buried under the Palaeozoic cover; and that the visible oldland, far from being the first part of the continent to rise from the primeval ocean, was the last part of the primeval continent to sink under the advancing Palaeozoic seas. When the oldland and its overlap of stratified deposits were elevated again, the overlapping strata must have had the appearance of a coastal plain, but that was long ago; the strata have since then been much eroded, and to-day possess neither the area nor the smooth form of their initial extent. Hence this district may be placed in the class of ancient coastal plains. As is always the case in the broad denudation of the gently inclined strata of such plains, the weaker layers are worn down in sub-parallel belts of lower land between the oldland and the belts of more resistant strata, which rise in uplands.

Few better illustrations of this class of forms are to be found than that presented in the district of the Great Lakes. The chief upland belt or cuesta is formed by the firm Niagara limestone, which takes its name from the gorge and falls cut through the upland by the Niagara river. As in all such forms, the Niagara cuesta has a relatively strong slope or infacing escarpment on the side towards the oldland, and a long gentle slope on the other side. Its relief is seldom more than 200 or 300 ft., and is commonly of small measure, but its continuity and its contrast with the associated lowlands worn on the underlying and overlying weak strata suffice to make it a feature of importance. The cuesta would be straight from east and west if the slant of the strata were uniformly to the south; but the strata are somewhat warped, and hence the course of the cuesta is strongly convex to the north in the middle, gently convex to the south at either end. The cuesta begins where its determining limestone begins, in west-central New York, there it separates the lowlands that contain the basins of lakes Ontario and Erie; thence it curves to the north-west through the province of Ontario to the belt of islands that divides Georgian Bay from Lake Huron, then westward through the land-arm between lakes Superior and Michigan, and south-westward into the narrow points that divide Green Bay from Lake Michigan, and at last westward to fade away again with the thinning out of the limestone, it is hardly traceable across the Mississippi river The arrangement of the Great Lakes is thus seen to be closely sympathetic with the course of the lowlands worn on the two belts of weaker strata on either side of the Niagara cuesta; Ontario, Georgian Bay and Green Bay occupy depressions in the lowland on the inner side of the cuesta; Erie, Huron and Michigan lie in depressions in the lowland on the outer side. When the two lowlands are traced eastward they become confluent after the Niagara limestone has faded away in central New York, and the single lowland is continued under the name of Mohawk Valley, an east-west longitudinal depression that has been eroded on a belt of relatively weak strata between the resistant crystalline rocks of the Adirondacks on the north and the northern escarpment of the Appalachian plateau (Catskills-Helderbergs) on the south; forming a pathway of great historic and economic importance between the Atlantic seaports and the interior.

In Wisconsin the inner lowland presents an interesting feature in a knob of resistant quartzites, known as Baraboo Ridge, rising from the buried oldland floor through the partly denuded cover of lower Palaeozoic strata. This knob or ridge may be appropriately regarded as an ancient physiographic fossil, inasmuch as, being a monadnock of very remote origin, it has long been preserved from the destructive attack of the weather by burial under sea-floor deposits, and recently laid bare, like ordinary organic fossils of much smaller size, by the removal of part of its cover by normal erosion.

The occurrence of the lake basins in the lowland belts on either side of the Niagara cuesta is an abnormal feature, not to be explained by ordinary erosion, which can produce only valleys. The basins have been variously ascribed to glacial erosion, to obstruction of normal outlet valleys by barriers of glacial drift, and to crustal warping in connexion with or independent of the presence of the glacial sheet. No satisfactory solution of this problem has been reached; but the association of the Great Lakes and other large lakes farther north in Canada with the great North American area of strong and repeated glaciation is highly suggestive.

Lake Superior is unlike the other lakes; the greater part of its basin occupies a depression in the oldland area, independent of the overlap of Palaeozoic strata. The western half of the basin occupies a trough of synclinal structure; but the making of this syncline is so ancient that it cannot be directly connected with the occurrence of the lake to-day. A more reasonable explanation ascribes the lake basin to a geologically modern depression within the Superior oldland area; but there is at present no direct evidence in favour of this hypothesis. The Great Lakes are peculiar in receiving the drainage of but a small peripheral land area, enclosed by an ill-defined water-parting from the rivers that run to Hudson Bay or the Gulf of St Lawrence on the north and to the Gulf of Mexico on the south.

Large canals and locks on both sides of the Sault (pronounced *Soo*) Ste Marie in the outlet of Lake Superior are actively used except during three or four winter months. The three lakes of the middle group stand at practically the same level: Michigan and Huron are connected by the Strait of Mackinac (pronounced Mackinaw); Huron and Erie by the St Clair and Detroit rivers, with the small Lake St Clair between them. The navigable depth of these two short rivers is believed to be the result of a slow elevation of the land in the north-east, still in progress, whereby the waters have risen on their former shores near Detroit. Niagara river, connecting lakes Erie and Ontario, with a fall of 326 ft. (160 ft. at the cataract) in 30 m., is manifestly a watercourse of very modern origin; for a large river would now have a thoroughly matured valley had it long followed its present course; the same is true of the St Lawrence, which in its several rapids and in its subdivision into many channels at the Thousand Islands, presents every sign of youth. Canals on the Canadian side of these unnavigable stretches admit vessels of a considerable size to lakes Ontario and Erie.

The Prairie States.—The originally treeless prairies of the upper Mississippi basin began in Indiana and extended westward and north-westward until they merged with the drier region described beyond as the Great Plains. An eastward extension of the same region, originally tree-covered, extended to central Ohio. Thus the prairies may be described as lying in a general way between the Ohio and Missouri rivers on the south and the Great Lakes on the north. Under the older-fashioned methods of treating physical geography, the prairies were empirically described as "level prairies," "rolling prairies," and so on. The great advance in the interpretation of land forms now makes it possible to introduce as thoroughly explanatory a description of these fertile plains as of forms earlier familiar, such as sand dunes, deltas and sea cliffs. The prairies are, in brief, a contribution of the glacial period; they consist for the most part of glacial drift, deposited unconformably on an underlying rock surface of moderate or small relief. The rocks here concerned are the extension of the same stratified Palaeozoic formations already described as occurring in the Appalachian region and around the Great Lakes. They are usually fine-textured limestones and shales, lying horizontal; the moderate or small relief that they were given by mature preglacial erosion is now buried under the drift, but is known by numerous borings for oil, gas and water.

The greatest area of the prairies, from Indiana to North Dakota, consists of till plains, that is, sheets of unstratified drift, 30, 50 or even 100 ft. thick, which cover the underlying rock surface for thousands of square miles (except where postglacial stream erosion has locally laid it bare), and present an extraordinarily even surface. The till is presumably made in part of preglacial soils, but it is more largely composed of rock waste mechanically comminuted by the creeping ice sheets; although the crystalline rocks from Canada and some of the more resistant stratified rocks south of the Great Lakes occur as boulders and stones, a great part of the till has been crushed and ground to a clayey texture. The till plains, although sweeping in broad swells of slowly changing altitude, are often level to the eye, and the view across them stretches to the horizon, unless interrupted by groves of trees along the watercourses, or by belts of low morainic hills. Here and there faint depressions occur, occupied by marshy "sloughs," or floored with a rich black soil of postglacial origin. It is thus by sub-glacial aggradation that the prairies have been levelled up to a smooth surface, in contrast to the higher and non-glaciated hilly country next south.

The great ice sheets formed terminal moraines around their border at various halting stages; but the morainic belts are of small relief in comparison to the great area of the ice; they rise gently from the till plains to a height of 50, 100 or more feet; they may be one, two or three miles wide; and their hilly surface, dotted over with boulders, contains many small lakes in basins or hollows, instead of streams in valleys. The morainic belts are arranged in groups of concentric loops, convex southward, because the ice sheets advanced in lobes along the lowlands of the Great Lakes; neighbouring morainic loops join each other in re-entrants (north-pointing cusps), where two adjacent glacial lobes came together and formed their moraines in largest volume. The discovery of this significant looped arrangement of the morainic belts is the greatest advance in interpretation of glacial phenomena since the first suggestion of a glacial period; it is also the strongest proof that the ice here concerned was a continuous sheet of creeping land ice, and not a discontinuous series of floating icebergs, as had been supposed. The moraines are of too small relief to be shown on any maps but those of the largest scale; yet small as they are, they are the chief relief of the prairie states, and, in association with the nearly imperceptible slopes of the till plains, they determine the course of many streams and rivers, which as a whole are consequent upon the surface form of the glacial deposits.

The complexity of the glacial period and its subdivision into several glacial epochs, separated by interglacial epochs of considerable length (certainly longer than the postglacial epoch) has a structural consequence in the superposition of successive till sheets, alternating with non-glacial deposits, and also a physiographic consequence in the very different amount of normal postglacial erosion suffered by the different parts of the glacial deposits. The southernmost drift sheets, as in southern Iowa and northern Missouri, have lost their initially plain surface and are now maturely dissected into gracefully rolling forms; here the valleys of even the small streams are well opened and graded, and marshes and lakes are wanting: hence these sheets are of early Pleistocene origin. Nearer the Great Lakes the till sheets are trenched only by the narrow valleys of the large streams; marshy sloughs still occupy the faint depressions in the till plains, and the associated moraines have abundant small lakes in their undrained hollows: hence these drift sheets are of late Pleistocene origin.

When the ice sheets fronted on land sloping southward to the Ohio, Mississippi and Missouri rivers, the drift-laden streams flowed freely away from the ice border; and as the streams, escaping from their subglacial channels, spread in broader channels, they ordinarily could not carry forward all their load; hence they acted not as destructive but as constructive agents, and aggraded their courses. Thus local sheets or "aprons" of gravel and sand are spread more or less abundantly along the outer side of the morainic belts; and long trains of gravel and sands clog the valleys that lead southward from the glaciated to the non-glaciated area. Later when the ice retreated farther and the unloaded streams returned to their earlier degrading habit, they more or less completely scoured out the valley deposits, the remains of which are now seen in terraces on either side of the present flood plains.

When the ice of the last glacial epoch had retreated so far that its front lay on a northward slope, belonging to the drainage area of the Great Lakes, bodies of water accumulated in front of the ice margin, forming glacio-marginal lakes. The lakes were small at first, and each had its own outlet at the lowest depression in the height of land to the south; but as the ice melted back, neighbouring lakes became confluent at the level of the lowest outlet of the group; the outflowing streams grew in the same proportion and eroded a broad channel across the height of land and far down stream, while the lake waters built sand reefs or carved shore cliffs along their margin, and laid down sheets of clay on their floors. All of these features are easily recognized in the prairie region. The present site of Chicago was determined by an Indian *portage* or "carry" across the low divide between Lake Michigan and the headwaters of the Illinois river; and this divide lies on the floor of the former outlet channel of the glacial Lake Michigan. Corresponding outlets are known for the glacial lakes Erie, Huron and Superior, and for a very large sheet of water, named Lake Agassiz, which once overspread a broad till plain in northern Minnesota and North Dakota. The outlet of this glacial lake, called river Warren, eroded a large channel in which the Minnesota river of to-day is an evident "misfit."

Certain extraordinary features were produced when the retreat of the ice sheet had progressed so far as to open an eastward outlet for the marginal lakes along the depression between the northward slope of the Appalachian plateau in west-central New York and the southward slope of the melting ice sheet; for when this eastward outlet came to be lower than the south-westward outlet across the height of land to the Ohio or Mississippi river, the discharge of the marginal lakes was changed from the Mississippi system to the Hudson system. Many well-defined channels, cutting across the north-sloping spurs of the plateau in the neighbourhood of Syracuse, N.Y., mark the temporary paths of the ice-bordered outlet river. Successive channels are found at lower and lower levels on the plateau slope, thus indicating the successive courses taken by the lake outlet as the ice melted farther and farther back. On some of these channels deep gorges were eroded heading in temporary cataracts which exceeded Niagara in height but not in breadth; the pools excavated by the plunging waters at the head of the gorges are now occupied by little lakes. The most significant stage in this series of changes occurred when the glacio-marginal lake waters were lowered so that the long cuesta of Niagara limestone was laid bare in western New York; the previously confluent waters were then divided into two lakes; the higher one, Erie, supplying the outflowing Niagara river, which poured its waters down the escarpment of the cuesta to the lower lake, Ontario, whose outlet for a time ran down the Mohawk Valley to the Hudson: thus Niagara falls began. (See NIAGARA.)

Many additional features associated with the glacial period might be described, but space can be given to four only. In certain districts the subglacial till was not spread out in a smooth plain, but accumulated in elliptical mounds, 100 or 200 ft. high, half a mile or a mile long, with axes parallel to the direction of the ice motion as indicated by striae on the underlying rock floor; these hills are known by the Irish name, drumlins, used for similar hills in north-western Ireland. The most remarkable groups of drumlins occur in western New York, where their number is estimated at over 6000, and in southern Wisconsin, where it is placed at 5000. They completely dominate the topography of their districts.

A curious deposit of an impalpably fine and unstratified silt, known by the German name *loess*, lies on the older drift sheets near the larger river courses of the upper Mississippi basin. It attains a thickness of 20 ft. or more near the rivers and gradually fades away at a distance of ten or more miles on either side. It is of inexhaustible fertility, being in this as well as in other respects closely like the loess in China and other parts of Asia, as well as in Germany. It contains land shells, and hence cannot be attributed to marine or lacustrine submergence. The best explanation suggested for loess is that, during certain phases of the glacial period, it was carried as dust by the winds from the flood plains of aggrading rivers, and slowly deposited on the neighbouring grass-covered plains.

South-western Wisconsin and parts of the adjacent states of Illinois, Iowa and Minnesota are known as the "driftless area," because, although bordered by drift sheets and moraines, it is free from glacial deposits. It must therefore have been a sort of oasis, when the ice sheets from the north advanced past it on the east and west and joined around its southern border. The reason for this exemption from glaciation is the converse of that for the southward convexity of the morainic loops; for while they mark the paths of greatest glacial advance along lowland troughs (lake basins), the driftless area is a district protected from ice invasion by reason of the obstruction which the highlands of northern Wisconsin and Michigan (part of the Superior oldland) offered to glacial advance.

The course of the upper Mississippi river is largely consequent upon glacial deposits. Its sources are in the morainic lakes in northern Minnesota; Lake Itasca being only one of many glacial lakes which supply the headwater branches of the great river. The drift deposits thereabouts are so heavy that the present divides between the drainage basins of Hudson Bay, Lake Superior and the Gulf of Mexico evidently stand in no very definite relation to the preglacial divides. The course of the Mississippi through Minnesota is largely guided by the form of the drift cover. Several rapids and the Falls of St Anthony (determining the site of Minneapolis) are signs of immaturity, resulting from superposition through the drift on the under rock. Farther south, as far as the entrance of the Ohio, the Mississippi follows a rock-walled valley 300 to 400 ft. deep, with a flood-plain 2 to 4 m. wide; this valley seems to represent the path of an enlarged early-glacial Mississippi, when much precipitation that is to-day discharged to Hudson Bay and the Gulf of St Lawrence was delivered to the Gulf of Mexico, for the curves of the present river are of distinctly smaller radius than the curves of the valley. Lake Pepin (30 m. below St Paul), a picturesque expansion of the river across its flood-plain, is due to the aggradation of the valley floor where the Chippewa river, coming from the north-east, brought an overload of fluvio-glacial drift. Hence even the "father of waters," like so many other rivers in the Northern states, owes many of its features more or less directly to glacial action.

The fertility of the prairies is a natural consequence of their origin. During the mechanical comminution of the till no vegetation was present to remove the minerals essential to plant growth, as is the case in the soils of normally weathered and dissected peneplains, such as the Appalachian piedmont, where the soils, though not exhausted by the primeval forest cover, are by no means so rich as the till sheets of the prairies. Moreover, whatever the rocky understructure, the till soil has been averaged by a thorough mechanical mixture of rock grindings; hence the prairies are continuously fertile for scores of miles together.

The true prairies, when first explored, were covered with a rich growth of natural grass and annual flowering plants. To-day they are covered with farms. The cause of the treelessness has been much discussed. It does not seem to lie in peculiarities of temperature or of precipitation; for trees thrive where they are properly planted on the prairies; every town and farm to-day has its avenues and groves of trees; but it should be noted that west of the Mississippi river increasing aridity becomes an important factor, and is the chief cause of the treelessness of the Great Plains (see below). The treelessness of the prairies cannot be due to insufficient time for tree invasion since glacial evacuation; for forests cover the rocky uplands of Canada, which were occupied by ice for ages after the prairies were laid bare. A more probable cause is found in the fineness of the prairie soil, which is inimical to the growth of young trees in competition with the grasses and annual plants. Prairie fires, both of natural and artificial origin, are also a contributive cause; for young trees are exterminated by fires, but annual plants soon reappear.

The Gulf Coastal Plain.—The westward extension of the Atlantic coastal plain around the Gulf of Mexico carries with it a repetition of certain features already described, and the addition of several new ones. As in the Atlantic coastal plain, it is only the lower, seaward part of this region that deserves the name of plain, for there alone is the surface unbroken by hills or valleys; the inner part, initially a plain by reason of its essentially horizontal (gently seaward-sloping) structure, has been converted by mature dissection into an elaborate complex of hills and valleys, usually of increasing altitude and relief as one passes inland.

The special features of the Gulf Plain are the peninsular extension of the plain in Florida, the belted arrangement of relief and soils in Alabama and in Texas, and the Mississippi embayment or inland extension of the plain half-way up the course of the Mississippi river, with the Mississippi flood plain there included.

Florida.

A broad, low crustal arch extends southward at the junction of the Atlantic and Gulf coastal plains; the emerged half of the arch constitutes the visible lowland peninsula of Florida; the submerged half extends westward under the shallow overlapping waters of the Gulf of Mexico. The northern part of the peninsula is composed largely of a weak limestone; here much of the lowland drainage is underground, forming many sink-holes (swallow-holes). Many small lakes in the lowland appear to owe their basins to the solution of the limestones. Valuable phosphate deposits occur in certain districts. The southern part of the state includes the "Everglades" (*q.v.*), a large area of low, flat, marshy land, overgrown with tall reedy grass, a veritable wilderness; thus giving Florida an unenvied first rank among the states in marsh area. The eastern coast is fringed by long-stretching sand reefs, enclosing lagoons so narrow and continuous that they are popularly called "rivers." At the southern end of the peninsula is a series of coral islands, known as "keys"; they appear to be due to the forward growth of corals and other lime-secreting organisms towards the strong current of the Gulf Stream, by which their food is supplied: the part of the peninsula composed of coral reefs is less than has been formerly supposed. The western coast has fewer and shorter off-shore reefs; much of it is of minutely irregular outline, which seems to be determined less by the work of the sea than by the forward growth of mangrove swamps in the shallow salt water.

Alabama.

A typical example of a belted coastal plain is found in Alabama and the adjacent part of Mississippi. The plain is here about 150 m. wide. The basal formation is chiefly a weak limestone, which has been stripped from its original innermost extension and worn down to a flat inner lowland of rich black soil, thus gaining the name of the "black belt." The lowland is enclosed by an upland or cuesta, known as Chunnenugga Ridge, sustained by partly consolidated sandy strata; the upland, however, is not continuous, and hence should be described as a "maturely dissected cuesta." It has a relatively rapid descent toward the inner lowland, and a very gradual descent to the coast prairies, which become very low, flat and marshy before dipping under the Gulf waters, where they are generally fringed by off-shore reefs.

The coastal plain extends 500 m. inland on the axis of the Mississippi embayment. Its inner border affords admirable examples of topographical discordance where it sweeps north-westward square

The Mississippi Embayment.

across the trend of the piedmont belt, the ridges and valleys, and the plateau of the Appalachians, which are all terminated by dipping gently beneath the unconformable cover of the coastal plain strata. In the same way the western side of the embayment, trending south and south-west, passes along the lower south-eastern side of the dissected Ozark plateau of southern Missouri and northern Arkansas, which in many ways resembles the Appalachian plateau, and along the eastern end of the Massern ranges of the Ouachita mountain system in central Arkansas, which in geological history and topographical form present many analogies with the ridges and valleys of the Appalachians; and as the coastal plain turns westward to Texas it borders the Arbuckle hills in Oklahoma, a small analogue of the crystalline Appalachian belt. In the embayment of the coastal plain some low cuesta-like belts of hills with associated strips of lowlands suggest the features of a belted coastal plain; the hilly belt or dissected cuesta determined by the Grand Gulf formation in western Mississippi is the most distinct. Important salt deposits occur in the coastal plain strata near the coast. The most striking feature of the embayment is the broad valley which the Mississippi has eroded across it.

The lower Mississippi is the trunk in which three large rivers join; the chief figures (approximate only) regarding them are as follows:—

	Drainage Area (square miles).	Percentage of Total Discharge.
Upper Mississippi	170,000	18
Ohio	210,000	31
Missouri	530,000	14

The Lower Mississippi River.

The small proportion of total water volume supplied from the great Missouri basin is due to the light precipitation in that region. The lower Mississippi receives no large tributary from the east, but two important ones come from the west; the Arkansas drainage area being a little less than that of the Ohio, and the basin of the Red River of Louisiana being about half as large. The great river thus constituted drains an area of about 1,250,000 sq. m., or about one-third of the United States; and discharges 75,000 cub. yds. of water per second, or 785,190,000,000 cubic yds. per annum, which corresponds roughly to one quarter of the total precipitation on its drainage basin. Its load of land waste (see I. C. Russell, *Rivers of North America*) is as follows:—

In suspension . . 6,718,694,400 cub. ft. or 241 ft. deep over 1 sq. m.
Swept along bottom 750,000,000 „ „ 26 „ „ 1 „
In solution . . . 1,350,000,000 „ „ 45 „ „ 1 „
Average annual removal of waste from entire basin, $\frac{1}{333}$ in. or 1 ft. in 4000 years.

The head of the coastal plain embayment is near the junction of the Ohio and the Mississippi. Thence southward for 560 m. the great river flows through the semi-consolidated strata of the plain, in which it has eroded a valley, 40 or 50 m. wide, and 29,700 sq. m. in area, enclosed by bluffs one or two hundred feet high in the northern part, generally decreasing to the southward, but with local increase of height associated with a decrease in flood plain breadth on the eastern side where the Grand Gulf cuesta is traversed. This valley in the coastal plain, with the much narrower rock-walled valley of the upper river in the prairie states, is the true valley of the Mississippi river; but in popular phrase the "Mississippi Valley" is taken to include a large central part of the Mississippi drainage basin. The valley floor is covered with a flood plain of fine silt, having a southward slope of only half a foot to a mile. The length of the river itself, from the Ohio mouth to the Gulf, is, owing to its windings, about 1060 m.; its mean fall is about 3 in. in a mile. On account of the rapid deposition of sediment near the main channel at times of overflow, the flood plain, as is normally the case on mature valley floors, has a lateral slope of as much as 5, 10, or even 12 ft. in the first mile from the river; but this soon decreases to a less amount. Hence at a short distance from the river the flood plain is often swampy, unless its surface is there aggraded by the tributary streams: for this reason Louisiana, Arkansas and Mississippi rank next after Florida in swamp area.

The great river receives an abundant load of silt from its tributaries, and takes up and lays down silt from its own bed and banks with every change of velocity. The swiftest current tends, by reason of centrifugal force, to follow the outer side of every significant curve in the channel; hence the concave bank, against which the rapid current sweeps, is worn away; thus any chance irregularity is exaggerated, and in time a series of large serpentines or meanders is developed, the most symmetrical examples at present being those near Greenville, Miss. The growth of the meanders tends to give the river continually increasing length; but this tendency is counteracted by the sudden occurrence of cut-offs from time to time, so that a fairly constant length is maintained.

The floods of the Mississippi usually occur in spring or summer. Owing to the great size of the drainage basin, it seldom happens that the three upper tributaries are in flood at the same time; the coincident occurrence of floods in only two tributaries is of serious import in the lower river, which rises 30, 40, or occasionally 50 ft. The abundant records by the Mississippi River Commission and the United States Weather Bureau (by which accurate and extremely useful predictions of floods in the lower river course are made, on the basis of the observed rise in the tributaries) demonstrate a number of interesting features, of which the chief are as follows: the fall of the river is significantly steepened and its velocity is accelerated down stream from the point of highest rise; conversely, the fall and the velocity are both diminished up stream from the same point.

The load of silt borne down stream by the river finally, after many halts on the way, reaches the waters of the Gulf, where the decrease of velocity, aided by the salinity of the sea water, causes the formation of a remarkable delta, leaving less aggraded areas as shallow lakes (Lake Pontchartrain on the east, and Grand Lake on the west of the river). The ordinary triangular form of deltas, due to the smoothing of the delta front by sea action, is here wanting, because of the weakness of sea action in comparison with the strength of the current in each of the four distributaries or "passes" into which the river divides near its mouth. (See MISSISSIPPI RIVER.)

The Texas Coastal Plain.

After constriction from the Mississippi embayment to 250 m. in western Louisiana, the coastal plain continues south-westward with this breadth until it narrows to about 130 m. in southern Texas near the crossing of the Colorado river, (of Texas); but it again widens to 300 m. at the national boundary as a joint effect of embayment up the valley of the Rio Grande and of the seaward advance of this river's rounded delta front: these several changes take place in a distance of about 500 m., and hence include a region of over 100,000 sq. m.—less than half of the large state of Texas. A belted arrangement of reliefs and soils, resulting from differential erosion on strata of unlike composition and resistance, characterizes almost the entire area of the coastal plain. Most of the plain is treeless prairie, but the sandier belts are forested; two of them are known as "cross timbers," because their trend is transverse to the general course of the main consequent rivers. An inland extension from the coastal plain in north-central Texas leads to a large cuesta known as Grand Prairie (not structurally included in the coastal plain), upheld at altitudes of 1200 or 1300 ft. by a resistant Cretaceous limestone, which dips gently seaward; its scalloped inland-facing escarpment overlooks a denuded central prairie region of irregular structure and form; its gentle coastward slope (16 ft. to a mile) is dissected by many branching consequent streams; in its southern part, as it approaches the Colorado river the cuesta is dissected into a belt of discontinuous hills. The western cross timbers follow a sandy belt along the inner base of the ragged escarpment of Grand Prairie; the eastern cross timbers follow another sandy belt in the lowland between the eastern slope of Grand Prairie and the pale western escarpment of the next eastward and lower Black Prairie cuesta. This cuesta is supported at an altitude of 700 ft. or less by a chalk formation, which gives an infacing slope some 200 ft. in height, while its gently undulating or "rolling" seaward slope (2 or 3 ft. in a mile), covered with marly strata and rich black soil, determines an important cotton district. Then comes the East Texas timber belt, broad in the north-east, narrowing to a point before reaching the Rio Grande, a low and thoroughly dissected cuesta of sandy Eocene strata; and this is followed by the Coast Prairie, a very young plain, with a seaward slope of less than 2 ft. in a mile, its smooth surface interrupted only by the still more nearly level flood plains of the shallow, consequent river valleys. Near the Colorado river the dissected cuesta of the Grand Prairie passes southward, by a change to a more nearly horizontal structure, into the dissected Edwards plateau (to be referred to again as part of the Great Plains), which terminates in a maturely dissected fault scarp, 300 or 400 ft. in height, the northern boundary of the Rio Grande embayment. From the Colorado to the Rio Grande, the Black Prairie, the timber belt and the Coast Prairie merge in a vast plain, little differentiated, overgrown with "chaparral" (shrub-like trees, often thorny), widening eastward in the Rio Grande delta, and extending southward into Mexico.

Although the Coast Prairie is a sea bottom of very modern uplift, it appears already to have suffered a slight movement of depression, for its small rivers all enter embayments; the larger rivers, however, seem to have counteracted the encroachment of the sea on the land by a sufficiently active delta building, with a resulting forward growth of the land into the sea. The Mississippi has already been mentioned as rapidly building forward its digitate delta; the Rio Grande, next in size, has built its delta about 50 m. forward from the general coast-line, but this river being much smaller than the Mississippi, its delta front is rounded by seashore agencies. In front of the Brazos and the Colorado, the largest of the Texan rivers, the coast-line is very gently bowed forward, as if by delta growth, and the sea touches the mainland in a nearly straight shore line. Nearly all the rest of the coast is fringed by off-shore reefs, built up by waves from the very shallow sea bottom; in virtue of weak tides, the reefs continue in long unbroken stretches between the few inlets.

The Great Plains.—A broad stretch of country underlaid by nearly horizontal strata extends westward from the 97th meridian to the base of the Rocky Mountains, a distance of from 300 to 500 m., and northward from the Mexican boundary far into Canada. This is the province of the Great Plains. Although the altitude of plains increases gradually from 600 or 1200 ft. on the east to 4000, 5000 or 6000 ft. near the mountains, the local relief is generally small; the sub-arid climate excludes tree growth and opens far-reaching views. The plains are by no means a simple unit; they are of diverse structure and of various stages of erosional development; they are occasionally interrupted by buttes and escarpments; they are frequently broken by valleys: yet on the whole a broadly extended surface of moderate relief so often prevails that the name, Great Plains, for the region as a whole is well deserved. The western boundary of the plains is usually well defined by the abrupt ascent of the mountains. The eastern boundary of the plains is more climatic than topographic. The line of 20 in. of annual rainfall trends a little east of northward near the 97th meridian, and if a boundary must be drawn where nature presents only a gradual transition, this rainfall line may be taken to divide the drier plains from the moister prairies. The plains may be described in northern, intermediate, central and southern sections, in relation to certain peculiar features.

The northern section of the Great Plains, north of latitude 44°, including eastern Montana, north-eastern Wyoming and most of the Dakotas, is a moderately dissected peneplain, one of the best examples of its class. The strata here are Cretaceous or early Tertiary, lying nearly horizontal. The surface is shown to be a plain of degradation by a gradual ascent here and there to the crest of a ragged escarpment, the cuesta-remnant of a resistant stratum; and by the presence of lava-capped mesas and dike-ridges, surmounting the general level by 500 ft. or more and manifestly demonstrating the widespread erosion of the surrounding plains. All these reliefs are more plentiful towards the mountains in central Montana. The peneplain is no longer in the cycle of erosion that witnessed its production; it appears to have suffered a regional elevation, for the rivers—the upper Missouri and its branches—no longer flow on the surface of the plain, but in well graded, maturely opened valleys, several hundred feet below the general level. A significant exception to the rule of mature valleys occurs, however, in the case of the Missouri, the largest river, which is broken by several falls on hard sandstones about 50 m. east of the mountains. This peculiar feature is explained as the result of displacement of the river from a better graded preglacial valley by the Pleistocene ice-sheet, which here overspread the plains from the moderately elevated Canadian highlands far on the north-east, instead of from the much higher mountains near by on the west. The present altitude of the plains near the mountain base is 4000 ft.

The northern plains are interrupted by several small mountain areas. The Black Hills, chiefly in western South Dakota, are the largest group: they rise like a large island from the sea, occupying an oval area of about 100 m. north-south by 50 m. east-west, reaching an altitude in Harney Peak of 7216 ft., and an effective relief over the plains of 2000 or 3000 ft. This mountain mass is of flat-arched, dome-like structure, now well dissected by radiating consequent streams, so that the weaker uppermost strata have been eroded down to the level of the plains where their upturned edges are evenly truncated, and the next following harder strata have been sufficiently eroded to disclose the core of underlying crystalline rocks in about half of the domed area.

In the intermediate section of the plains, between latitudes 44° and 42°, including southern South Dakota and northern Nebraska, the erosion of certain large districts is peculiarly elaborate, giving rise to a minutely dissected form, known as "bad lands," with a relief of a few hundred feet. This is due to several causes: first, the dry climate, which prevents the growth of a grassy turf; next, the fine texture of the Tertiary strata in the bad land districts; and consequently the success with which every little rill, at times of rain, carves its own little valley. Travel across the bad lands is very fatiguing because of the many small ascents and descents; and it is from this that their name, "mauvaises terres pour traverser," was given by the early French *voyageurs*.

The central section of the Great Plains, between latitudes 42° and 36°, occupying eastern Colorado and western Kansas, is, briefly stated, for the most part a dissected fluviatile plain; that is, this section was once smoothly covered with a gently sloping plain of gravel and sand that had been spread far forward on a broad denuded area as a piedmont deposit by the rivers which issued from the mountains; and since then it has been more or less dissected by the erosion of valleys. The central section of the plains thus presents a marked contrast to the northern section; for while the northern section owes its smoothness to the removal of local gravels and sands from a formerly uneven surface by the action of degrading rivers and their inflowing tributaries, the southern section owes its smoothness to the deposition of imported gravels and sands upon a previously uneven surface by the action of aggrading rivers and their outgoing distributaries. The two sections are also unlike in that residual eminences still here and there surmount the peneplain of the northern section, while the fluviatile plain of the central section completely buried the pre-existent relief. Exception to this statement must be made in the south-west, close to the mountains in southern Colorado, where some lava-capped mesas (Mesa de Maya, Raton Mesa) stand several thousand feet above the general plain level, and thus testify to the widespread erosion of this region before it was aggraded.

The southern section of the Great Plains, between latitudes 35½° and 29½°, lies in eastern Texas and eastern New Mexico; like the central section it is for the most part a dissected fluviatile plain, but the lower lands which surround it on all sides place it in so strong relief that it stands up as a table-land, known from the time of Mexican occupation as the Llano Estacado. It measures roughly 150 m. east-west and 400 m. north-south, but it is of very irregular outline, narrowing to the south. Its altitude is 5500 ft. at the highest western point, nearest the mountains whence its gravels were supplied; and thence it slopes south-eastward at a decreasing rate, first about 12 ft., then about 7 ft. in a mile, to its eastern and southern borders, where it is 2000 ft. in altitude: like the High Plains farther north, it is extraordinarily smooth; it is very dry, except for occasional shallow and temporary water sheets after rains. The Llano is separated from the plains on the north by the mature consequent valley of the Canadian river, and from the mountains on the west by the broad and probably mature valley of the Pecos river. On the east it is strongly undercut by the retrogressive erosion of the headwaters of the Red, Brazos and Colorado rivers of Texas, and presents a ragged escarpment, 500 to 800 ft. high, overlooking the central denuded area of that state; and there, between the Brazos and Colorado rivers, occurs a series of isolated outliers capped by a limestone which underlies both the Llano on the west and the Grand Prairies cuesta on the east. The southern and narrow part of the table-land, called the Edwards Plateau, is more dissected than the rest, and falls off to the south in a frayed-out fault scarp, as already mentioned, overlooking the coastal plain of the Rio Grande embayment. The central denuded area, east of the Llano, resembles the east-central section of the plains in exposing older rocks; between these two similar areas, in the space limited by the Canadian and Red rivers, rise the subdued forms of the Wichita Mountains in Oklahoma, the westernmost member of the Ouachita system.

The Cordilleran Region.—From the western border of the Great Plains to the Pacific coast, there is a vast elevated area, occupied by mountains, plateaus and intermont plains. The intermont plains are at all altitudes from sea-level to 4000 ft.; the plateaus from 5000 to 10,000 ft.; and the mountains from 8000 to 14,000 ft. The higher mountains are barren from the cold of altitude; the timber line in Colorado stands at 11,000 to 12,000 ft.

The chief provinces of the Cordilleran region are: The Rocky Mountain system and its basins, from northern New Mexico northward, including all the mountains from the front ranges bordering on the plains to the Uinta and Wasatch ranges in Utah; the Pacific ranges including the Sierra Nevada of California, the Cascade range of Oregon and Washington, and the Coast range along the Pacific nearly to the southern end of California; and a great intermediate area, including in the north the Columbian lava plains and in the south the large province of the Basin ranges, which extends into Mexico and widens from the centre southward, so as to meet the Great Plains in eastern New Mexico, and to extend to the Pacific coast in southern California. There is also a province of plateaus between the central part of the Basin ranges and the southern part of the Rocky Mountains. An important geological characteristic of most of the Cordilleran region is that the Carboniferous strata, which in western Europe and the eastern United States contain many coal seams, are represented in the western United States by a marine limestone; and that the important unconformity which in Europe and the eastern United States separates the Palaeozoic and Mesozoic eras does not occur in the western United States, where the formations over a great area follow in conformable sequence from early Palaeozoic through the Mesozoic.

The Rocky Mountains.

The Rocky Mountains begin in northern Mexico, where the axial crystalline rocks rise to 12,000 ft. between the horizontal structures of the plains on the east and the plateaus on the west. The upturned stratified formations wrap around the flanks of the range, with ridges and valleys formed on their eroded edges and drained southward by the Pecos river to the Rio Grande and the Gulf of Mexico. The mountains rapidly grow wider and higher northward, by taking on new complications of structure and by including large basins between the axes of uplift, until in northern Colorado and Utah a complex of ranges has a breadth of 300 m., and in Colorado alone there are 40 summits over 14,000 ft. in altitude, though none rises to 14,500. Then turning more to the north-west through Wyoming, the ranges decrease in breadth and height; in Montana their breadth is not more than 150 m., and only seven summits exceed 11,000 ft. (one reaching 12,834).

As far north as the gorge of the Missouri river in Montana, the Front range, facing the Great Plains, is a rather simple uplift, usually formed by upturning the flanking strata, less often by a fracture. Along the eastern side of the Front Range in Colorado most of the upturned stratified formations have been so well worn down that, except for a few low piedmont ridges, their even surface may now be included with that of the plains, and the crystalline core of the range is exposed almost to the mountain base. Here the streams that drain the higher areas descend to the plains through narrow canyons in the mountain border, impassable for ordinary roads and difficult of entrance even by railways; a well-known example is the gorge of Clear Creek east of the Georgetown mining district. The crystalline highlands thereabouts, at altitudes of 8000 to 10,000 ft., are of so moderate a relief as to suggest that the mass had stood much lower in a former cycle of erosion and had then been worn down to rounded hills; and that since uplift to the present altitude the revived streams of the current cycle of erosion have not entrenched themselves deep enough to develop strong relief. This idea is confirmed 80 m. farther south, where Pike's Peak (14,108 ft.), a conspicuous landmark far out on the plains, has every appearance of being a huge monadnock, surmounting a rough peneplain of 10,000 ft. in general elevation. The idea is still better confirmed farther north in Wyoming, where the Laramie Range, flanked with upturned strata on the east and west, is for the most part a broad upland at altitudes of 7000 or 8000 ft., with no strong surmounting summits and as yet no deep carved valleys. Here the first of the Pacific railways chose its pass. When the summit is reached, the traveller is tempted to ask, "Where are the mountains?" so small is the relief of the upland surface. This low range turns westward in a curve through the Rattlesnake Mountains towards the high Wind River Mountains (Gannett Peak, 13,775 ft.), an anticlinal range within the body of the mountain system, with flanking strata rising well on the slopes. Flanking strata are even better exhibited in the Bighorn Mountains, the front range of northern Wyoming, crescentic in outline and convex to the north-east, like the Laramie Range, but much higher; here heavy sheets of limestone arch far up towards the range crest, and are deeply notched where consequent streams have cut down their gorges.

Farther north in Montana, beyond the gorge of the Missouri river, the structure of the Front Range is altogether different; it is here the carved residual of a great mass of moderately bent Palaeozoic strata, overthrust eastward upon the Mesozoic strata of the plains; instead of exposing the oldest rocks along the axis and the youngest rocks low down on the flanks, the younger rocks of the northern range follow its axis, and the oldest rocks outcrop along its eastern flanks, where they override the much younger strata of the plains; the harder strata, instead of lapping on the mountain flanks in great slab-like masses, as in the Bighorns, form out-facing scarps, which retreat into the mountain interior where they are cut down by outflowing streams.

The structure of the inner ranges is so variable as to elude simple description; but mention should be made of the Uinta range of broad anticlinal structure in north-east Utah, with east-west trend, as if corresponding to the east-west Rattlesnake Mountains, already named. The Wasatch Range, trending north-south in central Utah, is peculiar in possessing large east-west folds, which are seen in cross-section in the dissected western face of the range, because the whole mass is there squarely cut off by a great north-south fault with down-throw to the Basin Range province, the fault face being elaborately carved.

Volcanic action has been restricted in the Rocky Mountains proper. West Spanish Peak (13,620 ft.), in the Front Range of southern Colorado, may be mentioned as a fine example of a deeply dissected volcano, originally of greater height, with many unusually strong radiating dike-ridges near its denuded flanks. In north-western Wyoming there are extensive and heavy lava sheets, uplifted and dissected, and crowned with a few dissected volcanoes. It is in association with this field of extinct volcanic activity that a remarkable group of geysers and hot springs has been developed, from which the Yellowstone river, a branch of the Missouri, flows north-eastward, and the Snake river, a branch of the Columbia, flows south-westward. The geyser district is held as a national domain, the Yellowstone Park.

Travellers whose idea of picturesqueness is based upon the abnormally sharpened peaks of the ice-sculptured Alps are disappointed with the scenery of the central and southern ranges of the Rocky Mountains. It is true that many of these ranges are characterized by the rounded tops and the rather evenly slanting, waste-covered slopes which normally result from the long-continued action of the ordinary agencies of erosion; that they bear little snow in summer and are practically wanting in glaciers; that forests are often scanty on the middle and lower slopes, the more so because of devastation by fires; and that the general impression of great altitude is much weakened because the mountains are seen from a base which itself is 5000 or 6000 ft. above sea-level. Nevertheless the mountains are of especial interest to the physiographer who wishes to make a comparative study of land forms as affected by normal and by glacial sculpture, in order to give due attention to "process" as well as to "structure and stage" in the analysis and description of mountain topography. A journey along the range from south to north reveals most strikingly a gradual increase in the share of sculpture due to Pleistocene glaciers. In New Mexico, if glaciers were formed at all in the high valleys, they were so small as not greatly to modify the more normal forms. In central Colorado and Wyoming, where the mountains are higher and the Pleistocene glaciers were larger, the valley heads were hollowed out in well-formed cirques, often holding small lakes; and the mountain valleys were enlarged into U-shaped troughs as far down as the ice reached, with hanging lateral valleys on the way. Different stages of cirque development, with accompanying transformation of mountain shape, are finely illustrated in several ranges around the headwaters of the Arkansas river in central Colorado, where the highest summit of the Rocky Mountains is found (Mt Massive, 14,424 ft., in the Sawatch range); and perhaps even better in the Bighorn range of Wyoming. In this central region, however, it is only by way of exception that the cirques were so far enlarged by retrogressive glacial erosion as to sharpen the preglacial dome-like summits into acute peaks; and in no case did glacial action here extend down to the plains at the eastern base of the mountains; but the widened, trough-like glaciated valleys frequently descend to the level of the elevated intermont basins, where moraines were deployed forward on the basin floor. The finest examples of this kind are the moraines about Jackson Lake on the basin floor east of the Teton Range (Grand Teton, 13,747 ft.), a superb north-south range which lies close to the meridional boundary line between Wyoming and Idaho. Farther north in Montana, in spite of a decrease of height, there are to-day a few small glaciers with snowfields of good size; and here the effects of sculpture by the much larger Pleistocene glaciers are seen in forms of almost alpine strength.

The intermont basins which so strongly characterize the Rocky Mountain system are areas which have been less uplifted than the enclosing ranges, and have therefore usually become the depositories of waste from the surrounding mountains.

Some of the most important basins may be mentioned. San Luis "Valley" is an oval basin about 60 m. long near the southern end of the mountain system in New Mexico and Colorado; its level, treeless floor, at an altitude of 7000 ft., is as yet hardly trenched by the Rio Grande, which escapes through an impassable canyon southward on its way to the Gulf of Mexico. The much smaller basin of the upper Arkansas river in Colorado is well known because the Royal Gorge, a very narrow cleft by which the river escapes through the Front Range to the plains, is followed by a railroad at river-level. South Park, directly west of Pike's Peak, is one of the highest basins (nearly 10,000 ft.), and gains its name from the scattered, park-like growth of large pine trees; it is drained chiefly by the South Platte river (Missouri-Mississippi system), through a deep gorge in the dissected mass of the plateau-like Front Range. The Laramie Plains and the Green river basin, essentially a single structural basin between the east-west ranges of Rattlesnake Mountains on the north and the Uinta Range on the south, measuring roughly 260 m. east-west by 100 m. north-south, is the largest intermont basin; it is well known from being traversed through its greatest length by the Union Pacific railway. Its eastern part is drained north-eastward through a gorge that separates the Laramie and Rattlesnake (Front) ranges by the North Platte river to the Missouri-Mississippi; its western part, where the basin floor is much dissected, often assuming a bad-land expression, is drained southward by the Green river, through a deep canyon in the Uinta Range to the Colorado river and then to the Pacific. The Bighorn basin has a moderately dissected floor, drained north-eastward by Bighorn river through a deep canyon in the range of the same name to the Missouri. Several smaller basins occur in Montana, all somewhat dissected and drained through narrow gorges and canyons by members of the Missouri system.

The Plateau Province.

The Plateau province, next west of the southern Rocky Mountains, is characterized for the most part by large-textured forms, developed on a great thickness of nearly horizontal Palaeozoic, Mesozoic and Tertiary formations, and by a dry climate. The province was uplifted and divided into great blocks by faults or monoclinal flexures and thus exposed to long-lasting denudation in a mid-Tertiary cycle of erosion; and then broadly elevated again, with renewed movement on some of the fault lines; thus was introduced in late Tertiary time the current cycle of erosion in which the deep canyons of the region have been trenched. The results of the first cycle of erosion are seen in the widespread exposure of the resistant Carboniferous limestone as a broad platform in the south-western area of greater uplift through central Arizona, where the higher formations were worn away; and in the development of a series of huge, south-facing, retreating escarpments of irregular outline on the edges of the higher formations farther north. Each escarpment stands forth where a resistant formation overlies a weaker one; each escarpment is separated from the next higher one by a broad step of weaker strata. A wonderful series of these forms occurs in southern Utah, where in passing northward from the Carboniferous platform one ascends in succession the Vermilion Cliffs (Triassic sandstones), the White Cliffs (Jurassic sandstones, of remarkably cross-bedded structure, interpreted the dunes of an ancient desert), and finally the Pink Cliffs (Eocene strata of fluviatile and lacustrine origin) of the high, forested plateaus. Associated with these irregular escarpments are occasional rectilinear ridges, the work of extensive erosion on monoclinal structures, of which Echo Cliffs, east of the Painted Desert (so called from its many-coloured sandstones and clays), is a good example.

With the renewal of uplift by which the earlier cycle of erosion was interrupted and the present cycle introduced, inequalities of surface due to renewed faulting were again introduced; these still appear as cliffs, of more nearly rectilinear front than the retreating escarpments formed in the previous cycle. These cliffs are peculiar in gradually passing from one formation to another, and in having a height dependent on the displacement of the fault rather than on the structures in the fault face; they are already somewhat battered and dissected by erosion. The most important line of cliffs of this class is associated with the western and southern boundary of the plateau province, where it was uplifted from the lower ground. The few rivers of the region must have reached the quiescence of old age in the earlier cycle, but were revived by uplift to a vigorous youth in the current cycle; and it is to this newly introduced cycle of physiographic evolution that the deep canyons of the Plateau province are due. Thus the Virgin river, a northern branch of the Colorado, has cut a vertical slit, 1000 ft. deep, hardly wider at the top than at the bottom, in the heavy Triassic sandstones of southern Utah; but the most famous example is the Grand Canyon (*q.v.*) of Arizona, eroded by the Colorado river across the uplifted platform of Carboniferous limestone.

During the current cycle of erosion, several of the faults, whose scarps had been worn away in the previous cycle, have been brought to light again as topographic features by the removal of the weak strata along one side of the fault line, leaving the harder strata on the other side in relief; such scarps are known as "fault-line scarps," in distinction from the original "fault scarps." They are peculiar in having their altitude dependent on the depth of revived erosion, instead of the amount of faulting, and they are sometimes "topographically reversed," in that the revived scarp overlooks a lowland worn on a weak formation in the upheaved fault-block. Another consequence of revived erosion is seen in the occurrence of great landslides, where the removal of weak (Permian) clays has sapped the face of the Vermilion Cliffs (Triassic sandstone), so that huge slices of the cliff face have slid down and forward a mile or two, all shattered into a confused tumult of forms for a score or more of miles along the cliff base.

Volcanic features occur in abundance in the Plateau province. Some of the high plateaus in the north are capped with remnants of heavy lava flows of early eruption. A group of large volcanoes occurs on the limestone platform south of the Grand Canyon, culminating in Mt San Francisco (12,794 ft.), a moderately dissected cone, and associated with many more recent smaller cones and fresh-looking lava flows. Mt Taylor in western New Mexico is of similar age, but here dissection seems to have advanced farther, probably because of the weaker nature of the underlying rocks, with the result of removing the smaller cones and exposing many lava conduits or pipes in the form of volcanic necks or buttes. The Henry Mountains in south-western Utah are peculiar in owing their relief to the doming or blistering up of the plateau strata by the underground intrusion of large bodies or "cisterns" (laccolites) of lava, now more or less exposed by erosion.

The lava plains of the Columbia basin are among the most extensive volcanic outpourings in the world. They cover 200,000 sq. m. or more in south-eastern Washington, eastern Oregon and south-western Idaho, and are known to be 4000 ft. deep in some river gorges. The lava completely buries the pre-existent land forms over most of its extent. The earlier supposition that these vast lava flows came chiefly from fissure eruptions has been made doubtful by the later discovery of flat-sloping volcanic cones from which much lava seems to have been poured out in a very liquid state. Some of the flows are still so young as to preserve their scoriaceous surface; here the "shore-line" of the lava contours evenly around the spurs and enters, bay-like, into the valleys of the enclosing mountains, occasionally isolating an outlying mass. Other parts of the lava flood are much older and have been more or less deformed and eroded. Thus the uplifted, dislocated and dissected lava sheets of the Yellowstone National Park in the Rocky Mountains on the east (about the headwaters of the Snake river) are associated with the older lavas of the Columbian plains.

The Columbia river has entrenched itself in a canyon-like valley around the northern and western side of the lava plains; Snake river has cut a deeper canyon farther south-east where the plains are higher and has disclosed the many lava sheets which build up the plains, occasionally revealing a buried mountain in which the superposed river has cut an even narrower canyon. One of the most remarkable features of this province is seen in the temporary course taken by the Columbia river across the plains, while its canyon was obstructed by Pleistocene glaciers that came from the Cascade Mountains on the north-west. The river followed the temporary course long enough to erode a deep gorge, known as "Grande Coulee," along part of its length.

The lava plains are treeless and for the most part too dry for agriculture; but they support many cattle and horses. Along parts of their eastern border, where the rainfall is a little increased by the approach of the westerly winds to the Rocky Mountains, there is a belt of very deep, impalpably fine soil, supposed to be a dust deposit brought from the drier parts of the plains farther west; excellent crops of wheat are here raised.

The Basin Range Province.

The large province of the Basin ranges, an arid region throughout, even though it reaches the sea in southern California, involves some novel problems in its description. It is characterized by numerous disconnected mountain ranges trending north and south, from 30 to 100 m. in length, the higher ranges reaching altitudes of 8000 or 10,000 ft., separated by broad, intermont desert plains or basins at altitudes varying from sea-level (or a little less) in the south-west, to 4000 or 5000 ft. farther inland. Many of the intermont plains—these chiefly in the north—appear to be heavily aggraded with mountain waste; while others—these chiefly in the south—are rock-floored and thinly veneered with alluvium. The origin of these forms is still in discussion; but the following interpretation is well supported. The ranges are primarily the result of faulting and uplifting of large blocks of the earth's crust. The structure of the region previous to faulting was dependent on long antecedent processes of accumulation and deformation and the surface of the region then was dependent on the amount of erosion suffered in the prefaulting cycle. When the region was broken into fault blocks and the blocks were uplifted and tilted, the back slope of each block was a part of the previously eroded surface and the face of the block was a surface of fracture; the present form of the higher blocks is more or less affected by erosion since faulting, while many of the lower blocks have been buried under the waste of the higher ones. In the north, where dislocations have invaded the field of the horizontal Columbian lavas, as in south-eastern Oregon and north-eastern California, the blocks are monoclinal in structure as well as in attitude; here the amount of dissection is relatively moderate, for some of the fault faces are described as ravined but not yet deeply dissected; hence these dislocations appear to be of recent date. In western Utah and through most of Nevada many of the blocks exhibit deformed structures, involving folds and faults of relatively ancient (Jurassic) date; so ancient that the mountains then formed by the folding were worn down to the lowland stage of old age before the block-faulting occurred. When this old-mountain lowland was broken into blocks and the blocks were tilted, their attitude, but not their structure, was monoclinal; and in this new attitude they have been so maturely re-dissected in the new cycle of erosion upon which they have now entered as to have gained elaborately carved forms in which the initial form of the uplifted blocks can hardly be perceived; yet at least some of them still retain along one side the highly significant feature of a relatively simple base-line, transecting hard and soft structures alike, and thus indicating the faulted margin of a tilted block. Here the less uplifted blocks are now heavily aggraded with waste from the dissected ranges: the waste takes the form of huge alluvial fans, formed chiefly by occasional boulder-bearing floods from the mountains; each fan heads in a ravine at the mountain base, and becomes laterally confluent with adjacent fans as it stretches several miles forward with decreasing slope and increasing fineness of material.

In the southern part of the Basin Range province the ranges are well dissected and some of the intermont depressions have rock floors with gentle, centripetal slopes; hence it is suggested that the time since the last dislocation in this part of the province is relatively remote; that erosion in the current cycle has here advanced much farther than in the central or northern parts of the province; and that, either by outwash to the sea or by exportation of wind-borne dust, the depressions—perhaps aggraded for a time in the earlier stages of the cycle—have now been so deeply worn down as to degrade the lower and weaker parts of the tilted blocks to an evenly sloping surface, leaving the higher and harder parts still in relief as residual ranges. If this be true, the southern district will furnish a good illustration of an advanced stage of the cycle of arid erosion, in which the exportation of waste from enclosed depressions by the wind has played an important part. In such case the washing of the centripetal slopes of the depressions by occasional "sheet-floods" (widespreading sheets of turbid running water, supplied by heavy short-lived rains) has been efficient in keeping the rock floor at even grade toward a central basin, where the finest waste is collected while waiting to be removed by the winds.

Only a small part of the Basin Range province is drained to the sea. A few intermont areas in the north-west part of the province have outlet westward by Klamath river through the Cascade range and by Pitt river (upper part of the Sacramento) through the Sierra Nevada: a few basins in the south-east have outlet by the Rio Grande to the Gulf of Mexico; a much larger but still narrow medial area is drained south-westward by the Colorado to the head of the Gulf of California, where this large and very turbid river has formed an extensive delta, north of which the former head of the gulf is now cut off from the sea and laid bare by evaporation as a plain below sea-level. It is here that an irrigation project, involving the diversion of some of the river water to the low plain, led to disaster in 1904, when the flooded river washed away the canal gates at the intake and overflowed the plain, drowning the newly established farms, compelling a railway to shift its track, and forming a lake (Salton Sea) which would require years of evaporation to remove (see COLORADO RIVER). Many streams descend from the ravines only to wither away on the desert basin floors before uniting in a trunk river along the axis of a depression; others succeed in uniting in the winter season, when evaporation is much reduced, and then their trunk flows for a few score miles, only to disappear by "sinking" (evaporating) farther on. A few of the large streams may, when in flood, spread out in a temporary shallow sheet on a dead level of clay, or *playa*, in a basin centre, but the sheet of water vanishes in the warm season and the stream shrinks far up its course, the absolutely barren clay floor of the playa, impassable when wet, becomes firm enough for crossing when dry. One of the south-western basins, with its floor below sea-level, has a plain of salt in its centre. A few of the basins are occupied by lakes without outlet, of which Great Salt Lake (*q.v.*), in north-west Utah, is the largest. Several smaller lakes occur in the basins of western Nevada, next east of the Sierra Nevada. During Pleistocene times all these lacustrine basins were occupied by lakes of much greater depth and larger size; the outlines of the eastern (Lake Bonneville) and the western (Lake Lahontan) water bodies are well recorded by shore lines and deltas on the enclosing slopes, hundreds of feet above the present lake surfaces; the abandoned shore lines, as studied by G. K. Gilbert and I. C. Russell, have yielded evidence of past climatic changes second in importance only to those of the Pleistocene glaciated areas. The duration of the Pleistocene lakes was, however, brief as compared with the time since the dislocation of the faulted blocks, as is shown by the small dimensions of the lacustrine beaches compared to the great volume of the ravine-heading fans on which the beaches often lie.

The Pacific Ranges.

Strong mountain ranges follow the trend of the Pacific coast, 150 or 200 m. inland. The Cascade Range enters from Canada, trending southward across the international boundary through Washington and Oregon to latitude 41°; the Sierra Nevada extends thence south-eastward through California to latitude 35°. The lower coast ranges, nearer the ocean, continue a little farther southward than the Sierra Nevada, before giving way to that part of the Basin Range province which reaches the Pacific in southernmost California.

The Cascade Range is in essence a maturely dissected highland, composed in part of upwarped Columbian lavas, in part of older rocks, and crowned with several dissected volcanoes, of which the chief are (beginning in the north) Mts Baker (10,827 ft.), Rainier (14,363 ft.), Adams (12,470 ft.) and Hood (11,225 ft.); the first three in Washington, the last in northern Oregon. These bear snowfields and glaciers; while the dissected highlands, with ridges of very irregular arrangement, are everywhere sculptured in a fashion that strongly suggests the work of numerous local Pleistocene glaciers as an important supplement to preglacial erosion. Lake Chelan, long and narrow, deep set between spurless ridges with hanging lateral valleys, and evidently of glacial origin, ornaments one of the eastern valleys. The range is squarely transected by the Columbia river, which bears every appearance of antecedent origin: the cascades in the river gorge are caused by a sub-recent landslide of great size from the mountain walls. Klamath river, draining several lakes in the north-west part of the Basin Range province and traversing the Cascade Range to the Pacific, is apparently also an antecedent river.

The Cascade Mountains present a marked example of the effect of relief and aspect on rainfall; they rise across the path of the prevailing westerly winds not far inland from a great ocean; hence they receive an abundant rainfall (80 in. or more, annually) on the westward or windward slope, and there they are heavily forested; but the rainfall is light on the eastward slope and the piedmont district is dry; hence the forests thin out on that side of the range and treeless lava plains follow next eastward.

The Sierra Nevada may be described, in a very general way, as a great mountain block, largely composed of granite and deformed metamorphosed rocks, reduced to moderate relief in an earlier (Cretaceous and Tertiary?) cycle of erosion, sub-recently elevated with a slant to the west, and in this position sub-maturely dissected. The region was by no means a peneplain before its slanting uplift; its surface then was hilly and in the south mountainous; in its central and still more in its northern part it was overspread with lavas which flowed westward along the broad open valleys from many vents in the eastern part: near the northern end of the range, eruptions have continued in the present cycle, forming many cones and young lava flows. The tilting of the mountain mass was presumably not a simple or a single movement; it was probably slow, for Pitt river (headwaters of the Sacramento) traverses the northern part of the range in antecedent fashion; the tilting involved the subdivision of the great block into smaller ones, in the northern half of the range at least; Lake Tahoe (altitude 6225 ft.) near the range crest is explained as occupying a depression between two block fragments; and farther north similar depressions now appear as aggraded highland "meadows." The tilting of the great block resulted in presenting a strong slope to the east, facing the deserts of the Basin Range province and in large measure determining their aridity; and a long moderate slope to the west. The altitudes along the upraised edge of the block, or range crest, are approximately 5000 ft. in the north and 11,000 ft. in the south. The mountains in the southern part of the block, which had been reduced to subdued forms in the former cycle of erosion, were thus given a conspicuous height, forming the "High Sierra," and greatly sharpened by revived erosion, normal and glacial. In this way Mt Whitney (14,502 ft.) came to be the highest summit in the United States (excluding Alaska). The displacement of the mountain block may still be in progress, for severe earthquakes have happened in the depression next east of the range; that of Owen's Valley in 1870 was strong enough to have been very destructive had there been anything in the desert valley to destroy. In the new altitude of the mountain mass, its steep eastern face has been deeply carved with short canyons; and on the western slope an excellent beginning of dissection has been made in the erosion of many narrow valleys, whose greatest depth lies between their headwaters which still flow on the highland surface, and their mouths at the low western base of the range. The highlands and uplands between the chief valleys are but moderately dissected; many small side streams still flow on the highland, and descend by steeply incised gorges to the valleys of the larger rivers. Some of the chief valleys are not cut in the floors of the old valleys of the former cycle, because the rivers were displaced from their former courses by lava flows, which now stand up as table mountains. Glacial erosion has been potent in excavating great cirques and small rock-basins, especially among the higher southern surmounting summits, many of which have been thus somewhat reduced in height while gaining an Alpine sharpness of form; some of the short and steep canyons in the eastern slope have been converted into typical glacial troughs, and huge moraines have been laid on the desert floor below them. Some of the western valleys have also in part of their length been converted into U-shaped troughs; the famous Yosemite Valley, eroded in massive granite, with side cliffs 1000 or 2000 ft. in height, and the smaller Hetch-Hetchy Valley not far away, are regarded by some observers as owing their peculiar forms to glacial modifications of normal preglacial valleys.

The western slope of the Sierra Nevada bears fine forests similar to those of the Cascade Range and of the Coast Range, but of more open growth, and with the redwood exchanged for groves of "big trees" (*Sequoia gigantea*) of which the tallest examples reach 325 ft. The higher summits in the south are above the tree line and expose great areas of bare rock: mountaineering is here a delightful summer recreation, with camps in the highland forests and ascents to the lofty peaks. Gold occurs in quartz veins traversing various formations (some as young as Jurassic), and also in gravels, which were for the most part deposited previous to the uplift of the Sierra "block." Some of the gravels then occurred as piedmont deposits along the western border of the old mountains; these gravels are now more or less dissected by new-cut valleys. Other auriferous gravels are buried under the upland lava flows, and are now reached by tunnels driven in beneath the rim of the table mountains. The reputed discovery of traces of early man in the lava-covered gravels has not been authenticated.

The northernmost part of the coast ranges, in Washington, is often given independent rank as the Olympic Range (Mt Olympus, 8150 ft.); it is a picturesque mountain group, bearing snowfields and glaciers, and suggestive of the dome-like uplift of a previously worn-down mass; but it is now so maturely dissected as to make the suggested origin uncertain. Farther south, through Oregon and northern California, many members of the coast ranges resemble the Cascades and the Sierra in offering well-attested examples of the uplift of masses of disordered structure, that had been reduced to a tame surface by the erosion of an earlier cycle, and that are now again more or less dissected.

Several of the ranges ascend abruptly from the sea; their base is cut back in high cliffs; the Sierra Santa Lucia, south of San Francisco, is a range of this kind; its seaward slope is almost uninhabitable. Elsewhere moderate re-entrants between the ranges have a continuous beach, concave seaward; such re-entrants afford imperfect harbourage for vessels; Monterey Bay is the most pronounced example of this kind. On still other parts of the coast a recent small elevatory movement has exposed part of the former sea bottom in a narrow coastal plain, of which some typical harbourless examples are found in Oregon. Most of the recent movements appear to have been upward, for the coast presents few embayments such as would result from the depression and partial submergence of a dissected mountain range; but three important exceptions must be made to this rule.

In the north, the Strait of Juan de Fuca and the intricately branching waterways of Puget Sound between the Cascade and the Olympic ranges occupy trough-like depressions which were filled by extensive glaciers in Pleistocene times; and thus mark the beginning of the great stretch of fiorded coast which extends northward to Alaska. The waterways here afford excellent harbours. The second important embayment is the estuary of the Columbia river; but the occurrence of shoals at the mouth decreases the use that might otherwise be made of the river by ocean-going vessels. More important is San Francisco Bay, situated about midway on the Pacific coast of the United States, the result of a moderate depression whereby a transverse valley, formerly followed by Sacramento river through the outermost of the Coast ranges, has been converted into a narrow strait—the "Golden Gate"—and a wider intermont longitudinal valley has been flooded, forming the expansion of the inner bay.

The Coast Range is heavily forested in the north, where rainfall is abundant in all seasons; but its lower ranges and valleys have a scanty tree growth in the south, where the rainfall is very light: here grow redwoods (*Sequoia sempervirens*) and live oaks (*Quercus agrifolia*). The chief metalliferous deposits of the range are of mercury at New Almaden, not far south of San Francisco. The open valleys between the spaced ranges offer many tempting sites for settlement, but in the south irrigation is needed for cultivation.

The belt of relative depression between the inner Pacific ranges and the Coast range is divided by the fine volcano Mt Shasta (14,380 ft.) in northern California into unlike portions. To the north, the floor of the depression is for the most part above baselevel, and hence is dissected by open valleys, partly longitudinal, partly transverse, among hills of moderate relief. This district was originally for the most part forested, but is now coming to be cleared and farmed.

South of Mt Shasta, the "Valley of California" is an admirable example of an aggraded intermont depression, about 400 m. long and from 30 to 70 m. wide. The floor of this depression being below baselevel, it has necessarily come to be the seat of the mountain waste brought down by the many streams from the newly uplifted

Sierra Nevada on the east and the coast ranges on the west; each stream forms an alluvial fan of very gentle slope; the fans all become laterally confluent, and incline very gently forward to meet in a nearly level axial belt, where the trunk rivers—the Sacramento from the north and the San Joaquin from the south-east—wander in braided courses; their tendency to aggradation having been increased in the last half century by the gravels from gold washing; their waters entering San Francisco Bay. Kings river, rising in the high southern Sierra near Mt Whitney, has built its fan rather actively, and obstructed the discharge from the part of the valley next farther south, which has thus come to be overflowed by the shallow waters of Tulare Lake, of flat, reedy, uncertain borders. A little north of the centre of the valley rise the Marysville Buttes, the remains of a maturely dissected volcano (2128 ft.). Elsewhere the floor of the valley is a featureless, treeless plain. (W. M. D.)

II.—Geology

All the great systems of rock formations are represented in the United States, though close correlation with the systems of Europe is not always possible. The general geological column for the country is shown in the following table:—

Eras of Time. *Groups of Systems.*	*Periods of Time.* *Systems of Rocks.*	
Cainozoic . . .	Present.	
	Pleistocene.	
	Pliocene.	
	Miocene.	
	Oligocene.	
	Eocene.	
	Transition (Arapahoe and Denver formations).	
Mesozoic . . .	Upper Cretaceous.	
	Widespread unconformity.	
	Comanchean (Lower Cretaceous).	
	Jurassic.	
	Triassic.	
Palaeozoic . .	Permian.	
	Coal Measures, or Pennsylvanian.	
	Widespread unconformity.	
	Subcarboniferous, or Mississippian.	
	Devonian.	
	Silurian.	
	Widespread unconformity.	
	Ordovician.	
	Cambrian.	
Proterozoic . .	*Great unconformity.*	
	Keweenawan.	
	Widespread unconformity.	
	Upper Huronian.	
	Widespread unconformity.	
	Middle Huronian.	
	Widespread unconformity.	
	Lower Huronian.	
Archeozoic. . .	*Great unconformity.*	
	Archean	Great Granitoid Series (intrusive in the main, Laurentian).
		Great Schist Series (Mona, Kitchi, Keewatin, Quinnissec; Lower Huronian of some authors).

Archeozoic (Archean) Group.—The oldest group of rocks, called the Archean, was formerly looked upon, at least in a tentative way, as the original crust of the earth or its downward extension, much altered by the processes of metamorphism. This view of its origin is now known not to be applicable to the Archean as a whole, since this system contains some metamorphosed sedimentary rocks. In other words, if there was such a thing as an original crust, which may be looked upon as an open question, the Archean, as now defined, does not appear to represent it. The meta-sedimentary rocks of the Archean include metamorphosed limestone, and schists which carry carbonaceous matter in the form of graphite. The marble and graphite, as well as some other indirect evidence of life less susceptible of brief statement, have been thought by many geologists sufficient to warrant the inference that life existed before the close of the era when the Archean rocks were formed. Hence the era of their formation is called the Archeozoic era.

Most of the Archean rocks fall into one or the other of two great series, a schistose series and a granitoid series, the latter being in large part intrusive in the former. The rocks of the granitoid series appear as great masses in the schist series, and in some places form great protruding bosses. They were formerly regarded as older than the schists and were designated on this account "primitive," "fundamental," &c. They have also been called *Laurentian*, a name which is still sometimes applied to them.

Nearly all known sorts of schist are represented in the schistose part of the system. Most of them are the metamorphic products of igneous rocks, among which extrusive rocks, many of them pyroclastic, predominate. Metamorphosed sedimentary rocks are widely distributed in the schistose series, but they are distinctly subordinate to the meta-igneous rocks, and they are so highly metamorphic that stratigraphic methods are not usually applicable to them. In some areas, indeed, it is difficult to say whether the schists are meta-sedimentary or meta-igneous. The likeness of the Archean of one part of the country to that of another is one of its striking features.

The Archean appears at the surface in many parts of the United States, and in still larger areas north of the national boundary. It appears in the cores of some of the western mountains, in some of the deep canyons of the west, as in the Grand Canyon of the Colorado in northern Arizona, and over considerable areas in northern Wisconsin and Minnesota, in New England and the piedmont plateau east of the Appalachian Mountains, and in a few other situations. Wherever it comes to the surface it comes up from beneath younger rocks which are, as a rule, less metamorphic. By means of deep borings it is known at many points where it does not appear at the surface, and is believed to be universal beneath younger systems.

Locally the Archean contains iron ore, as in the Vermilion district of northern Minnesota, and at some points in Ontario. The ore is mostly in the form of haematite.

Proterozoic (Algonkian) Systems.—The Proterozoic group of rocks (called also Algonkian) includes all formations younger than the Archean and older than the Palaeozoic rocks. The term Archean was formerly proposed to include these rocks, as well as those now called Archean, but the subdivision here recognized has come to be widely approved.

The Proterozoic formations have a wide distribution. They appear at the surface adjacent to most of the outcrops of the Archean, and in some other places. In many localities the two groups have not been separated. In some places this is because the regions where they occur have not been carefully studied since the subdivision into Archeozoic and Proterozoic was made, and in others because of the inherent difficulty of separation, as where the Proterozoic rocks are highly metamorphosed. On the whole, the Proterozoic rocks are predominantly sedimentary and subordinately igneous. Locally both the sedimentary and igneous parts of the group have been highly metamorphosed; but as a rule the alteration of the sedimentary portions has not gone so far that stratigraphic methods are inapplicable to them, though in some places detailed study is necessary to make out their structure.

The Proterozoic formations are unconformable on the Archean in most places where their relations are known. The unconformity between these groups is therefore widespread, probably more so than any later unconformity. Not only is it extensive in area, but the stratigraphic break is very great, as shown by (1) the excess of metamorphism of the lower group as compared with the upper, and (2) the amount of erosion suffered by the older group before the deposition of the younger. The first of these differences between the two systems is significant of the dynamic changes suffered by the Archean before the beginning of that part of the Proterozoic era represented by known formations. The extent of the unconformity is usually significant of the geographic changes of the interval unrecorded by known Proterozoic rocks.

The Proterozoic formations have been studied in detail in few great areas. One of these is about Lake Superior, where the formations have attracted attention on account of the abundant iron ore which they contain. Four major subdivisions or systems of the group have been recognized in this region, as shown in the preceding table. These systems are separated one from another by unconformities in most places, and the lower systems, as a rule, have suffered a greater degree of metamorphism than the upper ones, though this is not to be looked upon as a hard and fast rule. The commoner sorts of rock in the several Huronian systems are quartzite and slate (ranging from shale to schist); but limestone is not wanting, and igneous rocks, both intrusive and extrusive, some metamorphic and some not, abound. Iron ore occurs in the sedimentary part of the Huronian, especially in Minnesota, Michigan, Wisconsin and parts of Canada. The ore is chiefly haematite, and has been developed from antecedent ferruginous sedimentary deposits, through concentration and purification by ground water.

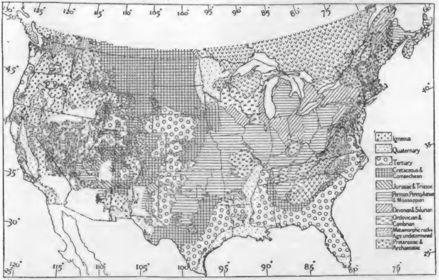
The lower part of the Keweenawan system consists of a great succession of lava flows, of prodigious thickness. This portion of the system is overlain by thick beds of sedimentary rock, mostly conglomerate and sandstone, derived from the igneous rocks beneath. A few geologists regard the sedimentary rocks here classed as Keweenawan as Palaeozoic; but they have yielded no fossils, and are unconformable beneath the Upper Cambrian, which is the oldest sedimentary formation of the region which bears fossils. The aggregate thickness of the Proterozoic systems in the Lake Superior region is several miles, as usually computed, but there are obvious difficulties in determining the thickness of such great systems, especially when they are much metamorphosed. The copper of the Lake Superior region is in the Keweenawan system, chiefly in its sedimentary and amygdaloidal parts.

The Proterozoic formations in other parts of the continent cannot be correlated in detail with those of the Lake Superior region. The number of systems is not everywhere the same, nor are they everywhere alike, and their definite correlation with one another is not possible now, and may never be. The Proterozoic formations have yielded a few fossils in several places, especially Montana and northern Arizona; but they are so imperfect, their numbers, whether of individuals or of species, are so small, and the localities where they occur so few, that they are of little service in correlation throughout the United States. The carbon-bearing shales, slates and schists, and the limestone, are indications that life was relatively abundant, even though but few fossils are preserved. Among the known fossils are vermes, crustacea and probably brachiopods and pteropods

The character of the sediments of the Proterozoic is such as to show that mature weathering affected the older rocks before their material was worked over into the Proterozoic formations. This mature weathering, resulting in the relatively complete separation of the quartz from the kaolin, and both from the calcium carbonate and other basic materials, implies conditions of rock decay comparable to those of the present time.

In all but a few places where their relations are known, the Proterozoic rocks are unconformable beneath the Palaeozoic Where conformity exists the separation is made on the basis of fossils, it having been agreed that the oldest rocks carrying the Olenellus fauna are to be regarded as the base of the Cambrian system.

The Palaeozoic and later formations are usually less altered, more accessible, and better known than the Proterozoic and Archeozoic, and will be taken up by systems.



Cambrian System.—The lower part of the Cambrian system, characterized by the Olenellus fauna, is restricted to the borders of the continent, where it rests on the older rocks unconformably in most places. The middle part of the system, characterized by the Paradoxides fauna, is somewhat more widespread, resting on the lower part conformably, but overlapping it, especially in the south and west. The upper part of the system, carrying the Dicellocephalus fauna, is very much more extensive; it is indeed one of the most widespread series of rocks on the continent. The lower, middle and upper parts of the system all contain marine fossils. This being the case, the distribution of the several divisions indicates that progressive submergence of the United States was in progress during the period, and that most of the country was covered by the sea before its close.

The system is composed chiefly of clastic rocks, and their composition and structure show that the water in which they were deposited was shallow. In the interior, the upper part of the system, the Potsdam sandstone, is generally arenaceous. It is well exposed in New York, Wisconsin, Missouri and elsewhere, about the outcrops of older rocks. The system is also exposed in many of the western mountains or about their borders, especially about those the cores of which are of Archean or Proterozoic rock.

The thickness of the system has been estimated at 10,000 to 12,000 ft. in eastern New York, and almost as much in the southern Appalachian Mountains (Georgia and Alabama); but its average thickness is much less. In Wisconsin, where the Upper Cambrian only is present, the thickness is about 1000 ft. The greater thickness in the east appears to be due in part to the fact that an extensive area of land, *Appalachia*, lay east of the site of the Appalachian Mountains throughout the Palaeozoic era, and quantities of sediment from it were accumulated where these mountains were to arise later. The greatness of the thickness, as it has been measured, is also due in part to the oblique position in which the beds of sediment were originally deposited.

The Cambrian formations have not been notably metamorphosed, except in a few regions where dynamic metamorphism has been effective. The system is without any notable amount of igneous rock. As in other parts of the world, the system here contains abundant fossils, among which trilobites, brachiopods and worms are the most abundant. The range of forms, however, is great.

Ordovician System.—The succeeding Ordovician (Lower Silurian) system of rocks is closely connected with the Cambrian, geographically, stratigraphically and faunally. Its distribution is much the same as that of the Upper Cambrian, with which it is conformable in many places. The Ordovician system contains much more limestone, and therefore much less clastic rock, than the Cambrian, pointing to clearer seas in which life abounded. The succession of beds in New York has become a sort of standard with which the system in other parts of the United States has been compared. The succession of formations in that state is as follows:—

Ordovician	Upper Ordovician (or Cincinnatian)	Richmond beds (in Ohio and Indiana). Lorraine beds. Utica shales.
	Middle Ordovician (or Mohawkian)	Trenton limestone. Black River limestone. Lowville limestone.
	Lower Ordovician (or Canadian)	Chazy limestone. Beekmantown limestone. (=Calciferous).

The classification in the right-hand column of this table is not applicable in detail to regions remote from New York.

There is in some places an unconformity between the Richmond beds (or their equivalent) and underlying formations, and this unconformity, together with certain palaeontological considerations, has raised the question whether the uppermost part of the system, as outlined above, should not be classed as Silurian (Upper Silurian). Over the interior the strata are nearly horizontal, but in the mountain regions of the east and west, as well as in the mountains of Arkansas and Oklahoma, they are tilted and folded, and locally much metamorphosed. The outcrops of the system appear for the most part in close association with the outcrops of the Cambrian system, but the system appears in a few places where the Cambrian does not, as in southern Ohio and central Tennessee. The thickness of the system varies from point to point, being greatest in the Appalachian Mountains, and much less in the interior.

The oil and gas of Ohio and eastern Indiana come from the middle portion of the Ordovician system. So also do the lead and zinc of south-western Wisconsin and the adjacent parts of Iowa and Illinois. The lead of south-eastern Missouri comes from about the same horizon.

The fossils of the Ordovician system show that life made great progress during the period, in numbers both of individuals and of species. The life, like that of the later Cambrian, was singularly cosmopolitan, being in contrast with the provincial character of the life of the earlier Cambrian and of the early (Upper) Silurian which followed. Beside the expansion of types which abounded in the Cambrian, vertebrate remains (fishes) are found in the Ordovician. So, also, are the first relics of insects. The departure of the Ordovician life from that of the Cambrian was perhaps most pronounced in the great development of the molluscs and crinoids (including cystoids), but corals were also abundant for the first time, and graptolites came into prominence.

Silurian System.—The Silurian system is much less widely distributed than the Ordovician. This and other corroborative facts imply a widespread emergence of land at the close of the Ordovician period. As a result of this emergence the stratigraphic break between the Ordovician and the Silurian is one of the greatest in the whole Palaeozoic group.

The classification of the system in New York is as follows:—

Silurian	Cayugan (Neo- or Upper Silurian)	Manlius limestone. Rondout waterlime. Cobleskill limestone. Salina beds.
	Niagaran (Meso- or Middle Silurian)	Guelph dolomite. Lockport limestone. Rochester shale. Clinton beds.
	Oswegan (Palaeo-or Lower Silurian)	Medina sandstone. Oneida conglomerate. Shawangunk grit.

The lower part of this system is chiefly clastic, and is known only in the eastern part of the continent. The middle portion contains much limestone, generally known as the Niagara limestone, and is much more widespread than the lower, being found very generally over the eastern interior, as far west as the Mississippi and in places somewhat beyond. The Niagara limestone contains the oldest known coral reefs of the continent. They occur in eastern Wisconsin and at other points farther east and south. It is over this limestone that the Niagara falls in the world-famous cataract. One member of the middle division of the system (Clinton beds) contains much iron ore, especially in the Appalachian Mountain region. The ore is extensively worked at some points, as at Birmingham, Alabama. The upper part of the system is more restricted than the middle, and includes the salt-bearing series of New York, Ohio and Pennsylvania, with its peculiar fauna. It is difficult to see how salt could have originated in this region except under conditions very different climatically from those of the present time.

In the interior the thickness of the system is less than 1000 ft. in many places, but in and near the Appalachian Mountains its thickness is much greater—more than five times as great if the maximum thicknesses of all formations be made the basis of calculation. In the Great Plains and farther west the Silurian has little known representation. Either this part of the continent was largely land at this time, or the Silurian formations here have been worn away or remain undifferentiated. Rocks of Silurian age, however, are known at some points in Arizona, Nevada and southern California.

Corals, echinoderms, brachiopods and all groups of molluscs abounded. Graptolites had declined notably as compared with the Ordovician, and the trilobites passed their climax before the end of the period. Certain other remarkable crustacea, however, had made their appearance, especially in connexion with the Salina series of the east.

There are numerous outliers of the Silurian north of the United States, even up to the Arctic regions. These outliers have a common fauna, which is closely related to that of the interior of the United States. They give some clue to the amount of erosion which the system has suffered, and also afford a clue to the route by which the animals whose fossils are found in the United States entered this country. Thus, the Niagara fauna of the interior of the United States has striking resemblances to the mid-Silurian faunas of Sweden and Great Britain. It seems probable, therefore, that marine animals found migratory conditions between these regions, probably by way of northern islands. The fauna of the Appalachian region is far less like that of Europe, and indicates but slight connexion with the fauna of the interior. Both the earlier and the later parts of the Silurian period seem to have been times when physical conditions were such as to favour the development of provincial faunas, while during the more widespread submergence of the middle Silurian the fauna was more cosmopolitan.

Devonian System.—The Devonian system appears in some parts of New England, throughout most of the Appalachian region, over much of the eastern interior from New York to the Missouri River, in Oklahoma, and perhaps in Texas. It is absent from the Great Plains, so far as now known, and is not generally present in the Rocky Mountains, though somewhat widespread between them and the western coast. As a whole, the system is more widespread than the Silurian, though not so widespread as the Ordovician. As in the case of the Ordovician and the Silurian, the New York section has become a standard with which the system in other parts of the country is commonly compared. This section is as follows:—

Devonian	Upper Devonian	Chautauquan-Chemung (including Catskill).	
		Senecan	Portage beds. Genesee shale. Tully limestone.
	Middle Devonian	Erian	Hamilton shale. Marcellus shale.
		Ulsterian	Onondaga (Corniferous limestone) Schoharie grit. Esopus grit.
	Lower Devonian	Oriskanian	Oriskany beds.
		Helderbergian	Kingston beds. Becraft limestone. New Scotland beds. Coeymans limestone.

The formations most widely recognized are the Helderberg limestone, the Onondaga limestone and the Hamilton shale.

The Catskill sandstone, found chiefly in the Catskill Mountain region of New York, is one of the distinctive formations of the system. It has some similarity to the Old Red Sandstone of Great Britain. In part, at least, it is equivalent in time of origin to the Chemung formation; but the latter is of marine origin, while the Catskill formation appears to be of terrestrial origin.

No other system of the United States brings out more clearly the value of palaeontology to palaeogeography. The faunas of the early Devonian seem to have entered what is now the interior of the United States from the mid-Atlantic coast. The Onondaga fauna which succeeded appears to have resulted from the commingling of the resident lower Devonian fauna with new emigrants from Europe by way of the Arctic regions. The Hamilton fauna which followed represents the admixture of the resident Onondaga fauna with new types which are thought to have come from South America, showing that faunal connexions for marine life had been made between the interior of the United States and the lands south of the Caribbean Sea, a connexion of which, before this time, there was no evidence. The late Devonian fauna of the interior represents the commingling of the Hamilton fauna of the eastern interior with new emigrants from the north-west, a union which was not effected until toward the close of the period.

Like the earlier Palaeozoic systems, the Devonian attains its greatest known thickness in the Appalachian Mountains, where sediments from the lands of pre-Cambrian rock to the east accumulated in quantity. Here clastic rocks predominate, while limestone is more abundant in the interior. If the maximum thicknesses of all Devonian formations be added together, the total for the system is as much as 15,000 ft.; but such a thickness is not found in any one place.

The Devonian system yields much oil and gas in western Pennsylvania, south-western New York, West Virginia and Ontario; and some of the Devonian beds in Tennessee yield phosphates of commercial value. The Hamilton formation yields much flagstone.

Among the more important features of the marine life of the period were (1) the great development of the molluscs, especially of cephalopods; (2) the abundance of large brachiopods; (3) the aberrant tendencies of the trilobites; (4) the profusion of corals; and (5) the abundance, size and peculiar forms of the fishes. The life of the land waters was also noteworthy, especially for the great deployment of what may be called the crustacean-ostracodermo-vertebrate group. The crustacea were represented by eurypterids, the ostracoderms by numerous strange, vertebrate-like forms (*Cephalaspis, Cyathaspis, Trematopsis, Bothriolepis,* &c.), and the vertebrates by a great variety of fishes. The land life of the period is represented more fully among the fossils than that of any preceding period. Gymnosperms were the highest types of plants.

The Devonian system is not set off from the Mississippian by any marked break. On the other hand, the one system merges into the other, so that the plane of separation is often indistinct.

Mississippian System.—The Mississippian system was formerly regarded as a part of the Carboniferous, and was described under the name of Lower Carboniferous, or Subcarboniferous, without the rank of a system. This older classification, which has little support except that which is traditional, is still adhered to by many geologists; but the fact seems to be that the system is set off from the Pennsylvanian (Upper Carboniferous) more sharply than the Cambrian is from the Ordovician, the Silurian from the Devonian, or the Devonian from the Mississippian.

The system is well developed in the Mississippi Basin, whence its name. Its formations are much more widespread than those of any other system since the Ordovician. They appear at the surface in great areas in the interior, in the south-west and about many of the western mountains. In many places in the west they rest on what appear to be Ordovician beds, but without unconformity. The explanation of the apparent conformity of the strata from the Cambrian to the Pennsylvanian in some parts of the west, with no fossils defining with certainty any horizon between the Ordovician and the Mississippian, is one of the open problems in the geology of the United States.

The subdivision of the system for various regions in the eastern part of the United States is as follows:—

Mississippi River States.	Ohio.	Pennsylvania.	Maryland.
4. Kaskaskia or Chester	7. Maxville		
3. St Louis	6. Logan		3. Mauch Chunk
2. Osage or Augusta (including the Burlington, Keokuk and Warsaw)	5. Black Hand	2. Mauch Chunk	
	4. Cuyahoga		2. Greenbrier
	3. Sunbury		
	2. Berea grit		
1. Kinderhook or Chouteau	1. Bedford	1. Pocono	1. Pocono

In the interior the Kinderhook series has a distribution similar to that of the Devonian; the Osage series is more widespread, pointing to progressive submergence; and the St Louis is still more extensive. This epoch, indeed, is the epoch of maximum submergence during the period, and the maximum since the Ordovician. Before its close the sea of the Great Basin which had persisted since the Devonian was connected with the shallow sea which covered much of the interior of the United States. The fourth series, the Kaskaskia or Chester, is more restricted, and points to the coming emergence of a large part of the United States. In the Mississippi Basin the larger part of the system is of limestone, though there is some clastic material in both its basal and its upper parts. In Ohio the system contains much clastic rock, and in Pennsylvania little else. The Mauch Chunk series (shale and sandstone) is now believed to be largely of terrestrial origin.

The system ranges in thickness from nearly 5000 ft. maximum in Pennsylvania to 1500 ft. in the vicinity of the Mississippi river. In West Virginia some 2000 ft. of limestone are assigned to this system. The zinc and lead of the Joplin district of Missouri are in the limestone of this system, and the corresponding limestone in some parts of Colorado, as at Leadville, is one of the horizons of rich ore.

The end of the period was marked by the widespread emergence of the continent, and parts of it were never again submerged, so far as is known. Certainly there is no younger marine formation of comparable extent in the continent. When deposition was renewed in the interior of the continent, the formations laid down were largely non-marine, and, over great areas, they rest upon the Mississippian unconformably.

From the conditions outlined it is readily inferred that the faunas of the system were cosmopolitan. All types of life to which shallow, clear sea-water was congenial appear to have abounded in the interior. It was perhaps at this time that the crinoids, as a class, reached their climax, and most forms of lime-carbonate-secreting life seem to have thriven. Where the seas were less clear, as in Ohio, the conditions are reflected in the character of the fossils. Marine fishes had made great progress before the close of the period. Amphibia appeared before its close, and plant life was abundant and varied, though the types were not greatly in advance of those of the Devonian. The time of such widespread submergence was hardly the time for the great development of land vegetation.

Pennsylvanian System.—The Pennsylvanian or Upper Carboniferous system overlies the Mississippian unconformably over a large part of the United States. In the eastern half of the country the system consists of shales and sandstones chiefly, but there is some limestone, and coal enough to be of great importance economically, though it makes but a small part of the system quantitatively. The larger part of the system in this part of the country is not of marine origin; yet the sea had access to parts of the interior more than once, as shown by the marine fossils in some of the beds. The dominantly terrestrial formations of the eastern half of the country are in contrast with the marine formations of the west. The line separating the two phases of the system is a little east of the 100th meridian. West of the Mississippi the Coal Measures are subdivided into two series, the Des Moines below and the Missouri above. In the eastern part of the country (Pennsylvania, Ohio, &c.) the system is divided into four principal parts:—

Pennsylvanian.
4. Monongahela formation (or series)—Upper Productive Coal Measures.
3 Conemaugh formation (or series)—Lower Barren Coal Measures.
2. Allegheny formation (or series)—Lower Productive Coal Measures.
1. Pottsville formation (or series).

The Pottsville formation is chiefly clastic, and corresponds roughly to the Millstone Grit of England. The Allegheny and Monongahela series contain most of the coal, though it is not wanting in the other subdivisions of the system. Productive coal beds are found in five principal fields. These are (1) the Anthracite field in eastern Pennsylvania, nearly 500 sq. m. in extent; (2) the Appalachian field, having an area of about 71,000 sq. m. (75 % being productive), and extending from Pennsylvania to Alabama; (3) the northern interior field, covering an area of about 11,000 sq. m. in southern Michigan; (4) the eastern interior field in Indiana, Illinois and Kentucky, with an area of about 58,000 sq. m. (55 % being productive); and (5) the western interior and south-western field, some 94,000 sq. m. in extent, reaching from Iowa on the north to Texas on the south. There is also a coalfield in Nova Scotia and New Brunswick, about 18,000 sq. m. in extent. Some of the well-known beds of coal are known to be continuous for several thousands of square miles.

Unlike the older systems of the Palaeozoic, the Pennsylvanian system has not its maximum thickness in the Appalachian Mountains, but in Arkansas, in a region which was probably adjacent to high lands at that time. These lands perhaps lay in the present position of the Ouachita Mountains.

The close of the Pennsylvanian period was marked by the beginning of profound changes, changes in geography and climate, and therefore changes in the amount and habitat of life, and in the sites of erosion and sedimentation. One of the great changes of this time was the beginning of the development of the Appalachian Mountain system. The site of these mountains had been, for the most part, an area of deposition throughout the Palaeozoic era, and the body of sediments which had gathered here at the western base of Appalachia, by the close of the Pennsylvanian period, was very great. At this time these sediments, together with some of Appalachia itself, began to be folded up into the Appalachian Mountains. These mountains have since been worn down, so that, in spite of their subsequent periods of growth, their height is not great.

The chief interest of the palaeontology of this system is in the plants, which were very like those of the Coal Measures of other parts of the earth and showed a high development of forms that are now degenerate. Among land animals the amphibia had great development at this time. So also had insects and some other forms of land life.

Permian Period.—The Permian system appears in smaller areas in the United States than any other Palaeozoic system. The "Upper Barren Coal Measures" of some parts of the east (Ohio, Pennsylvania, &c.) are now classed as Permian on the basis of their fossil plants. They represent but a part of the Permian period, and are commonly described under the name of the Dunkard series.

The system has much more considerable development west of the Mississippi than east of it, especially in Texas, Kansas, Nebraska and beyond. Some of the Permian beds of this region are marine, while others are of terrestrial origin. In this part of the country the Permian beds are largely red sandstone, often saliferous and gypsiferous. They are distinguished with difficulty from the succeeding Triassic, for the beds have very few fossils. The system has its maximum known thickness in Texas, where it is said to be 7000 ft. in maximum thickness. West of the Rocky Mountains the Permian has not been very generally separated from overlying and underlying formations, though it has been differentiated in a few places, as in south-western Colorado and in some parts of Arizona. Perhaps the most remarkable feature of the palaeontology of the system is its paucity of fossils, especially in those parts of the system, such as the Red Beds, which are of terrestrial origin.

In the United States no direct evidence has been found of the low temperature which brought about glaciation in many other parts of the earth during this period. Salt and gypsum deposits, and other features of the Permian beds, together with the fewness of fossils, indicate that the climate of the Permian was notably arid in many regions.

Triassic System.—This system has but limited representation in the eastern part of the United States, being known only east of the Appalachian Mountains in an area which was land throughout most of the Palaeozoic era, but which was deformed when the eastern mountains were developed at the close of the Palaeozoic. In the troughs formed in its surface during this time of deformation, sediments of great thickness accumulated during the Triassic period. These sediments are now mostly in the form of red sandstone and shale, with conglomerate, black shale and coal in some places. These rocks do not represent the whole of the period. They are often known as the Newark series, and seem to be chiefly, if not wholly, of terrestrial origin. The sedimentary rocks are affected by many dikes and sheets of igneous rock, some of the latter being extrusive and some intrusive. The strata are now tilted and much faulted, though but little folded. In the western plains and in the western mountains the Triassic is not clearly separated from the Permian in most places. So far as the system is differentiated, it is a part of the Red Beds of that region. The tendency of recent years has been to refer more and more of these beds to the Permian. The

Triassic system is well developed on the Pacific coast, where its strata are of marine origin, and they extend inland to the Great Basin region.

The climate of the period, at least in its earlier part, seems to have been arid like that of the Permian, as indicated both by the paucity of fossils and by the character of the sediments. The salt and gypsum constitute a positive argument for aridity. The character of some of the conglomerate of the Newark series of the east, and the widespread redness of the beds, so far as it is original, also point to aridity.

As in other parts of the earth, the Triassic was the age of gymnosperms, which were represented by diverse types. Reptiles were the dominant form of animals, and land reptiles (dinosaurs) gained over their aquatic allies.

Jurassic System.—This system is not known with certainty in the eastern half of the United States, though there are some beds on the mid-Atlantic coast, along the inland border of the coastal plain, which have been thought by some, on the basis of their reptilian fossils, to be Jurassic. The lower and middle parts of the system are but doubtfully represented in the western interior. If present, they form a part of the Red Beds of that region. On the Pacific coast marine Jurassic beds reach in from the Pacific to about the same distance as the Triassic system. The Upper Jurassic formations are much more widely distributed. During the later part of the period the sea found entrance at some point north of the United States to a great area in the western part of the continent, developing a bay which extended far down into the United States from Canada. In this great bay formations of marine origin were laid down. At the same time marine sedimentation was continued on the Pacific coast, but the faunas of the west coast and the interior bay are notably unlike, the latter being more like that of the coast north of the United States. This is the reason for the belief that the bay which extended into the United States had its connexion with the sea north of the United States.

The Jurassic faunas of the United States were akin to those of other continents. The great development of reptiles and cephalopods was among the notable features. At the close of the period there were considerable deformations in the west. The first notable folding of the Sierras that has been definitely determined dates from this time, and many other mountains of the west were begun or rejuvenated. The close of the period, too, saw the exclusion of the sea from the Pacific coast east of the Sierras, and the disappearance, so far as the United States is concerned, of the great north-western bay of the late Jurassic. Before the close of the period, the aridity which had obtained during the Permian, and at least a part of the Triassic, seems to have disappeared.

Comanchean System.—This system was formerly classed as the lower part of the Cretaceous, but there are strong reasons for regarding it as a separate system. Its distribution is very different from that of the Upper Cretaceous, and there is a great and widespread unconformity between them. The faunas, too, are very unlike. The Comanchean formations are found (1) on the inland border of the coastal plain of the Atlantic (Potomac series) and Gulf coasts (Tuscaloosa series at the east and Comanchean at the west); (2) along the western margin of the Great Plains and in the adjacent mountains; and (3) along the Pacific coast west of the Sierras. In the first two of these positions, the formations show by their fossils that they are of terrestrial origin in some places, and partly of terrestrial and partly of marine origin in others. In the coastal plain the Comanchean beds are generally not cemented, but consist of gravel, sand and clay, occupying the nearly horizontal position in which they were originally deposited. Much plastic clay and sand are derived from them. In Texas, whence the name "Comanchean" comes, and where different parts of the system are of diverse origins, there is some limestone. This sort of rock increases in importance southward and has great development in Mexico. In the western interior there is difference of opinion as to whether certain beds rich in reptilian remains (the Morrison, Atlantosaurus, Como, &c.) should be regarded as Jurassic or Comanchean. On the western coast the term Shastan is sometimes applied to Lower Cretaceous. In the United States, marine Shastan beds are restricted to the area west of the Sierras, but they here have great thickness.

Widespread changes at the end of the period exposed the areas where deposition has been in progress during the period to erosion, and the (Upper) Cretaceous formations rest upon the Comanchean unconformably in most parts of the country. The Comanchean system contains the oldest known remains of netted-veined leaved plants, which mark a great advance in the vegetable world. Reptiles were numerous and of great size. They were the largest type of life, both on land and in the sea.

Cretaceous System.—This system is much more extensively developed in the United States than any other Mesozoic system. It is found (1) on the Atlantic coastal plain, where it laps up on the Comanchean, or over it to older formations beyond its inland margin; (2) on the coastal plain of the Gulf region in similar relations; (3) over the western plains; (4) in the western mountains; and (5) along the Pacific coast. Unlike the Comanchean, the larger part of the Cretaceous system is of marine origin. The distribution of the beds of marine origin shows that the sea crept up on the eastern and southern borders of the continent during the period, covered the western plains, and formed a great mediterranean sea between the eastern and western lands of the continent, connecting the Gulf of Mexico on the south and the Arctic Ocean on the north. This widespread submergence, followed by the deposition of marine sediments on the eroded surface of Comanchean and older rocks, is the physical reason for the separation of the system from the Comanchean. This reason is reinforced by palaeontological considerations.

Both on the Atlantic and over the western plains the system is divided into four principal subdivisions:—

Atlantic Coast.	*Western Plains.*
4. Manasquan formation.	4. Laramie.
3. Rancocas formation.	3. Montana: Fox Hills; Fort Pierre.
2. Monmouth formation.	2. Colorado: Niobrara; Benton.
1. Matawan formation.	1. Dakota.

The most distinctive feature of the Cretaceous of the Atlantic coastal plain is its large content of greensand marl (glauconite). The formations are mostly incoherent, and have nearly their original position. In the eastern Gulf states there is more calcareous material, represented by limestone or chalk. In the Texan region and farther north the limestone becomes still more important. In the western plains, the first and last principal subdivisions of the system (Dakota and Laramie) are almost wholly non-marine. The Dakota formation is largely sandstone, which gives rise to "hog-backs" where it has been tilted, indurated and exposed to erosion along the eastern base of the Rocky Mountains. The Colorado series contains much limestone, some of which is in the form of chalk. This is *par excellence* the chalk formation of the United States. That the chalk was deposited in shallow, clear seas is indicated both by the character of the fossils other than foraminifera and by the relation of the chalk to the clastic portions of the series. The Montana series, most of which is marine, was deposited in water deeper than that of the Colorado epoch, though the series is less widespread than the preceding. The Laramie is the great coal-bearing series of the west, and corresponds in its general physical make-up and in its mode of origin to the Coal Measures of the east. The coal-bearing lands of the Laramie have been estimated at not less than 100,000 sq. m. On the Pacific coast the Cretaceous formations are sometimes grouped together under the name of Chico. The distribution of the Chico formations is similar to that of the Comanchean system in this region.

The Cretaceous system is thick. If maximum thicknesses of its several parts in different localities, as usually measured, are added together, the total would approach or reach 25,000 ft.; but the strata of any one region have scarcely more than half this thickness, and the average is much less.

The close of the period was marked by very profound changes which may be classed under three general headings: (1) the emergence of great areas which had been submerged until the closing stages of the period; (2) the beginning of the development of most of the great mountains of the west; (3) the inauguration of a protracted period of igneous activity, stimulated, no doubt, by the crustal and deeper-seated movements of the time. These great changes in the relation of land and water, and in topography, led to correspondingly great changes in life, and the combination marks the transition from the Mesozoic to the Cainozoic era.

Tertiary Systems.—The formations of the several Tertiary periods have many points of similarity, but in some respects they are sharply differentiated one from another. They consist, in most parts of the country, of unconsolidated sediments, consisting of gravel, sand, clay, &c., together with large quantities of tuff, volcanic agglomerate, &c. Some of the sedimentary formations are of marine, some of brackish water, and some of terrestrial origin. In the western part of the country there are, in addition, very extensive flows of lava covering in the aggregate some 200,000 sq. m. Terrestrial sedimentation was, indeed, a great feature of the Tertiary. This was the result of several conditions, among them the recent development, through warping and faulting and volcanic extrusion, of high lands with more or less considerable slopes. From these high lands sediments were borne down to lodge on the low lands adjacent. The sites of deposition varied as the period progressed, for the warping and faulting of the surface, the igneous extrusions, and the deposition of sediments obliterated old basins and brought new ones into existence. The marine Tertiary formations are confined to the borders of the continent, appearing along the Atlantic, Gulf and Pacific coasts. The brackish water formations occur in some parts of the same general areas, while the terrestrial formations are found in and about the western mountains. As in other parts of the world, the chiefest palaeontological interest of the Tertiary attaches to the mammalian fossils.

Eocene System.

The Eocene beds are unconformable, generally, upon the Cretaceous, and unconformable beneath the Miocene. On the Atlantic coast they are nearly horizontal, but dip gently seaward. On this coast they are nowhere more than a few hundred feet thick. In the Gulf region the system is more fully represented, and attains a greater thickness—1700 ft. at least. In the Gulf region the Eocene system contains not a little non-marine material. Thus the lower Eocene has some lignite in the eastern Gulf region, while in Texas lignite and saliferous and gypsiferous sediments are found, though most of the system is marine and of shallow water origin. The Eocene of the western Gulf region is continued north as far as Arkansas. The classification of the Eocene (and Oligocene) formations in the Gulf region, especially east of the Mississippi, is as follows:—

4. Jacksonian	Upper Eocene.
3. Claibornian	Middle Eocene.
2. Chickasawan	Lower Eocene.
1. Midwayan	

The Jacksonian is sometimes regarded as Oligocene. This classification is based almost wholly on the fossils, for there seems to be little physical reason for the differentiation of the Oligocene anywhere on the continent.

On the Pacific coast the marine Eocene lies west of the Sierras, and between it and the Cretaceous there is a general, and often a great, unconformity. The system has been reported to have a thickness of more than 7000 ft. in some places, and locally (*e.g.* the Pescadero formation) it is highly metamorphic. The Eocene of southern California carries gypsum enough to be of commercial value. It is also the source of much oil. The system is wanting in northern California and southern Oregon, but appears again farther north, and has great development in Oregon, where its thickness has been estimated at more than 10,000 ft. As in other comparable cases, this figure does not make allowance for the oblique attitude in which the sediments were deposited, and should not be construed to mean the vertical thickness of the system.

In Washington the Eocene is represented by the Puget series of brackish water beds, with an estimated thickness exceeding that of the marine formations of Oregon. Workable coal beds are distributed through 3000 ft. of this series. The amount of the coal is very great, though the coal is soft.

Terrestrial Eocene formations—eolian, fluvial, pluvial and lacustrine—are widespread in the western part of the United States, both in and about the mountains. By means of the fossils, several more or less distinct stages of deposition have been recognized. Named in chronological order, these are:—

1. The *Fort Union stage*, when the deposition was widespread about the eastern base of the northern part of the Rocky Mountains, and at some points in Colorado (Telluride formation) and New Mexico (Puerco beds), where volcanic ejecta entered largely into the formation. The Fort Union stage is closely associated with the Laramie, and their separation has not been fully effected.
2. The *Wasatch stage*, when deposition was in progress over much of Utah and western Colorado, parts of Wyoming, and elsewhere.
3. The *Bridger stage*, when deposition was in progress in the Wind River basin, north of the mountain of that name, and in the basin of Green river.
4. The *Uinta stage*, when the region south of the mountains of that name, in Utah and Colorado, was the site of great deposition.

More or less isolated deposits of some or all of these stages are found at numerous points in the western mountain region. The present height of the deposits, in some places as much as 10,000 ft., gives some suggestion of the changes in topography which have taken place since the early Tertiary. The thickness of the system in the west is great, the formations of each of the several stages mentioned above running into thousands of feet, as thicknesses are commonly measured.

Miocene System.

The Miocene system, generally speaking, has a distribution similar to that of the Eocene. The principal formation of the Atlantic coastal plain is the Chesapeake formation, largely of sand. In Florida the system contains calcium phosphate of commercial value. The Miocene of the Atlantic and Gulf regions nowhere attains great thickness. The oil of Texas and Louisiana is from the Miocene (or possibly Oligocene) dolomite. On the Pacific coast the system has greater development. It contains much volcanic material, and great bodies of siliceous shale; locally estimated at 4000 ft. thick and said to be made up largely of the secretions of organisms. Such thicknesses of such material go far to modify the former opinion that the Tertiary periods were short. The Miocene of California is oil-producing. The terrestrial Miocene formations of the western part of the country are similar in kind, and, in a general way, in distribution, to the Eocene of the same region. The amount of volcanic material, consisting of both pyroclastic material and lava flows, is great.

At the close of the Miocene, deformative movements were very widespread in the Rocky Mountains and between the principal development of the Coast ranges of California and Oregon, and mountain-making movements, new or renewed, were somewhat general in the west. At the close of the period the topography of the western part of the country must have been comparable to that of the present time. This, however, is not to be interpreted to mean that it has remained unmodified, or but slightly modified since that time. Subsequent erosion has changed the details of topography on an extensive scale, and subsequent deformative movements have renewed large topographic features where erosion had destroyed those developed by the close of the Miocene. But in spite of these great changes since the Miocene, the great outlines of the topography of the present were probably marked out by the close of that period. Volcanic activity and faulting on a large scale attended the deformation of the closing stages of the Miocene.

Pliocene System.

The Pliocene system stands in much the same stratigraphic relation to the Miocene as the Miocene does to the Eocene. The marine Pliocene has but trifling development on the Atlantic coast north of Florida, and somewhat more extensive development in the Gulf region. The marine Pliocene of the continent has its greatest development in California (the Merced series, peninsula of San Francisco), where it is assigned a maximum thickness of nearly 6000 ft., and possibly as much as 13,000 ft. This wide range is open to doubt as to the correlation of some of the beds involved. Thicknesses of several thousand feet are recorded at other points in California and elsewhere along the coast farther north. Marine Pliocene beds are reported to have an altitude of as much as 5000 ft. in Alaska. The position of these beds is significant of the amount of change which has taken place in the west since the Pliocene period. The non-marine formations of the Pliocene are its most characteristic feature. They are widely distributed in the western mountains and on the Great Plains. In origin and character, and to some extent in distribution, they are comparable with the Eocene and Miocene formations of the same region, and still more closely comparable with deposits now making. In addition to these non-marine formations of the west, there is the widespread Lafayette formation, which covers much of the Atlantic and Gulf coastal plain, reaching far to the north from the western Gulf region, and having uncertain limits, so far as now worked out, in various directions. The Lafayette formation has been the occasion of much difference of opinion, but is by many held to be a non-marine formation, made up of gravels, sands and clays, accumulated on land, chiefly through the agency of rain and rivers. Its deposition seems to have followed a time of deformation which resulted in an increase of altitude in the Appalachian Mountains, and in an accentuation of the contrast between the highlands and the adjacent plains. Under these conditions sediments from the high lands were washed out and distributed widely over the plains, giving rise to a thin but widespread formation of ill-assorted sediment, without marine fossils, and, for the most part, without fossils of any kind, and resting unconformably on Cretaceous, Eocene and Miocene formations. To the seaward the non-marine phase of the formation doubtless grades into a marine phase along the shore of that time, but the position of this shore has not been defined. The marine part of the Lafayette is probably covered by sediments of later age.

In earlier literature the Lafayette formation was described under the name of Orange Sand, and was at one time thought to be the southern equivalent of the glacial drift. This, however, is now known not to be the case, as remnants of the formation, isolated by erosion, lie under the old glacial drift in Illinois, and perhaps elsewhere. It seems probable that the Lafayette formation of the Gulf coastal plain is continuous northward and westward with gravel deposits on the Great Plains, washed out from the Rocky Mountains to the west. The careful study of these fluvial formations is likely to throw much light on the history of the deformative movements and changes in topography in the United States during the late stages of geological history.

Deformative movements of the minor sort seem to have been in progress somewhat generally during the Tertiary periods, especially in the western part of the country, but those at the close of the Pliocene seem to have exceeded greatly those of the earlier stages. They resulted in increased height of land, especially in the west, and therefore in increased erosion. This epoch of relative uplift and active erosion is sometimes called the Sierran or Ozarkian epoch. The details of the topography of the western mountains are largely of post-Pliocene development. The summits of some of the high mountains, such as the Cascades, appear to be remnants of a peneplain developed in post-Miocene time. If so, the mountains themselves must be looked upon as essentially post-Pliocene. Deformative movements resulting in close folding were not common at this time, but such movements affected some of the coast ranges of California. This epoch of great deformation and warping marks the transition from the Tertiary to the Quaternary.

Glacial.

Quaternary Formations.—The best-known formations of the Quaternary period are those deposited by the continental glaciers which were the distinguishing feature of the period and by the waters derived from them. The glacial drift covers something like half of the continent, though much less than half of the United States. Besides the drift of the ice-sheets, there is much drift in the western mountains, deposited by local glaciers. Such glaciers existed in all the high mountains of the west, even down to New Mexico and Arizona.

The number of glacial epochs now recognized is five, not counting minor episodes. Four defined zones of interglacial deposits are detected, all of which are thought to represent great recessions of the ice, or perhaps its entire disappearance. The climate of some of the interglacial epochs was at least as warm as that of the present time in the same regions. The glacial epochs which have been differentiated are the following, numbered in chronological order: (5) Wisconsin, (4) Iowan, (3) Illinoian, (2) Kansan, (1) Sub-Aftonian, or Jerseyan. Of these, the Kansan ice-sheet was the most extensive, and the later ones constitute a diminishing series.

Essentially all phases of glacial and aqueo-glacial drift are represented. The principal terminal moraines are associated with the ice of the Wisconsin epoch. Terminal moraines at the border of the Illinoian drift are generally feeble, though widely recognizable, and such moraines at the margin of the Iowan and Kansan drift sheets are generally wanting. The edge of the oldest drift sheet is buried by younger sheets of drift in most places.

Loess is widespread in the Mississippi River basin, especially along the larger streams which flowed from the ice. Most of the loess is now generally believed to have been deposited by the wind. The larger part of it seems to date from the closing stages of the Iowan epoch, but loess appears to have come into existence after other glacial epochs as well. Most of the fossils of the loess are shells of terrestrial gastropods, but bones of land mammals are also found in not a few places. Some of the loess is thought to have been derived by the wind from the surface of the drift soon after the retreat of the ice, before vegetation got a foothold upon the new-made deposit; but a large part of the loess, especially that associated with the main valleys, appears to have been blown up on to the bluffs of the valleys from the flood plains below. As might be expected under these conditions, it ranges from fine sand to silt which approaches clay in texture. Its coarser phases are closely associated with dunes in many places, and locally the loess makes a considerable part of the dune material.

Much interest attaches to estimates of time based on data afforded by the consequences of glaciation. These estimates are far apart, and must be regarded as very uncertain, so far as actual numbers are concerned. The most definite are connected with estimates of the time since the last glacial epoch, and are calculated from the amount and rate of recession of certain falls, notably those of the Niagara and Mississippi (St Anthony Falls) rivers. The estimate of the time between the first and last glacial epochs is based on changes which the earlier drift has undergone as compared with those which the younger drift has undergone. Some of the estimates make the lapse of time since the first glacial epoch more than a million years, while others make it no more than one-third as long. The time since the last glacial epoch is but a fraction of the time since the first—probably no more than a fifteenth or a twentieth.

Non-glacial.

Outside the region affected by glaciation, deposits by wind, rain, rivers, &c., have been building up the land, and sedimentation has been in progress in lakes and about coasts. The non-glacial deposits are much like the Tertiary in kind and distribution, except that marine beds have little representation on the land. On the coastal plain there is the Columbia series of gravels, sands and loams, made up of several members. Its distribution is similar to that of the Lafayette, though the Columbia series is, for the most part, confined to lower levels. Some of its several members are definitely correlated in time with some of the glacial epochs. The series is widespread over the lower part of the coastal plain. In the west the Quaternary deposits are not, in all cases, sharply separated from the late Tertiary, but the deposits of glacial drift, referable to two or more glacial epochs, are readily differentiated from the Tertiary; so, also, are certain lacustrine deposits, such as those of the extinct lakes Bonneville and Lahontan. On the Pacific coast marine Quaternary formations occur up to elevations of a few scores of feet, at least, above the sea.

Igneous rocks, whether lava flows or pyroclastic ejections, are less important in the Quaternary than in the Tertiary, though volcanic activity is known to have continued into the Quaternary. The Quaternary beds of lakes Bonneville and Lahontan have been faulted in a small way since they were deposited, and the old shore lines of these lakes have been deformed to the extent of hundreds of feet. So also have the shorelines of the Great Lakes, which came into existence at the close of the glacial period.

Much has been written and more said concerning the existence of man in the United States before the last glacial epoch. The present state of evidence, however, seems to afford no warrant for the conclusion that man existed in the United States before the end of the glacial period. Whatever theoretical reasons there may be for assuming his earlier existence, they must be held as warranting no more than a presumptive conclusion, which up to the present time lacks confirmation by certain evidence.

The following sections from selected parts of the country give some idea of the succession of beds in various type regions. The thicknesses, especially where the formations are metamorphosed, are uncertain.

WEST CENTRAL MASSACHUSETTS

Triassic.	
Chicopee shale	200 ft. (?)
Granby tuff	580 ,,
Blackrock diabase (cones and dikes).	
Longmeadow sandstone	1000 ,,
Sugarloaf arkose	4660 ,,
Mount Toby conglomerate.	
Unconformity.	
Devonian.	
Bernardston series	1950 ft.
Unconformity.	
Silurian.	
Leyden argillite	300 ft.
Conway schist	5000 ,, (?)
Amherst schist	
Brinfield fibrolite-schist	
Goshen schist	2000 ,, (?)
Unconformity.	
Ordovician.	
Hawley schist	2000 ft. (?)
Savoy schist	5000 ,, (?)
Chester amphibolite	3000 ,, (?)
Rowe schist	4000 ,, (?)
Hoosic schist	1500 ,, (?)
Unconformity.	
Cambrian.	
Becket gneiss	2000 ft. (?)
Unconformity.	
Proterozoic.	
Washington gneiss	2000 ft. (?)
(Base not exposed.)	

The above section is fairly representative for considerable parts of New England.

WEST VIRGINIA, &C.

Pennsylvanian.	
(Top of system removed by erosion.)	
Braxton formation	700 ft.
Upshur sandstone	300– 500 ,,
Pugh formation	300– 450 ,,
Pickens sandstone	400– 500 ,,
Unconformity.	
Mississippian.	
Canaan formation	1000–1300 ft.
Greenbrier limestone	350– 400 ,,
Pocono sandstone	70– 90 ,,
Devonian.	
Hampshire formation	1500–1800 ft.
Jennings formation	3000–3800 ,,
Romney shale	1000–1300 ,,
Unconformity.	
Monterey sandstone	50– 200 ft.
Silurian.	
Lewiston limestone	550–1050 ft.
Rockwood formation	100– 800 ,,
Cacapon sandstone	100– 630 ,,
Tuscarora quartzite	30– 300 ,,
Juniata formation	205–1250 ,,
Ordovician.	
Martinsburg shale	800–1800 ft.
Middle and Upper Cambrian.	
Shenandoah limestone	2400 ft.
(Base not exposed.)	

This section is fairly representative for the Appalachian Mountain tract, though the Cambrian is often more fully represented.

OHIO

Permian.	
Dunkard formation	c. 25 ft.
Pennsylvanian.	
Monongahela formation	200– 250 ft.
Conemaugh formation	400– 500 ,,
Alleghany formation	165– 300 ,,
Pottsville conglomerate	250 ,,
Unconformity.	
Mississippian.	
Maxville limestone	c. 25 ft.
Waverley series—	
Logan group	100– 150 ft.
Black Hand conglomerate	50– 500 ,,
Cuyahoga shale	150– 300 ,,
Sunbury shale	5– 30 ,,
Berea grit	5– 175 ,,
Bedford shale	50– 150 ,,
Devonian.	
Ohio shale	300–2600 ft.
Olentangy shale	20– 35 ,,
Delaware limestone	30– 40 ,,
Columbus limestone	110 ,,
Silurian.	
Monroe formation	50– 600 ft.
Niagara group	150– 350 ,,
Clinton limestone	10– 50 ,,
Medina shales (?)	50– 150 ,,
(Belfast bed.)	

Ordovician.	
Saluda beds	20 ± ft
Richmond formation	300 ± ,,
Lorraine formation	300 ± ,,
Eden (Utica) shale	250 ,,
Trenton limestone	130 ,,

Iowa

Glacial drift.	
Unconformity.	
Upper Cretaceous.	
Benton formation	0– 150 ft.
Dakota formation	50– 100 ,,
Unconformity.	
Pennsylvanian.	
Missouri formation	1500 ft.
Des Moines formation	250– 400 ,,
Unconformity.	
Mississippian.	
St Louis limestone	100 ft.
Osage (Augusta) formation	200– 300 ,,
Kinderhook formation	150– 200 ,,
Devonian.	
Lime Creek formation	80 ft.
State Quarry beds	20– 40 ,,
Sweetland Creek shales	20– 40 ,,
Unconformity.	
Cedar Valley limestone	250– 300 ft.
Wapsipinicon formation (Independence, Fayette, Davenport)	100– 150 ,,
Silurian.	
Anamosa limestone	50– 75 ft.
Le Claire limestone	50 ,,
Delaware stage	200 ,,
Unconformity.	
Ordovician.	
Maquoketa shales	175 ft.
Possible Unconformity.	
Galena-Trenton limestone	290 ft.
St Peters sandstone	100 ,,
Oneota formation (includes Shakopee, New Richmond and Oneota proper)	300 ,,
Cambrian.	
St Croix sandstone (= Potsdam)	1000 ft.
Unconformity.	
Proterozoic.	
Sioux quartzite	(?)

This section is fairly representative for much of the central Mississippi Basin.

Oklahoma

Pennsylvanian.	
(Summit removed by erosion.)	
Seminole conglomerate	50 ft.
Holdenville shale	260 ,,
Wewaka formation	700 ,,
Wetumka shale	120 ,,
Calvin sandstone	145– 240 ,,
Senora formation	140– 485 ,,
Stuart shale	90– 280 ,,
Thurman sandstone	80– 260 ,,
Boggy shale	2000–2600 ,,
Savannah sandstone	750–1100 ,,
McAlester shale	1150–1500 ,,
Hartshorne sandstone	150– 200 ,,
Atoka formation (Chickahoc chert lentil)	3200 ,,
Wapanucka limestone	100– 150 ,,
Mississippian.	
Caney shale	1500 ft.
Devonian.	
Woodford chert	600 ft.
Silurian.	
Hunton limestone	160 ft.
Sylvan shale (upper part)	50– 100 ,,
Ordovician.	
Sylvan shale (lower part)	250 ft.
Viola limestone	750 ,,
Simpson series	1600 ,,
Arbuckle limestone	4000–6000 ,,
Cambrian.	
Regan sandstone	50– 100 ft.
Unconformity.	
Pre-Cambrian.	
Tishomingo granite	(?)

Composite section. The upper part is taken from vicinty of Coalgate, the lower part from the vicinity of Atoka.

West Central Colorado

Eocene or later.	
West Elk breccia	3000 ft.
Unconformity.	
Cretaceous.	
Ruby formation	2500 ft.
Unconformity.	
Ohio formation (local only)	200 ft.
Unconformity.	
Laramie formation	2000 ft.
Montana formation	2800 ,,
Niobrara formation	100– 200 ,,
Benton formation	150– 300 ,,
Dakota formation	40– 300 ,,
Jurassic.	
Gunnison formation	350– 500 ft.
Unconformity.	
Pennsylvanian.	
Maroon conglomerate	4500 ft.
Possible unconformity.	
Weber limestone	100– 550 ft.
Unconformity.	
Mississippian.	
Leadville limestone	400– 525 ft.
Apparent unconformity.	
Ordovician.	
Yule limestone	350– 450 ft.
Upper Cambrian.	
Sawatch quartzite	50– 350 ft.
Unconformity.	
Archean.	

The Bighorn Mountains of Wyoming

Cretaceous.	
De Smet formation (shale and sandstone)	4000 ft.
Kingsbury conglomerate	0–1500 ,,
Piney formation (shale and sandstone)	2500 ,,
Parkman sandstone	350 ,,
Pierre shale	1500–3500 ,,
Colorado formation	1050–1700 ,,
Comanchean.	
Cloverly formation (upper part may be Cretaceous)	30– 300 ft.
Morrison formation (may be Jurassic)	100– 300 ,,
Jurassic.	
Sundance formation	250– 350 ft.
Unconformity.	
Triassic and Permian.	
Chugwater formation	750–1200 ft.
Pennsylvanian.	
Tensleep sandstone	30– 150 ft.
Amsden sandstone	150– 350 ,,
Mississippian.	
Madison limestone	1000 ft.
Unconformity.	
Ordovician.	
Bighorn limestone	300 ft.
Unconformity.	
Cambrian (Upper).	
Deadwood formation	900 ft.
Unconformity.	
Pre-Cambrian.	
Granites.	

This section is fairly representative for the Rocky Mountains.

Southern California

Quaternary.	
Alluvium, &c.	
Terrace deposits and dune sand.	
Pliocene (?)	
Paso Robles formation	1000+ft.
Unconformity.	
Miocene (?)	
Pismo formation (in south part of area)	3000 ± ft.
Santa Margarita (in north part of area)	1550 ± ,,
Unconformity.	
Miocene.	
Monterey shale	5000–7000 ft.
Vaquero sandstone	0– 500 ,,
Unconformity.	
Cretaceous.	
Atascadero formation	3000–4000 ft.
Unconformity.	
Comanchean.	
Toro formation (Knoxville)	3000 ± ft.
Unconformity.	

Jura-Trias.	
San Luis formation (Franciscan)	1000± ft.
Unconformity.	
Granite—age undetermined.	

This section is representative of the southern Pacific coast.

SECTION IN CENTRAL WASHINGTON

Pliocene (?).	
Howson andesite	250 ft.
Miocene.	
Keechelus andesite series	4000 ft.
Unconformity.	
Guye formation (sedimentary beds with some lava flows)	3500± ft.
Eocene.	
Roslyn formation (sandstone and shale; coal)	*c.* 3000 ft.
Teanaway basalt	4000 ,,
Kachess rhyolite	0–2000 ,,
Swauk formation (clastic rocks with some tuff, &c.)	200–5000 ,,
Unconformity.	
Pre-Tertiary.	
Igneous and metamorphic rocks.	

This section is representative of the north-west part of the country.

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III.—CLIMATE

The chief features of the climate of the United States may be best apprehended by relating them to the causes by which they are controlled. Two leading features, from which many others follow, are the intermediate value of the mean annual temperatures and the prevalence of westerly winds, with which drift the areas of high and low pressure—cyclonic and anticyclonic areas—controlling the short-lived, non-periodic weather changes. The first of these features is determined by the intermediate position of the United States between the equator and the north pole; the second by the equatorial-polar temperature contrast and the eastward rotation of the planet. Next, dependent on the inclination of the earth's axis, is the division of the planetary year into the terrestrial seasons, with winter and summer changes of temperature, wind-strength and precipitation; these seasonal changes are not of the restrained measure that is characteristic of the oceanic southern temperate zone, but of the exaggerated measure appropriate to the continental interruptions of the northern land-and-water zone, to which the term "temperate" is so generally inapplicable. The effects of the continent are already visible in the mean annual temperatures, in which the poleward temperature gradient is about twice as strong as it is on the neighbouring oceans; this being a natural effect of the immobility of the land surface, in contrast to the circulatory movement of the ocean currents, which thus lessen the temperature differences due to latitude: on the continent such differences are developed in full force. Closely associated with the effect of continental immobility are the effects dependent on the low specific heat and the opacity of the lands, in contrast with the high specific heat and partial transparence of the ocean waters. In virtue of these physical characteristics, the air over the land becomes much warmer in summer and much colder in winter than the air over the oceans in corresponding latitudes; hence the seasonal changes of temperature in the central United States are strong; the high temperatures appropriate to the torrid zone advance northward to middle latitudes in summer, and the low temperatures appropriate to the Arctic regions descend almost to middle latitudes in winter. As a result, the isotherms of July are strongly convex poleward as they cross the United States, the isotherm of 70° sweeping up to the northern boundary in the north-west, and the heat equator leaping to the overheated deserts of the south-west, where the July mean is over 90°. Conversely, the isotherms of January are convex southward, with a monthly mean below 32° in the northern third of the interior, and of zero on the mid-northern boundary. The seasonal bending of the isotherms is, however, unsymmetrical for several reasons. The continent being interrupted on its eastern side by the Gulf of Mexico and Hudson Bay, with the Great Lakes between these two large water bodies, the northward bending of the July isotherms is most pronounced in the western part of the United States. Indeed the contrast between the moderate temperatures of the Pacific coast and the overheated areas of the next interior deserts is so great that the isotherms trend almost parallel to the coast, and are even "overturned" somewhat in southern California, where the most rapid increase of temperatures in July is found not by moving southward over the ocean toward the equator, but north-eastward over the land to the deserts of Nevada and Arizona. So strong is the displacement of the area of highest interior temperatures westward from the middle of the continent that the Gulf of California almost rivals the Red Sea as an ocean-arm under a desert-hot atmosphere. In the same midsummer month all the eastern half of the United States is included between the isotherms of 66° and 82°; the contrast between Lake Superior and the coast of the Gulf of Mexico, 1200 m. to the south, is not so great as between the coast of southern California and the desert 150 m. inland to the north-east. In January the northern water areas of the continent are frozen and snow-covered; Hudson Bay becomes unduly cold, and the greatest southward bending of the isotherms is somewhat east of the continental axis, with an extension of its effects out upon the Atlantic; but the southward bending isotherms are somewhat looped back about the unfrozen waters of the lower Great Lakes. In the midwinter month, it is the eastern half of the country that has strong temperature contrasts; the temperature gradients are twice as strong between New Orleans and Minneapolis as on the Pacific coast, and the contrast between Jacksonville, Fla., and Eastport, Me., is about the same as between San Diego, Cal., and the Aleutian Islands.

The strong changes of temperature with the seasons are indicated also by the distribution of summer maxima and winter minima; summer temperatures above 112° are known in the south-western deserts, and temperatures of 100° are sometimes carried far northward on the Great Plains by the "hot winds" nearly to the Canadian boundary; while in winter, temperatures of −40° occur along the mid-northern boundary and freezing winds sometimes sweep down to the border of the Gulf of Mexico. The temperature anomalies are also instructive: they rival those of Asia in value, though not in area, being from 15° to 20° above the mean of their latitude in the northern interior in summer, and as much below in winter. The same is almost true of the mean annual range (mean of July to mean of January), the states of the northern prairies and plains having a mean annual range of 70° and an extreme range of 135°. In this connexion the effect of the prevailing winds is very marked. The equalizing effects of a conservative ocean are brought upon the Pacific coast, where the climate is truly temperate, the mean annual range being only 10° or 12°, thus resembling western Europe; while the exaggerating effects of the continental interior are carried eastward to the Atlantic coast, where the mean annual range is 40° or 50°.

The prevailing winds respond to the stronger poleward temperature gradients of winter by rising to a higher velocity and a more frequent and severer cyclonic storminess; and to the weaker gradients of summer by relaxing to a lower velocity with fewer and weaker cyclonic storms; but furthermore the northern zone occupied by the prevailing westerlies expands as the winds strengthen in winter, and shrinks as they weaken in summer; thus the stormy westerlies, which impinge upon the north-western coast and give it plentiful rainfall all through the year, in winter reach southern California and sweep across part of the Gulf of Mexico and Florida; it is for this reason that southern California has a rainy winter season, and that the states bordering on the Gulf of Mexico are visited in winter by occasional intensified cold winds, inappropriate to their latitude. In summer the stormy westerly winds withdraw from these lower latitudes, which are then to be more associated with the trade winds. In California the effect of the strong equatorward turn of the summer winds is to produce a dry season; but in the states along the Gulf of Mexico and especially in Florida the withdrawal of the stormy westerlies in favour of the steadier trade winds (here turned somewhat toward the continental interior, as explained below) results in an increase of precipitation. The general winds also are much affected by the changes of pressure due to the strong continental changes of temperature. The warmed air of summer produces an area of low pressure in the west-central United States, which interrupts the belt of high pressure that planetary conditions alone would form around the earth about latitude 30°; hence there is a tendency of the summer winds to blow inward from the northern Pacific over the Cordilleras toward the continental centre, and from the trades of the torrid Atlantic up the Mississippi Valley; conversely in winter time, the cold air over the lands produces a large area of high pressure from which the winds tend to flow outward; thus repelling the westerly winds of the northern Pacific and greatly intensifying the outflow southward to the Gulf of Mexico and eastward to the Atlantic. As a result of these seasonal alternations of temperature and pressure there is something of a monsoon tendency developed in the winds of the Mississippi Valley, southerly inflowing winds prevailing in summer and northerly outflowing winds in winter; but the general tendency to inflow and outflow is greatly modified by the relief of the lands, to which we next turn.

The climatic effects of relief are seen directly in the ascent of the higher mountain ranges to altitudes where low temperatures prevail, thus preserving snow patches through the summer on the high summits (over 12,000 ft.) in the south, and maintaining snowfields and moderate-sized glaciers on the ranges in the north. With this goes a general increase of precipitation with altitude, so that a good rainfall map would have its darker shades very generally along the mountain ranges. Thus the heaviest measured rainfall east of the Mississippi is on the southern Appalachians; while in the west, where observations are as yet few at high level stations, the occurrence of forests and pastures on the higher slopes of mountains which rise from desert plains clearly testifies to the same rule. The mountains also introduce controls over the local winds; diurnal warming in summer suffices to cause local ascending breezes which frequently become cloudy by the expansion of ascent, even to the point of forming local thunder showers which drift away as they grow and soon dissolve after leaving the parent mountain. Conversely, nocturnal cooling produces well-defined descending breezes which issue from the valley mouths, sometimes attaining an unpleasant strength toward midnight.

The mountains are of larger importance in obstructing and deflecting the course of the general winds. The Pacific ranges, standing transverse to the course of the prevailing westerlies near the Pacific Ocean, are of the greatest importance in this respect; it is largely by reason of the barrier that they form that the tempering effects of the Pacific winds are felt for so short a distance inland in winter, and that the heat centre is displaced in summer so far towards the western coast. The rainfall from the stromy westerly winds is largely deposited on the western slopes of the mountains near the Pacific coast, and arid or desert interior plains are thus found close to the great ocean. The descending winds on the eastern slopes of the ranges are frequently warm and dry, to the point of resembling the Föhn winds of the Alps; such winds are known in the Cordilleran region as Chinook winds. The ranges of the Rocky Mountains in their turn receive some rainfall from the passing winds, but it is only after the westerlies are reinforced by a moist indraft from the Gulf of Mexico and the Atlantic—the result of summer or of cyclonic inflow—that rainfall increases to a sufficient measure on the lower lands to support agriculture without irrigation. The region east of the Mississippi is singularly favoured in this way; for it receives a good amount of rainfall, well distributed through the year, and indeed is in this respect one of the largest regions in the temperate zones that are so well watered. The Great Plains are under correspondingly unfavourable conditions, for their scanty rainfall is of very variable amount. Along the transition belt between plains and prairies the climate is peculiarly trying as to rainfall; one series of five or ten years may have sufficient rainfall to enable the farmers to gather good crops; but the next series following may be so dry that the crops fail year after year.

The cyclonic inflows and anticyclonic outflows, so characteristic of the belt of westerly winds the world over, are very irregular in the Cordilleran region; but farther eastward they are typically developed by reason of the great extent of open country. Although of reduced strength in the summer, they still suffice to dominate weather changes; it is during the approach of a low pressure centre that hot southerly winds prevail; they sometimes reach so high a temperature as to wither and blight the grain crops; and it is almost exclusively in connexion with the cloudy areas near and south-east of these cyclonic centres that violent thunderstorms, with their occasional destructive whirling tornadoes, are formed. With the passing of the low pressure centre, the winds shift to west or northwest, the temperature falls, and all nature is relieved. In wintertime, the cyclonic and anticyclonic areas are of increased frequency and intensity; and it is partly for this reason that many meteorologists have been disposed to regard them as chiefly driven by the irregular flow of the westerly winds, rather than as due to convectional instability, which should have a maximum effect in summer. One of the best indications of actual winter weather, as apart from the arrival of winter by the calendar, is the development of cyclonic disturbances of such strength that the change from their warm, sirocco-like southerly inflow in front of their centre, to the "cold wave" of their rear produces non-periodic temperature changes strong enough to overcome the weakened diurnal temperature changes of the cold season, a relation which practically never occurs in summer time. A curious feature of the cyclonic storms is that, whether they cross the interior of the country near the northern or southern boundary or along an intermediate path, they converge towards New England as they pass on toward the Atlantic; and hence that the north-eastern part of the United States is subjected to especially numerous and strong weather changes. (W. M. D.)

IV.—FAUNA AND FLORA

Fauna.—Differences of temperature have produced in North America seven transcontinental life-zones or areas characterized by relative uniformity of both fauna and flora; they are the Arctic, Hudsonian and Canadian, which are divisions of the Boreal Region; the Transition, Upper Austral and Lower Austral, which are divisions of the Austral Region, and the Tropical. The Arctic, Hudsonian and Canadian enter the United States from the north and the Tropical from the south; but the greater part of the United States is occupied by the Transition, Upper Austral and Lower Austral, and each of these is divided into eastern and western subzones by differences in the amount of moisture. The Arctic or Arctic-Alpine zone covers in the United States only the tops of a few mountains which extend above the limit of trees, such as Mt Katahdin in Maine, Mt Washington and neighbouring peaks in the White Mountains of New Hampshire, and the loftier peaks of the Rocky, Cascade and Sierra Nevada Mountains. The larger animals are rare on these mountain-tops and the areas are too small for a distinct fauna. The Hudsonian zone covers the upper slopes of the higher mountains of New England, New York and North Carolina and larger areas on the elevated slopes of the Rocky and Cascade Mountains; and on the western mountains it is the home of the mountain goat, mountain sheep, Alpine flying-squirrel, nutcracker, evening grosbeak and Townsend's solitaire. The Canadian zone crosses from Canada into northern and north-western Maine, northern and central New Hampshire, northern Michigan, and north-eastern Minnesota and North Dakota, covers the Green Mountains, most of the Adirondacks and Catskills, the higher slopes of the mountains in Pennsylvania, West Virginia, Virginia, western North Carolina and eastern Tennessee, the lower slopes of the northern Rocky and Cascade Mountains, the upper slopes of the southern Rocky and Sierra Nevada Mountains, and a strip along the Pacific coast as far south as Cape Mendocino, interrupted, however, by the Columbia Valley. Among its characteristic mammals and birds are the lynx, marten, porcupine, northern red squirrel, Belding's and Kennicott's ground squirrels, varying and snowshoe rabbits, northern jumping mouse, white-throated sparrow, Blackburnian warbler, Audubon warbler, olive-backed thrush, three-toed woodpecker, spruce grouse, and Canada jay; within this zone in the North-eastern states are a few moose and caribou, but farther north these animals are more characteristic of the Hudsonian zone. The Transition zone, in which the extreme southern limit of several boreal species overlaps the extreme northern limit of numerous austral species, is divided into an eastern humid or Alleghanian area, a western arid area, and a Pacific coast humid area. The Alleghanian area comprises most of the lowlands of New England, New York and Pennsylvania, the north-east corner of Ohio, most of the lower peninsula of Michigan, nearly all of Wisconsin, more than half of Minnesota, eastern North Dakota, north-eastern South Dakota, and the greater part of the Appalachian Mountains from Pennsylvania to Georgia. It has few distinctive species, but within its borders the southern mole and cotton-tail rabbit of the South meet the northern star-nosed and Brewer's moles and the varying hare of the North, and the southern bobwhite, Baltimore oriole, bluebird, catbird, chewink, thrasher and wood thrush are neighbours of the bobolink, solitary vireo and the hermit and Wilson's thrushes. The Arid Transition life-zone comprises the western part of the Dakotas, north-eastern Montana, and irregular areas in Washington, Oregon, Idaho, Wyoming, California, Nevada, Utah, Colorado, Arizona, New Mexico and western Texas, covering for the most part the eastern base of the Cascade and Sierra Nevada Mountains and the higher parts of the Great Basin and the plateaus. Its most characteristic animals and birds are the white-tailed jack-rabbit, pallid vole, sage hen, sharp-tailed grouse and green-tailed towhee; the large Columbia ground-squirrel (*Spermophilus columbianus*) is common in that part of the zone which is west of the Rocky Mountains, but east of the Rockies it is replaced by another species (*Cynomys*) which closely resembles a small prairie dog. The Pacific Coast Transition life-zone comprises the region between the Cascade and Coast ranges in Washington and Oregon, parts of northern California, and most of the California coast region from Cape Mendocino to Santa Barbara. It is the home of the Columbia black-tail deer, western raccoon, Oregon spotted skunk, Douglas red squirrel, Townsend's chipmunk, tailless sewellel (*Haplodon rufus*), peculiar species of pocket gophers and voles, Pacific coast forms of the great-horned, spotted, screech and pigmy owls, sooty grouse, Oregon ruffed grouse, Steller's jay, chestnut-backed chickadee and Pacific winter wren. The Upper Austral zone is divided into an eastern humid (or Carolinian) area and a western arid (or Upper Sonoran) area. The Carolinian area extends from southern Michigan to northern Georgia and from the Atlantic coast to western Kansas, comprising Delaware, all of Maryland except the mountainous western portion, all of Ohio except the north-east corner, nearly the whole of Indiana, Illinois, Iowa and Missouri, eastern Nebraska and Kansas, south-eastern South Dakota, western central Oklahoma, northern Arkansas, middle and eastern Kentucky, middle Tennessee and the Tennessee valley in eastern Tennessee, middle Virginia and North Carolina, western West Virginia, north-eastern Alabama, northern Georgia, western South Carolina, the Connecticut Valley in Connecticut, the lower Hudson Valley and the Erie basin in New York, and narrow belts along the southern and western borders of the lower peninsula of Michigan. It is the northernmost home of the opossum, grey fox, fox squirrel, cardinal bird, Carolina wren, tufted tit, gnat catcher, summer tanager and yellow-breasted chat. The Upper Sonoran life-zone comprises south-eastern Montana, central, eastern and north-eastern Wyoming, a portion of south-western South Dakota, western Nebraska and Kansas, the western extremity of Oklahoma, north-western Texas, eastern Colorado, south-eastern New Mexico, the Snake plains in Idaho, the Columbia plains in Washington, the Malheur and Harney plains in Oregon, the Great Salt Lake and Sevier deserts in Utah, and narrow belts in California, Nevada and Arizona. Among its characteristic mammals and birds are the sage cotton-tail, black-tailed jack-rabbit, Idaho rabbit, Oregon, Utah and Townsend's ground squirrels, sage chipmunk, five-toed kangaroo rats, pocket mice, grasshopper mice, burrowing owl, Brewer's sparrow, Nevada sage sparrow, lazuli finch, sage thrasher, Nuttall's poor-will, Bullock's oriole and rough-winged swallow. The Lower Austral zone occupies the greater part of the Southern states, and is divided near the 98th meridian into an eastern humid or Austroriparian area and a western arid or Lower Sonoran area. The Austroriparian zone comprises nearly all the Gulf States as far west as the mouth of the Rio Grande, the greater part of Georgia, eastern South Carolina, North Carolina and Virginia, and extends up the lowlands of the Mississippi Valley across western Tennessee and Kentucky into southern Illinois and Indiana and across eastern and southern Arkansas and eastern Oklahoma into south-eastern Missouri and Kansas. It is the home of the southern fox-squirrel, cotton rat, ricefield rat, wood rat, free-tailed bat, mocking bird, painted bunting, prothonotary warbler, red-cockaded woodpecker, chuckwill's-widow, and the swallow-tailed and Mississippi kites. A southern portion of this zone, comprising a narrow strip along the Gulf Coast from Texas to Florida and up the Atlantic coast to South Carolina, is semi-tropical, and is the northernmost habitation of several small mammals, the alligator (*Alligator mississippiensis*), the ground dove, white-tailed kite, Florida screech owl and Chapman's night-hawk. The Lower Sonoran zone comprises the most arid parts of the United States: south-western Texas, south-western Arizona and a portion of northern Arizona, southern Nevada and a large part of southern California. Some of its characteristic mammals and birds are the long-eared desert fox, four-toed kangaroo rats, Sonoran pocket mice, big-eared and tiny white-haired bats, road runner, cactus wren, canyon wren, desert thrashers, hooded oriole, black-throated desert sparrow, Texas night-hawk and Gambel's quail. It is the northernmost home of the armadillo, ocelot, jaguar, red and grey cats, and the spiny pocket mouse, and in southern Texas especially it is visited by several species of tropical birds. There is some resemblance to the Tropical life-zone at the south-eastern extremity of Texas, but this zone in the United States is properly restricted to southern Florida and the lower valley of the Colorado along the border of California and Arizona, and the knowledge of the latter is very imperfect. The area in Florida is too small for characteristic tropical mammals, but it has the true crocodile (*Crocodilus americanus*) and is the home of a few tropical birds. Most of the larger American mammals are not restricted to any one faunal zone. The bison, although now nearly extinct, formerly roamed over nearly the entire region between the Appalachian and the Rocky Mountains. The black bear and beaver were also widely distributed. The Virginia deer still ranges from Maine to the Gulf states and from the Atlantic coast to the Rocky Mountains. The grizzly bear, cougar, coyote, prairie dog and antelope are still found in several of the Western states, and the grey wolf is common in the West and in northern Minnesota, Wisconsin and Michigan.

Flora.—The Alpine flora, which is found in the United States only on the tops of those mountains which rise above the limit of trees, consists principally of a variety of plants which bloom as soon as the snow melts and for a short season make a brilliant display of colours. The flora of the Hudsonian and the Canadian zone consists largely of white and black spruce, tamarack, canoe-birch, balsam-poplar, balsam-fir, aspen and grey pine. In the Alleghanian Transition zone the chestnut, walnut, oaks and hickories of the South are interspersed among the beech, birch, hemlock and sugar maple of the North. In the Western Arid Transition zone the flora consists largely of the true sage brush (*Artemisia tridentata*), but some tracts are covered with forests of yellow or bull pine (*Pinus ponderosa*). The Pacific coast Transition zone is noted for its forests of giant conifers, principally Douglas fir, Sitka spruce, Pacific cedar and Western hemlock Here, too, mosses and ferns grow in profusion, and the *sadal* (*Gaultheria shallon*), thimble berry (*Rubus nootkanus*), salmon berry (*Rubus spectabilis*) and devil's club (*Falsia horrida*) are characteristic shrubs. In the Carolinian zone the tulip tree, sycamore, sweet gum, rose magnolia, short-leaf pine and sassafras find their northernmost limit Sage brush is common to both the western arid Transition zone and the Upper Sonoran zone, but in suitable soils of the latter several greasewoods (*Artiplex confertifolia*, *A. canescens*, *A. nuttalli*, *Tetradymia canescens*, *Sarcobatus vermiculatus* and *Grayia spinosa*) are characteristic species, and on the mountain slopes are some nut pines (*piñon*) and junipers. The Austroriparian zone has the long-leaf and loblolly pines, magnolia and live oak on the uplands, and the bald cypress, tupelo and cane in the swamps; and in the semi-tropical Gulf strip are the cabbage palmetto and Cuban pine; here, too, Sea Island cotton and tropical fruits are successfully cultivated. The Lower Sonoran zone is noted for its cactuses, of which there is a great variety and some of them grow to the height of trees; the mesquite is also very large, and the creosote bush, acacias, yuccas and agaves are common. The Tropical belt of southern Florida has the royal palm, coco-nut palm, banana, Jamaica dogwood, manchineel and mangrove; the Tropical belt in the lower valley of the Colorado has giant cactuses desert acacias, palo-verdes and the Washington or fan-leaf palm. Almost all of the United States east of the 98th meridian is naturally a forest region, and forests cover the greater part of the Rocky Mountains, the Cascades, the Sierra Nevadas and the Coast Range, but throughout the belt of plains, basins and deserts west of the Rocky Mountains and on the Great Plains east of the Rocky Mountains there are few trees except along the watercourses, and the prevailing type of vegetation ranges from bunch grass to sage brush and cactuses according to the degree of aridity and the temperature. In the eastern forest region the number of species decreases somewhat from south to north, but the entire region differs from the densely forested region of the Pacific Coast Transition zone in that it is essentially a region of deciduous or hardwood forests, while the latter is essentially one of coniferous trees; it differs from the forested region of the Rocky Mountains in that the latter is not only essentially a region of coniferous trees, but one where the forests do not by any means occupy the whole area, neither do they approach in density or economic importance those of the eastern division of the country. Again, the forests of most of the eastern region embrace a variety of species, which, as a rule, are very much intermingled, and do not, unless quite exceptionally, occupy areas chiefly devoted to one species; while, on the other hand, the forests of the west—including both Rocky Mountain and Pacific coast divisions—exhibit a small number of species, considering the vast area embraced in the region; and these species, in a number of instances, are extraordinarily limited in their range, although there are cases in which one or two species have almost exclusive possession of extensive areas.

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V.—POPULATION AND SOCIAL CONDITIONS

Geographical Growth of the Nation.—The achievement of independence found the people of the United States owning the entire country between the Gulf and the Great Lakes, excepting only Florida, as far to the west as the Mississippi; but the actual settlements were, with a few minor exceptions, confined to a strip of territory along the Atlantic shore. The depth of settlement, from the coast inland, varied greatly, ranging from what would be involved in the mere occupation of the shore for fishing purposes to a body of agricultural occupation extending back to the base of the great Atlantic chain, and averaged some 250 m.[1]

Westward, beyond the general line of continuous settlement, were four extensions of population through as many gaps in the Appalachian barrier, constituting the four main paths along which migration westward first took place: the Mohawk Valley in New York, the upper Potomac, the Appalachian Valley, and around the southern base of the Appalachian system. Four outlying groups beyond the mountains, with perhaps a twentieth part of the total population of the nation,—one about Pittsburg, one in West Virginia, another in northern Kentucky, and the last in Tennessee: all determined in situation by river highways—bore witness to the qualities of strength and courage of the American pioneer. Finally, there were in 1790 about a score of small trading or military posts, mainly of French origin, scattered over the then almost unbroken wilderness of the upper Mississippi Valley and region of the Great Lakes.

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[1] In the *Statistical Atlas* volume of the census of 1900 the reader will find for each decennial census since 1790 a map showing the distribution of population, with indication of the density of settlement, and an elaborate explanatory text. In Orin Grant Libby's *Geographical Distribution of the Vote of the Thirteen States on the Federal Constitution, 1787–1788* (University of Wisconsin, Madison, 1894), along with a valuable map interesting facts are given regarding the social and economic characteristics of different sections.

Twelve decennial censuses taken since that time (1800–1910) have revealed the extraordinary spread of population over the present area of the country (see CENSUS: *United States*). The large percentage of the population, particularly of the great urban centres, that is established to-day in the river lowlands, reflects the rôle that water highways have played in the peopling of the country. The dwindlings and growths of Nevada down to the present day, and to not a slight degree the general history of the settlement of the states of the Rocky Mountain region, are a commentary on the fate of mining industries. The initial settlement of the Pacific coast following the discovery of gold in California in 1848, and of the eastern base of the Rocky Mountains after the discovery of gold in 1859, illustrates the same factor. The Mormons settled Utah to insure social isolation, for the security of their theological system. A large part of the Great Plains to the east of the Rockies was taken up as farms in the decade 1880–1890; abandoned afterwards, because of its aridity, to stock grazing; and reconverted from ranches into farms when a system of dry farming had proved its tillage practicable. The negro more or less consciously moves, individually, closer into the areas whose climate and crops most nearly meet his desires and capabilities as a farmer; and his race as a whole unconsciously is adjusting its habitat to the boundaries of the Austroriparian life zone. The country's centre of population in 110 years moved more than 500 m. westward, almost exactly along the 39th parallel of latitude: 9·5 degrees of longitude, with an extreme variation of less than 19 minutes of latitude.

Growth of the Nation in Population.—If the 19th century was remarkable with respect to national and urban growth the world over, it was particularly so in the growth of the United States. Malthus expressed the opinion that only in such a land of unlimited means of living could population freely increase. The total population increased from 1800 to 1900 about fourteen fold (1331·6%).[1] The rate of growth indicated in 1900 was still double the average rate of western Europe.[2] In the whole world Argentina alone (1869–1895) showed equal (and greater) growth. At the opening of the century not only all the great European powers of to-day but also even Spain and Turkey exceeded the United States in numbers; at its close only Russia. At the census of 1910, while the continental United States population (excluding Alaska) was 91,972,266, the total, including Alaska, Hawaii and Porto Rico, but excluding the Philippine Islands, Guam, Samoa and the Canal Zone, was 93,402,151.

Census Years.	Continental United States, exclusive of Alaska.													
	Population enumerated.				Number of foreign immigrants entering in preceding decade.	Areas (excluding water), in square miles.								
	Population within area of 1790.	Population within added area.	Total population.			Total area.		Settled area.						
			Number.	Decennial increase per cent.		Total.	Area acquired in preceding decade.	Area with not less than two persons per sq. m.	Total area covered by census.		Density of population.			
									Estimated area of isolated settlements beyond the general frontier.	Total.	Of area with not less than two persons per sq. m.	Of entire census area		
												Area of 1790.	Added area.	Whole area.
1790	3,929,625	—	3,929,214	—	—	819,466	—	239,935	13,850	417,170	16·4	9·4	—	9·6
1800	5,247,355	61,128	5,308,483	35·1	—	819,466	—	305,708	33,800	434,670	17·4	12·6	0·2	12·2
1810	6,779,308	460,573	7,239,881	36·4	—	1,698,107	878,641§	407,945	25,100	556,010	17·7	16·3	0·8	13·0
1820	8,293,869	1,344,584	9,638,453	33·1	250,000†	1,752,347	54,240‖	508,717	4,200	688,670	18·9	19·9	2·4	13·9
1830	10,240,232	2,625,788	12,860,692*	33·5	143,439	1,752,347	—	632,717	4,700	877,170	20·3	24·5	4·3	14·5
1840	11,781,231	5,288,222	17,063,353*	32·7	599,125	1,752,347	—	807,292	2,150	1,183,870	21·1	28·2	7·1	14·4
1850	14,569,584	8,622,292	23,191,876	35·9	1,713,251	2,939,021	1,186,674¶	979,249	38,375	1,519,170	23·7	34·9	5·3	15·2
1860	17,326,157	14,117,164	31,443,321	35·6	2,598,214	2,970,038	31,017**	1,194,754	107,375	1,951,520	26·3	41·5	5·7	16·1
1870	19,687,504	18,870,867	38,558,371	22·6	2,314,824	2,970,038	—	1,272,239	131,910	2,126,290	30·3	47·2	7·6	13·4
1880	23,925,639	26,263,570	50,155,783	30·1	2,812,191	2,970,038	—	1,569,565	260,025	2,727,454	32·0	57·4	10·6	18·4
1890	28,188,321	34,791,445	62,947,714	24·9	5,246,613	2,970,038	—	1,947,280	—	2,974,159	32·2	67·6	13·6	19·2
1900	33,533,630	42,749,757	75,994,575*	20·7	3,844,420	2,970,138	100	1,925,590	—	2,974,159	39·5	80·4	16·7	25·5
1910	—	—	91,972,266*	21·0	7,753,816‡	—	—	—	—	2,974,159	—	—	—	30·9

* Excludes persons of the military and naval service stationed abroad (5318 in 1830; 6100 in 1840; 91,219 in 1900).
† Estimates of total up to 1820.
‡ Total, 27,604,509, exclusive of at least some hundreds of thousands of Canadians and Mexicans.
§ Louisiana purchase from France.
‖ Florida purchase from Spain; population counted first, 1830.
¶ Annexation of Texas (385,926 sq. m.); peace cession from Mexico (520,068 sq. m.); extinction of British claims to Oregon (280,680 sq. m.).
** Gadsden purchase from Mexico.

In 1790 there were about 600,000 white families in the United States. Speaking broadly, there were few very rich and few very poor. Food was abundant. Both social traditions and the religious beliefs of the people encouraged fecundity. The country enjoyed domestic tranquillity. All this time, too, the land was but partially settled. Mechanical labour was scarce, and even upon the farm it was difficult to command hired service, almost the only farm labourers down to 1850, in the north, being young men who went out to work for a few years to get a little money to marry upon. A change was probably inevitable and came, apparently, between 1840 and 1850.

The accessions in that decade from Ireland and Germany were enormous, the total immigration rising to 1,713,251 against 599,125 during the decade preceding, and against only 143,439 from 1820 to 1830. These people came in condition to breed with unprecedented rapidity, under the stimulus of an abundance, in regard to food, shelter and clothing, such as the most fortunate of them had never known. Yet in spite of these accessions, the population of the country realized a slightly smaller proportion of gain than when the foreign arrivals were almost insignificant.

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[1] Unless otherwise explicitly stated, by "United States" is to be understood continental United States exclusive of Alaska.

[2] According to Lavasseur and Bodio, 14·5% from 1860 to 1880; 21·2% from 1880 to 1900; from 1886–1900, 11·0%.

For a time the retardation of the normal rate of increase among the native population was concealed from view by the extraordinary immigration. In the decade 1850–1860 it was seen that almost a seventh of the population of the country consisted of persons born abroad. From 1840 to 1860 there came more than four million immigrants, of whom probably three and a half million, with probably as many children born in America, were living at the latter date.

The ten years from 1860 to 1870 witnessed the operation of the first great factor which reduced the rate of national increase, namely the Civil War. The superintendent of the Ninth Census, 1870, presented a computation of the effects of this cause—first, through direct losses, by wounds or disease, either in actual service of the army or navy, or in a brief term following discharge; secondly, through the retardation of the rate of increase in the coloured element, due to the privations, exposures and excesses attendant upon emancipation; thirdly, through the check given to immigration by the existence of war, the fear of conscription, and the apprehension abroad of results prejudicial to the national welfare. The aggregate effect of all these causes was estimated as a loss to the population of 1870 of 1,765,000. Finally, the temporary reduction of the birth-rate, consequent upon the withdrawal of perhaps one-fourth of the national militia (males of 18 to 44 years) during two-fifths of the decade, may be estimated at perhaps 750,000.

The Tenth Census put it beyond doubt that economic and social forces had been at work, reducing the rate of multiplication. Yet no war had intervened; the industries of the land had flourished; the advance in accumulated wealth had been beyond all precedent; and immigration had increased.

It is an interesting question what has been the contribution of the foreign elements of the country's population in the growth of the aggregate. This question is closely connected with a still more important one: namely, what effect, if any, has foreign immigration had upon the birth-rate of the native stock. In 1850 the foreign-born whites (2,244,602 in number) were about two-thirds of the coloured element and one-eighth of the native-white element; in 1870 the foreign-born whites (5,567,229) and the native whites of foreign parentage (5,324,786) each exceeded the coloured. In 1900 the two foreign elements constituted one-third of the total population. The absolute numbers of the four elements were: native whites of native parents, 40,949,362; natives of foreign parents, 15,646,017; foreign-born whites, 10,213,817; coloured, 8,833,994.

Separating from the total population of the country in 1900 the non-Caucasians (9,185,379), all white persons having both parents foreign (20,803,800), and one-half (2,541,365) of the number of persons having only one parent foreign, the remaining 43,555,250 "native" inhabitants comprised the descendants of the Americans of 1790, plus those of the few inhabitants of annexed territories, plus those in the third and higher generations of the foreigners who entered the country after 1790 (or for practical purposes, after 1800). The second element may be disregarded. For the exact determination of the last element the census affords no precise data, but affords material for various approximations, based either upon the elimination of the probable progeny of immigrants since 1790; on the known increase of the whites of the South, where the foreign element has always been relatively insignificant; on the percentage of natives having native grandfathers in Massachusetts in 1905; or upon the assumed continuance through the 19th century of the rate of native growth (one-third decennially) known to have prevailed down at least to 1820. The last is the roughest approximation and would indicate a native mass of 50,000,000 in 1900, or a foreign contribution of approximately half. The results of computations by the first two methods yield estimates of the contribution of foreign stock to the "native" element of 1900 varying among themselves by only 1·8%. The average by the three methods gives 8,539,626 as such contribution, making 31,884,791 the total number of whites of foreign origin in 1900; and this leaves 35,015,624 as the progeny of the original stock of 1790.[1] Adding to the true native whites of 1900 (35,015,624) the native negroes (8,813,658), the increase of the native stock, white and black, since 1790 would thus be about 1091%, and of the whites of 1790 (3,172,006) alone about 1104%. It is evident that had the fecundity of the American stock of 1790 been equal only to that of Belgium (the most fertile population of western Europe in the 19th century) then the additions of foreign elements to the American people would have been by 1900 in heavy preponderance over the original, mainly British, elements. A study of the family names appearing on the census rolls of two prosperous and typical American counties, one distinctively urban and the other rural, in 1790 and 1900, has confirmed the popular impression that the British element is growing little, and that the fastest reproducers to-day are the foreign elements that have become large in the immigration current in very recent decades. In applying to the total population of 1790 the rate of growth shown since 1790 by the white people of the South, this rate, for the purpose of the above computations, is taken in its entirety only up to 1870, and thereafter—in view of the notorious lesser birth-rate since that year in the North and West—only one half of the rate is used. If, however, application be made of the rate in its entirety from 1790 to 1900, the result would be a theoretical pure native stock in 1900 equal to the then actually existing native and foreign stock combined.

In 1900 more than half of every 100 whites in New England and the Middle states (from New York to Maryland) were of foreign parentage (*i.e.* had one or both parents foreign), and in both sections the proportion is increasing with great rapidity. The Southern states, on the other hand, have shown a diminishing relative foreign element since 1870, and had in 1900 only 79 of foreign parentage in 1000 whites. Relatively to their share of the country's aggregate population the North Atlantic states, and those upon the Great Lakes—the manufacturing and urbanized states of the Union—hold much the heaviest share of immigrant population.

The shares of different nationalities in the aggregate mass of foreigners have varied greatly. The family names on the registers of the first census show that more than 90% of the white population was then of British stock, and more than 80 was English. The Germans were already near 6%. The entry of the Irish began on a great scale after 1840, and in 1850 they formed nearly half of all the foreign-born. In that year 85·6% of this total was made up by natives of Great Britain and Germany. The latter took first place in 1880. In 1900 these two countries represented of the total only 52·7%; add the Dutch, the Danes, Swedes, Norwegians and Swiss to the latter and the share was 65·1%. A great majority of all of these elements except the British are settled in the states added to the original Union—the Scandinavians being the most typically agricultural element; while almost all the other nationalities are in excess, most of them heavily so, in the original states of 1790, where they land, and where they are absorbed into the lower grades of the industrial organization. Since 1880 Italians, Russians, Poles, Austrians, Bohemians and Hungarians have enormously increased in the immigrant population. Germans, Irish, British, Canadians, Scandinavians, Slavs and Italians were the leading elements in 1900.

In 1790 the negroes were 19·3% of the country's inhabitants; in 1900 only 11·6%. While the growth of the country's aggregate population from 1790 to 1900 was 1833·9%, that of the whites was 2005·9%, and of the negroes only 1066·7%.

Certain generalizations respecting the "South" and the "North," the "East" and the "West" are essential to an understanding of parts of the history of the past, and of social conditions in the present. For the basis of such comparisons the country is divided by the census into five groups of states: (1) the North Atlantic division—down to New Jersey and Pennsylvania; (2) the South Atlantic division—from Delaware to Florida (including West Virginia); (3) the North Central division—including the states within a triangle tipped by Ohio, Kansas and North Dakota; (4) the South Central division—covering a triangle tipped by Kentucky, Alabama and Texas; and (5) the Western division—including the Rocky Mountains and Pacific states. The first and third lead to-day in manufacturing interests; the third in agricultural; the fifth in mining.

Groups 1 and 3 (with the western boundary somewhat indefinite) are colloquially known as the "North" and 2 and 4 as the "South." The two sections started out with population growths in the decade 1790–1800 very nearly equal (36·5 and 33·7%); but in every succeeding decade before the Civil War the growth of the North was greater, and that of the South less, than its increment in the initial decade. In the two twenty-year periods after 1860 the increases of the North were 61·9 and 48·7%; of the South, 48·4 and 48·5%. In 1790 the two sections were of almost equal population; in 1890, 1900 and 1910 the population of the North was practically double that of the South. In the decade 1890–1900 the increase of the South exceeded slightly that of the North for the same period owing to the rapid development in recent years of the Southern states west of the Mississippi, which only the Western group has exceeded since 1870.[2] In general the increase of the two sections since 1880 has been nearly equal. But while this growth was relatively uniform over the South, in the North there was a low (often a decreasing) rate of rural and a high rate of urban growth. Throughout the 19th century the rates of growth of the North Central division and that of the eastern half of the South Central division steadily decreased. It is notable that that of the South Atlantic group has grown faster since 1860 than ever before, despite the Civil War and the conditions of an old settled region: a fact possibly due to the effects of the emancipation of the slaves.

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[1] W. S. Rossiter, *A Century of Population Growth* (Bureau of the Census, Washington, 1909), pp. 85 seq.

[2] The number of inhabitants of the North at each census for every 1000 in the South was as follows from 1790 to 1900: 1004; 1025; 1092; 1181; 1253; 1455; 1562; 1769; 2057; 1930; 2005; 1932.

Comparing now the population of the regions east and west of the Mississippi, we find that the population of the first had grown from 3,929,214 in 1790 to 55,023,513 in 1900; and that of the second from 97,401 in 1810 to 20,971,062 in 1900. From 1860 to 1890 the one increased its numbers decennially by one half, and the other by under one fifth; but from 1890 to 1910 the difference in growth was slight, owing to a tremendous falling off in the rate of growth of much of the Western and the western states of the North Central divisions. Only an eighth of the country's total population lived in 1900 west of the 96th meridian, which divides the country into two nearly equal parts. Although, as already stated, the population of the original area of 1790 was passed in 1880 by that of the added area, the natives of the former were still in excess in 1900.

Urban and Rural Population.—The five cities of the country that had 8000 or more inhabitants in 1790 had multiplied to 548 in 1900. Only one of the original six (Charleston) was in the true South, which was distinctly rural. The three leading colonial cities, Philadelphia, New York and Boston, grew six-fold in the 18th century, and fifty-fold in the next. The proportion of the population living in cities seems to have been practically constant throughout the 18th century and up to 1820. The great growth of urban centres has been a result of industrial expansion since that time. This growth has been irregular, but was at a maximum about the middle of the century. On an average throughout the 110 years, the population in cities of 8000 considerably more than doubled every twenty years.[1] The rate of rural growth, on the other hand, fell very slowly down to 1860,[2] and since then (disregarding the figures of the inaccurate census of 1870) has been steady at about half the former rate. In Rhode Island, in 1900, eight out of every ten persons lived in cities of 8000 or more inhabitants; in Massachusetts, seven in ten. In New York, New Jersey and Connecticut the city element also exceeded half of the population. At the other extreme, Mississippi had only 3% of urban citizens. If the limit be drawn at a population of 2500 (a truer division) the urban element of Rhode Island becomes 95·0%; of Massachusetts, 91·5; of Mississippi, 7·7. All the Southern states are still relatively rural, as well to-day as a hundred years ago. Ten states of the Union had a density in 1910 exceeding 100 persons to the square mile: Illinois (100·7), Delaware (103), Ohio (117), Maryland (130·3), Pennsylvania (171·3), New York (191·2), Connecticut (231·3), New Jersey (337·3), Massachusetts (418·8) and Rhode Island (508·5).

There are abundant statistical indications that the line (be the influence that draws it economic or social) between urban centres of only 2500 inhabitants and rural districts is much sharper to-day than was that between the country and cities of 8000 inhabitants (the largest had five times that number) in 1790. The lower limit is therefore a truer division line to-day. Classifying, then, as urban centres all of above 2500 inhabitants, three-tenths of the total population lived in the latter centres in 1880 and four-tenths (30,583,411) in 1900; their population doubled in these twenty years. If one regards the larger units, they held naturally a little more of the total population of the country—just a third (33·1%; ten times their proportion of the country's total in 1790); and they grew a little faster. The same years, however, made apparent a rapid fall, general and marked, yet possibly only temporary, in the rate at which such urban centres, as well as larger ones, had been gaining upon the rural districts; this reaction being most pronounced in the South and least so in the North Atlantic states, whose manufacturing industries are concentrated in dense centres of population.

Interstate migration is an interesting element in American national life. A fifth of the total population of 1900 were living in other states than those of birth; and this does not take account of temporary nor of multiple migration. Every state numbers among its residents natives of nearly every other state. This movement is complicated by that of foreign immigration. In 1900 the percentage of resident natives varied from 92·7% in South Carolina to 15% in Oklahoma; almost all of the Southern states having high percentages.

Sexes.—The percentages of males and females, of all ages, in the aggregate population of 1900, were 51·0 and 49·0 respectively. The corresponding figures for the main elements of the population were as follows: for native whites, 50·7 and 49·3; foreign whites, 54·0 and 46·0; negroes, 49·6 and 50·4. The absolute excess of males in the aggregate population has been progressively greater at every successive census since 1820, save that of 1870—which followed the Civil War, and closed a decade of lessened immigration. The relative excess of males in each unit of population has not constantly progressed, but has been continuous. In densely settled regions females generally predominate; and males in thinly settled regions. In every 1000 urban inhabitants there were, in 1900, 23 (in 1890 only 19) more females than in 1000 rural inhabitants. In the rural districts, so far as there is any excess of females, it is almost solely in the Southern cotton belt, where negro women are largely employed as farm hands.

Vital Statistics, 1900.—The median age of the aggregate population of 1900—that is, the age that divides the population into halves—was 22·85 years. In 1800 it was 15·97 years. A falling birth-rate, a falling death-rate, and the increase in the number of adult immigrants, are presumably the chief causes of this difference. The median age of the foreign-born in 1900 was 38·42 years. The median age of the population of cities of 25,000 or more inhabitants was 3·55 years greater than that of the inhabitants of smaller urban centres and rural districts, owing probably in the main to the movement of middle-aged native and foreign adults to urban centres, and the higher birth-rate of the rural districts. The median age of the aggregate population is highest in New England and the Pacific states, lowest in the South, and in the North Central about equal to the country's average. The average age of the country's population in 1900 was 26·2 years. The United States had a larger proportion (59·1%) within the "productive" age limits of 15 and 60 years than most European countries; this being due to the immigration of foreign adults (corresponding figure 80·3%), the productive group among the native whites (55·8%) being smaller than in every country of Europe. The same is true, however, of the population over 60 years of age.

Death-rate.

The death-rate of the United States, though incapable of exact determination, was probably between 16 and 17 per 1000 in 1900; and therefore less than in most foreign countries. The following statement of the leading causes of death during the eleven years 1890–1900 in 83 cities of above 25,000 population, is given by Dr J. S. Billings:—

Average Annual Death-rate per 100,000 Population for the Cities of the Sections Indicated.	Consumption.	Pneumonia.	Typhoid Fever.	Diphtheria and Croup.
New England . .	244	220	30	77
Middle states . .	259	268	32	101
Lake states . .	156	159	48	79
Southern states .	277	189	50	54
West North Central	183	142	38	61

Marriage.

Among the statistics of conjugal condition the most striking facts are that among the foreign-born the married are more than twice as numerous as the single, owing to the predominance of adults among the immigrants; and the native whites of foreign parents marry late and in much smaller proportion than do the native whites of native parentage—the explanation of which is probably to be found in the reaction of the first American generation caused on one hand by the high American standard of living, and on the other by the relative economic independence of women. In 1900 1·0% of the males and 10·9% of the females from 15 to 19 years of age were married; from 20 to 24 years, 21·6% and 46·5% respectively. Of females above 15 years of age 31·2% were single, 56·9 married, 11·2 widowed, 0·5 divorced; many of the last class undoubtedly reporting themselves as of the others. The corresponding figures for males were: 40·2, 54·5, 4·6 and 0·3%. In 1850 there were 5·6 persons (excluding the slave population) in an average American family; fifty years later there were only 4·7—a decline, which was constant, of 16·1%. In 1790, 5 persons was also the normal family—*i.e.* the greatest proportion (14%) of the total were of this size; but in 1900 the model family was that of 3 persons by a more decisive proportion (18%). The minimum state average of 1790, which was 5·4 in Georgia, was greater than the maximum of 1900. Within the area of 1790 there were twice as many families in 1900 as in 1790 consisting of 2 persons, and barely half as many consisting of 7 and upward; New England having shown the greatest and the South the least decrease. In 1790 about a third and in 1900 more than one half of all families had less than 5 members.

Families.

Birth-rate.

The data gathered by the Federal census have never made possible a satisfactory and trustworthy calculation of the birth-rate, and state and local agencies possess no such data for any considerable area. But the evidence is on the whole cumulative and convincing that there was a remarkable falling off in the birth-rate during the 19th century. And it may be noted, because of its bearing upon the theory of General Francis A. Walker, that the Old South of 1790, practically unaided by immigration, maintained a rate of increase at least approximating that attained by other sections of the country by native and foreign stock combined. Not a state of the Union as it existed in 1850 showed an increase, during the half-century following, in the ratio of white children under 16 to 1000 white females over 16 years: the ratio declined for the whole country from 1600 to 1100; and it has fallen for the census area of 1790 from 1900 in that year to 1400 in 1850 and 1000 in 1900. On the other hand, elaborate colonial censuses for New York in 1703 and 1812 show

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[1] Average 62·2% decennially. [2] Average 31·9% decennially.

Sections of the Country.[1]	Whites under 16 Years per 1000 of Total Population.				
	1790.	1820.	1850.	1880.	1900.
Area of 1790	490	483	414	373	344
New England	470	443	358	309	291
Middle states	494	485	405	358	326
Old South	502	508	464	431	402
Added area	—	526	463	406	368

ratios of 1900 and 2000, and reinforce the suggestions of various other facts that the social, as well as the economic, conditions in colonial times were practically constant.

The decline in the proportion of children since 1860 has been decidedly less in the South (Southern Atlantic and South Central states as defined below) than in the North and West, but in the most recent decades the last section has apparently fast followed New England in having a progressively lesser proportion of children. In the North there was little difference in 1900 in the ratios shown by city and country districts, but in the South the ratio in the latter was almost twice that reported for the former.

The decades 1840–1850, 1880–1890 and 1860–1870 have shown much the greatest decreases in the percentage of children; and some have attributed this to the alleged heavier immigration of foreigners (largely adults) in the case of the two former decades, and the effects of the Civil War in the third. So also the three decades immediately succeeding the above showed minimum decreases; and this has been attributed to a supposed greater birth-rate among the immigrants.

These uncertainties raise a greater one of much significance, viz. what has been the cause of the reduction in the national birth-rate indicated by the census figures? The question has been very differently judged. In the opinion of General Francis A. Walker, superintendent of the censuses of 1870 and 1880, the remarkable fact that such reduction coincided with a cause that was regarded as certain to quicken the increase of population, viz. the introduction of a vast body of fresh peasant blood from Europe, afforded proof that in this matter of population morals are far more potent than physical causes. The change, wrote General Walker, which produced this falling off from the traditional rate of increase of about 3% per annum, was that from the simplicity of the early times to comparative luxury; involving a rise in the standard of living, the multiplication of artificial necessities, the extension of a paid domestic service, the introduction of women into factory labour[2] In his opinion the decline in the birth-rate coincidently with the increase of immigration, and chiefly in those regions where immigration was greatest, was no mere coincidence; nor was such immigrant invasion due to a weakening native increase, or economic defence; but the decline of the natives was the effect of the increase of the foreigners, which was "a shock to the principle of population among the native element." Immigration therefore, according to this theory, had "amounted not to a reinforcement of our population, but to a replacement of native by foreign stock. That if the foreigners had not come, the native element would long have filled the places the foreigners usurped, I entertain"—says General Walker—"not a doubt."

It is evident that the characteristics of the "factory age" to which reference is made above would have acted upon native British as upon any other stock; and that it has universally so acted there is abundant statistical evidence, in Europe and even in a land of such youth and ample opportunities as Australia. The assumption explicitly made by General Walker that among the immigrants no influence was yet excited in restriction of population, is also not only gratuitous, but inherently weak; the European peasant who landed (where the great majority have stayed) in the eastern industrial states was thrown suddenly under the influence of the forces just referred to; forces possibly of stronger influence upon him than upon native classes, which are in general economically and socially more stable. On the whole, the better opinion is probably that of a later authority on the vital statistics of the country, Dr John Shaw Billings,[3] that though the characteristics of modern life doubtless influence the birth-rate somewhat, by raising the average age of marriage, lessening unions, and increasing divorce and prostitution, their great influence is through the transmutation into necessities of the luxuries of simpler times; not automatically, but in the direction of an increased resort to means for the prevention of child-bearing.

Education.—In the article EDUCATION (*United States*), and in the articles on the several states, details are given generally of the conditions of American education. Here the statistics of literacy need only be considered.

In 1900 illiterates (that is, persons unable to write, the majority of these being also unable to read) constituted nearly one-ninth (10·7%) of the population of at least ten years of age; but the greatest part of this illiteracy is due to the negroes and the foreign immigrants. Since 1880 the proportion of illiteracy has steadily declined for all classes, save the foreign-born between 1880 and 1890, owing to the beginning in these years, on a large scale, of immigration from southern Europe. Illiteracy is less among young persons of all classes than in the older age-groups, in which the foreign-born largely fall. This is due to the extension of primary education during the last half of the 19th century. The older negroes (who were slaves) naturally, when compared with the younger, afford the most striking illustration of this truth. On the other hand, a notable exception is afforded by the native whites of native parents, particularly in the South, where child illiteracy (and child labour) is highest; the declining proportion of illiterates shown by the age-groups of this class up to 24 years is apparently due to a will to learn late in life.

The classification of the illiterate population (above 10 years of age) by races shows that the Indians (56·2%), negroes (44·5%), Chinese (29·0%), Japanese (18·3%), foreign white (13·0%), native white of native parentage (5·7%), and native whites of foreign parents (1·6%), are progressively more literate. The advantage of the last as compared with native whites of native parentage is apparently owing to the lesser concentration of these in cities. The percentages of illiterate children for different classes in 1900 were as follows: negroes, 30·1; foreign whites, 5·6; native whites of foreign parentage, 0·9; native whites of native parentage, 4·4. There is a greater difference in the North than in the South between the child illiteracy of the Caucasian and non-Caucasian elements; also a ranking of the different sections of the country according to the child illiteracy of one and the other race shows that the negroes of the South stand relatively as high as do its whites. All differences are lessened if the comparison be limited to children, and still further lessened if also limited to cities. Thus, the illiteracy of non-Caucasians was 44·5%, of their children 30·1%, and of such in cities of 25,000 inhabitants, 7·7%.

In the total population of 10 years of age and over the female sex is more illiterate than the male, but within the age-group 10 to 24 years the reverse is true. In 1890 females preponderated among illiterates only in the age-group 10 to 19 years. The excess of female illiteracy in the total population also decreased within the same period, from 20·3 to 10·8 illiterates in a thousand. The tendency is therefore clearly toward an ultimate higher literacy for females; a natural result where the two sexes enjoy equal facilities of schooling, and the females greater leisure. Among the whites attending school there was still in 1900 a slight excess of males; among the negro pupils females were very decidedly in excess. In all races there has been since 1890, throughout the country, a large increase in the proportion of girls among the pupils of each age-group; and this is particularly true of the group of 15 years and upward—that is of the grammar school and high school age, in which girls were in 1900 decidedly preponderant. A similar tendency is marked in college education.

Religious Bodies.—According to the national census of religious bodies taken in 1906 there were then in the country 186 denominations represented by 212,230 organizations, 92·2% of which represented 164 bodies which in history and general character are identified more or less closely with the Protestant Reformation or its subsequent development. The Roman Catholic Church contributed 5·9% of the organizations. Among other denominations the Jewish congregations and the Latter Day Saints were the largest. The immigrant movement brings with it many new sects, as, for example, the Eastern Orthodox churches (Russian, Servian, Syrian and Greek), which had practically no existence in 1890, the year of the last preceding census of religious bodies. But the growth of independent churches is most remarkable, having been sixfold since 1890.

The statistics of communicants or members are defective, and because of the different organization in this respect of different bodies, notably of the Protestants and Roman Catholics, comparisons are more or less misleading. Disregarding, however, such incomparability, but excluding 15% of all Roman Catholics (for children under 9 years of age), the total number of church members was 32,936,445, of whom 61·6% were Protestants, 36·7% Roman Catholics and 1·7% members of other churches. The corresponding figures in 1890 were 68·0, 30·3 and 1·7%. For the reasons just given these figures do not accurately indicate the religious affiliations of the population of the United States. In this particular they very largely understate the number of Hebrews, whose communicants (0·3 %) are heads of families only, and largely of the Protestants; whereas they represent practically the total Roman Catholic population above 9 years of age. In comparing the figures of 1890 with those of 1906 these cautions are not of force, since both census counts were taken by the same methods. The membership of the Protestant bodies increased in the interval 44·8 %, while that of the Roman Catholic Church increased 93·5 %. The immigration from Catholic countries could easily account for (though this does not prove that in fact it is the only cause of) this great increase of the Roman Catholic body.

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[1] Table from Rossiter, *op. cit.*, p. 103.

[2] See his *Discussions in Economics and Statistics*, ii. 422, "Immigration and Degradation."

[3] See the *Forum* (June, 1893), xv. 467.

Among the Protestants, the Methodists with 17·5 % of the total membership, the Baptists with 17·2, the Lutherans with 6·4, the Presbyterians with 5·6 and the Disciples and Christians with 3·5—each of these bodies comprising more than a million members—together include one-half of the total church membership of the country, and four-fifths (81·3 %) of all Protestant members.

The Baptists and Methodists are much stronger in the South, relatively to other bodies, than elsewhere; the former constituting in the South Atlantic states 43·9 % of all church members, and in the South Central states 39·5 %. Adding in the Methodists these proportions become 76·3 and 65·3 %. The Lutherans are relatively strongest in the North Central division of the country (13·2 %); the Presbyterians in the North Atlantic and Western divisions (6·0 %); and the Disciples in the South Central division (6·1 %). The Roman Catholics are strongest in the Western division and the North Atlantic division, with 49·2 % in the former and 56·6 % in the latter of all church members; their share in the North Central division is 36·9 %. Thus the numerical superiority of the Baptists and Methodists in the two Southern divisions is complementary to that of the Roman Catholics in the other three divisions of the country. New York, Rhode Island, Massachusetts and New Hampshire in the eastern part of the country, Louisiana in the south, and New Mexico, Arizona, California and Montana in the western part are distinctively Roman Catholic states, with not less than 63 % of these in the total church body. Racial elements are for the most part the explanation. So also the immigration of French Canadians and of Irish explains the fact that in every state of one-time Puritan New England the Roman Catholics were a majority over Protestants and all other churches. This was true in 1890 of 12 states, while in one other the Roman Catholics held a plurality; in 1906 the corresponding figures were 16 and 20. The Protestant bodies are more widely and evenly distributed throughout the country than are the Roman Catholics.

The total value of church property (almost in its entirety exempt from taxation) reported in 1906 was $1,257,575,867, of which $935,942,578 was reported for Protestant bodies, $292,638,786 for Roman Catholic bodies, and $28,994,502 for all other bodies.

Occupations.—29,073,233 persons 10 years or more of age—nearly two-fifths (38·3 %) of the country's total population—were engaged in gainful occupations in 1900. Occupations were reported first for free males in 1850, and since 1860 women workers have been separately reported. Five main occupation groups are covered by the census: (1) agriculture, (2) professional service, (3) domestic and personal service, (4) trade and transportation, (5) manufacture and mechanical pursuits. The percentage of all wage-earners engaged in these groups in 1900 was 35·7, 4·3, 19·2, 16·4, and 24·4 respectively. Outside of these are the groups of mining and fishing.

Although manufactures have increased tremendously of recent years—their products representing in 1905 a gross total of $14,802,147,087 as compared with $6,309,000,000 for those of farms (according to the U.S. Department of Agriculture)—agriculture is still the predominant industry of the United States, employing nearly half of the workers, and probably giving subsistence to considerably more than half of the people of the country.

Turning to the factor of sex, it may be stated that the total number of the gainfully employed in 1900 above given included 80·0 % of all the men and boys, and 18·8 % of all the women and girls in the country. The corresponding figures in 1880 were 78·7 and 14·7 %. The proportion of women workers is greatest in the North Atlantic group of states (22·1 %) where they are engaged in manufacturing, and in the South (23·8) where negro women are engaged in agricultural operations. The percentage of such wage-earners is therefore increasing much more rapidly in the former region. But in all other parts of the country the increase is faster than in the South; since aside from agriculture, which has long been in a relatively stable condition, there is not by any means so strong a movement of women into professional services in city districts. The increase is universal. There is not a state that does not show it. The greatest increase for any section between 1880 and 1900 was that of the North Central division from 8·8 to 14·3 %. Here too both factors—farm-life, as in North Dakota, and manufacturing, as in Illinois—showed their plain influence.

Of all agricultural labourers 9·4 % were females in 1900 (7·7 in 1880); but in the South the proportion was much greater—16·5 in the South Atlantic and 14·9 in the South Central division. In professional service 34·2 % (in 1880, 29·4) were females, the two northern sections showing the highest proportions. In the occupations of musicians and teachers of music, and of school-teachers and professors (which together account for seven-eighths of professional women) women preponderate. The same sex constituted only 37·5 % (34·6 % in 1880) of the wage-earners of the third group; the South also showing here, as is natural in view of its coloured class, much the highest and the Western division of states much the lowest percentage. Women are in excess in the occupations of boarding and lodging house keepers, housekeepers, launderers, nurses and midwives, and servants and waiters. These account for almost all women in this group; servants and waitresses make up two-thirds of the total. Finally, in the fourth and fifth groups the percentage of women was 10·6 (3·4 in 1880) and 18·5 (16·7 in 1880). In manufactures the South Atlantic states show a higher percentage than the North Central, owing to the element of child-labour already indicated. In the third group women greatly preponderate in the occupation of stenographers and type-writers; and in those of book-keepers and accountants, clerks and copyists, packers and shippers, saleswomen (which is the largest class), and telegraph and telephone operators they have a large representation (13 to 34 %). A great variation exists in the proportion of the sexes employed in different manufacturing industries. Of dress-makers, milliners, seamstresses (which together make up near half of the total in this occupation group) more than 96 % are women. Of the makers of paper boxes, of shirts, collars and cuffs, of hosiery and knitting mill operatives, of glove-makers, silk mill operatives and book-binders they are more than half; so also of other textile workers, excluding wool and cotton mill operatives (these last the second largest group of women workers in manufactures), in which occupations males are in a slight excess. The distribution of women wage-earners in 1900 among the great occupation groups was as follows: in agriculture, 18·4 %; professional service, 8·1 %; domestic and personal service, 39·4 %; trade and transportation, 9·4 %; manufacturing and mechanical pursuits, 24·7 %.

The proportion which children 10 to 15 years of age engaged in gainful occupations bore to the whole number of such children was in 1880 24·4 % for males, and 9·0 % for females. Twenty years later the corresponding figures were 26·1 and 10·2 %. In the North Atlantic and North Central states, notwithstanding their manufacturing industries, the proportions were much lower (17·1 and 17·0 in 1900), and they increased very little in the period mentioned. In the Western group the increase was even less, and the total (10·9 % in 1900) also. But in the South Atlantic and the South Central states—where agriculture, mining and manufacturing have in recent decades become important—although the increase was very slight, the proportions were far above those of the other sections, both in 1880 and in 1900. In the former year the ratios were 40·2 and 41·5, in the latter 41·6 and 42·7 %. In Alabama (70·8 % in 1880), North and South Carolina, and Arkansas the ratio exceeded 50 % in 1900.

National Wealth.—Mulhall has estimated the aggregate wealth of the United States in 1790 at $620,000,000, assigning of this value $479,000,000 to lands and $141,000,000 to buildings and improvements. It is probable that this estimate is generous according to the values of that time. But even supposing $1,000,000,000 to be a juster estimate according to present-day values, it is probable that the increase of this since 1790 has been more than a hundredfold and since 1850 (since when such data have been gathered by the census) about fifteenfold. The value of farm property increased from $3,967,343,580 in 1850 to $20,439,901,164 in 1900. The gross value of manufactures rose in the same interval from $1,019,106,616 to $13,010,036,514; of farm products, from $2,212,540,927 in 1880 to $6,309,000,000 in 1900. The census estimate of the true value of "property" constituting the national wealth was limited in an enumeration of 1850 to taxable realty and privately held personalty; in 1900 it covered also exempt realty, government land, and corporation and public personalty. The estimate of the national wealth of 1850 was $7,135,780,228; in 1904 (made by the census office), $107,104,192,410. It may be added that the net ordinary revenue of the government was in 1850 $43,592,889, and in 1909 $662,324,445; that the value of imports rose from $7·48 *per capita* in 1850 to $14·47 in 1909; and of exports from $6·23 to $18·50. The public debt on the 1st of November 1909, less certificates and notes offset by cash in the Treasury, was $1,295,147,432.04.

(F. S. P.)

VI.—Industries and Commerce

Manufactures.—In the colonial period there were beginnings in some lines of manufacturing, but the policy of the British government was generally hostile and the increase was insignificant. In the first decades after the establishment of independence the resources and energies of the nation were absorbed in the task of occupying the vacant spaces of a continent, and subduing it to agriculture; and so long as land was so abundant that the spreading population easily sustained itself upon the fruits of the soil, and satisfied the tastes of a simple society with the products of neighbourhood handicrafts, there was no incentive to any real development of a factory economy. This has been, for the most part, a development since the Civil War.

No attempt was made in the census enumerations of 1790 and 1800 to obtain statistics of manufactures. In 1810 Congress provided for such a report, but the results were so imperfect that there was never published any summary for the country, nor for any state. Nor were the data secured in 1820 and 1840 of much value. Since 1850, however, provision has been made on an ample scale for their collection, although the constant modifications of the schedules under which the statistics were arranged makes very difficult comparisons of the latest with the earlier censuses.

From 1850 to 1900 fairly full industrial statistics were gathered as a part of each decennial census. In 1905 was taken the first of a new series of special decennial censuses of manufactures, in which only true factories—that is, establishments producing standardized products intended for the general market—were included, and mere "neighbourhood" (local) establishments of the hand trades were excluded. Without corrections, therefore, the figures of earlier censuses are not comparable with those of the census of 1905. Thus of 512,254 establishments included in the reports of 1900, six-tenths, employing 11·2% of the total number of wage-earners and producing 12·3% of the total value of all manufactures, must be omitted as "neighbourhood" establishments in order to make the following comparison of the results of the two enumerations of 1900 and 1905. The magnitude in 1905 of each of the leading items, and its increase since 1900, then appear as follows: number of factories, 216,262, increase 4·2%; capital invested, $12,686,265,673, increase 41·3%; salaries, $574,761,231, increase 50·9%; total wages, $2,009,735,799, increase 29·9%; miscellaneous expenses, $1,455,019,473, increase 60·7%; cost of materials, $8,503,949,756, increase 29·3%; value of products, including custom work and repairing (in such factories), $14,802,147,087, being an increase of 29·7%. Of the last item $3,269,757,067 represented the value of the products of rural factories (that is, those in cities of under 8000 inhabitants). The increase of the different items during the five years was greater in every case in the rural than in the urban factories. There was a very slight decline in the number of child labourers both in city and country, their total number in 1905 being 159,899 and in 1900 161,276. The total wages paid to children under 16 years, however, which was in 1905 $27,988,207, increased both in the city and, especially, in the country, and was 13·9% greater in 1905 than five years earlier. In the same period there was an increase of 16·0% in the number and of 27·5% in the wages of women workers of 16 years (and upwards) of age.

Deducting from the total value of manufactured products in 1905 the cost of partially manufactured materials, including mill supplies, a net or true value of $9,821,205,387 remains. Partially manufactured articles imported for use in manufactures are not included. Deducting from this the cost of raw materials and adding the cost of mill supplies, the result—$6,743,399,718—is the value added to materials by manufacturing processes.

The extent to which manufactures are controlled by large factories is shown by the fact that although in 1905 only 11·2% of the total number reported products valued at $100,000 or over, these establishments controlled 81·5% of the capital, employed 71·6% of the wage earners, and produced 79·3% of the value of the products, of all establishments reported. 52·3% of the total number, employing 66·3% of all wage-earners, and producing 69·7% of the total product-value, were in urban centres.

Only six establishments in a thousand employed as many as 500 workers, and only two in a thousand employed as many as 1000 workers. Cotton mills are most numerous in the last class of establishments. The manufacture of lumber and timber gave employment to the largest total number of workers; and this industry, together with those of foundry and machine shops (including locomotives, stoves and furnaces), cotton goods (including small wares), railway car and repair shops, and iron and steel, were (in order) the five greatest employers of labour.

Measured by the gross value of products, wholesale slaughtering and meat packing was the most important industry in 1905. The products were valued at $801,757,137. In each of four other industries the products exceeded in value five hundred millions of dollars, namely, those of foundry and machine shops, flour and grist mills, iron and steel, and lumber and timber. In one other, cotton goods, the value was little less. These six industries contributed 27·2% of the value of all manufactured products. Both in 1905 and in 1900 the group of industries classed as of food and kindred products ranked first in the cost of materials used and the value of products; the group of iron and steel ranking first in capital and in wages paid; and textiles in the number of wage-earners employed.

The close relation of manufactures to agriculture is reflected in the fact that, of the raw materials used, 79·4% came from the farm. The remainder came from mines and quarries, 15·0%; forests, 5·2%; the sea, 0·4%.

Four states—New York, Pennsylvania, Illinois and Massachusetts—each manufactured in 1900 products valued at over $1,000,000,000; New York exceeding and Pennsylvania attaining almost twice that sum. The manufacture of some products is highly localized. Thus, of silk goods, worsteds, the products of blast furnaces, of rolling mills and steel works, glass, boots and shoes, hosiery and knit goods, slaughtering and meat products, agricultural implements, woollens, leather goods, cotton goods and paper and wood pulp, four leading states produced in each case from 88·5%, in the case of silk goods, to 58·6% in the case of pulp.

M. G. Mulhall (*Industry and Wealth of Nations*, 1896) assigned fourth place to the United States in 1880 and first place in 1894 in the value of manufactured products, as compared with other countries. Paul Leroy-Beaulieu (*Les États-Unis au* xxme *Siècle*, Paris, 1904) would assign primacy to the United States as far back as 1885. Since the English board of trade estimated the exports of British manufactured goods at from 17 to 20% of the industrial output of the United Kingdom in 1902, this would indicate a manufactured product hardly two-thirds as great as that of the true factory establishments of the United States in 1900. But exact data for comparison do not exist for other countries than the United States. In the production of pig iron, the share of the United States seems to have been in 1850 about one-eighth and that of Great Britain one-half of the world's product; while in 1903 the respective shares were 38·8 and 19·3%; and Germany's also slightly exceeded the British output. In the manufacture of textiles the United States holds the second place, after Great Britain; decidedly second in cottons, a close competitor with Great Britain and France in woollens, and with France in silks. In the manufacture of food products the United States holds a lead that is the natural result of immense advantages in the production of raw materials. No other country produces half so much of leather. In the dependent industry of boots and shoes her position is commanding. These facts give an idea of the rank of the country among the manufacturing countries of the world. The basis of this position is generally considered to be, partly, immense natural resources available as materials, and, partly, an immense home market.

For *Agriculture*, see the article AGRICULTURE; for *Fisheries*, see FISHERIES; and for *Forestry*, see FORESTS AND FORESTRY.

Minerals.—In 1619 the erection of "works" for smelting the ores of iron was begun at Falling Creek, near Jamestown, Va., and iron appears to have been made in 1620; but the enterprise was stopped by a general massacre of the settlers in that region. In 1643 the business of smelting and manufacturing iron was begun at Lynn, Mass., where it was successfully carried on, at least up to 1671, furnishing most of the iron used in the colony. From the middle of the 17th century the smelting of this metal began to be of importance in Massachusetts Bay and vicinity, and by the close of the century there had been a large number of ironworks established in that colony, which, for a century after its settlement, was the chief seat of the iron manufacture in America, bog ores, taken from the bottom of the ponds, being chiefly used. Early in the 18th century the industry began to extend over New England and into New Jersey, the German bloomery forge being employed for reducing the ore directly to bar iron, and by the middle of that century it had taken a pretty firm hold in the Atlantic colonies. About 1789 there were fourteen furnaces and thirty-four forges in operation in Pennsylvania. Before the separation of the colonies from the mother country, the manufacture of iron had been extended through all of them, with the possible exception of Georgia. As early as 1718 iron (both pig and bar) began to be sent to Great Britain, the only country to which the export was permitted, the annual amount between 1730 and 1775 varying ordinarily between 2000 and 3000 tons, but in one year (1771) rising to between 7000 and 8000 tons.

The first metal other than iron mined by whites within the territory of the United States was lead, the discovery of which on the American continent was recorded in 1621. The first English settlers on the Atlantic bartered lead of domestic origin with the Indians in the 17th century, and so did the French in the upper Mississippi Valley. The ore of the metal occurring in the Mississippi basin—galena—is scattered widely and in large quantities, and being easily smelted by the roughest possible methods was much used at an early date. In the second half of the 18th century, during the period of French and Spanish domination in the valley, lead was a common medium of exchange, but no real mining development took place. Copper was the next metal to be mined, so far as is known. The first company began work about 1709, at Simsbury, Conn. The ore obtained there and in New Jersey seems to have been mostly shipped to England. A few years later attempts were made to work mines of lead and cobalt in Connecticut and Massachusetts.

The first mining excitement of the United States dates back to the discovery of gold by the whites in the Southern states, along the eastern border of the Appalachian range, in Virginia, and in North and South Carolina. The existence of gold in that region had been long known to the aboriginal inhabitants, but no attention was paid to this by the whites, until about the beginning of the 19th century, when nuggets were found, one of which weighed 28 lb, From 1824 the search for gold continued, and by 1829 the business had become important, and was attended with no little excitement. In 1833 and 1834 the amount annually obtained had risen to fully a million of dollars. A rapid development of the lead mines of the West, both in Missouri and on the Upper Mississippi in the region where Iowa, Wisconsin and Illinois adjoin one another, took place during the first quarter of the 19th century, and as early as 1826 or 1827 the amount of this metal obtained had risen to nearly 10,000 tons a year. By this time the making of iron had also become important, the production for 1828 being estimated at 130,000 tons.

In 1820 the first cargo of anthracite coal was shipped to Philadelphia. From 1830 the increase in the production was very rapid, and in 1841 the annual shipments from the Pennsylvania anthracite region had nearly reached 1,000,000 tons, the output of iron at that time being estimated at about 300,000 tons. The development of the coal and iron interests, and the increasing importance of the gold product of the Appalachian auriferous belt, and also of the lead product of the Mississippi Valley, led to a more general and decided interest in geology and mining; and about 1830 geological surveys of several of the Atlantic states were begun, and more systematic explorations for the ores of the metals, as well as for coal, were carried on over all parts of the country then open to settlement. An important step was taken in 1844, when a cession of the region on the south shore of Lake Superior was obtained from the Chippewa Indians. Here explorations for copper immediately began, and for the first time in the United States the business of mining for the metals began to be developed on an extensive scale, with suitable appliances, and with financial success. An event of still greater importance took place almost immediately after the value of the copper region in question had been fully ascertained. This was the demonstration of the fact that gold existed in large quantities along the western slope of the Sierra Nevada of California. In five years from the discovery of gold at Coloma on the American river, the yield from the auriferous belt of the Sierra Nevada had risen to an amount estimated at between sixty-five and seventy millions of dollars a year, or five times as much as the total production of this metal throughout the world at the beginning of the century.

Mining Industries about 1850.

The following details show the development of the mineral resources of the country at the middle of the 19th century. In 1850 the shipments of anthracite amounted to nearly 3,500,000 tons; those of Cumberland or semi-bituminous coal were about 200,000 tons. The yearly production of pig iron had risen to between 500,000 and 600,000 tons. The annual yield of gold in the Appalachian belt had fallen off to about $500,000 in value, that of California had risen to $36,000,000, and was rapidly approaching the epoch of its culmination (1851–1853). No silver was obtained in the country, except what was separated from the native gold, that mined in California containing usually from 8 to 10 % of the less valuable metal. The ore of mercury had been discovered in California before the epoch of the gold excitement, and was being extensively worked, the yield in the year 1850–1851 being nearly 2,000,000 lb. At this time the copper mines of Lake Superior were being successfully developed, and nearly 600 tons of metallic copper were produced in 1850. At many points in the Appalachian belt attempts had been made to work mines of copper and lead, but with no considerable success About the middle of the century extensive works were erected at Newark, New Jersey, for the manufacture of the oxide of zinc for paint; about 1100 tons were produced in 1852. The extent and value of the deposits of zinc ore in the Saucon Valley, Pennsylvania, had also just become known in 1850. The lead production of the Missouri mines had for some years been nearly stationary, or had declined slightly from its former importance; while that of the upper Mississippi region, which in the years just previous to 1850 had risen to from 20,000 to 25,000 tons a year, was declining, having in 1850 sunk to less than 18,000 tons.

Present Position of Mining Industries.

At the end of the century, in only fifty years, the United States had secured an easy first place among the mineral-producing countries of the world. It held primacy, with a large margin, in the yield of coal, iron, lead and copper, the minerals most important in manufactures; in gold its output was second only to that of South Africa (though practically equalled by that of Australia); and in silver to that of Mexico. Although the data are in general incomplete upon which might be based a comparison of the relative standing of different countries in the production of minerals of lesser importance than those just mentioned, it was estimated by M. G. Mulhall (*Industries and Wealth of Nations*, edition of 1896, pp. 34–35) that Great Britain then produced approximately one-third, the United States one-third, and all other countries collectively one-third of the minerals of the world in weight.

The leading products, as reported by the Geological Survey for 1907, were as follows: coal, $614,798,898 (85,604,312 tons of anthracite coal, 394,759,112 of bituminous); petroleum, $120,106,749; natural gas, $54,222,399; iron ore, $131,996,147 (pig iron, $529,958,000); copper, refined, $173,799,300; gold, coinage value, $90,435,700; building-stone, $71,105,805; silver, commercial value, $37,299,700; lead, refined, $38,707,596; and zinc, refined, $26,401,910. The North Atlantic and the North Central census groups of states (that is, the territory east of the Mississippi and north of the Ohio rivers, and north of Maryland) produced two-thirds of the total output. Pennsylvania, Ohio, Illinois, West Virginia, California, Colorado, Montana, Michigan, New York and Missouri were the ten states of greatest absolute production in 1907. The rank relative to area or population is of course different. Those which, according to the bureau of the census, produced $1000 or over per sq. m. in 1902 were Pennsylvania, Ohio and West Virginia; $500 to $1000, Illinois, Michigan, Indiana, Vermont and Massachusetts. Seventeen states produced from $100 to $500 per sq. m.

The total mineral output for the decade 1899–1908 according to the United States Geological Survey was as follows:—

Year.	Total Value of Products.	Value of Non-metallic Products.	Value of Metallic Products.
	$	$	$
1908	1,595,670,186	1,045,497,070	549,923,116
1907	2,071,607,964	1,167,705,720	903,802,244
1906	1,902,517,565	1,016,206,709	886,110,856
1905	1,623,928,720	921,075,619	702,453,101
1904	1,361,067,554	859,383,604	501,099,950
1903	1,491,928,980	793,962,609	624,318,008
1902	1,323,102,717	617,251,154	642,258,584
1901	1,141,972,309	567,318,592	518,266,259
1900	1,107,020,352	512,195,262	550,425,286
1899	1,014,355,705	446,090,251	525,472,981

The vastly greater part of mineral products are used in manufactures within the United States, and only an insignificant part (for example, 2·47 % in 1902) is exported in the crude form.

Coal.

Coal exists in the United States in large quantity in each of its important varieties: anthracite, or hard coal; bituminous, or soft coal; and lignite; and in various intermediate and special grades. Geologically the anthracite and bituminous coals mainly belong to the same formation, the Carboniferous, and this is especially true of the better qualities; though it is stated by the United States Geological Survey that the geologic age of the coal beds ranges from Carboniferous in the Appalachian and Mississippi Valley provinces to Miocene (Tertiary) on the Pacific coast, and that the quality of the coal varies only to a very uncertain degree with the geologic age. The following estimates rest upon the same authority: (1) total area underlaid by coal measures, 496,776 sq. m., of which 250,531 are credited to anthracite and bituminous, 97,636 to sub-bituminous and 148,609 to lignite; (2) total original coal supply of the country, 3,076,204,000,000 short tons, including 21,000,000,000 tons of anthracite in Pennsylvania, and small amounts elsewhere (semi-anthracite and semi-bituminous), 650,157,000,000 tons of sub-bituminous and 743,590,000,000 tons of lignite; (3) easily accessible coal still available, 1,992,979,000,000 tons; (4) available coal accessible with difficulty, 1,153,225,000,000 tons.

The total production of coal from 1814 (the year in which anthracite was first mined in Pennsylvania) to 1908 amounted to 7,280,940,265 tons, which represented an exhaustion—adding 50 % for waste in mining and preparation—of 11,870,049,900, or four-tenths of 1 % of the supposed original supply.

In 1820 the total production was only 3450 tons In 1850 it was already more than 7,000,000. And since then, while the population increased 230 % from 1850 to 1900, the production of coal increased 4,084 %. At the same time that the per capita consumption thus rose in 1907 to 5·6 tons, the waste was estimated by the National Conservation Commission at 3·0 tons per capita. This waste, however, is decreasing, the coal abandoned in the mine having averaged, in the beginning of mining, two or three times the amount taken out; and the chief part of the remaining waste is in imperfect combustion in furnaces and fire-boxes. Thus, notwithstanding the fact that the supposed supply still available at the close of 1908 was 7369 times the production of that year, and 4913 times the exhaustion such production represented, so extraordinary has been the increased consumption of the country that, in the opinion of the Geological Survey (1907), "if the rate of increase that has held for the last fifty years is maintained, the supply of easily available coal will be exhausted before the middle of the next century" (A.D. 2050).

In 1870 both Great Britain and Germany exceeded the United States in the production of coal. Germany was passed in 1871 (definitively in 1877); Great Britain in 1899. Since 1901 the United States has produced more than one-third of the world's output.

Coal was produced in 1908 in 30 states out of the 46 of the Union; and occurs also in enormous quantities in Alaska; 690,438 men were employed in this year in the coal mines. Pennsylvania (117,179,527 tons of bituminous and 83,268,754 of anthracite), Illinois (47,659,690), West Virginia (41,897,843), Ohio (26,270,639), Indiana (12,314,890) and Alabama (11,604,593) were the states of greatest production. The production of each was greater still in 1907.

The total output amounted to 415,842,692 short tons, valued at

$532,314,117 in 1908; and to 480,363,424 tons, valued at $614,798,898 in 1909. Pennsylvania produced three-fourths of the total output of the country in 1860, and since 1900 slightly less than one-half. Up to 1870 there was more anthracite mined in Pennsylvania than bituminous in the whole country, but since that year the production of the latter has become vastly the greater, the totals in 1907, in which year each stood at its maximum, being 83,268,754 and 332,573,944 tons respectively.

Inasmuch as the present production is not considered locally—and with more or less justice—as at all indicative of the wealth in coal of the respective states, it may be said that according to estimates of the Geological Survey the following states are credited with the deposits indicated of true bituminous coal, including local admixtures of anthracite, the figures being millions of short tons: Colorado, 296,272; Illinois, 240,000; West Virginia, 231,000; Utah, 196,408; Pennsylvania, 112,574; Kentucky, 104,028; Ohio, 86,028; Alabama, 68,903; Indiana, 44,169; Missouri 40,000; New Mexico, 30,805. Tennessee, 25,665; Virginia, 21,600; Michigan, 12,000; Maryland, 8 044; Texas, 8,000; Kansas, 7,022; and Montana, 5,000; with lesser deposits in other states. At the same time there are estimated deposits of sub-bituminous coal, isolated or mixed with bituminous, amounting to 75,498 millions of tons in Colorado (which is probably the richest coal area of the country); and in other states as follows: Wyoming, 423,952 millions of tons; New Mexico, 132,975; Washington, 20,000; Montana, 18,560; California and Oregon, 1,000 each; and lesser amounts elsewhere. Finally, of true lignite beds, or of lignite mixed with sub-bituminous qualities, the states of North Dakota, Montana, Texas and South Dakota are credited with deposits of 500,000; 279,500; 23,000; and 10 000 millions of tons respectively. But it is to be remembered that the amount and the fuel value of both the lignite and, to a lesser degree, the sub-bituminous coals, is uncertain to a high degree.

Petroleum.

Petroleum, according to the report of the National Conservation Commission in 1908, was then the sixth largest contributor to the nation's mineral wealth, furnishing about one-sixteenth of the total. Oil was produced in 1908 in sixteen states. This productive area is divided by the United States Geological Survey into six "fields" (in addition to some scattering states) with reference to the quality of oil that they produce, such quality determining their uses. The Appalachian field (Pennsylvania, New York, Ohio, West Virginia and Tennessee) produces oil rich in paraffin, practically free from sulphur and asphalt, and yielding the largest percentage of gasoline and illuminating oils. This is the highest grade crude oil produced in the world. The California field produces oil characterized by much asphalt and little or no paraffin, and low in volatile constituents. The Lima (Ohio)-Indiana, the Illinois, the Mid-Continent (Kansas, Oklahoma and northern Texas) and the Gulf (Texas and Louisiana) fields produce oils containing more or less of sulphur and asphalt between the extremes of the two other fields just mentioned. The geological conditions of the different fields, and the details of the composition of the oils yielded, are exceedingly varied, and their study has been little more than begun

In 1859, when the total output of the country is supposed to have been only 2000 barrels of oil, production was confined to Pennsylvania and New York. Ohio, West Virginia and California appeared as producers in 1876, Kentucky and Tennessee in 1883, Colorado in 1887, Indiana in 1889, along with Illinois, Kansas, Texas and Missouri, Oklahoma in 1891, Wyoming in 1894, and, lastly, Louisiana in 1902. From 1859 to 1876 the Appalachian field yielded 100% of the total output of the country; in 1908 its share had fallen to 13·9%. In the same period of 50 years the yearly output rose from 2000 to 179,572,479 barrels (134,717,580 in 1905) and to a grand total of 1,986,180,942 barrels,[1] worth $1,784,583,943, or more than half the value of all the gold, and more than the commercial value of all the silver produced in the country since 1792. The production in 1908 exceeded in value the output of both metals. Deducing from the figures of production since 1859 an equation of increase, one finds that in each nine years as much oil has been produced as in all preceding years together, and in recent years the factor of increase has been higher. So rapid has been the extension of the yielding areas, so diverse the fate of many fields, so shifting their relative rank in output, that the outlook from year to year as regards all these elements is too uncertain to admit of definite statements respecting the relative importance of the five fields already mentioned The total output of these, it may be stated, from 1901 to 1908—uniting the yield of the Illinois to the Lima-Indiana field (since their statistics were long so united, until their industrial differences became apparent), and adding a sixth division for the production of scattered areas of production—was as follows: Appalachian, 235,999,859; Lima-Indiana-Illinois, 219,609,347; Mid-Continent, 136,148,892; Gulf, 159,520,306; California, 27,931,687; and others, 3,367,666; the leading producers in 1907-1908 being the Mid-Continent and the California areas.

The world's output of oil was trebled between 1885 and 1895, and quadrupled between 1885 and 1900. In this increase the United States had the largest share. So recently as 1902 the output of the United States was little greater than that of Russia (the two yielding 91·4% of the world's product), but this advantage has since then been greatly increased, so that the one has produced 63·1 and the other 21·8% of the total output of the world. In 1908 the Geological Survey issued a preliminary map of the then known areas productive of oil and natural gas in the United States, estimating the extent of the former at 8850 and of the latter at 9365 sq. m. The supply of oil in this area was estimated at from 15,000,000,000 to 20,000,000,000 barrels; and the National Conservation Commission of 1908 expressed the opinion that in view of the rapid increase of production and the enormous loss through misuse the supply cannot be expected to last beyond the middle of this century.

Natural Gas.

Natural gas, as a source of light and for metallurgical purposes, became important in the mid-eighties. In recent years its use for industrial purposes has lessened, and for domestic purposes increased. The existence of outflows or springs of gas in the region west of the Alleghanies had long been known, and much gas was used for illuminating purposes in Fredonia, New York, as early as 1821. Such gas is a more or less general concomitant of oil all through the petroleum-bearing areas of the country. The total output of the country rose from a value of $215,000 in 1882 to one of $54,640,374 in 1908, with several fluctuations up and down in that interval. Pennsylvania, with a product valued at $155,620,395 from 1899 to 1908, West Virginia with $84,955,496, Ohio with $48,172,450 and Indiana with $46,141,553 were the greatest producers of the Union.

The National Conservation Commission in 1908 estimated the area of the known gas fields of the country at 9000 sq. m.; the portion of their yield in 1907 that was utilized at 400,000,000,000 cub. ft.; and the waste at an equal amount—more than 1,000,000,000 of cub. ft. daily, or enough to supply all the cities in the United States of above 100,000 population.

Of other non-metallic mineral substances, apart from coal; petroleum and natural gas, little need be said in detail. Stone is of the greatest actual importance, the value of the quarry output, including some prepared or manufactured product, such as dressed and crushed stone, averaging $65,152,312 annually in 1904–1908. Limestone is by far the largest element, and with granite makes up two-thirds of the total value. Vermont, Pennsylvania and New York are the leading producers. In this, as in other cases, actual product may indicate little regarding potential resources, and still less regarding the distribution of these throughout the Union. Glass and other sands and gravel ($13,270,032), lime ($11,091,186), phosphate rock ($10,653,558), salt ($7,553,632), natural mineral waters ($7,287,269), sulphur ($6,668,215, almost wholly from Louisiana), slate ($6,316,817), gypsum ($4,138,560), clay ($2,599,986), asphalt ($1,888,881), talc and soapstone ($1,401,222), borax ($975,000, all from California), and pyrite ($857,113) were the next most important products in 1908. It may be noted that the output in almost every item of mineral production was considerably greater in 1907 than in 1908, and the isolated figures of the latter year are of little interest apart from showing in a general way the relative commercial importance of the products named. In the yield of gypsum, phosphate rock and salt the United States leads the world. In sulphur it is a close second to Sicily. Phosphate rock is heavily exported, and in the opinion of the National Conservation Commission of 1908 the supply cannot long satisfy the increasing demand for export, which constitutes a waste of a precious natural resource. Other minerals whose production may be found stated in detail in the annual volume on *Mineral Resources* of the United States Geological Survey are: natural pigments, felspar, white mica, graphite, fluorspar, arsenic, quartz, barytes, bromine. Some dozens of varieties of precious stones occur widely. Of building-stone, clay, cement, lime, sand and salt, the country's supply was estimated by the National Conservation Commission of 1908 to be "ample."

Iron.

In 1907 iron ore was mined for blast-furnace use in twenty-nine states only, but the ore occurs in almost every state of the Union. As nearly as can be estimated from imperfect statistics, the total ore production of the country rose steadily from 2,873,400 long tons in 1860 to 51,720,619 tons in 1907. The United States became practically independent of foreign ore imports during the decade 1870 to 1879. The iron-producing area of the country may be divided, with regard to natural geographic, historic and trade considerations, into four districts: (1) the Lake Superior district, embracing the states of Minnesota, Michigan and Wisconsin; (2) the southern district, embracing the triangle tipped by Texas, Maryland and Georgia; (3) the northern district, embracing the triangle tipped by Ohio, New Jersey and Massachusetts, plus the states of Iowa and Missouri; (4) the western district, which includes the states of the Rocky Mountain region and Pacific coast. Of these districts the Lake Superior region—which embraces the Marquette range (opened in 1854), the Menominee (1872), the Gogebic (1884), the Vermilion (1884) and the Mesabi (1892)—first attracted exploration about 1844, when the copper deposits of the same region were opened, and produced from 1854 to 1908 a total of 410,239,551 long tons, of which 341,036,883 were mined in the period 1889–1908. From the Mesabi range alone, opened in 1892, no less than 168,143,661 long tons were taken up to 1908. The share of the whole district for some years past has been practically four-fifths of the total output of the country; and together with the yield of the southern district, more than 90%. Minnesota alone produces more than half of the same total, having multiplied her product since 1889 by more than 33 times. Michigan held first place in output until 1901. Alabama is the third great producer of the Union, and with the other two made up in 1907 more than four-fifths of the country's total. In 1907 the product of Minnesota (28,969,658 long tons) was greater than that of Germany (with Luxemburg), and nearly twice the production of Great Britain.

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[1] Barrels of 42 gallons.

Of the two classes of iron minerals used as ores of that metal, namely, oxides and carbonates, the latter furnish to-day an insignificant proportion of the country's product, although such ores were the basis of a considerable part of the early iron industry, and even so late as 1889 represented one-thirteenth of the total. Of the oxides, various forms of the brown ores in locations near to the Atlantic coast were the chief basis of the early iron industries. Magnetites were also early employed, at first in Catalan forges, in which by means of a direct process the metal was secured from the ores and forged into blooms without being cast; later they were smelted in blast furnaces. But in the recent and great development of the iron industry the red haematite ores have been overwhelmingly predominant. From 1889 to 1907 the average yearly percentages of the red haematite, brown ores, magnetite and carbonate in the total ore production were respectively 82·4, 10·1, 7·1 and 0·4. In the census of 1870 the share of the three varieties appeared almost equal; in 1899 that of the red ores had risen to near two-thirds of the total. The red and brown ores are widely distributed, every state in the Union in 1907, save Ohio and North Carolina, producing one or both. Magnetite production was confined to mountain regions in the east and west, and only in Ohio were carbonates mined.

An investigation was made in 1908 for the National Conservation Commission of the ore reserves of the country. This report was made by Dr. C. W. Hayes of the Geological Survey. With the reservations that only in the case of certain red haematite bedded deposits can any estimate be made of relative accuracy, say within 10%; that the concentration deposits of brown ore can be estimated only with an accuracy represented by a factor varying between 0·7 and 3; and that the great Lake Superior and the less known Adirondack deposits can be estimated within 15 to 20%, the total supply of the country was estimated at 79,594,220,000 long tons—73,210,415,000 of which were credited to haematite ores and 5,054,675,000 to magnetite. Almost 95% is believed to lie about Lake Superior.

The output of pig iron and steel in 1907 was 25,781,361 and 23,362,594 long tons respectively. It is believed that the first steel made in the United States was made in Connecticut in 1728. Crucible steel was first successfully produced in 1832, Bessemer and open-hearth in 1864. Pennsylvania, Ohio, Illinois, Alabama and New York are the leading states in production.

Gold and Silver. The washing of the high or Tertiary gravels by the hydraulic process and the working of mines in the solid rock did not, on the whole, compensate for the diminished yield of the ordinary placer and river diggings, so that the product of gold in California continued to fall off, and by 1860 had decreased to about half what it had been ten years before. Discoveries in other Cordilleran territories, notably in Montana and Idaho, made up, however, in part for the deficiency of California, so that in 1860 the total amount of gold produced in the United States was estimated at not less than $45,000,000. In the latter part of the decade 1850–1859 the territories adjacent to California on the east, north and south were overrun by thousands of miners from the Sierra Nevada goldfields, and within a few years an extraordinary number of discoveries were made, some of which proved to be of great importance. The most powerful impulse to mining operations, and the immediate cause of a somewhat lengthy period of wild excitement and speculation, was the discovery and successful opening of the Comstock lode in 1859, in the western part of what is now Nevada, but was then part of Utah. About this lode grew up Virginia City. From 1859 to 1902 the total yield of this lode was $204,653,040 in silver and $148,145,385 in gold; the average annual yield from 1862 to 1868 was above eleven millions; the maximum yield $36,301,537 in 1877; and the total product to July 1880 was variously estimated at from $304,752,171·54 to $306,181,251·25. The lode was an ore channel of great dimensions included within volcanic rocks of Tertiary age, themselves broken through pre-existing strata of Triassic age, and exhibited some of the features of a fissure vein, combined in part with those of a contact deposit and in part with those of a segregated vein. The gangue was quartz, very irregularly distributed in bodies often of great sizes, for the most part nearly or quite barren of ore. The metalliferous portion of the lode was similarly distributed in great masses, known as "bonanzas." The next most famous lode is that of Leadville, Colorado, which from 1879 to 1889 yielded $147,834,186, chiefly in silver and lead. In later years the Cripple Creek district of Colorado became specially prominent.

The total output of gold and silver in the United States according to the tables published by the Director of the Mint has been as follows:—

Years.	Gold		Silver.	
	Quantity in Fine Ounces.	Value.	Quantity in Fine Ounces.	Commercial Value.
		$		$
1792-1847	1,187,170	24,537,000	300,500	404,500
1848-1872	58,279,778	1,204,750,000	118,568,200	157,749,900
1873-1908	88,833,231	1,836,344,000	1,664,271,300	1,379,862,200
	148,300,179	$3,065,631,000	1,783,140,000	$1,538,016,600

Colorado ($22,871,000), Alaska ($19,858,800), California ($19,329,700), Nevada ($11,689,400), South Dakota ($7,742,200), Utah ($3,946,700), Montana ($3,160,000) and Arizona ($2,500,000) were the leading producers in 1908, in which year the totals for the two metals were $94,560,000 for gold and $28,050,600 for silver.

The grade of precious ores handled has generally and greatly decreased in recent years—according to the census data of 1880 and 1902, disregarding all base metallic contents—from an average commerical value of $29·07 to one of $8·29; nevertheless the product of gold and silver has greatly increased. This is due to improvements in mining methods and reduction processes, which have made profitable low-grade ores that were not commercially available in 1880.

Copper. Copper was produced in 1908 in twenty-four states of the Union. Their output was almost seventeenfold the quantity reported by the census of 1860. The quantity produced from 1845—the year in which the Lake Superior district became a producer, and in which the total product was only 224,000 lb—up to 1908 was 13,106,205,634 lb. The increases from 1845 to 1850, in each decennial period thereafter, and from 1901 to 1908, were as follows, in percentages: 50·0, 27·0, 6·1, 7·2, 14·8, 9·1 and 5·8. The total product passed 10,000,000 lb in 1857, 20,000,000 lb in 1867, 30,000,000 lb in 1873, 40,000,000 lb in 1875, 50,000,000 lb in 1879 and 100,000,000 lb in 1883. Comparing the product of the United States with that of the world, the figures for the two respectively were 23,350 and 151,936 long tons in 1879, when the United States was second to both Spain (and Portugal) and Chile as a producer; 51,570 and 199,406 long tons in 1883, when the Unites States first took leading rank; 172,300 and 334,565 long tons in 1895, when the yield of the United States first exceeded that of all other parts of the world combined; and 942,570,000 and 1,667,098,000 lb in 1908.

The three leading producing states or Territories of the Union are, and since the early 'eighties have been, Arizona, Montana and Michigan. With Utah and California their yield in 1908 was 93% of the total. During the decade ending with that year the average yearly output of the three first-named was 197,706,968 lb, 267,172,951 lb and 192,187,488 lb respectively.

Lead. The production of lead was for many years limited, as already mentioned, to two districts near the Mississippi: one the so-called Upper Mines of Wisconsin, Iowa and Illinois; the other the Lower Mines of south-eastern Missouri. The national government, after reserving the mineral lands (1807) and attempting to lease them, concluded in 1847 to sell them, owing to the difficulty of preventing illegal entry and collecting royalties. The yield of the Upper Mines culminated about 1845, and long ago became insignificant. The greatest lead district is in south-western Missouri and south-eastern Kansas, known as the Joplin-Galena district after the names of the two cities that are its centre. The United States is the greatest lead producer and consumer in the world, its percentage of the total output and consumption averaging 30·4% and 32·5% respectively in the years 1904–1908. Since 1825 the total product of lead refined from domestic ores and domestic base bullion was, up to the close of 1908, 7,091,548 short tons. An annual yield of 100,000 tons was first passed in 1881; of 200,000, in 1891; of 300,000, in 1898. The total refined domestic product in 1907 was 337,340, and the total domestic lead smelted was 365,166 tons. Of the smelter domestic product 235,559 tons were of desilverized lead and 129,607 of soft lead. Considerable quantities of foreign ores and base bullion are also refined in the United States. The average percentage of metallic recovery from lead ores was about 68%, in 1880, and again in 1902, according to the national censuses of these years. According to the bureau of the census the value in 1902 of the lead yielded by copper, by non-argentiferous lead and zinc, and by gold and silver ores respectively was $19,053, $5,850,721 and $12,311,239. This reflects the revolutionary change in the history of lead mining since the first discovery of argentiferous lead ores in the Rocky Mountain states in 1864, which became available only after the building of railways. Until the completion of the Union Pacific in 1869 there was no smelting of such ores except for their silver contents. The deposits in the Joplin-Galena district were discovered in 1848, but attracted little attention for three decades. Of the soft lead smelted in 1907 no less than 94·8% came from Missouri. Idaho, Utah and Colorado produce together almost as great a proportion of the desilverized lead, half of which has come in recent years from Idaho.

Spelter production began in the United States in 1858 in an experimental way, and regular production in 1860. The census of

Zinc.

the latter year reported an output of product valued at $72,600. According to the census data for 1889 and 1902 there was an increase in value of product of 184·1 % in the interval, and of 109·5 % in the quantity of ore produced. The value of products in 1902 were reported as $340,686 from gold and silver ores, and $8,665,675 from non-argentiferous lead and zinc ores. The total product of zinc from domestic ore for the entire country was 7343 short tons in 1873, passed 100,000 tons in 1898, and 200,000 in 1907, when it amounted to 223,745 tons. From 1904 to 1908 the share of the United States in the world's output averaged 28·2 %, and in the world's consumption (disregarding stocks) 27·5 %. Of the product of 1907 above stated no less than 63·4 % came from Missouri alone; Colorado, Wisconsin, Kansas and New Jersey yielding together 30·8 % more.

Mercury.

Most of the quicksilver produced in the United States comes from California (86 % of the total in 1908), but a considerable quantity comes from Texas, and small amounts are produced in Utah, Arizona and Oregon. Veins of cinnabar are known elsewhere in the Rocky Mountain and Sierra Nevada regions but not in workable quantities. The mercurial ores of the Pacific Coast ranges occur in very irregular deposits in the form of strings and bunches, disseminated through a highly metamorphosed siliceous rock. The first locality where the metal was successfully mined was at New Almaden, about 100 m. south of San Francisco. These mines have been productive since 1824. Another old mine, discovered in 1853, is the New Idria located another 100 m. farther south. These two are still among the foremost producers.

From 1850 to 1908 California produced a total of 2,052,000 flasks of metal, of 76·5 lb (since June 1, 1904, 75·0 lb net) each. The year of greatest yield was 1877, with 79,395 flasks. The production had steadily fallen to 16,984 flasks in 1908, but in the opinion of the United States Geological Survey this reduction is mainly attributable, in recent years at least, to market conditions, and does not truly indicate the exhaustion of the mines, although the ores now available are of low grades, those of New Almaden having shown a decrease in yield from 36·7 % in 1850–1851 to 0·74 % in 1895–1896, so that only the greatest metallurgical skill and business economy can sustain the mines against a weak market.

Other Metals.

Bauxite was produced on a commercial scale in four states in 1908: Alabama, Arkansas, Georgia and Tennessee; Arkansas producing—as for years past—more than six-tenths of the total product of the country. This rose from an insignificant amount in 1889 to 97,776 long tons (valued at $480,330) in 1907. The consumption of the United States is, however, much larger than its product, and is rapidly growing. The production of aluminium rose from 83 lb in 1883 to 7,500,000 lb in 1903, and a consumption (the Geological Survey not reporting the production) of 17,211,000 lb in 1907. Antimony, bismuth, selenium, tellurium, chromic iron ore, tin, nickel, cobalt, vanadium, titanium, molybdenum, uranium and tantalum are produced in the United States in small amounts, but such "production" in several cases has amounted to only slight discoveries, and in general they are of little importance in the market. Of tungsten the United States was in 1907 the greatest producer in the world (1640 tons in a total of 6062). Tin ores have been widely discovered, but though much has been hoped for from them, particularly from the deposits in the Black Hills region of South Dakota, there has been no more than a relatively insignificant commercial production.

Commerce, Foreign and Domestic.—The English colonies that became the United States carried on during the colonial period a commerce with the mother country, and also, both so far as the legislative trammels of the British colonial system permitted it and illicitly, a fairly active commerce with the West Indies. This latter became of increasing moment in the successive periods of European colonial wars of the 18th century. With the achievement of independence by the United States the same interest became of still greater importance to the new nation, so as to constitute a leading element in its early diplomacy. Although relatively unsuccessful in securing access to the British islands, the importance of the United States as a supplier of the other West Indies continually grew, and when the communication of the French and Spanish islands with their metropolises was practically cut off by the British during the Napoleonic wars, the dependence of these colonies upon the American carrying trade became absolute. It was the profits of this neutral trade, notwithstanding the losses to which it was exposed by the high-handed measures of the British and the French governments, that caused these insults to be more or less patiently endured by the trading interests. When President Jefferson, and after him President Madison, attempted to secure redress for these injuries by the imposition of an embargo on American vessels, the West Indian trade was temporarily ruined, the war of 1812–15 with Great Britain contributing to the same end. The East Indian trade had been opened from New England ports late in the 18th century. The whaling and cod and mackerel fisheries were of earlier colonial origin. As general carriers American ships gained no importance until the Napoleonic wars; and this interest was greater in the West Indies than in Europe. Such were the main branches of national commerce up to the time of the second war with England. After the war of 1812 new outlets were found in all directions, and the commerce of the country grew apace, until in the years immediately preceding the Civil War the United States was a close second to Great Britain among the trading countries of the world. The Civil War caused enormous losses to the merchant marine, and the world-wide substitution about this time of iron steamers for wooden steamers and sailing vessels contributed to prevent a recovery; because, although ship-building was one of the earliest arts developed in the colonies, and one that was prosecuted with the highest success so long as wooden ships were the dominant type, the United States has never achieved marked success with the iron steamer, and the law has precluded the registry as American of vessels built abroad. The American "clipper" ships that were constructed at Baltimore and elsewhere during the last three decades before the Civil War were doubtless the swiftest sailers that have ever been built.

The total trade of the country by land and sea, the movement inward and outward, is shown in the following table for various years since 1861:—

Year.	Imports by Land and Sea.	Exports by Land and Sea.	Total Commerce.
	$	$	$
1861	335,650,153	249,344,913	584,995,066
1870	462,377,587	529,519,302	991,896,889
1880	667,954,746	835,638,658	1,503,593,404
1890	789,310,409	857,828,684	1,647,139,093
1900	849,941,184	1,394,483,082	2,244,424,266
1905	1,117,513,071	1,518,561,666	2,636,074,737
1909	1,475,612,580	1,728,203,271	3,203,815,851

The excess of exports over imports in the decade 1899–1908 totalled $5,728,214,844; and in the same period there was an excess of exports of gold and silver, above imports, of $444,908,963. Of the total exports of 1909 $1,700,743,638 represented domestic merchandise. The remainder, or element of foreign exports, has been of similarly small relative magnitude since about 1880, but was of course much larger while the carrying trade was of importance. From 1820 up to 1880 agricultural products made up with remarkable steadiness almost exactly four-fifths of all exports of domestic merchandise. Since then the increase of manufactures, and to a slight degree that of minerals, has lessened much the share of agricultural products, which in 1906 was 56·43 %, that of manufactures being 35·11 % and of minerals 3·09 %. The following table indicates in a general way the increased value, in round millions of dollars, of the leading agricultural exports since 1860:—

Year.	Raw Cotton.	Bread Stuffs.	Leaf Tobacco.	Meats and Dairy Products.	Cattle, and other Animals.
1860	192·0	24·0	16·0	16·9	1·8
1900	242·9	262·7	29·4	184·5	43·6
1905	381·4	107·7	29·8	200·0	46·7
1909	461·9	139·5	36·8	152·0	20·8

Classifying imports and domestic exports as of six groups: (1) crude foodstuffs and good animals; (2) foodstuffs partly or wholly prepared; (3) raw materials for use in manufacturing; (4) manufactured articles destined to serve as materials in further processes of manufacture; (5) finished manufactures; (6) miscellaneous products—the table on p. 645 shows the distribution of imports and exports among these six classes since 1820.[1]

It will be seen from the table that the share of the first two classes in both imports and exports has been relatively constant. On the other hand the great increase of imports of class III., and the great decrease of class V.; and of exports the great increase of those of class IV., and decrease of thoee of classes III. and V., all reflect the great development of manufactures in modern times. The table also shows the great rapidity of this change in recent years.

Europe takes, of course, a large share of the exports of finished manufactures—a little more than a third of the total in the quinquennial period 1903–1908; but North America takes but very slightly less. On the other hand, above 70 % of manufactures destined to serve as material in further processes of manufacture went, in the same years, to Europe, and from eight- to nine-tenths of the first three classes of exports. After Europe the largest shares of exports are taken by North America, Asia and Oceania, South America and Africa in order. The share of the five continental divisions in 1909 was as follows, respectively: $1,169,672,326; $344,767,613; $113,129,907; $83,509,047 and $17,124,298. The respective shares of the same divisions in the imports of the country were as follows: $763,704,486; $277,863,210; $223,254,724; $193,202,131 and $17,558,029. It will be seen that the commercial

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[1] The official statistics are kept current since 1820. For the years 1789–1818 consult Adam Seybert's *Statistical Annals* (Philadelphia, 1818), which are based upon official documents, a large part of which are no longer in existence.

Years.	All Imports. Percentages by Classes.						Exports of Domestic Merchandise. Percentages by Classes.					
	I.	II.	III.	IV.	V.	VI.	I.	II.	III.	IV.	V.	VI.
1820	11·15	19·85	3·64	7·48	56·86	1·02	4·79	19·51	60·46	9·42	5·66	0·16
1830	11·77	15·39	6·72	8·22	56·97	0·93	4·65	16·32	62·34	7·04	9·34	0·31
1840	15·54	15·46	11·71	11·56	45·09	0·64	4·09	14·27	67·61	4·34	9·47	0·22
1850	10·38	12·37	6·75	15·08	54·93	0·49	5·59	14·84	62·26	4·49	12·72	0·10
1860	10·11	15·26	10·48	6·67	56·52	1·00	3·85	12·21	68·31	3·99	11·33	0·31
1870	12·38	22·08	12·18	12·51	39·69	1·16	11·12	13·53	56·64	3·66	14·96	0·09
1880	15·01	17·69	19·74	16·59	29·43	1·54	32·30	23·47	28·98	3·52	11·26	0·47
1890	16·28	16·89	21·62	14·81	29·23	1·17	15·62	26·59	36·03	5·50	15·68	0·58
1900	11·52	15·65	32·50	15·79	23·90	0·64	16·59	23·21	23·75	11·15	24·22	1·08
1908	12·19	12·31	30·43	16·43	27·77	0·87	10·30	18·10	30·34	14·23	26·68	0·35
1909	11·67	10·99	35·89	17·48	23·24	0·73	6·75	16·76	33·62	14·89	27·52	0·46

interests in South America are relatively small. The shares of the ten nations having the largest part in the trade of the country were as follows in 1909:—

	Imports from	Exports to
	$	$
Great Britain	247,474,104	521,281,999
Germany	161,951,673	247,310,084
Canada, Newfoundland and Labrador	88,321,706	191,438,400
France	132,069,748	126,361,959
Cuba	107,334,716	48,217,689
Brazil	117,062,725	19,765,836
Holland	30,905,712	89,121,124
Mexico	52,578,454	53,512,947
Japan	68,116,665	23,471,837
Belgium	36,236,568	44,477,380

The leading imports in 1909 were as follows, indicating in each case, when not evidently unnecessary, the value of finished manufactures and of unmanufactured materials: Silk (manufactured, $32,963,162; unmanufactured, $75,512,401); hides and skins, other than fur skins ($103,758,277); sugar and molasses ($91,535,466); fibres, vegetables and textile grasses (manufactured, $33,511,696; unmanufactured, $54,860,698); coffee ($86,524,006); chemicals ($86,401,432); cotton (manufactured, $68,380,780; raw and waste, $15,421,854); rubber (manufactured, $1,462,541, unmanufactured, $83,682,013); wool (manufactured, $22,058,712; unmanufactured, $55,530,366); and wood (manufactured, $43,620,591; unmanufactured, $13,584,172). Precious stones ($43,620,591); fruits and nuts; copper, iron and steel; tobacco (leaf $25,897,650; manufactured, $4,138,521); tin; spirits, wines and liquors; oils, paper, works of art, tea and leather ($16,270,406), being the remaining items in excess of $15,000,000 each. The leading exports of domestic merchandise in excess of the same value were the following: cotton ($496,334,448); iron and steel, excluding ores ($157,680,331); meat and dairy products ($151,964,037); petroleum, vegetable and animal oils ($126,350,916); wheat and wheat flour ($100,529,381); copper, excluding ores ($92,584,640); wood ($72,312,880); leather ($47,146,415); tobacco ($41,554,058); coal ($38,441,518); agricultural implements ($27,327,428); corn and corn meal ($27,062,128); animals ($21,007,122); chemicals ($20,330,335); oil-cake ($20,245,818); fruits and nuts ($18,707,670); vehicles ($16,774,036); naval stores ($16,103,076); and paper ($15,280,541).

New York, New Orleans, Boston, Galveston, Philadelphia, Baltimore, San Francisco and Puget Sound are, in order, the leading customs districts of the country in the value of their imports and exports. Almost one-half of the country's foreign trade is done through the single port of New York. In 1909 more than eight-tenths of all imports of the country entered by, and more than seven-tenths of all exports went out through, the eight customs districts just named. Savannah and Charleston are other great ports and southern outlets, particularly for cotton.

Of the imports and exports of 1861 two-thirds (in value) were carried in American vessels. By 1864 the proportion had fallen to 27·5%, and except for a temporary slight recovery after the close of the war there has been a steady progress downward since that time, until in 1908 only 9·8% of the commerce of the country was carried on under its own flag. More than half the shipping entering and leaving the ports of the United States in 1908 was British; Germany, the Scandinavian countries, France, Holland and Italy ranking next in order; the United States, although ranking after Great Britain, contributed less than a seventh of the total. The total tonnage entered was 38,539,195 net tons (of 100 cub. ft. each), as compared with 18,010,649 tons in 1880.

Of the total of tonnage entered in 1909, 30,443,695 tons represented seaport entries, the remainder entering across the land frontiers.

The merchant marine of the United States in 1900 totalled 5,164,839 net tons, which was less than that of 1860 (5,353,808), in which year American shipping attained an amount which only in recent years has been again reached. In the decline that followed the Civil War an apparent minimum was reached of 4,068,034 tons in 1880; but this does not adequately indicate the depression of the shipping interest, inasmuch as the aggregate was kept up by the tonnage of vessels engaged in the coasting trade and commerce of the inland waters, from which foreign shipping is by law excluded. The decline of tonnage engaged in ocean traffic was from 2,546,237 net tons in 1860 to 1,352,810 in 1880; and this decline continued in later years. On the other hand the aggregate tonnage of the country has again begun to rise, and in 1908 the total was 7,365,445 net tons, a third of this being on the Great Lakes, and somewhat under one-half on the Gulf and Atlantic coasts. Of the same total 6,371,865 tons represented the coasting trade, only 930,413 tons being engaged in the foreign trade of the country. New England still supplies a quarter of the shipping annually built along the entire seaboard of the country; but more is yearly built upon the Great Lakes than upon the seaboard.

Internal Commerce: Railways and Canals.—Large as has become the foreign commerce of the country, it is small beside the aggregate interior commerce between the states of the Union. The basis of this is necessarily facilities for transportation. At the end of 1908 the railway lines[1] of the country totalled 232,046 m.—more than those of all Europe. The traffic on these, measured in units moved one mile, was 28,797,781,231 passenger-miles, and 214,340,129,523 freight miles. Various systems, with joint or separate outlets from the Pacific coast to the Mississippi Valley, provide for the handling of transcontinental freight. Rivers and canals are relatively much less important to-day than in the middle decades of the 19th century, before the growth of the railway traffic made small by comparison the movement on the interior watercourses. According to a special report of the department of commerce and labour of 1906, 290 streams are used to a "substantial degree" for navigation, affording together an aggregate of 2600 m. of 10 ft. navigation, or 5800 m. of 6 ft. navigation at ordinary water. Of the last almost half belongs to the Mississippi river. More than $250,000,000 has been spent by the national government for the improvement of waterways, yet no general system exists, and a large part of this enormous sum has been wasted on unimportant or impossible projects, especially in recent decades, since the river navigation has been a declining interest. 1360 m. of state-owned canals and 632 m. of private canals of "some importance" were also reported as in operation in 1909. More than an equal length of canal ways (2444 m., costing $80,000,000) was reported as having been abandoned after construction. Of recent years there has been a great revival of interest in the improvement of inland waterways upon systematic plans, which promises better than an earlier period of "internal improvements" in the first half of the 19th century, the results of which were more or less disastrous for the state and local governments that undertook them, and only less so for the national government. The Erie Canal in New York, the Chesapeake & Delaware Canal, and the Sault Ste Marie Canal are the most important in the country.

Coal, iron ore, building materials, lumber, livestock, cotton, fruits, vegetables, tobacco and grain are the great items in the domestic commerce of the country, upon its railways, inland waterways, and in the coasting trade. The magnitude of these items is so great as to defy exact determination; data for the formation of some idea of them can be found in the account of the mineral, forest and agricultural resources of the country. It was estimated by the Bureau of the Census that in 1906 the tonnage of freight moved by American vessels within American waters, excluding harbour traffic, was 177,519,758 short tons (as compared with 1,514,906,985 long tons handled by the railways of the country). Of this total 42·6% was moved on the Great Lakes, and 36·8% on the Atlantic and Gulf coasts and waterways.

The Great Lakes are connected by canals with the Atlantic, the St Lawrence river and the Mississippi; the connexion with the first being through the Erie Canal, a 7-ft. waterway, and that with the St Lawrence through Canadian canals that afford a 14-ft. navigation. The connexion with the Mississippi is through the drainage-canal of Chicago, and thence into branches of the Mississippi affording as yet even less water than the Atlantic outlet. The commerce on the lakes is largely in grain, coal, iron and lumber. The tonnage of vessels cleared between American ports on the lakes in 1908 was 103,271,885 net tons; the freight they carried came to 80,974,605 long tons. Vessels aggregating 46,751,717 net tons, carrying 57,895,149 tons of freight, valued at $470,141,318, passed through the Sault Ste Marie Canal and 47,621,078 tons of freight were moved through the Detroit river in the same year. In these figures no account is taken of the trade of the Canadian ports on the lakes. Compared with this volume of traffic the movement through the Suez Canal is small.

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[1] See further RAILWAY.

It has been estimated by O. P. Austin, chief of the national bureau of statistics, using data of 1903, that the internal commerce of the United States exceeds in magnitude the total international commerce of the world. (F. S. P.)

VII.—CONSTITUTION AND GOVERNMENT

I.—*Introductory.*

§ 1. A description of the government of the United States falls naturally into three parts:—

First, an account of the states and their governments.

Second, an account of the Federal system, including the relation of the states as communities to the Federation as representing the whole nation.

Third, an account of the structure and organization of the Federal government considered as the general government of the nation.

As the states are older than the Federal government, and as the latter was, indeed, in many respects modelled upon the scheme of government which already existed in the thirteen original states, it may be convenient to begin with the states and then to proceed to the national government, whose structure is more intricate and will require a fuller explanation.

Before entering, however, on a description of the state governments, one feature must be noticed which is common both to the states and to the Federation, and gives to the governmental system of both a peculiar character, different from that of the government of Great Britain. This feature is the existence of a supreme instrument of government, a document, enacted by the people, which controls, and cannot be altered by, any or all of the ordinary organs of government. In Great Britain parliament is the supreme power, and can change any of the laws of the country at any moment. In the American Union, and in every state of the Union, there exists a documentary or rigid constitution, creating and defining the powers of every authority in the government. It is the expression of the ultimate sovereignty of the people, and its existence gives to the working both of the Federal government and of the several state governments, a certain fixity and uniformity which the European, and especially the British, reader must constantly bear in mind, because under such a constitution every legislative body enjoys far scantier powers than in the United Kingdom and most European countries.

II.—*The State Governments.*

Origin of the American State.

§ 2. The state is the oldest political institution in America, and is still the basis and the indestructible unit of the American system. It is the outgrowth from, or rather the continuation of, the colony, as the latter existed before the Declaration of Independence in 1776. In every one of the North American colonies there was in operation at that date a system of self-government, in seven colonies under a charter from the Crown. In each there was a governor, with minor executive officers, a legislature, and a judiciary; and although the Crown retained the power of altering the charter, and the British parliament could (in strict legal view) legislate over the head of the colonial legislature so as to abrogate statutes passed by the latter, still in practice each colony was allowed to manage its own affairs and to enact the laws it desired. Thus the people were well accustomed to work their institutions, and when they gained their independence continued to maintain those institutions with comparatively little change. In two colonies, Rhode Island and Connecticut, the colonial charter was substantially maintained as the constitution of the state for many years, in the former case till 1842, in the latter till 1818.

Rights and Powers of a State.

§ 3. Each state was under the Confederation of 1781 sovereign (except as regarded foreign relations), and for most purposes practically independent. In adopting the Federal Constitution of 1787–1789, each parted with some of the attributes of sovereignty, while retaining others. Those which were retained have been to some extent diminished by the 14th and 15th amendments to the Constitution, and if the right to secede from the Union ever existed (a point much controverted), it was finally negatived by the Civil War of 1861–65. Otherwise, however, these attributes survive. The powers of a state are inherent, not delegated, and each retains all such rights and functions of an independent government as it has not, by entering the Union, affirmatively divested itself of in favour of the Federal government. Each has its own documentary constitution; its legislature of two elective houses; its executive, consisting of a governor and other officials; its judiciary, whose decisions are final, except in cases involving Federal law; its system of local government and local taxation; its revenue, system of taxation, and debts; its body of private civil and criminal law and procedure; its rules of citizenship, which may admit persons to be voters in state and national elections under conditions differing from those prevailing in other states.

The rights and functions of a state practically cover the field in which lie most of the relations of private citizens to one another and to the authorities with which they come into contact in daily life. An American may through a long life never be reminded of the Federal government, except when he votes at Federal elections (once in every two years), lodges a complaint against the post office, or is required to pay duties of customs or excise. His direct taxes are paid to officials acting under state laws. The state (or a local authority created by the state) registers his birth, appoints his guardian, provides schools for him and pays for them, allots him a share in the property of a parent dying intestate, licences him when he enters a trade (if the trade needs a licence), marries him, divorces him, entertains civil actions against him, tries and executes him for murder. The police that guard his house, the local boards which care for the poor, control highways, provide water, all derive their powers from the state. Nevertheless the state is (as will be explained later) a slightly declining factor in the public life of the nation, because public interest tends more and more to centre in the Federal or national government.

State Constitutions.

§ 4. The constitution of each state is framed and enacted by the state itself, without any Federal interference, save that the Federal Constitution requires that the Constitution under which a new state seeks admission to the Union must be "republican"; and under this requirement, Congress has seemed to assume a right of making the adoption, or omission, of any particular provision in a state constitution a condition of the admission of that particular state. Even in these cases, however, the constitution derives its force not from the national government, but from the people of the state. The invariable method of forming a constitution is for the citizens to elect by special popular vote a body called a convention to draft the document, which, when drafted and circulated, is usually, though not quite invariably, submitted to popular vote. This is done either when a state is to be formed out of a Territory (as to which see *post*, § 10), or when an existing state desires to give itself a new constitution.[1]

A state constitution usually consists of the following parts:—

A description of the state boundaries (now frequently omitted);

A bill of rights, defining the so-called "primordial rights" of the citizens to security of life, liberty and property;

A declaration and enactment of the frame of state government, *i.e.* the names, functions and powers of the houses of the legislature, the chief executive officials, and the courts of justice, with provisions regulating the electoral franchise;

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[1] Details as to state constitutions will be found in J. Bryce, *American Commonwealth*, chs. xxxvii.–xxxix., which is referred to here and subsequently as containing a fuller treatment of all the topics dealt with in this article. Further details may be found also in the articles on the separate states.

Provisions creating, or directing the creation of, a system of local government for cities and rural areas;

Miscellaneous provisions relating to law and administration, including the militia, revenue and taxation, state prisons and hospitals, agriculture, banking and other corporations, railways, labour questions;

Provisions for the amendment of the constitution;

A schedule prescribing the method of submitting the draft constitution to the vote of the people, with temporary provisions regulating the mode of transition from the old constitutional arrangements to the new ones.

The method of amending the constitution varies in detail from state to state, but that most usual is for the legislature to propose amendments, often by a prescribed majority, and for these amendments to be voted on by the people. Such amendments have latterly come to include many matters not strictly constitutional, and so to constitute a species of direct legislation by the people similar in principle to what is called in Switzerland the Referendum. Some states have recently allowed a prescribed number of voters to propose, by what is called the Initiative, amendments which are submitted to the vote of all the citizens without the intervention of the legislature.

Two remarkable changes have passed over the state constitutions. In the earlier days of the republic they were comparatively short and simple instruments, confined to the definition of civic rights and the establishment of a frame of government. They have now become very long and elaborate documents, seven, eight or ten times as long as the Federal Constitution, and containing a vast number of provisions on all sorts of subjects, many of them partaking of the nature of ordinary statutes passed by a legislature rather than safeguards suitable to a fundamental instrument. And secondly, whereas in earlier days the constitutions were seldom changed, they are now frequently recast or amended. Only Maine and Massachusetts and a few of the newer states live under original constitutions, and only Massachusetts is under a constitution older than the 19th century. Some have recast their constitutions seven or eight times. Some provide for the revision of the constitution at stated intervals. Notwithstanding the facility and frequency of amendments, the variations between one constitution and another are less conspicuous than might have been expected. There is, however, a distinction of type and character between those of the western and southern and those of the eastern states, the former being generally more prolix, more prone to go into details, more apt to contain new experiments in legislation.

Comparing the old constitutions with the new ones, it may be said that the note of those enacted in the first thirty or forty years of the republic was their jealousy of executive power and their careful safeguarding of the rights of the citizen; that of the second period, from 1820 to the Civil War (1861–65), the democratization of the suffrage and of institutions generally; that of the third period (since the war to the present day), a disposition to limit the powers and check the action of the legislature, and to commit power to the hands of the whole people voting at the polls.

State Legislatures.

§ 5. In every state the legislature consists of two houses. This remarkable feature, originally due to the practice that had prevailed in some colonies, and to the example of Great Britain, soon became universal, and the belief in its necessity has passed into a fundamental dogma, the idea being that a single chamber would be either hasty, or tyrannical or unscrupulous—perhaps all three—so that there must always be a second chamber to keep the first in order. The smaller house is called the Senate, the larger one is (usually) called the House of Representatives, sometimes, however, the Assembly—sometimes the House of Delegates. Both are chosen by popular vote, almost universally by the same voters, and usually in single-membered districts, and at the same time The senatorial districts are, of course, larger than the house districts. A senator is usually chosen for a longer term (often four years) than a representative, and, in most cases, whereas the house is elected all at once, the senate is renewed only partially at each election. In some states by law, and in all by custom also, a member must reside in the district which he represents.

Universal manhood suffrage, subject to certain disqualifications (*e.g.* certain crimes or receipt of poor relief), is the rule in the great majority of states. Certain terms of residence within the United States, in the state, and in the voting district are generally prescribed, the periods varying from state to state. Nine states allow voting rights to aliens who have declared their intention to become citizens, and in some they can as taxpayers vote on financial matters submitted to a special vote. Kansas grants them a full municipal suffrage. Fourteen prescribe some sort of educational qualification. Five states—Wyoming, Colorado, Utah, Idaho and Washington—give the suffrage for all elections to women.[1] In 1905 women could vote at school elections in twenty-four states. Of late years seven Southern states, beginning with Mississippi (constitution of 1890) and including Virginia, North Carolina, South Carolina, Georgia, Alabama and Louisiana, have so altered their constitutions as to exclude from voting the great bulk of their respective negro populations, by means of educational tests, property qualifications, a combination of both, or by other means, while various ingenious devices have been employed to admit a large part, at least, of the illiterate whites. In 1910 Oklahoma adopted provisions of the same kind. The suffrage for legislature elections generally determines that for all other elections within the state, and as a rule it carries with it eligibility to office. And by the Federal Constitution it is also the suffrage for Federal elections, viz. elections of representatives in Congress and of presidential electors.

Elections are now practically everywhere conducted under that system of secret voting, which is called in America "the Australian ballot," and which is very similar to that used in the United Kingdom since 1872. There used to be a good deal of fraud practised at elections, including "personating" and "repeating," as well as a good deal of bribery in a few states and in some of the larger cities. Legislation has reduced these evils in recent years; and efforts have been made to prevent the excessive expenditure of money at elections, and the making of contributions to party "campaign funds" by wealthy corporations who desire to secure some benefit for themselves. Another evil which has not yet been dealt with is the large number of posts for which the voter is expected at an election to select the best men. This, of course, does not apply to elections to a legislature, but in city elections, and to some extent in state elections and county elections also, it creates great difficulties, for how is the average citizen to know (especially in a large city) who are the fittest men out of a long list of candidates for perhaps ten or twenty offices, all of which have to be filled by election at the same time? The perception of these difficulties has evoked a movement for what is called "a short ballot."

The number of members of the legislative chambers varies from state to state. Delaware with 17 senators and 35 representatives, has the smallest; Minnesota, with 63 senators, has the largest Senate; and New Hampshire (a small state) has, with its 390 representatives, the largest House. The New York houses number 51 and 150 respectively; those of Pennsylvania, 50 and 204; of Illinois, 51 and 153; of Ohio, 34 and 118; of Massachusetts, 40 and 240. In all states, members of the legislature receive a salary, which is the same for both houses, some states fixing an annual sum, but most preferring a per diem rate, while the maximum is generally determined by a limitation on the length of the session.

It has become the wish of the people in most places to have sessions both short and few. Whereas formerly legislatures met annually, regular sessions are now biennial except in New York, New Jersey, Massachusetts, Rhode Island, Georgia and South Carolina—all original states. In Alabama the legislature meets regularly once only in four years, though it may be convoked in the interval.

Powers and Functions of the State Legislatures.

The Senates act as courts for the trial of state officers impeached by the house (in imitation of the British House of Lords and the Federal Senate), and have in some states the function of confirming or refusing appointments made by the governor. Otherwise the powers and procedure of the two houses are everywhere substantially identical, though it is worth noting that whereas every house chooses its own Speaker, the president of the Senate is, in most states, a lieutenant-governor, whom the people have directly elected. Bills may originate in either house, but in about half of the states money bills must originate in the House of Representatives—a survival of British custom which has here, where both houses equally represent the people, no functional value. Both houses do most of their work by committees, much after the fashion (to be presently described) of the Federal Congress, and it is in these committees that the form of bills is usually settled and their fate decided. Sometimes, when a committee is taking evidence on an important question, reporters are present, and the proceedings receive comment in the newspapers; but in general the proceedings of committees and even debates in the houses are imperfectly reported and excite no great public interest. In all the states except one, viz. North Carolina, bills passed by the two houses must be submitted to the state governor for his approval. Should he return it to the legislature disapproved, it is lost unless repassed "over his veto" by a majority usually of two-thirds, but sometimes larger, in each house. A good governor is apt to use his veto freely—indeed, a frequent exercise of the power is deemed in many states to be a sort of test of the governor's judgment and courage.

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[1] Woman suffrage amendments to state constitutions have been rejected by the people in at least twelve states and in two territories. State organizations of women to oppose the extension of the suffrage to women exist in Illinois, Massachusetts, New York and Oregon: possibly in other states also.

Subjects of state legislation may be classified under three heads:—

1. Ordinary private law, including property, contracts, torts, family relations, offences, civil and criminal procedure.

2. Administrative law, including the regulation of urban and rural local government, state and local taxation and finance, education, public works, the liquor traffic, vaccination, adulteration, charities, asylums, prisons, the inspection of mines and factories, general laws relating to corporations, railways, labour questions.

3. Matters of a local or special nature, such as bills for chartering and incorporating gas, water, canal, tramway, railway or telephone companies, or for conferring franchises in the nature of monopolies or special privileges upon such companies, or for altering their constitutions, as also for incorporating cities or minor communities and regulating their affairs. Although there usually exist general laws under which corporations or companies (including railway and electric car companies) can be formed, laws which in some states and for some purposes confer a greater freedom of incorporation than the general law allows in the United Kingdom, there is nevertheless a noticeable tendency to come to the legislature for special purposes of this kind.

As respects class 1, there is not much change in the law from year to year. The legal profession does not like to see the ordinary and established rules disturbed. Sometimes the laws belonging to this class are codified, or rather consolidated, and then usually by a special committee of competent lawyers whose work is passed *en bloc* by the legislature.

As respects class 2, a good many measures are passed, particularly in matters affecting labour, and for the protection of any sections of the population which may be deemed to need protection.

It is, however, in class 3 that the legislatures show most activity, much of it pernicious, because prompted by persons seeking to serve private interests which are often opposed to the interests of the whole community. The great "public service" corporations have, in particular, frequently succeeded in obtaining franchises of large pecuniary value without making any adequate payment therefor. A peculiarly notable form of this special or private bill legislation is that of dealing by special statutes with the governmental forms and details of management of municipalities; and the control exercised by the state legislatures over city governments is not only a most important branch of legislative business, but at the same time a means of power to scheming politicians and of enrichment to greedy ones. This has led in some states to the grant of power to cities to frame their own charters. Speaking generally, it is chiefly in the sphere of special or private legislation that state legislatures have shown their weak side, and incurred, in many states, the distrust of the people.

The members of these bodies belong for the most part, though by no means entirely, and least so in the agricultural states, to the class of professional politicians. They are seldom persons of shining ability or high standing in their communities. Except as a stepping-stone to a seat in Congress or a high executive post, the place is not one which excites the ambition of aspiring men. The least respected legislatures are those of the richest and most populous states, such as New York and Pennsylvania, because in such states the opportunities offered to persons devoid of scruple are the largest.

The general decline in the quality of these bodies, and especially their proneness to pass ill-considered or pernicious bills at the instance of private promotors, has led to the restriction in recent years of their powers by the insertion in the state constitutions of many provisions forbidding the enactment of certain classes of measures, and regulating the procedure to be adopted in the passing, either of statutes generally or of particular kinds of statutes. Even these provisions, however, are frequently evaded.

The State Executive.

§ 6. At the head of every state government stands an official called the governor, who is the descendant and representative of the governor of colonial times. Under the earlier constitutions of most of the original thirteen states he was chosen by the legislature, but he is now everywhere directly elected by the people, and by the same suffrage as the legislature. His term of office is four years in twenty-three states (including Pennsylvania and Illinois), three years in one state, two years in twenty, and one year in two (Massachusetts and Rhode Island). In a few states there are prohibitions on re-election.

It is the duty of the governor to see that the laws of the state are faithfully administered by all officials, and the judgments of the courts carried out. He has, in most states, the right of reprieving or pardoning offenders, but some recent constitutions place restrictions on this power. He is also commander of the militia or other armed forces of the state, which he can direct to repel invasion, or suppress insurrection or riot. He appoints some of the state officials, his nominations usually requiring the concurrence of the state senate; but his patronage is in most states not very large—in many it is indeed insignificant—because the offices of greatest importance are filled by direct popular election. He has also the almost mechanical function of representing the state for various formal purposes, such as demanding from other states the extradition of offenders, the issuing of writs for the election of members of the legislature and of members of the Federal House of Representatives, and the receiving of reports from various state officials or boards.

Not less important than his directly executive work is the influence which the governor exerts upon state legislation through his possession (in all the states but one) of a veto power. His right of recommending measures to the legislature (which does not formally include that of framing and presenting bills, but practically permits him to have a bill prepared and use all his influence on its behalf) is of greater value according to the extent to which he leads the public opinion of his state. The legislature need not regard his counsels, but if he is a strong man whom the people trust, it may fear him and comply with his demands. When a commercial crisis occurs much may depend on his initiative. Moreover, his veto is a thing to be reckoned with. It is seldom overridden by the prescribed majority, especially if the bill against which it is directed be one of a jobbing nature. And as the people look to him to kill bad measures, he is frequently able, if he be a man both strong and upright, to convey intimations to the legislature, or to those who are influential in it, that he will not approve of certain pending measures, or will approve of them only if passed in a form satisfactory to him. The use of this potential authority, which the possession of the veto power gives, has now become one of a governor's most important duties.

In New England, and in the greater states generally, the governorship is still a post of dignity, and affords an opportunity for a display of character and talents. During the War of Secession, when each governor was responsible for organizing troops from his state, much turned upon his energy, popularity and loyalty. And in recent years the danger of riots during strikes has, in some states, made it important to have a man of decision and fearlessness in the office which issues orders to the state militia. There has been of late years a revival in the case of some able governors of the old respect for, and deference to, the office.

In thirty-five states there is a lieutenant-governor, elected by popular vote. He is usually president of the state senate, is sometimes a member of some administrative boards, and steps into the governor's place should it become vacant.

Executive councils advising the governor, but not chosen by him, existed under the first constitutions of all the original thirteen states. In New York the council of appointment advised the governor only in regard to appointing officers; and in Georgia there was no executive council after 1789. True executive councils have now disappeared except in Massachusetts, Maine and New Hampshire.

Administrative Offices in a State.

§ 7. The names and duties of the other officers vary from state to state. In every state there are a secretary of state, who is custodian of the documents and archives, and a treasurer. Nearly everywhere there are also a comptroller or auditor, who keeps the accounts and is the principal financial officer, an attorney-general or legal adviser, an adjutant-general, who has immediate charge of the militia, and a superintendent of public instruction, with some little authority over the public schools. Most of the states have also a board of charities, a board of health, a board of railway commissioners, and either boards or single commissioners for banking, insurance, agriculture, public lands and prisons. Other administrative departments found in different states are those having control of public works—principally canals—insane hospitals, factory inspection, labour statistics and immigration. New York state, with nearly fifty different administrative bureaus, has a larger number than any other state. In many states the most important of these officials are elected by the people at a general election, but some officials are either chosen by the legislature or appointed by the governor, the latter method applying mainly to offices of recent creation. The terms of office vary for the different offices, very few exceeding four years. The state officials, being thus largely independent of the governor, and responsible only to the people, are in no sense a cabinet (save in North Carolina). Each administers his own department, subject to the detailed regulation imposed by statutes, and as these statutes determine such matters as might come into controversy, a general agreement in policy among the administrative officials is not essential.

In many states officials may be removed, not only by impeachment, but also sometimes by vote of the legislature, sometimes by the governor on the address of both houses, or by the governor either alone or with the concurrence of the senate; but such removals must be made for specific misconduct.

The extent of direct state administration of public institutions and works is very limited, and most of the state bureaus have only a supervision over private enterprises, or over local administrative officers. On this account the subordinate civil service of the state is not large compared with that of either the Federal government or of the large municipalities, and only in a few states does it possess any importance. However, these bureaus are seldom well manned, because salaries and tenure of office are seldom such as to induce able men to offer themselves, while the places are often given as rewards for political service. New York, Massachusetts and a few other states have systems of civil service examinations, similar to those in the Federal administration, which serve to keep certain branches out of politics.

The State Judiciary.

§ 8. The judiciary is in every state an independent department of the government, directly created by the state constitution, and not controlled in the exercise of its functions either by the legislature or by the executive. In every state it includes three sets of courts: a supreme court or court of appeal; superior courts of record; and local courts, but the particular names and relations of these several tribunals vary greatly from state to state. Most of the original thirteen colonies once possessed also separate courts of chancery; and these were maintained for many years after the separation from Great Britain, and were imitated in several of the earlier among the new states, but special chancery courts now exist only in a few of the states, chiefly in the East and South. In other states the common law judges have also equity jurisdiction; and in four states—New York, North Carolina, California and Idaho—there has been a complete fusion of law and equity.

In colonial days the superior judges were appointed by the governors, except in Rhode Island and Connecticut, where the legislatures elected them. These precedents were followed in all the revolutionary constitutions, except in Georgia, where election by the people was established. During the democratizing period from 1820 to 1860 the system of popular election was extended, especially in the new states, and at present this system prevails in thirty-six states, including practically all of the new states and five of the original states—New York, Pennsylvania, Maryland, North Carolina and Georgia. Three of the original thirteen have their judges elected by the legislatures, and in five others, together with Maine and Mississippi among the newer states, they are appointed by the governor, subject to the approval of the executive council, the Senate, or (in Connecticut) the General Assembly. Local judges are generally chosen by the voters of the district in which they hold court.

Originally the superior judges were in most states appointed for life and held office during good behaviour, but only three states now retain this system. Eight to ten years is the average term of service; it is longer in New York (14), Maryland (15), and Pennsylvania (21), where alone superior judges are not re-eligible. Salaries, too, are small in most states, often not more than one-tenth of what a prominent lawyer can make by private practice.

These three factors—popular election, limited terms and small salaries—have all tended to lower the character of the judiciary; and in not a few states the state judges are men of moderate abilities and limited learning, inferior (and sometimes conspicuously inferior) to the best of the men who practise before them. Nevertheless, in most states the bench is respectable in point of character, while in some it is occasionally adorned by men of the highest eminence. The changes introduced since 1870 have been, on the whole, for the better, though there is still room for further improvement. Corruption seems to be very rare, but instances of subservience to powerful political groups sometimes shake public confidence. Things would doubtless have become worse but for the watchfulness which the bar generally shows in endeavouring to secure the selection of honest and fairly competent men. The administration of civil justice is decidedly better than that of criminal justice. The latter is in many states neither prompt nor certain, offenders frequently escaping through the excessive regard for technicalities even more than through the indulgence of juries and the occasional weakness of judges.

It must be remembered that the courts of each state form a judicial system, complete in itself, and independent of the Federal courts, and, of course, of other states. There is no appeal from the highest state court, except in those cases where a question of Federal law is involved, for then such cases may be removed, in manner to be explained hereafter, to the Federal courts. And, subject only to this limitation, the jurisdiction of the state courts covers the entire field of civil and criminal law. The existing legal system of all the states, except Louisiana, whose law is based on the Roman, have been built upon the foundation of the principles contained in the common and statute law of England as that law stood in 1776, when the thirteen colonies declared their independence. In the development of the law since that time the courts of one state are not bound either by law or by usage to follow the decisions either of the Federal courts or of the courts of any other state, any more than they would follow English courts, although such decisions are used and discussed as evidence of the common law, and great deference is always shown to the opinions expressed by the Federal courts. In many states the legislatures have taken action in the development of law by adopting statutory codes of procedure, and in some instances have even enacted codes embodying the substance of the common law fused with the statutes. These latter codes have not, however, received the general approval of the legal profession.

It is, of course, to the state courts that the duty belongs of construing the constitution as well as the statutes of the state, and if they find any state law to be inconsistent with the state constitution it is their duty to declare it invalid. It is also the duty of the state court to declare any state law invalid if it is contrary to the Federal constitution or to a Federal statute or treaty. As in the case of the similar power of the Federal judges, this is founded on no special commission, but arises out of the ordinary judicial function of expounding the law and discriminating between the fundamental law and laws of inferior authority (see *post*, § 25).

Change in the Political Importance of the State.

§ 9. Wide as is the range of the rights and powers of a state, and elaborate as is the structure of its government, the state holds a practically less important position in the American system than it once did, and has not so strong a hold as it had in the first quarter of the 19th century upon the loyalty and affection of its citizens. The political interest and the patriotism of the people generally are now given rather to the nation as a whole than to a state, whereas in the two generations following the Revolutionary War the opposite would have been the case. This notable difference is due not to any constitutional changes, for there has been none except those contained in the 13th, 14th and 15th amendments to the Constitution, but to the three following causes:—

The first is the growth of the party system with its complicated machinery, which has linked the citizens of different states more closely together, and has led to the eclipsing of political issues confined to a state by issues which are matters of controversy throughout the nation.

The second cause is the Civil War of 1861–65, which practically negatived the far-reaching claims of state sovereignty and the right of secession made by statesmen of the type of Calhoun, and showed that the nation was really much stronger than any group of states.

The third is the enormous development of swift and cheap communications by land and water, and the growth of commerce and of productive industry, which have brought every part of the country into much closer relations with every other part, and have increased the sense of economic solidarity.

The Territories.

§ 10. During the entire history of the United States there has been a considerable area within the jurisdiction of the Federal government not included in that of any one or more of the states; and the systems of government for the various parts of this area require some description. The Territories (strictly so called) were at one time important, though now less so, because there remain only two, the unorganized Territory or District of Alaska, and the Hawaiian Islands in the Pacific Ocean. Till 1910 there were the two organized Territories of Arizona and New Mexico, but in that year Congress passed an act for their admission as states. Previously to that year there had been ever since 1787 a large area of the continent which, while belonging to the United States, was deemed too thinly peopled to be fit to be divided up into states. Parts of this area were, however, set off and organized as Territories, receiving a qualified form of self-government while under the ultimate control of Congress for the purposes of legislation. When these parts had been sufficiently filled up by settlers, they were allowed to organize themselves as states, each giving itself a constitution. The Territorial government consisted of a legislature of two houses elected by the people, with a governor appointed by the president of the United States, with the consent of the Senate, and judges similarly appointed. The Territories were not represented in Congress, but each could send a delegate to the House of Representatives, who could speak there but not vote.

Since the Spanish War of 1898 there have been added to the United States various transmarine dominions, none of which has been formed into a state, or is likely to be so formed for a good while to come; and there is also one small piece of original area of the United States, viz. the District of Columbia, which is outside any state, because it contains the national capital. The transmarine dominions are Alaska, the Hawaiian Islands, Porto Rico, the Philippine Islands, and the Canal Zone on the Isthmus of Panama.

III.—*Local Government.*

Rural Local Government.

§ 11. Every state in the Union has its own system of local administrative areas and local authorities, working under its own laws, these systems agreeing in many points with one another, and differing in many others. Three main types of rural local government may be distinguished, prevailing in different regions. The first is characterized by its unit, the town or township, and exists in the six New England states. The second is characterized by a much larger unit, the county, and prevails in the southern states. The third may be called the mixed system, combining some features of the first with some of the second, and is found under a considerable variety of forms in the middle and north-western states. The different types spring from the original differences in the character of the colonists who settled on the Atlantic coast, and in the conditions under which the various colonial communities developed. (See *American Commonwealth*, chs. xlvii. and xlix.)

The *town*, or township, of New England is generally a rural community occupying a comparatively small area, and with a population averaging about 3000, but ranging from 200 in newly-settled districts or thinly-peopled hilly districts up to 17,000 in the vicinity of large cities and in manufacturing neighbourhoods. Each town is governed by the town meeting, an assembly of all the qualified voters within the limits, which meets at least once a year in the spring, and also at other times when specially summoned. This assembly elects the town officials at the annual meetings, but it is much more than an electoral body. It is also a deliberative assembly and the legislative authority for local matters. It enacts by-laws and ordinances, receives the reports of the local officials, passes their accounts, manages the town property, votes appropriations for each item of expenditure, and authorizes the necessary taxation. Every resident citizen has the right to bring forward and to speak in favour of any proposal. The meeting is presided over by a chairman called the moderator. In rural communities the attendance is usually good, the debates are sensible and practical, and a satisfactory administration is generally secured. But when the town meeting has grown to exceed seven or eight hundred persons, and especially when the farming class of native American stock has been replaced by factory operatives of other nationalities, the institution works far less perfectly.

The town officials consist of the "selectmen" (usually three, five or seven, sometimes nine), the town clerk, treasurer, assessors, tax collector, school committee men, and the holders of divers minor offices according to local needs. These are elected annually, except that in some cases the "selectmen" and school committee have a term of several years, one member of each board being elected annually. The "selectmen," who receive no regular salary, but may charge for expenses actually incurred, form a sort of directory or executive committee, which manages the ordinary administrative and financial business under such instructions as may have been given by the town meeting.

In the Middle and Western states the township is a more artificial organism than the rural town of New England. In one group of states—Pennsylvania, New Jersey, New York, Ohio, Indiana, Iowa—while the township has more or less power, and there are town officials, there is no town meeting. In another group—Michigan, Illinois, Wisconsin, Minnesota, the two Dakotas—the town meeting reappears, though in a less primitive and less perfect form. In the states west of the Alleghanies each township covers an artificial area 6 m. square, and a separate quasi-municipal organization is usually provided for the villages which have grown up in many townships.

The *county* is to be found in every state of the Union, but its importance varies inversely with the position held in the system of local government by that smaller and older organism, the town. In New England the county was originally an aggregation of towns for judicial purposes, and in that part of the Union it is still in the main a judicial district. There is no general representative council or board, but judicial officers, a sheriff and a clerk, are elected in each county, and also a county treasurer and county commissioners. The latter have the management of county buildings, such as courthouses and prisons, have power to lay out new main highways, to grant licences, and to apportion among the towns and cities the taxation necessary to meet county expenses. Besides these officials there are generally to be found in New England a county school superintendent and an overseer of roads. In the Southern states the county is the local administrative unit, and in addition to its original judicial and financial functions it has now also control over public schools, the care of the poor and the construction and management of roads. County government is generally vested in a board of county commissioners, elected (in almost every state) by the people, and in various officials also directly elected. In some Southern states some counties have been subdivided into school districts, each of which elects a school committee, and from this nucleus there may possibly develop something resembling the New England town. In those Middle and Western states where the town meeting is not found, the functions and officials of the county tend to resemble those existing in the Southern states, while even in those parts of the west where the town meeting is found the county remains more important than in New England. Thus in many of these states poor relief is a county and not a town charge. In most states county administration belongs to a small board of three commissioners elected for the county at large, but in New York, Michigan, Illinois and Wisconsin there is a larger board of supervisors elected by townships and cities within each county. Although local affairs do not now enlist, even in New England, so large a measure of interest and public spirit as the town system used to evoke in Massachusetts, Rhode Island and Connecticut in the 'thirties, still, broadly speaking, the rural local government of America may be deemed satisfactory. The administration is fairly cheap and fairly efficient, most so, on the whole, in the Northern and Western states, while jobbery and corruption are uncommon. The value of local self-government as a training for the duties of citizenship has been very great, and in many parts of the country, especially where the funds dealt with are small, elections are not fought and offices not distributed upon party lines.

City Government.

§ 12. The tendency, now so marked in nearly all civilized countries, to the development of urban communities has been nowhere more marked than in the United States. The increase in the range and importance of municipal functions has been not less striking than the growth of urban population. This can best be illustrated by the figures of municipal expenditure. In 1810 the annual budget of New York city—with a population of 100,000—was $100,000, to-day an average city of 100,000 population has an annual expenditure of from $1,000,000 to $2,000,000, and the total expenditure of the city of New York in 1909 exceeded $150,000,000. Municipal government is therefore a matter of high concern to America, and plays a large part in any study of American political institutions.

The historical origin of American municipal government is to be found in certain boroughs which had been chartered in the colonial period, after the fashion of English boroughs. These American corporations had the usual English system of borough government, consisting of a mayor, aldermen and councilmen, who carried out the simple administrative and judicial functions needed for the then small communities. The basis for the government of each American city is still a charter, but since the Revolution these charters have been granted by the state legislatures, and are subject to constant change by statute. The charters of cities have shown the same process of increasing length and detailed regulation as the state constitutions; and in details there are many differences between different cities. In some states cities are now permitted to enact their own charters. (See *American Commonwealth*, chs. l.-lii.)

As a rule, one finds (1) a mayor, elected directly by the voters within the city, who is the head of the administration; (2) administrative officers or boards, some directly elected by the city voters, others nominated by the mayor or chosen by the council; (3) a council or assembly, consisting sometimes of two, but more frequently of one chamber, elected directly by the city voters; and (4) judges, usually elected by the city voters, but sometimes appointed by the state.

The mayor is by far the most important official in the city government. He is elected usually for two years, but sometimes for one, three or four (in New York his term is now four years). He has almost everywhere a veto on all ordinances passed by the council, modelled on the veto of the Federal president and of a state governor. In many cities he appoints some or all of the heads of the administrative departments, usually with the approval of the council, but in some important cities the mayor has an absolute power of appointment. As the chief executive officer, he preserves the public peace. In practice he is often allowed to exert a certain discretion as to the enforcement of the laws, especially those providing for Sunday closing, and this discretion has sometimes become a source of mischief. He usually receives a considerable salary, varying with the size of the city.

The practical work of municipal administration is carried on by a number of departments, some under single heads, and some under boards or commissions. The number and classification of these departments vary widely in the different cities. The board of education, which controls the public schools, is usually largely independent of the council, and in some important cities has an independent power of taxation. In Boston, St Louis, Baltimore, and some few other cities, the police board (or commissioner) is appointed by the governor because police matters had been mismanaged by the municipal authorities and occasionally allowed to become a means of extortion and a door to corruption.

The city councils pass local ordinances, vote appropriations, levy taxes and generally exert some control over appointments to administrative positions. The recent tendency has been, however, to decrease the powers of the council and to increase those of the mayor. In some cities the mayor has received an absolute power of appointment; the departments, especially the boards of health, have large ordinance-making powers; statutes passed by the state legislature determine (excepting the states where cities can make their own charters) the principal lines of municipal policy, and the real control over appropriations and taxes is occasionally found vested in a board of estimate, consisting of the mayor, comptroller (the chief financial officer), and a few other administrative officials. In New York City, where the council had lost public confidence, and in some other places, the only important power still possessed by the council is that of granting franchises to street railways, gas companies and the like. In the smaller cities, however, the councils have retained a wider measure of authority. In 1902 the city of Galveston, in Texas, adopted a new form of municipal government by vesting all powers in a commission of five persons, elected by the citizens on a "general ticket," one of whom is mayor and head of the commission, while each of the others has charge of a department of municipal administration. A similar plan, differing in some details, was subsequently introduced in the city of Des Moines, in Iowa; and the success which has attended this new departure in both cities has led to its adoption in many others, especially, but not exclusively, in the Western states. In 1910 more than seventy cities were so administered. Under it administration would appear to have become both more pure and more efficient. The functions of city government may be distributed into three groups: (*a*) Those which are delegated by the state out of its general coercive and administrative powers, including the police power and the granting of licences; (*b*) those which, though done under general laws, are properly matters of local charge and subject to local regulation, such as education and the relief of the poor; and (*c*) those which involve no questions of policy, but are of a purely business nature, such as the paving and cleansing of streets, the construction and maintenance of drains, the provision of water, &c.

Initiative, Referendum and Recall.

It is here proper to advert to a remarkable extension of direct popular government which has in recent years been applied both to states and to cities. Several state constitutions now contain provisions enabling a prescribed number (or proportion) of the voters in a state or city to submit a proposition to all the registered voters of the state (or city) for their approval. If carried, it takes effect as a law. This is the Initiative. These constitutions also allow a prescribed number of voters to demand that a law passed by the state legislature, or an ordinance passed by the municipal authority, be submitted to all the voters for their approval. If rejected by them, it falls to the ground. This is the Referendum. Some cities also provide in their charters that an official, including the mayor or a member of the council, may be displaced from office if, at a special election held on the demand of a prescribed number of the city voters, he does not receive the largest number of votes cast. This is the Recall. All these three institutions are in operation in some Western states and are spreading to some of the Eastern cities. Their working is observed with lively interest, for they carry the principle of direct popular sovereignty to lengths unprecedented except in Switzerland. But it is not merely to the faith of the Western Americans in the people that their introduction is due. Quite as much must be ascribed to the want of faith in the legislatures of states and cities, which are deemed too liable to be influenced by selfish corporations.

IV.—*The Federal System.*

§ 13. When, in 1776, the thirteen colonies threw off their allegiance to the British Crown and took the title of states, they proceeded to unite themselves in a league by the Articles of Confederation of 1781. This scheme of union proved defective, for its central authority, an assembly called Congress, was hopelessly weak. It had neither an executive nor a judiciary, nor had it proper means of coercing a recalcitrant state. Its weakness became so apparent, especially after the pressure of the war with Great Britain had been removed, that the opinion of the wisest men called for a closer and more effective union. Thus the present Constitution was drafted by a convention in 1787, was ratified by nine states (the prescribed number) in 1788, and was set to work under George Washington as first president in 1789.

The Federal Constitution.

§ 14. The Constitution is a document of the first importance in the history of the world, because it has not only determined the course of events in the American Republic, but has also influenced, or become a model for, other constitutions, such as those of Switzerland (1848 and 1874), Canada (1867), Australia (1900), besides Mexico and the numerous republics of South and Central America. It was in substance a compromise effected between those who wished for a centralized government and those who desired to leave very wide powers to the component states, and many subsequent difficulties arose from the omission to settle certain points, and from the somewhat vague language in which other points were referred to. Of these omissions and points left vague, some were inevitable, because an agreement could not have been reached, some were due to the impossibility of foreseeing what difficulties the future would bring with it. But they were, considering the conditions under which the instrument was framed, comparatively few, and the Constitution, when one regards it as a piece of drafting, deserves the admiration which it has received from nearly all American and most foreign critics. It is, on the whole, admirably clear, definite and concise, probably superior in point of technique to all the documents since framed on its model.

As respects substance, the Constitution, being enacted by and expressing the will of the people, who are the ultimate source of political power, is the supreme law of the land over the whole Union, entitled to prevail over all laws passed by Congress, the legislature which it creates, as well as over all state constitutions and all state laws. It can be altered only by the people, in manner to be hereafter mentioned. It is a comparatively short document, and consists of seven articles, subdivided into sections. Art. I. deals with the Federal legislature, its structure and powers, and imposes certain restrictions upon the states. Art. II. provides for the election of an executive head, the president, and assigns certain powers and duties to him. Art. III. treats of the judicial power, defining its range and the mode of its exercise. Arts. IV., V. and VI. contain certain miscellaneous provisions, including those which regulate the mode of amendment. Two alternative methods of proposing amendments and also two of passing them are recognized. They may be proposed either by a two-thirds vote in each house of Congress, or by a convention called by Congress on the application of the legislatures of two-thirds of the states. They may be passed either by the legislatures of three-fourths of the states, or by conventions in three-fourths of the states. Congress has in every instance preferred the method of itself proposing amendments and the method of submitting them to the state legislatures for ratification.

The provisions of the Constitution, which is later in date than the creation of the original states, and presupposes the existence and activity of those communities, include two sets of matters, which must be considered separately—(*a*) the Federal system, *i.e.* the relations of the national government to the states; and (*b*) the structure of the national government itself.

Distribution of Powers between the Nation and the State.

§ 15. In the determination and allotment of the rights and powers of the national government on one side and of the states on the other, a determination which is the foundation of every federal system, the American Constitution proceeds upon these principles:—

1. No powers are expressly allotted to the states, because the states are contemplated as continuing to enjoy those pre-existing powers which they have by their own right, and not as devolved upon them by the nation.

2. The powers allotted to the national government are those, and those only, which are required for the purposes of the collective life of the nation, *i.e.* (*a*) powers which relate to its action in the international sphere; and (*b*) powers which can be exercised within the Union more efficiently and more to the benefit of the people by one central government than by a number of separate governments.

3. All powers which are not expressly allotted to the national government are left to the states, unless specially forbidden to be exercised by the latter, *i.e.* powers not specifically referred to remain with the states, and if the national government wishes to claim any particular power, it must show affirmatively that that power has been granted to it by the Constitution. [This principle has been followed in the Constitution of Australia, but not in that of Canada.]

The powers given to the national government may be described as those which subserve purposes of common national utility.[1] They are the following (see Const. art. I. § 8):—

To impose and collect taxes, which must be uniform throughout the United States;

To borrow money on the credit of the United States;

To regulate foreign and inter-state commerce;

To establish a uniform rule of naturalization and a uniform bankruptcy law;

To coin money and fix the standard of weights and measures;

To establish post offices and post roads;

To secure exclusive rights for limited time by granting patents and copyrights;

To constitute tribunals inferior to the Supreme Court;

To declare war, and regulate captures on land and water;

To raise and maintain an army and a navy;

To provide for calling out the militia, for organizing and arming them, and for governing such part of them as may be in the actual service of the United States;

To exercise exclusive jurisdiction in the area selected for the seat of the national government and over spots acquired for military or naval purposes;

To make all laws necessary for carrying out the above powers (including laws punishing such offences as fall within Federal jurisdiction as being transgressions of Federal law);

To pass laws protecting citizens of the United States against unjust or discriminating legislation by any state (amendments xiii. and xiv.).

Powers withheld from the National Government.

§ 16. The national government is, however, interdicted from using these powers in certain directions by the following prohibitions (art. I. § 9, and first ten amendments): It may not suspend the writ of habeas corpus (except in time of war or public danger) or pass a bill of attainder or an *ex post facto* law; give any state a commercial preference over another; grant any title of nobility; establish or prohibit any religion, or impose any religious test as a condition of holding office; abridge the freedom of speaking or writing, or of public meeting, or of bearing arms; try any person for certain offences except on the presentment of a grand jury, or otherwise than by a jury of his state and district; decide any common law action where the value in dispute exceeds $20 except by a jury.

Although prima facie all powers not given to the national government remain with the states, the latter are debarred from some powers. No state may (art I. § 10, and amendments xiii., xiv. and xv.) make any treaty or alliance; coin money or make anything, save gold and silver coin, a legal tender; pass any bill of attainder or *ex post facto* law, or law impairing the obligation of contracts; have any but a republican form of government; grant any title of nobility; maintain slavery; abridge the privileges of any citizen of the United States, or deny to him the right of voting on account of race, colour or previous condition of servitude; deprive any person of life, liberty or property without due process of law; deny to any person the equal protection of the laws.

There are also certain powers which, though not absolutely withdrawn from the states, can be exercised only with the consent of the national legislature, viz. those of laying duties on exports or imports, keeping troops or war-ships in time of peace, entering into agreements with another state or foreign power, engaging in war unless invaded. And it may be added that there are certain powers which, since they do not lie within the province of the national government, and have been refused to the states, are said to be "reserved to the people." This expression means that it is only the people who can confer them and direct them to be exercised. Should the people wish to confer them, they would have to do so by way of amending the Constitution; and herein lies a remarkable difference between the American system on the one hand and those of some European countries on the other, which, although they have created rigid constitutions, do not expressly debar the legislature from using any and every power of government.

Relations of the National Government to the States.

§ 17. The aim of those who framed the Constitution was to avoid friction between the state governments and the Federal government by rendering their respective spheres of action as separate and distinct as possible. They saw that the less contact the less danger of collision. Their wish was to keep the two mechanisms as independent of each other as was compatible with the still higher need of subordinating, for national purposes, the state to the central government.

Nevertheless there are, as was unavoidable, certain points of contact between the two, the chief of which are the following:—

The Constitution requires each state government to direct the choice of, and accredit to the seat of the national government, two senators and so many representatives as the state is (in respect of its population) entitled to send; to provide for the election, meeting and voting of presidential electors in each state, and to transmit their votes to the national capital; to organize and arm the militia forces of the state, which, when duly summoned by the national government for active service, are placed under the command of the president.

Besides these direct services imposed upon the states, each state is of course practically limited in its legislative and executive action by the power of the Federal judiciary (in the exercise of its function of interpreting the Constitution) to declare invalid laws passed or acts done inconsistent with the Federal Constitution, or with statutes passed by the Federal legislature within the scope of its authority under the Constitution.

So, too, when a subject, such as bankruptcy, is one on which a state may legislate in the absence of legislation by Congress, the state law is valid only so long as Congress does not legislate.

Finally, another point of contact exists in the right of a state to call upon the national government to protect it against invasion or domestic violence. This right has been several times exerted. The national government is also bound to guarantee to every state a republican form of government. (See *American Commonwealth*, ch. xxviii.)

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[1] As to the scheme and working of the Federal government in its relation to the states, see *American Commonwealth*, chs. xxvii.–xxx.

Direct Authority of the National Government over the Citizens of the States.

§ 18. It is a fundamental principle of the American system that the national government possesses a direct and immediate authority over all its citizens, quite irrespective of their allegiance and duty to their own state. This authority corresponds to and is coextensive with the sphere of the Federal government. So far as the functions of that government extend, it acts upon the citizens not through the states, but as of its own right and by its own officers. Beyond that sphere its authority stops, and state authority, unless inhibited by the Federal Constitution, begins. But Federal authority is always entitled to prevail, as against a state legislature or officer, in all matters specifically allotted to it; and in these its power of direct action has two great advantages. It makes the citizen recognize his allegiance to the power which represents the unity of the nation; and it avoids the necessity of calling upon the state to enforce obedience to Federal authority, for a state might possibly be weak or dilatory, or even itself inclined to disobedience. Thus the indirect taxes of customs and excise which the Federal government imposes are levied by Federal custom-house collectors and excisemen, and the judgments of Federal courts are carried out by United States marshals distributed over the country. Nothing has done more to give cohesion to the American Federal system than the direct action of the Federal executive and judiciary.

V.—*The Federal Government.*

§ 19. The Federal or national government was created *de novo* by the Constitution of 1787–1789. It was really a new creation rather than a continuation of the feeble organization of the pre-existing Confederation. But the principles on which it was constructed were old principles, and most of its features were drawn from the state governments as they then existed. These states themselves had been developed out of the previous colonial governments, and both they and the national government have owed something to the example of the British Constitution, which had suggested the division of the legislature into two branches and the independent position of the judiciary. It was, however, mainly from the state constitutions, and not from the arrangements prevailing in Great Britain or in any other country, that the men of the convention of 1787 drew their ideas and precedents.

Following what was then deemed a fundamental maxim of political science, they divided the government into three departments, the legislative, the executive and the judicial, and sought to keep each of these as far as possible detached from and independent of the other two.

The Federal Legislature.

In 1787 all the states but three had bicameral legislatures—it was therefore natural that the new national government should follow this example, not to add that the division into two branches seems calculated to reduce the chances of reckless haste, and to increase the chances of finding wisdom in a multitude of counsellors. There was, however, another reason. Much controversy had raged over the conflicting principles of the equal representation of states and of representation on the basis of numbers, the larger states advocating the latter, the smaller states the former principle; and those who made themselves champions of the rights of the states professed to dread the tyrannical power which an assembly representing population might exert. The adoption of a bicameral system made it possible to give due recognition to both principles. One house, the Senate, contains the representatives of the states, every state sending two; the other, the House of Representatives, contains members elected on a basis of population. The two taken together are called Congress, and form the national legislature of the United States.

House of Representatives.

§ 20. The House of Representatives is composed of members elected by popular vote in each of the various states, the representation of each state being in proportion to its population. Each state is at liberty under the Constitution to adopt either the "general ticket" system, *i.e.* the plan of electing all its members by one vote over the whole state, or to elect them in one-membered districts (the "district system"). The system of single-member districts now prevails almost everywhere. (Pennsylvania, however, has two representatives elected at large from the entire state, and there have been other similar instances.) The number of members in the house was originally 65, but it has steadily increased until, in December 1910, there were 398. Besides the full members, each of the Territories is allowed to send a delegate, who has, however, no vote. The electoral franchise on which the house is elected is for each state the same as that by which, under the provisions of the state constitution, the members of the more numerous branch of the state legislature are chosen. Originally franchises varied much in different states, but for many years prior to 1890 what was practically manhood suffrage prevailed in nearly all of the states. In that year and since, not a few of the southern states have introduced restrictions which tend to exclude the bulk of the coloured population (see *ante*, § 5). It has already been observed that paupers and convicted criminals are excluded in many states, illiterates in some states. Every member must reside in the state which sends him, and custom, rarely broken, requires that he should reside even in the district which he represents. This habit restricts the field of choice and has operated unfavourably on the political life of the nation.

The House of Representatives is chosen for two years, the terms of all the members expiring together. The election of a new house takes place in November[1] of the even years (*i.e.* 1910, 1912, &c.). Members enter on their term of service in the March following, but the first regular session does not begin until the following December, or more than a year after the election. In fact, the old house holds its second regular session of three months after the new house has been elected. The rules are very complicated, and considerably limit the power of debate. A remedy against obstruction has been found in a system of closure called the "previous question." Speeches are limited to one hour, and may be confined in committee of the whole house to five minutes. There is comparatively little good debating in the European sense of the term, and this is due partly to the great size of the hall, partly to the system of legislation by committees.

The Committee System.

The organization of the house is entirely different from that of the British House of Commons or of most assemblies on the European continent. The ministers of the president do not sit, and since there are thus no officials to undertake the leadership of the majority and conduct business, legislative work is shaped and directed by a number of committees in each house. Every bill when introduced is referred to some committee, and each bill comes up for consideration by the whole house on the report of the committee which has dealt with it. There were in 1910 62 regular or standing committees in the House of Representatives, each consisting of from 3 to 20 members. The most important committees are the following: ways and means, rules, elections, appropriations (with several committees for different branches of public expenditure), rivers and harbours, banking and currency, and foreign affairs. Each committee has complete control of all bills referred to it, and nineteen-twentieths of the bills introduced meet their death by the failure of the committee to take action on them. The bills taken up for action are debated and freely amended by the committees, and sometimes public hearings are held. The committees on the expenditure of the various government departments conduct minute investigations into the administration of each. A bill, as finally agreed on by a committee, is reported to the house, and when taken up for action the fate of most bills is decided by an hour's discussion, opened by the member of the committee making the report. The more important measures, including taxation and appropriation bills, receive genuine discussion by the house at large, through special orders submitted by the committee on rules. Of the enormous number of bills brought in very few pass.

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[1] In June in Oregon; in September in Maine and Vermont.

The Speaker.

The unifying force of this complicated system of committee legislation is the Speaker of the House of Representatives. Like the Speaker of the British House of Commons, he is primarily the presiding official, but the character of his office has become different from that of the impartial moderator of the British house. The American Speaker, who of course has a vote like other members, always belongs to the party which commands a majority, and is, indeed, virtually the leader of the majority party in the House of Representatives. He resembles in some respects a European prime minister, and is second only to the president in political importance. His power is derived from three main sources. He appoints the members of nearly all committees, he chooses the chairman of each, and he directs the reference of bills to the various committees. Of the committee on rules, which practically determines the order in which important measures come before the house, he was formerly chairman, and he had the power of appointing the committee; but on the 19th of March 1910, the house passed a resolution which increased the membership of this committee from 5 to 10, excluded the Speaker, and transferred the appointments to the house. As presiding officer the Speaker exercises a right of discrimination between members rising to speak in debate, and can thus advance or retard the progress of a measure. He is elected by the House of Representatives at its first session for the whole Congress, and his election is regularly carried by a strict party vote.

The Senate.

§ 21. The Senate in 1910 consisted of 92 members, two persons deputed from each state, be it great or small (New York with 9,100,000 population and Nevada with 81,875 having the same representation), who must be inhabitants of that state, and at least thirty years of age. They are elected by the legislature of their state for six years, and are re-eligible. It used to be supposed by many Europeans, following Tocqueville, that this method of election was the cause of the (former) superiority of the senators to members of the House. This was an error, the true reason being that able men preferred a seat in the Senate owing to its larger powers and longer term. One-third retire every two years, so that the old members are always twice as numerous as the new members, and the body has been continuous ever since its first creation. Senators are re-elected more frequently than members of the House, so there is always a considerable proportion of men of long service and mature experience.

There has long been a demand for an amendment to the Constitution which should vest the election of senators in the peoples of the several states, and more than one-half of the state legislatures have at one time or another passed resolutions in favour of the change. Within the last few years the object desired has been practically attained in a few states by provisions they have introduced for taking a popular vote as to the person whom the legislature ought to elect, the latter being expected to defer to the popular will.

The vice-president of the United States is *ex officio* presiding officer of the Senate, and this is his only active function in the government. He has, however, no vote in the Senate, except a casting vote when the numbers are equally divided, and his authority on questions of order is very limited.

The methods of procedure in the Senate are somewhat different from those in the House of Representatives. There is a similar committee system, but the Senate committees and their chairmen are chosen, not by the presiding officer, but by the Senate itself voting by ballot. Practically they are selected by caucuses of the majority and minority parties. The Senate rules have no provision for the closure of debate, nor any limitation on the length either of a debate or of a speech. For the consideration of some classes of business the Senate goes into executive or secret session, although what is done at this session usually leaks out, and finds its way to the public through the press.

The functions of the Senate fall into three classes—legislative, executive and judicial. In legislative matters its powers are identical with those of the House of Representatives, with the single restriction that bills for raising revenue must originate in the popular assembly. In practice, too, the Senate is at least as influential in legislation as the House. Disagreements, which are frequent, are usually settled in conference, and in these the Senate is apt to get the better of its antagonist. Serious deadlocks are of comparatively rare occurrence.

The executive functions of the Senate are: (1) To approve or disapprove the president's nominations of Federal officers, including judges, ministers of state and ambassadors; (2) to approve, by a majority of two-thirds of those present, of treaties submitted by the president. Through the latter power the Senate secures a general control over foreign policy. Its approval is necessary to any important action, and in general the president finds it advisable to keep the leaders of the senatorial majority, and in particular the Senate committee on foreign relations, informed of pending negotiations. Foreign governments often complain of this power of the Senate, because it prevents them from being able to rely upon the carrying out of arrangments they have made with the executive; but as the president is not responsible to Congress and is irremovable (except by impeachment) during his term of office, there would be objections to giving him an unqualified treaty-making authority. Through the power of confirming or rejecting the president's nominations to office, the senators of the president's party are able to influence a large amount of patronage. This sort of "dual control" works with less friction and delay than might have been expected, but better appointments would probably be secured if responsibility were more fully and more clearly fixed on the president alone, though there would no doubt be a risk that the president might make a serious error.

The judicial function of the Senate is to sit as a high court for the trial of persons impeached by the House of Representatives, a vote of two-thirds of those present being needed for conviction. There have been eight cases of impeachment. The most important was that of President Johnson, whose conviction failed by one vote—35 to 19. Five of the other seven cases also ended in acquittal, one for want of jurisdiction,[1] and one by the resignation of the official before the impeachment was preferred in the Senate. Two Federal judges were many years ago thus deprived of office, impeachment being the only process by which a Federal judge can be removed.

Congressional Legislation and Finance.

§ 22. The procedure of each house in framing and passing bills has already been noted. When a bill has passed one chamber it is sent to the other, and there referred to the appropriate committee. In course of time this committee may report the bill as received from the other house, but frequently an amended or an entirely new measure is presented, which is discussed and enacted on by the second house. When bills passed by the two chambers are not identical, and each persists in its own view, the regular procedure is to appoint a committee of conference, consisting of an equal number of members from the Senate and from the House. These meet in secret, and generally agree upon a compromise measure, which is forthwith adopted by both chambers. If no compromise can be arranged, the conflict continues until one side yields, or until it ends by the adjournment of Congress. After passing both houses, the bill goes to the president, and if approved by him, or not returned by him within ten days, becomes law: if vetoed, it returns to the house in which it originated; and if re-passed by a two-thirds vote, is sent to the other house; and if again passed there by a two-thirds vote, it becomes law without the president's consent.

The scope of Congressional legislation has been indicated in the list given of the powers of the national government

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[1] This case was that of the impeachment of a senator, and the failure to convict arose from the fact that some of the senators at the time held the now generally accepted opinion that a member of Congress is not subject to impeachment.

(see *ante*, § 15). The most important measures are those dealing with the revenues and appropriations, and the procedure on these matters is slightly different from that on other bills. The secretary of the treasury sends annually to Congress a report containing a statement of the national income and expenditure and of the condition of the public debt, together with remarks on the system of taxation and suggestions for its improvement. He also sends what is called his annual letter, enclosing the estimates, framed by the various departments, of the sums needed for the public service of the United States during the coming year. With this the action of the executive ceases, and the matter passes into the hands of Congress.

Revenue bills for imposing or continuing the various customs duties and internal taxes are prepared by the House committee on ways and means, whose chairman is always a leading man in the majority party. The report presented by the secretary of the treasury has been referred to this committee, but the latter does not necessarily in any way regard that report. Neither does it proceed on estimates of the sums needed to maintain the public service, for, in the first place, it does not know what appropriations will be proposed by the spending committees; and in the second place, a primary object of the customs duties has been for many years past, not the raising of revenue, but the protection of American industries by subjecting foreign imports to a very high tariff. Regular appropriation bills down to 1883 were all passed by the House committee on appropriations, but in that year a new committee—on rivers and harbours—received a large field of expenditure; and in 1886 certain other supply bills were referred to sundry standing committees. These various appropriation committees start from, but are not restricted by and do not in fact adopt, the estimates of the secretary of the treasury. Large changes are made both by way of increasing and reducing his estimates.

The financial bills are discussed, as fully as the pressure of work permits, in committee of the whole House. Fresh items of appropriations are often added, and changes are made in revenue bills in the interest of particular purposes or localities. If the Senate is controlled by the same party as the House, it is likely to secure the acceptance of many of its amendments. The majorities in the two houses then labour together to satisfy what they believe to be the wishes of their party. Important legislation is almost impossible when one of the houses is controlled by one party and the other house by the other.

When finally adopted by the House, the bills go to the Senate and are forthwith referred to the committee on finance or to that on appropriations. The Senate committees amend freely both classes of bills, and further changes may be made by the Senate itself. When the bills go back to the House that body usually rejects the amendments: the Senate declines to recede, and a conference committee is appointed by which a compromise is arranged, usually hastily and in secret, often including entirely new items, and this compromise is accepted with little or no discussion, generally at the end of the session.

Thus it comes that comparatively slight use is made of the experience of the permanent financial officials in the framing of revenue-raising and appropriation bills. There is little relation between the amounts proposed to be spent in any one year and the amounts proposed to be raised, and there is a strong tendency to deplete the public treasury through special grants secured by individual members. These defects have long been felt, but Congress is not disposed either to admit officials to attend its sittings or to modify the methods to which it has grown accustomed. A tariff commission was, however, created by statute in 1909, the reports of which may have some influence on the framing of tariffs in future.

The President.

§ 23. The executive power of the nation is vested in a president of the United States of America, who holds office during the term of four years. He, together with the vice-president, is nominally chosen by a system of double election through an electoral college, but in practice this system operates merely as a roundabout way of getting the judgment of the people, voting by states.

The Electoral College.

The Constitution directs each state to choose a number of "presidential electors equal to the number of its representatives in Congress" (both senators and members of the House of Representatives). Members of Congress and holders of Federal offices are ineligible as electors. These electors (in 1908, 483) meet in each state on the second Monday in January, and give their votes in writing for the president and vice-president. The votes are transmitted to Washington, and there opened by the president of the Senate, in the presence of both houses of Congress, and counted. A majority of the whole number of electors is necessary to elect. If no person have such majority, the president is chosen by the House of Representatives voting by states, and the vice-president is chosen by the Senate. This plan of creating an electoral college to select the president was expected to secure the choice by the best citizens of each state, in a tranquil and deliberate way, of the man whom they in their unfettered discretion should deem fittest to be the chief magistrate of the Union. In fact, however, the electors exercise no discretion, and are chosen under a pledge to vote for a particular candidate. Each party during the summer preceding a presidential election holds a huge party meeting, called a national convention, which nominates candidates for president and vice-president. (See *post*, § 33.) Candidates for the office of elector are also nominated by party conventions, and the persons who are in each state chosen to be electors—they are chosen by a strict party vote—are expected to vote, and do in point of fact vote, for the presidential candidates named by their respective parties at the national conventions. The Constitution leaves the method of choosing electors to each state, but by universal custom they are now everywhere elected by popular vote, and all the electors for each state are voted for on a "general ticket." In the early days the electors were chosen in many states by the legislatures, but by 1832 South Carolina was the only state retaining this method, and in 1868 she also dropped it. Some states also, for a time, chose electors by districts, but by 1832 all had adopted the "general ticket" system. Michigan, however, in the election of 1892 reverted to the "district" system, thereby dividing its electoral vote. Thus the election is virtually an election by states, and the struggle concentrates itself in the large states, where the great parties are often nearly equally divided, *e.g.* the party which carries New York by even a small majority gains all the 39 electoral votes of that state. The polling for electors takes place early in November on the same day over the whole union, and when the result is known the contest is over, because the subsequent meeting and voting of the electors is a mere matter of form. Nevertheless, the system here described, being an election by states, is not the same thing as a general popular vote over the union, for it sometimes happens that a person is chosen president who has received a minority of the popular vote cast.

The Constitution requires the president to be a native-born citizen of the United States, not under thirty-five years of age, and for fourteen years resident in the United States. There is no legal limitation to his re-eligibility any number of times; but tradition, dating from the refusal of George Washington to be nominated for a third term, has virtually established the rule that no person shall be president for more than two continuous terms. If the president dies, the vice-president steps into his place; and if the latter also dies in office, the succession passes to the secretary of state.[1] The president receives a salary of $75,000 a year, besides $25,000 a year for travelling expenses, and has an official residence called the Executive Mansion, or more familiarly the White House.

Functions of the President.—These may be grouped into three classes: those which (1) relate to foreign affairs; (2) concern legislation; (3) relate to domestic administration.

The president appoints ambassadors and ministers to foreign countries, and receives those sent by foreign countries to the United States. He has, through his secretary of state, immediate direction of all negotiations with such countries, and an unfettered initiative in all foreign affairs. He does not, however, enjoy a free hand in finally determining the foreign policy of the government. Treaties require the approval of two-thirds of the Senate, and the foreign affairs committee of that body is usually kept informed of the negotiations which are being conducted by the executive. The power to declare war formally belongs to Congress; but the executive may, without an act of Congress, virtually engage in hostilities and thus bring about a state of war, as happened in 1845–46, when war broke out with Mexico.

As respects legislation, the position of the president is in marked contrast to that of the British crown. While nearly all important measures are brought into parliament by the ministers of the sovereign, and nominally under his instructions, the American president cannot introduce bills either directly or through his ministers. All that the Constitution permits him to do in this direction is to inform Congress of the state of the nation and to recommend the measures which he deems to be necessary. This latter function is discharged by written messages addressed by the president to Congress, the message sent at the beginning of each session being usually the most important; but the suggestions made in these messages do not necessarily or directly induce legislation, although it is open to him to submit a bill or have one drafted by a minister presented to Congress through a member.

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[1] The order of succession, after the secretary of state, is as follows: the secretary of the treasury, the secretary of war, the attorney-general, the postmaster-general, the secretary of the navy, the secretary of the interior—this order to apply only to such officers as "shall have been appointed by the advice and consent of the Senate . . . and such as are eligible to the office of president . . . and not under impeachment. . . ."

More constantly effective is the president's part in the last stage of legislation. His so-called "veto-power" permits him to return to Congress, within ten days after its passage, any bill of which he may disapprove, and, unless this bill re-passes both houses by a two-thirds vote, it does not become law. Most presidents have made use of the veto power sparingly. Jackson, however, as well as Tyler, Johnson and especially Cleveland, employed it pretty boldly. Most of Johnson's vetoes were promptly overruled by the large majority opposed to him in both houses, but the vetoes of all the other presidents have generally prevented the enactment of the bills of which they disapproved.

The domestic executive authority of the president in time of peace is small, because by far the larger part of law and administration belongs to the state and local governments, while the Federal administration is regulated by statutes which leave little discretion to the executive. The power of making appointments to the administrative service would invest him with a vast influence but for the constitutional requirement of securing the consent of the Senate to the more important appointments made. The president is given a free hand in choosing his cabinet ministers; but for most other appointments, whether or not they are by law in his sole gift, the senators belonging to the president's party have practically controlled the selections for offices lying within their respective states, and a nomination made by the president against the will of the senator concerned will generally be disapproved by the Senate. The members of the president's party in the House also demand a share in the bestowal of offices as a price for their co-operation in those matters wherein the executive may find it necessary to have legislative aid. Nevertheless, the distribution of offices under the so-called "spoils system" remains the most important ordinary function of the president, and the influence he exerts over Congress and legislation is due mainly to his patronage.

In time of war or of public disturbance, however, the domestic authority of the president expands rapidly. This was markedly the case during the Civil War. As commander-in-chief of the army and navy, and as "charged with the faithful execution of all laws," he is likely to assume, and would indeed be expected to assume, all the powers which the emergency requires. In ordinary times the president may be almost compared to the managing clerk in a large business establishment, whose chief function is to select his subordinates, the policy of the concern being in the hands of the board of directors. But when foreign affairs reach a critical stage, or when disorders within the Union require Federal intervention, immense responsibility is then thrown on one who is both commander-in-chief of the army and the head of the civil executive. In no European country is there any personage to whom the president can be said to correspond. He may have to exert more authority, even if he enjoys less dignity, than a European king. He has powers which are in ordinary times narrower than those of a European prime minister; but these powers are more secure, for instead of depending on the pleasure of a parliamentary majority, they run on to the end of his term. Although he is always elected as a party candidate, he generally receives, if he shows tact and dignity, abundant respect and deference from all citizens, and is able to exert influence beyond the strict limits of his legal power.

The only way of removing the president from office is by impeachment, an institution borrowed from Great Britain, where it had not become obsolete at the time when the United States constitution was adopted. The House of Representatives may impeach the president. The Senate tries him, and a two-thirds majority is required for conviction. Andrew Johnson is the only president who has been impeached.

The Cabinet and Administrative Officials.

§ 24. There is in the government of the United States no such thing as a cabinet, in the British or French or Italian sense of the word. But the term is regularly used to describe a council of the president, composed of the heads of the chief administrative departments: the secretary of state, the secretary of the treasury, secretary of war, attorney-general, secretary of the navy, postmaster-general, secretary of the interior, secretary of agriculture, and secretary of commerce and labor. Like the British cabinet, this council is not formally recognized by the law, but it is nevertheless accepted as a permanent feature in the government. It is really a group of persons, each individually dependent on, and answerable to, the president, but with no joint policy, no collective responsibility. The final decision on all questions rest with the president, who is solely and personally responsible. Moreover, the members of the cabinet are excluded from Congress, and are entirely independent of that body, so that an American cabinet has little to do in the way of devising parliamentary tactics, or of preparing bills, or of discussing problems of foreign policy. It is not a government, as Europeans understand the term, but a group of heads of departments, whom their chief, though he usually consults them separately, often finds it useful to bring together for a talk about current politics and the course proper for the administration to take in them, or in order to settle some administrative question which lies on the borderland between the provinces of two ministers.

Administrative Departments.

The principal administrative departments are those already named, whose heads form the president's cabinet. The most important are the state and treasury departments. The former has the conduct of foreign affairs and interests, and directs the diplomatic service, but is obliged to keep in touch with the Senate, because treaties require the consent of the latter. It also has charge of the great seal of the United States, keeps the archives, publishes the statutes of Congress and controls the consular service.

The two main functions of the treasury department are the administration of the government revenues and expenditures, and of the banking and currency laws. The secretary has, however, a smaller range of action than a finance minister in European countries, for, as he is excluded from Congress, he has nothing directly to do with the imposition of taxes, and very little with the appropriations for government expenditure.

The department of the interior is less important than in France or Italy, since the principal functions which there belong to it lie, in the United States, within the field of state powers. In the United States the principal matters in this department are the management of the public lands, the conduct of Indian affairs, the issue of patents, the administration of pension laws, of the national census and of the geological survey, and the collection of educational information.

The department of war controls the formerly very small, but now largely increased, army of the United States; and its corps of engineers execute the river and harbour improvements ordered by Congress. The navy department has charge of the dockyards and vessels of war; and the post office department directs the postal system, including the railway mail service. The department of agriculture includes the weather bureau, the bureau of animal industry and other bureaus which conduct investigations and experiments. The attorney-general is the legal adviser of the president, public prosecutor and standing counsel for the United States, and also has general oversight of the Federal judicial administration, especially of the prosecuting officers called district attorneys and of the executive court officers called marshals.

The department of commerce and labor controls the bureaus which deal with the mercantile marine, the lighthouse and life-saving service, commercial statistics, immigration, and the coast and geodetic survey, and the census is also under its charge.

Two commissions not connected with any of the above departments deserve some notice. The inter-state commerce commission, established by statute in 1887, is a semi-judicial, semi-administrative board of five members, with limited powers of control over inter-state railway transportation. The chief duty is to prevent discriminations in freight rates and secret rebates from the published list of charges. Its powers have been much extended by subsequent acts, especially that of 1910. The civil service commission, established in 1883, conducts competitive examinations for appointments to subordinate positions under all of the administrative departments. Some 235,000 posts have now been placed under civil service rules and withdrawn from the category of spoils.

The Federal Judiciary.

§ 25. The Federal judicial system is made by the Constitution independent both of the legislature and of the executive. It consists of the Supreme Court, the circuit court of appeals, the circuit courts and the district courts.

The Supreme Court is created by the Constitution, and consisted in 1910 of nine judges, who are nominated by the president and confirmed by the Senate. They hold office during good behaviour, *i.e.* are removable only by impeachment, thus having a tenure even more secure than that of English judges. The court sits at Washington from October to July in every year. The sessions of the court are held in the Capitol. A rule requiring the presence of six judges to pronounce a decision prevents the division of the court into two or more benches; and while this secures a thorough consideration of every case, it also retards the despatch of business. Every case is discussed twice by the whole body, once to ascertain the view of the majority, which is then directed to be set forth in a written opinion; then again when the written opinion, prepared by one of the judges, is submitted for criticism and adoption by the court as its judgment.

The other Federal courts have been created by Congress under a power in the Constitution to establish "inferior courts." The circuit courts consist of twenty-nine circuit judges, acting in nine judicial circuits, while to each circuit there is also allotted one of the justices of the Supreme Court. The judges of each circuit, acting with or without the justice of the Supreme Court for the circuit, constitute a circuit court of appeals, established to relieve the Supreme Court. Some cases may, however, be appealed to the Supreme Court from the circuit court of appeals, and others directly from the lower courts. The district courts are now eighty in number, each having usually a single justice, rarely two. There is also a special tribunal called the court of claims, which deals with the claims of private persons against the Federal government. It is not strictly a part of the general judicial system, but is a creation of Congress designed to relieve that body of a part of its own labours. A customs court of five judges was created by an act of 1909 for the hearing of cases relating to the tariff.

The jurisdiction of the Federal courts extends only to those cases in which the Constitution makes Federal law applicable. All other cases are left to the state courts, from which there is no appeal to the Federal courts, unless where some specific point arises which is affected by the Federal Constitution or a Federal law. The classes of cases dealt with by the Federal courts are as follows:—

1. Cases in law and equity arising under the Constitution, the laws of the United States and treaties made under their authority;
2. Cases affecting ambassadors, other public ministers and consuls;
3. Cases of admiralty and maritime jurisdiction;
4. Controversies to which the United States shall be a party;
5. Controversies between two or more states, between a state and citizens of another state, between citizens of different states, between citizens of the same state claiming lands under grants of different states, and between a state or the citizens thereof and foreign states, citizens or subjects (Const. art. iii. § 2). Part of this jurisdiction has, however, been withdrawn by the eleventh amendment to the Constitution, which declares that "the judicial power of the United States shall not be construed to extend to any suit in law or equity commenced or prosecuted against one of the United States by citizens of another state, or by citizens or subjects of any foreign state."

The jurisdiction of the Supreme Court is original in cases affecting ambassadors, and wherever a state is a party; in other cases it is appellate. In some matters the jurisdiction of the Federal courts is exclusive; in others it is concurrent with that of the state courts.

As it frequently happens that cases come before state courts in which questions of Federal law arise, a provision has been made whereby due respect for the latter is secured by giving the party to a suit who relies upon Federal law, and whose contention is overruled by a state court, the right of having the suit removed to a Federal court. The Judiciary Act of 1789 (as amended by subsequent legislation) provides for the appeal to the Supreme Court of the United States of "a final judgment or decree in any suit rendered in the highest court of a state in which a decision in the suit could be had where is drawn in question the validity of a treaty or statute for an authority exercised under the United States, and the decision is against their validity; or where is drawn in question the validity of a statute of, or an authority exercised under, any state, on the ground of their being repugnant to the Constitution, treaties or laws of the United States, and the decision is in favour of their validity; or where any title, right, privilege or immunity is claimed under the Constitution, or any treaty or statute of, or commission held or authority exercised under the United States, and the decision is against the title, right, privilege or immunity specially set up or claimed by either party under the Constitution, treaty, statute, commission or authority." If the decision of the state court is in favor of the right claimed under Federal law or against the validity or applicability of the state law set up, there is no ground for appeal, because the applicability or authority of Federal law in the particular case could receive no further protection from a Federal court than has in fact been given by the state court.

The power exercised by the Supreme Court in declaring statutes of Congress or of state legislatures (or acts of the executive) to be invalid because inconsistent with the Federal Constitution, has been deemed by many Europeans a peculiar and striking feature of the American system. There is, however, nothing novel or mysterious about it. As the Federal Constitution, which emanates directly from the people, is the supreme law of the land everywhere, any statute passed by any lower authority (whether the Federal Congress or a state legislature) which contravenes the Constitution must necessarily be invalid in point of law, just as in the United Kingdom a railway bye-law which contravened an act of parliament would be invalid. Now, the functions of judicial tribunals—of all courts alike, whether Federal or state, whether superior or inferior—is to interpret the law, and if any tribunal finds a congressional statute or state statute inconsistent with the Constitution, the tribunal is obliged to hold such statute invalid. A tribunal does this not because it has any right or power of its own in the matter, but because the people have, in enacting the Constitution as a supreme law, declared that all other laws inconsistent with it are *ipso jure* void. When a tribunal has ascertained that an inferior law is thus inconsistent, that inferior law is therewith, so far as inconsistent, to be deemed void. The tribunal does not enter any conflict with the legislature or executive. All it does is to declare that a conflict exists between two laws of different degrees of authority, whence it necessarily follows that the weaker law is extinct. This duty of interpretation belongs to all tribunals, but as constitutional cases are, if originating in a lower court, usually carried by appeal to the Supreme Court, men have grown accustomed to talk of the Supreme Court as in a special sense the guardian of the Constitution.

The Federal courts never deliver an opinion on any constitutional question unless or until that question is brought before them in the form of a lawsuit. A judgment of the Supreme Court is only a judgment on the particular case before it, and does not prevent a similar question being raised again in another lawsuit, though of course this seldom happens, because it may be assumed that the court will adhere to its former opinion. There have, however, been instances in which the court has virtually changed its view on a constitutional question, and it is understood to be entitled so to do.

Results of Constitutional Interpretation.

§ 26. As the Federal Constitution is a short document, which deals very concisely with most of the subjects it touches, a vast number of questions have arisen upon its interpretation in the course of the 122 years which have elapsed since its enactment. The decisions of the Supreme Court upon these questions form a large body of law, a knowledge of which is now indispensable to a mastery of the Constitution itself. By them the Constitution has been so expanded in the points which it expressly treats of, and so filled up in the matters which it covers only by way of implication, that it is now a much more complete instrument than it was when it came from the hands of its framers. Thus the courts have held that, while the national government can exercise only such powers as have been affirmatively granted, it is not restricted in its choice of the methods for exercising such powers as have been granted. From this doctrine there has been derived a conspicuous activity of the national government in such fields as taxation, borrowing of money, regulating commerce and carrying on war. Executive and legislative acts not authorized by the letter of the Constitution have also been allowed to remain unchallenged, and thus precedents have been in fact established.

with the tacit recognition of the courts and the people, through which the sphere of the national government has been enlarged. The purchase of Louisiana from France by President Jefferson is an instance. It may indeed be said that the Constitution as it now stands is the result of a long process of development; and that process is still going on. In 1901 the Supreme Court delivered several judgments in cases arising out of the annexation of Porto Rico, which handled, though they did not fully settle, divers points of novelty and of importance, and still more recently questions of great intricacy affecting the respective legislative rights of the Federal and the state governments have come before it.

Development of the Constitution by Usage.

§ 27. It is not, however, only by way of interpretation that the Constitution has been developed. A great many matters which it passed over have become the subject of legislation by Congress; and there has also sprung up a large mass of usages regulating matters not touched either by the Constitution or by any express enactment. These usages have in many cases lasted so long and become so generally accepted, that they may be regarded as parts of the actual or (so to speak) "working" Constitution, although of course they could be at any moment changed. Among the matters that are now thus settled by usage the following may be mentioned:—

The president practically is limited to two continuous terms of office. The presidential electors are expected to vote for the candidate of the party which has chosen them, exercising no free will of their own. The Senate always confirms the nominations to a cabinet office made by the President.

It may be added that in respect of one matter assigned by the Constitution to the states a momentous change has taken place since the enactment of the Constitution. This matter is the electoral franchise in Federal elections. In 1789 property qualifications were general, but now in all the northern and western states these have been long since abolished, and the electoral suffrage is practically manhood suffrage. In Wyoming, Colorado, Utah, Idaho and Washington universal adult suffrage prevails. Down till 1890 manhood suffrage had prevailed in all the Southern states also (as to some Southern states now see *ante*, § 5). As the electoral suffrage for state legislature elections is also that for Federal elections (including the election of presidential electors), the working of the Federal Constitution has thus been affected without any change in the Constitution itself.

Amendments to the Constitution.

§ 28. Besides these changes which have been brought about by judicial interpretation and by usage, the Constitution has also been altered in the regular and formal way which its own provisions permit (see *ante*, § 14). This has happened four times. Ten amendments were enacted immediately after the adoption of the Constitution itself, in order to meet certain objections which had been taken to it. These may be described as a sort of bill of rights. Another, the eleventh, was enacted in 1794–1798 to negative the construction which the Supreme Court had put upon its own powers in holding that it could entertain a suit by a private person against a state. Another, the twelfth (1803–1804), corrected a fault in the method of choosing the president; and three more (1865–1870) confirmed and secured some of the results of the victory of the North in the War of Secession (1861–65). In 1909 Congress proposed an amendment for enabling the national legislature to impose an income tax. But few amendments pass beyond the first stage of a formal proposal. This is due not merely to the respect of the Americans for their fundamental law, but also to the difficulties which surround the process of change. It is hard to secure the requisite majorities in Congress, and still harder a majority in three-fourths of the states. The obstacles placed in the way of amendment, which are greater than in the case of almost any other Constitution, may be reckoned among the causes which led to the War of Secession.

§ 29. As compared with the cabinet system of Great Britain, of the British self-governing colonies, and of such European countries as France, Italy, Holland and Belgium, the characteristic features of the scheme of the American national government are the following:—

General character of the Frame of National Government.

a. The legislature and the executive are independent and disjoined. The executive does not depend upon the legislature, but holds its powers by a direct commission from the people. No member of the executive sits in the legislature, nor can the legislature eject any one from office save by impeachment.

b. Both the legislature and the executive sit for fixed terms.

c. No method is provided for getting rid of deadlocks, either between the legislature and the executive or between the two branches of the legislature. Should action be needed which cannot be legally taken without the concurrence of these different authorities, and should they be unable to concur, the legal situation must remain *in statu quo* until by a new election the people have changed one or more of the conflicting authorities, and so brought them into harmony.

d. The judiciary holds a place of high importance, because it is the proper interpreter of the will of the people expressed in the supreme law, the Federal Constitution, which the people have enacted.

It will be noted that the structure of the Federal Government is less democratic than that of the state governments. The only posts in the former conferred by popular election are those of the president and the members of the legislature, and while the two houses are a check on each other, the president is a check upon both.

The defects which have been remarked in this system are, broadly speaking, the following: There is a danger that prompt action, needed in the interests of the nation, may fail to be taken owing to a deadlock between legislature and executive, or between the two branches of the legislature. There may be a difficulty in fixing responsibility upon any person, or small group of persons, because cases may arise in which the executive, being unable to act without the concurrence of the legislature, can hardly be blamed for failing to act, while yet it is unable to relieve itself by resigning; while on the other hand the legislature—which consists of two bodies, each of them numerous, and in neither of which are there recognized leaders—contains no person on whom responsibility can be fixed. On the other hand, the characteristic merits of the system may be summed up as consisting in the safeguards it provides against the undue predominance of any one power or person in the government, and therewith against any risk there may be that the president should become a despot, and in the full opportunities it secures for the due consideration of all important measures. It is a system amply provided with checks and balances; it recognizes and enforces the principle of popular sovereignty, while subjecting that principle to many checks in practice; and it is well calculated to maintain unchanged the relation of its component parts each to the other. There has been, in point of fact, no permanent shifting of weight or strength from any one organ of government to any other. At some particular epoch the president has seemed to be gaining upon Congress, at other epochs Congress has seemed to be gaining upon the president. Much depends on the personal qualities of the president and his power of inspiring the people with trust in his courage and his uprightness. When he possesses that power he may overawe Congress, and make them follow, even reluctantly, in the path he points out. Now and then the Senate has been more influential than the House, now and then it has fallen back, at least so far as the confidence of the people in it is concerned. The part played by the judiciary has at some moments been of special importance, while at others it has been little noticed. But, taking the history of the republic as a whole, that equilibrium between the several organs of the government which the Constitution was intended to secure has been substantially maintained.

VI.—*The Party System.*

§ 30. The actual working of the government of the Union and of the governments of the several states cannot be properly

Influence of the Party System upon the Working of the Government.

understood without some knowledge of the party system as it exists in the United States. That system is, as has been well observed by H. J. Ford,[1] a sort of link between the executive and the legislative departments of government, and thus the policy and action of the party for the time being in power forms a sort of second and unofficial government of the country, directing the legal government created by the Constitution. In no country have political parties been so carefully and thoroughly organized. In no country does the spirit of party so completely pervade every department of political life; not that party spirit is any more bitter than it is in Europe, for in some respects it is usually less bitter and less passionate than in France, the United Kingdom or Austria, but that it penetrates farther into the body of the people, and exerts a more constant influence upon their minds. Party organizations have in the United States a wide range of action, for they exist to accomplish five purposes. Three of these are pursued in other countries also. These three are: first, to influence governmental policy; secondly, to form opinion; and thirdly, to win elections. But the two others are almost (if now not quite) peculiar to the United States, viz. to select candidates for office and to procure places of emolument for party workers. The selecting by a party of its candidates, instead of allowing candidates to start on their own account, is a universal practice in the United States, and rests upon the notion that the supreme authority and incessant activity of the people must extend not only to the choice of officials by vote, but even to the selection of those for whom votes shall be cast. So the practice of securing places for persons who have served the party, in however humble a capacity, has sprung from the maxim that in the strife of politics "the spoils belong to the victors," and has furnished a motive of incomparable and ever-present activity ever since the administration (1829–1837) of President Andrew Jackson. It is chiefly through these two practices that the party organizations have grown so powerful, and have been developed into an extremely complicated system of machinery, firm yet flexible, delicate yet quickly set up, and capable of working efficiently in the newest and roughest communities.

Origin and History of the Parties.

§ 31. The contests over the adoption of the Federal Constitution by the several states in 1787–1790 brought to the surface two opposite tendencies, which may be called the centrifugal and centripetal forces, a tendency to maintain both the freedom of the individual and the independence, in legislation, in administration and in jurisdiction, of the several states, and an opposite tendency to subordinate the states to the nation, and to vest large powers in the central Federal authority. These tendencies soon arranged themselves in concrete bodies, and thus two great parties were formed. One, which took the name of Republican, became the champion of states' rights, and claimed to be also the champion of freedom. It was led by Thomas Jefferson. The other, the Federalist party, led by Alexander Hamilton, stood for an energetic exercise of the powers of the central government, and for a liberal interpretation of the powers granted that government by the Federal Constitution. The Jeffersonian party has had an unbroken continuity of life, though it has been known since about 1830 as the Democratic party. The Federalist party slowly decayed, and ultimately vanished between 1820 and 1830, but out of its ruins a new party arose, practically its heir, which continued powerful, under the name of Whigs, till 1854, when it broke up over questions connected with the extension of slavery. Very soon thereafter a party, nominally new, but largely formed out of the Whigs, and maintaining many of its traditions, sprang up, and took the name of Republicans. Since 1856 these two great parties, Democrats and Republicans, have confronted one another, including between them the vast majority of the people. After the Civil War, when the questions attending Reconstruction had become less acute, economic discontents gave rise to other smaller parties, such as Greenbackers, Labor party and Populists, and the sense of the harm done by the licensed sale of alcohol evoked a party which became known as the Prohibitionists. Still later the growth of Collectivist views, especially among the immigrants from Continental Europe, led to the formation of a Socialist Labor party and a Socialist party, some of those who had belonged to the Populists associating themselves with these new groups.

The Democratic party began to form for itself a regular organization in the presidency (1829–1837) of Andrew Jackson, and the process seems to have been first seriously undertaken in New York state. The Whigs did the same; and when the Republicans organized themselves, shortly after the fall of the Whigs, they created a party machinery on lines resembling those which their predecessors had struck out. The establishment of the system in its general form may be dated from before the Civil War, but it has since been perfected in its details.

Outline of the System of Party Organization.

§ 32. The machinery of an American party consists of two distinct but intimately connected sets of bodies, the one permanent, the other temporary, or rather intermittent. The function of the former is to manage the general business of the party from month to month and year to year. That of the latter is to nominate candidates for the next ensuing elections and to make declarations of party opinion intended to indicate the broad lines of party policy.

Party Committees.

The permanent organization consists of a system of committees, one for each of the more important election areas. There is a committee for every city, every county, and every congressional district, and in some states even for every township and every state legislature district. There is, of course, a committee for every state, and at the head of the whole stands a national committee for the whole Union, whose special function it is to make arrangements for the conduct of party work at a presidential election. Thus the country from ocean to ocean is covered by a network of committees, each having a sphere of action corresponding to some election area, whether a Federal area or a state area. Each committee is independent and responsible so far as regards the local work to be done in connexion with the election in its own area, but is subordinate to the party committees above it as respects work to be done in its own locality for the general purposes of the party. The ordinary duties of these committees are to raise and spend money for electioneering and otherwise in the interests of the party, to organize meetings, to "look after the press," to attend to the admission of immigrants or new-comers as voters, and generally to attract and enrol recruits in the party forces. At election times they also direct and superintend the work of bringing up voters to the polls and of watching the taking and counting of the votes; but in this work they are often aided or superseded by specially appointed temporary bodies called "campaign committees." These party committees are permanent, and though the membership is renewed every year, the same men usually continue to serve. The chairman in particular is generally reappointed, and is often, in a populous area, a person of great and perhaps autocratic power, who has large funds at his disposal and a regular army of "workers" under his orders.

Party Nominating Conventions.

The other and parallel branch of the party organization consists of the bodies whose function it is to nominate party candidates for elective posts, whether legislative or executive. (It must be remembered that many executive state, county and city officers are chosen by direct popular vote.) These bodies are meetings of the members of the party resident in each election area. In the smallest areas, such as the township or city ward, the meeting is composed of all the recognized members of the party who are entitled to vote, and it is then called a primary. In the larger election areas, such as a county or city, the number of voters who would be entitled to be present renders it impossible to admit all, so the nominating meetings in these areas are composed of delegates elected in the various primaries included in the area, and the meeting is called a nominating convention. This is the rule, but in some parts of the South and West nominations for members of the state legislature and county officials, and even for members of Congress, are made by primary assemblies meeting over the entire area, which all the party voters are entitled to attend. Where candidates are to be nominated for a state election, the number of delegates from primaries would be too large, so the state nominating convention is composed of delegates chosen at representative conventions held in smaller areas.

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[1] *Rise and Growth of American Politics.*

Every registered voter belonging to the party in the local election area for which party candidates are to be nominated is presumably entitled to vote in the primary. In rural districts little difficulty arises, because it is known what citizens belong to each party; but in cities, and especially in large cities, where men do not know their neighbours by sight, it becomes necessary to have regular lists of the party voters entitled to attend a primary; and these lists are either prepared and kept by the local party committee, or are settled by the votes of the persons previously on the party rolls. The composition of these lists is of course a serious matter, because the primary is the foundation of the whole party edifice. Accordingly, those who control the local organizations usually take pains to keep on the lists all the voters whom they can trust, and are apt to keep off those whom they think likely to show a dangerous independence. By their constant activity in this direction, and by their influence over the pliable members of the party, they are generally able to have a primary subservient to their will, which is ready to nominate those whom they may suggest as suitable candidates, and to choose as delegates to the conventions persons on whom they can rely. In this way a few leaders may sometimes be able to obtain control of the nominating machinery of a city, or even of a state, for the local committees usually obey instructions received from the committees above them. (See, as to the details of party machinery, *American Commonwealth*, chs. lix.-lxiv., M. Ostrogorski on *Democracy in England and America*, and Professor Jesse Macy on *Party Organization and Machinery*, 1904.)

The great importance of these nominating bodies lies not only in the fact that there are an enormous number of state, county and city offices (including judicial offices) filled by direct popular election, but also in the fact that in the United States a candidate has scarcely any chance of being elected unless he is regularly nominated by his party, that is to say, by the recognised primary or convention. To control the primary or the convention (as the case may be) of the party which is strongest in any given area is therefore, in ninety-nine cases out of a hundred, to control the election itself, so far as the party is concerned, and in many places one party has a permanent majority.

As the desire to dominate primaries was found to lead to many abuses, both in the way of manipulating the lists of party voters and in the unfair management of the primary meetings themselves, a movement was started for reforming the system, which, beginning soon after 1890, gathered so much support that now in the large majority of the states laws have been enacted for regulating the proceedings at primary nomination meetings. These laws vary greatly in their details from state to state, but they all aim at enabling the voters to exercise a free and unfettered voice in the selection of their candidates, and they have created a regular system of elections of candidates preliminary to the election of office-holders from among the candidates. In most states the voter is required, when he obtains his ballot at the primary election, to declare to which party he belongs, but sometimes the primary is "open" and he may vote for any one of the persons who are put forward as desiring to be selected as candidates. The laws usually contain provisions punishing fraud or bribery practised at a primary, similar to those which apply to the subsequent elections to office. Although political parties were originally mere private organizations, little objection seems to have been felt to giving them statutory recognition and placing the proceedings at them under full official control.

The National Nominating Convention.

§ 33. One nominating body is of such conspicuous magnitude as to need special notice. For the selection of party candidates for the offices of president and vice-president of the United States there is held once every four years, in the summer preceding the election (which takes place in November) of the president, a huge party assembly of delegates from conventions held in the several states, each state having twice as many delegates as it has electoral votes to cast (*i.e.* twice as many as its Federal senators and Federal representatives). Two delegates are chosen for each congressional district by a district convention, and four delegates for the state at large by a state convention. Each state delegation usually keeps together during the national convention, and holds private meetings from time to time to decide on its course.

When the national convention has been duly organized by the appointment of committees and of a chairman, its first business is to discuss and adopt a series of resolutions (prepared by the committee on resolutions, but subject to amendment by the convention as a whole), which, taken together, embody the views, programme and policy of the party, and constitute what is called its "platform" for the ensuing election. This declaration of principles and plans is sometimes of importance, not only as an appeal to the people in respect of the past services and merits of the party, but as pledging them to the measures they are to introduce and push forward if they win the election. It then proceeds to receive the nomination of various aspirants to the position of party candidate for the presidency. The roll of states is called alphabetically, and each state, as reached in the roll, is entitled to present a candidate. Thereafter a vote is taken between the several aspirants. The roll of states is again called, and the chairman of each state delegation announces the vote of the state. In Democratic conventions a state delegation, when instructed by the state convention to cast its whole vote solid for the particular aspirant favoured by the majority of the delegation, must do so (this is called the unit rule); in the conventions of the other parties individual delegates may vote as they please. If one aspirant has obtained on the first roll-call an absolute majority of the whole number of delegates voting—or, in Democratic conventions, a majority of two-thirds of those voting—he is held to have been duly chosen, and the choice is then made unanimous. If, however, no one obtains the requisite majority, the roll is again called until some one competitor secures the requisite number of votes. Sometimes one or two votings are sufficient, but sometimes the process has to be repeated many times—it may even continue for several days—before a result is reached. Where this happens there is much room for the display of tactical skill by the party managers in persuading delegates who favour one of the less prominent aspirants to transfer their votes to the person who seems most likely to unite the party.

When one aspirant has been duly selected as the party candidate for the presidency, the convention proceeds to choose in the same way a person to be candidate for the vice-presidency. This is a much simpler matter, because the post is much less sought after, and it is usually despatched with ease and promptitude. The two nominees are then deemed to be the candidates of the whole party, entitled to the support, at the ensuing election, of the party organizations and of all sound party men throughout the Union, and the convention thereupon dissolves.

Influences which guide the Parties.

§ 34. It is hardly too much to say that in the United States the parties work the government. The question follows, Who work the parties? The action of the parties depends upon and is the resultant of three factors, which are indeed more or less present in all constitutional representative governments. These are (*a*) individual leaders, who are powerful either by their talents or by the influence they enjoy over the citizens; (*b*) rich men, who can supply the party with the very large sums of money needed for maintaining the party machinery in efficiency and for fighting the elections; and (*c*) the opinion of the mass of the citizens, who, though generally disposed to adhere to the traditions and follow the leaders of the party to which they belong, do, especially in the more educated classes and in the most advanced parts of the country, exert a certain measure of independence, and may refuse to vote for the party candidates if they either distrust those candidates personally or disapprove of the policy which the party seems to be following. It need hardly be said that the relative importance of these three factors varies from time to time. Fortunately that of the second has grown weaker in recent years.

General Results of the Power of the Party System.

§ 35. The national parties have been so pervasive in their influence, and the working of their machinery has formed so important a part of the political history of the United States, that it is necessary here to call attention to the high significance of this element in the system of the Republic. The party system has made nearly all elections, including those for state offices and city offices, the functions of which have, as a rule, nothing whatever to do with national party issues, matters of party strife fought upon party lines. It has disposed voters in state and city elections to support party candidates, of whom they might otherwise have disapproved, for the sake of maintaining in full strength for national purposes the local party organization, and it has thereby become a fruitful source of municipal misgovernment. It has thrown great power into the hands of party managers, because where the strife between the two great parties is keen and the result of a contest doubtful, discipline and obedience are deemed needful for success. It has tended to efface state lines, and to diminish the interest in state issues, and has thus helped to make the nation overshadow the states. (J. Br.)

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J.D.Richardson compiled the *Messages and Papers of the Presidents, 1789–1897* (10 vols., Washington, 1896–1899). The best account of the presidential elections is in Edward Stanwood's *History of the Presidency* (Boston, 1898). For the executive departments the Annual Reports of each and numerous executive documents are useful. Some of the more important secondary works on special topics are: Mary P. Follett, *The Speaker of the House of Representatives* (New York, new ed., 1910); H. B. Fuller, *Speakers of the House* (Boston, 1909); J. A. Fairlie, *National Administration of the United States* (New York, 1907); L. G. McConachie, *Congressional Committees: a Study of the Origins and Development of our National and Local Legislative Methods* (ibid., 1898); Woodrow Wilson, *Congressional Government: a Study in American Politics* (15th ed., Boston, 1900); Jesse Macy, *Party Organization and Machinery* (New York, 1904); M. 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VIII.—Finance

The taxing powers within the United States are as follows:—

a. The national government, whose revenue powers are only limited by: (*a*) the provision of the constitution which prohibits all duties on exports, and (*b*) the provision that all direct taxes must be levied in proportion to population—a provision which deprives direct taxes of nearly all their efficiency for revenue purposes.

b. The several states, whose revenue powers are only limited by: (*a*) restrictions in their respective constitutions, and (*b*) the general principle that those powers must not be exercised in such a way as to contravene laws of the United States, or to destroy sources of the national revenue, although a state may prohibit within its borders the sale of liquors, from taxes upon which the United States Treasury derives a considerable part of its receipts.

c. Within each state powers of taxation, to a determinate or to an indeterminate extent, as the case may be, are by the constitution and laws of the state conferred, almost always for strictly defined purposes, (1) upon counties, (2) upon cities, boroughs and incorporate villages, and (3) in nearly all the states, though in widely varying degrees, upon the primary geographical divisions of counties, such as the "town" of New England and the "township" of the Middle and Western states.

The revenues of the several states, and of minor governmental areas within them, are mainly derived from a general property tax, laid directly upon realty and personalty. More than 82% of the tax revenues of state and local governments were thus derived in 1902. The average real rate of assessment was $0·72 in 1880 and $0·74 in 1902. The details of this system, which has no other refuge in the civilized world save partially in Switzerland, are remarkable for a most extraordinary diversity in the manner of collection, which practically becomes, however, self-assessment, and an equally extraordinary and general evidence of the crudity and inadequacy of the system, which has been the target of state tax reports throughout the Union for half a century. Nevertheless, only recently have other sources of revenue been largely developed, and the general property tax to a degree abandoned. Thus an inheritance tax was first adopted by Pennsylvania in 1826, yet sixty years later only two states were taxing collateral inheritances. In 1907 there were 34 such, and 19 of these were taxing direct inheritances as well. This is a modern democratic tax, and there are similar tendencies in other taxes. Business taxes are fast increasing, and many special property taxes, these two classes yielding in 1902 7·24% of state and local revenues. The taxation of corporations is recent and rapidly increasing. The same is true of habitation taxes. A beginning has been made with income taxes. Finally, the strain upon municipal finances incident to a realization of civic improvements has called attention to intangible wealth: street railways are no longer taxed as scrap iron but as working systems, with due attention to their franchises; and there is a beginning of the doctrine that the increase in value of unimproved realty constitutes income that should be taxed. The same conditions have made of importance general theories, such as the single tax theory of Henry George, for taxing landed values. All these tendencies, although strongest in municipal finances, are general.

Restrictions upon the taxing power, and unwise classifications of property for taxation purposes, embodied without good understanding in state constitutions, have been a primary obstacle to the development of sound systems of taxation in the several states. A lack of interstate comity, and double taxation of certain classes of property, have also offered difficulties. The progress toward better conditions has, however, been in late years rapid.

A similar restriction placed by the Constitution (art. 1, § 2) upon the power of the Federal government to lay "direct taxes" has been interpreted by the Supreme Court, by a bare majority, in such a way as to make very difficult, if not impossible, the imposition of an income tax (although, it may be added, such taxes had been unanimously held constitutional by the court in earlier decisions, which rested in turn upon interpretations of the constitutional provision just referred to given by the court when it counted among its members justices who had been members of the convention that framed the constitution).

The entire Federal system is the result, partly of constitutional provisions, partly of experience. The Federal authority naturally resorted first to customs duties upon foreign commerce, because in this field it had exclusive authority. It adopted next excise duties on articles produced or consumed within the country, notably liquors and tobacco. These two species of indirect taxes have from the beginning been the main sources of national revenue. At three periods, namely 1800–1802, 1814–1817 and 1863–1871, direct taxes have contributed considerable amounts to the revenue. These taxes included in the last period—that of the Civil War—income and legacy taxes, taxes on commercial transactions, and taxes on persons and property. At times also the proceeds of the sales of public lands have formed an important element of the receipts of government, although it has been the accepted policy to sell such lands to actual settlers at rates so low as to be inconsistent with the object or attainment (relatively) of revenue. Indeed, under the homestead law, large portions of the public domain have been given away to settlers (see HOMESTEAD AND EXEMPTION LAWS), while even larger amounts have been alienated in aid of schools, public improvements, &c., so that the portion sold has not been a third of the total amount alienated. It is possible, however, that the growing consciousness of the necessity of conserving the national resources may lead to a much greater income in the future from the small amounts still remaining in the hands of the national government. In 1908 there still remained unappropriated and unsurveyed, according to the General Land Office, 754,895,296 acres. Of these, 387,000,000 acres were still open to entry, but most of this vast extent consisted, in the opinion of the National Conservation Commission of 1908, of lands either arid or otherwise unsuited for settlement. There were also, in July 1908, about 235,000,000 acres of national forests, parks and other reservations for public use.

Customs duties have been found to be in general the most cheaply collected, the least conspicuous, and least annoying of all taxes. They have, however, never been a stable source of revenue, even during periods when the tariff was constant; and compared with the steady returns shown by the selected articles of the British tariff list this instability has been most extraordinary. Very often their income has been far above the amount needed for all disbursements of the government. In times of war they have of course fallen to a minimum. Thus, in the period 1791 to 1811 their ratio to total government expenditure ranged from 41·6 to 189·6%; during the years 1812–1817, from 17·2 in 1814, when war finances reached their weakest point, to 131·4% in 1817, showing how rapid was their response under the return of peace; in the period 1817–1859 from 29·9% in the crisis year of 1837 to 158·9%; in the period 1860–1869 from 6·5% in 1865, when the government's bonds fell in price to $50·93 per hundred and the war policy of loans was most desperate, to 84·1%; in the years 1870–1893 from 51·4 to 85%; and, finally, in the years 1893–1909, from 36·9% (in 1898) to 52·7%.

Of the total imports of 1909 47·4%, of a value of $699,799,771, entered duty free. More than half of these were crude materials for manufactures. The total imports per capita and the duty collected upon them per capita have been as follows since 1885, taking every fifth year: 1885—$10·32 and $3·17; 1890—$12·35 and $3·62; 1895—$10·61 and $2·17; 1900—$10·88 and $3·01; 1905—$13·08 and $3·11; 1908—$13·57 and $3·24.

The attempts of the Federalist party to create a system of internal taxation was a leading cause of its downfall. During the years in which it was in power little more than a tenth of the national revenue was derived from excises, yet they became a national political issue, and the Whisky Rebellion shows how little they were fitted to the nation at that time. The excise system disappeared with the incoming of the Democratic party in 1801. As a temporary necessity such taxes were again resorted to during the war of 1812, and again during the Civil War. In the latter period the excise proved of great richness, and quickly responsive in its returns; whereas the customs were inelastic so long as the war continued. After the war a system of internal revenue was therefore continued.

Of recent years the growing stringency of both national and local finances by enormously increased disbursements has made important the question of the relation of national with state and local taxation. The customs revenue, in its form of high protection, has always had against it a strong free trade sentiment, generally unorganized, and this seems to be growing. The internal revenue is affected by the remarkable spread of the prohibition movement. A considerable and growing public sentiment in favour of the use of the taxing power for the regulation of wealth taken from society demands the introduction into the Federal system of income and inheritance taxes. The last—inasmuch as an income tax that is constitutional can perhaps not be framed—is the only promising source that can give the addition to the Federal revenues that must be needed in case the customs or the excise revenues are reduced.

From 1860 to 1870 the population increased 22·6%, and the net ordinary expenditures of government, not including payments on the national debt, rose 173%; from 1870 to 1900 the corresponding figures (using the official estimated population) were 129% and 408%. The aggregate net ordinary receipts into the United States treasury, from 1791 to the 30th of June 1885, were as follows, in millions of dollars: from customs, 5642; from internal revenue, 3449; from direct taxes, 28; from public lands, 241; from miscellaneous sources, 578; total, 9938. The corresponding figures for the years from 1886 to the 30th of June 1909 were as follows, respectively: 5403; 4618; 0·142; 121; 969.

The expenditures of the government increased steadily per capita up to the opening of the Civil War. The ease with which money was acquired in the war period, the acquiescence of the people, and the influences of extravagance and corruption engendered by the war, opened, at the return of peace, a period of extravagant expenditure that has continued with progressive increase down to the present. A phenomenal growth of both customs and excise revenue has made such expenditures easy. From 1791 to 1886 the aggregate net ordinary expenditures of the government—these expenditures being exclusive of payments on account of principal and interest of the public debt—were as follows, in millions of dollars: for the army, 4563; navy, 1106; military pensions, 900; miscellaneous, 2168; total 8737. The corresponding figures for the period 1887 (June 30) to 1908 (June 30) were: 2003; 1219; 2884; 2790; total 8896.

The average yearly ordinary receipts of the decade 1900–1909, distributed by source, was as follows: from customs, $280,728,741·30; from excise, $257,477,356·45; from miscellaneous sources, $48,736,721·89; total ordinary revenue, $586,942,919·64 or $7·11 per capita; revenue from sale of Panama bonds, $8,730,959·48; from premiums exclusive of Panama bonds, $397,894·20. The average yearly disbursements during the decade, distributed according to object, were as follows: for civil list and miscellaneous objects, $143,697,123·09; army, $130,416,902·62; navy, $96,722,000·90; military pensions, $144,856,529·16; Indians, $12,966,563·00; on account of debt, $25,632,072·60; total, $586,942,920.

In 1909 the ordinary receipts were $637,773,165, or $7·17 per capita; and the ordinary disbursements $670,507,889, or $7·54 per capita. The revenues of all the states, counties, cities and other local governments, plus those of the national government, aggregated in 1879 only $584,980,614.

Since 1870 the national census office has determined several times the aggregate indebtedness of the national, state and other local governments. The results are stated below, for 1870 and 1902, in round millions of dollars. Sinking funds are deducted.

Government.	1870.		1902.	
	Total.	Per capita.	Total.	Per capita.
	$	$	$	$
United States	2,331·2	60·46	925·0	11·77
States and territories	352·9	9·15	234·9	2·99
Counties	187·6	4·87	196·6	2·50
Other local governments, excluding rural school districts	328·2	8·51	1,387·3	17·65
School districts outside of urban centres of 8000 or more inhabitants	—*	—	46·2	0·59

* Included in 1870 in the preceding category.

The national government set out in 1790 with a revolutionary debt of about 75 millions of dollars. This debt continued, slightly increased but without any very important change, until 1806, when a reduction began, continuing until 1812, when the debt was about 45 millions. The then ensuing war with England carried the debt up to 127 millions in 1816. This was reduced to 96 millions in 1819, to 84 millions in 1825 and to 24 millions in 1832, and in the three years following was extinguished. The crisis of 1837, and the financial difficulties ensuing, created indebtedness, fluctuating in amount, which at the beginning of the war with Mexico was about 16 millions. At the conclusion of peace the debt had risen to 63 millions, near which point it remained until about 1852, from which time successive reductions brought it down to 28 millions in 1857. The financial crisis of that year caused an increase, which continued until the imminence of the Civil War, when it rose from 65 millions in 1860 to 91 millions in 1861, to 514 in 1862, to 1120 in 1863, to 1816 in 1864, to 2681 in June, and its maximum (2846 millions) in August 1865. These figures are of gross indebtedness. The amount of the debt per capita of population, less cash in the treasury, was $15·63 in 1800; it fell to $0·21 in 1840; rose again, and in 1865 reached a maximum of $76·98; since when it had fallen by the 30th of June 1908 to $10·76. The amount of the debt outstanding, minus gold and silver certificates and Treasury notes offset by cash in the Treasury, was $1,295,147,432·04 on the 1st of November 1909. Of this amount $913,317,490 was bearing interest.

IX.—ARMY

The regular army has always been small, and in time of war reliance has been upon volunteer forces (see ARMY). This was truer of the Civil War than of the War of Independence or the war with Mexico. In the last the numbers of militia and volunteers was but little more than twice, and in the second little more than equal to the number of regulars engaged; while in the Civil War the proportion was as one to twenty. Again, the number of regular troops engaged in the War of Independence (namely, 130,711 men enlisted) was greater, absolutely, than that engaged in the Civil War (126,587). Finally, it is interesting to note that in 1799, when war seemed probable with France, the army was organized with a force of 52,766 men, and during the second war with Great Britain the number was made 57,351 in 1813 and 62,674 in 1814; while the organized strength under the law of 1861, which was in force throughout the Civil War, was only 39,273 men. Small as the regular force has always been, its organization has been altered some two score of times in all.

The law for its organization in force in 1910 provides that the total enlisted strength shall not at any one time exceed 100,000. The full active force of the present organization is as follows: 15 regiments of cavalry, with 765 officers and 13,155 enlisted men; 6 regiments of field artillery, with 236 officers and 5220 enlisted men; 30 regiments of infantry, with 1530 officers and 26,731 enlisted men; 3 battalions of engineers, with 2002 enlisted men, commanded by officers detailed from the corps of engineers; a special regiment of infantry for Porto Rico, with 31 officers and 576 enlisted men; a provisional force of 50 companies of native scouts in the Philippines, with 178 officers and 5731 enlisted men; staff men, service school detachments, the military academy at West Point, Indian scouts, &c., totalling 11,777 enlisted men. The total number of commissioned officers, staff and line, on the active list, is 4209 (including 219 first lieutenants of the medical reserve corps on active duty). The total enlisted strength, staff and line, is 78,782, exclusive of the hospital corps and the provisional force. (See also NAVY AND NAVIES.)

(F. S. P.)

X.—HISTORY

A.—*Beginnings of Self-government, 1578–1690.*

1. The American nation owes its origin to colonizing activities in which the British, Dutch, Swedes, French and Spaniards bore a share, and which were continued during a period of more than two centuries at the beginning of the modern era. The settlements of the Dutch and Swedes (New Netherland and New Sweden) were soon merged in those of the British, and of the territory colonized by Frenchmen and Spaniards the United States, as it was in 1783, included only certain outlying regions (Florida and certain posts on the Great Lakes and in the Mississippi Valley). All the European nations which were interested in colonization shared in the enterprise, and the population of the region was therefore cosmopolitan from the outset. But the British, especially after 1660, secured a controlling influence, to such an extent that the history of the period can properly be regarded as the record of an experiment in British colonization.

Permanent settlements on the Atlantic seaboard were first made in the early years of the 17th century, and they continued steadily to increase until after 1680. Relatively speaking, that was the period of settlement, but population continued slowly to advance westward. In the 18th century occurred a large immigration of Germans and Scottish-Irish, who settled in Pennsylvania and New York and thence overflowed into the western parts of Virginia and the Carolinas. The only colony which was founded in the 18th century was Georgia (1732), by means of which British outposts on the Florida frontier were strengthened.

General Aspects of Colonization.

2. British colonization originated chiefly in private initiative, though it acted in half-conscious obedience to certain general principles of action. From this fact originated the trend toward self-government, which was fundamental and controlling in the history of the British on the American continent. But to an extent the tendencies which favoured self-government were counteracted by the influence of the British Crown and parliament. The influence of the Crown was continuous, except during the period of the Civil War and Commonwealth (1642–1660), while that of parliament was not felt until the middle of the 17th century, and its colonial legislation subsequent to that time was chiefly confined to matters of trade. The activities of Crown and parliament were directed toward the securing of Imperial interests and of that degree of subordination and conformity which, in states that have developed from Roman and feudal origins, attaches to the condition of colonies or dependencies. The term "imperial control" therefore suggests the second tendency in colonial affairs, to the discussion of which the historian must address himself.

3. Among the colonists the trend toward local independence and self-government was in harmony with the spirit of the English. Neither was it lacking among the other nationalities represented in the colonies. But in the case of the British it was greatly strengthened by the fact that the colonies were founded by private initiative, the government legalizing the efforts of the "adventurers" and planters, but leaving them in many cases almost wholly to themselves. Hence many small colonies and settlements were founded along the coast. A variety of motives—economic, religious and political—contributed to the founding of these colonies, and people correspondingly different in type came to inhabit them. As they differed from one another, so their descendants came to differ from the Europeans, out of the midst of whom they had come. The remoteness of the colonies from Europe and the difficulties under which communication with them was maintained confirmed and perpetuated the tendency toward independence both of England and its government. Somewhat similar conditions controlled intercolonial relations, kept the colonists apart from one another and checked efforts at co-operation. Thus it was that the causes which confirmed the colonists in the spirit of independence toward the mother country at the same time made them jealous of any external authority.

Chartered Colonies.

4. The term "chartered colonies" is the one which best describes the forms under which the British-American settlements were founded and under which they all continued for periods varying from a single generation to that of the entire duration of their colonial existence. They were the direct and characteristic results of private initiative in colonization. The discoverers and would-be

colonizers, acting individually or in groups, collected the ships, men and resources necessary for their enterprises, and procured from the Crown a charter. By this document the king conveyed to them a claim to the soil which would be valid in English law, gave them the right to transfer Englishmen thither as colonists, to trade with them and with the natives, and to govern the colony, subject to the conditions of allegiance and of British sovereignty in general. The rights and liberties of the colonists as British subjects, without attempt to define what they were, were guaranteed by the charters, and the grantee was prohibited from passing laws or issuing orders which were repugnant to those of England. In only a part of the charters—those chiefly which were issued subsequent to 1660—was express reference made to the calling of assemblies in the colonies. So general were the provisions of the charters that they only remotely determined the forms which government should assume under them and what the rights of the colonists should be. A considerable variety of institutions and social types existed under them. But their very indefiniteness made them valuable as objects of appeal to those who in time of controversy were upholding local rights and liberties.

Proprietary Provinces.

5. Of the chartered colonies there were two varieties—proprietary provinces and corporate colonies. Though alike in the fact that the patentees who founded them were mesne tenants of the Crown, they were quite unlike in their internal organization and to a considerable extent also in the character of the people who inhabited them. The proprietary province was a development from the principle of the fief, though with many variations. The early charters of discovery, those for example which were granted to John and Sebastian Cabot and to Sir Humphrey Gilbert, contemplated the founding of feudal principalities in the New World. The grant to Sir Walter Raleigh, which resulted in the abortive colonial experiment at Roanoke, was of the same character. At the period of transition from the rule of the Tudors to that of the Stuarts, trading companies and companies whose purpose was colonization were increasing in number and importance. The first half of the 17th century was distinguished by the founding of many such, in France and the Netherlands as well as in England. The joint companies which were chartered by James I. in 1606, one to have its residence at London and the other at Plymouth, were of this character. They were granted the right to colonize, the one in northern and the other in southern "Virginia"; the intervening territory, three degrees in breadth, being left common to the two. The rights of the companies were confined to those of settlement and trade. The Plymouth patentees achieved no permanent result; but those of London founded Jamestown (1607) and other settlements along the James river, which later became the province of Virginia (*q.v.*).

London and Plymouth Companies.

6. But before this result had been reached the London patentees had secured in succession two new charters, one in 1609 and another in 1612. By means of these grants they had practically separated from the Plymouth Company, had secured a concession of territory 400 m. broad and extending through the continent, and had been able to perfect the organization of their company. By the grant of 1606 the right to govern the colonies had been reserved to councils of royal appointees, one resident in England and one in each distinct colony which should be founded. But by their later charters the London patentees were fully incorporated, and in connection therewith received not only the power to grant land but rights of government as well. This made the Virginia Company of London in the full sense of the word the proprietor of the province which it was founding. It now appointed resident governors, councillors and other officials for the colony, and instructed and controlled them in all ways, subject of course to the general supervision of the king in council. Under the charter of 1606, in order to facilitate colonization on a strange continent, joint management of land and trade was temporarily instituted. But under the fully organized company, as managed by Sir Thomas Smith, and especially by Sir Edwin Sandys and the Ferrars, this system was abandoned, and private property in land and the control of trade through private "magazines" were established. A number of distinct plantations and settlements were founded which later developed into counties and parishes. From these localities, in 1619, under authority from the company, representatives were elected who met with the governor and council at Jamestown and formed the first colonial assembly held on American soil. Its acts were duly submitted to the company in London for its approval or disapproval. Other assemblies were called, the tobacco industry was established and the principles upon which traffic in that staple was to be conducted with Europe were announced. Thus Virginia assumed the form of a proprietary province, with an English trading company as its proprietor.

New England Council.

7. Meantime west of England men had been making fishing voyages and voyages of discovery to northern "Virginia", which now was coming to be known as New England. In 1620 a new charter was procured, the reorganized company being known, in brief, as the New England Council. Like the London patentees, this body was now fully incorporated and received a grant of the vast territory between 40° and 48° N. lat. and extending through to the South Sea (Pacific). Full rights of government, as well as of trade and settlement, were also bestowed. The moving spirit in this revived enterprise was Sir Ferdinando Gorges (*q.v.*), an Anglican and royalist from the west of England. For a time John Mason (*q.v.*) was his most active coadjutor. Such backing as the company received came from nobles and courtiers, and it had the sympathy of the court. But lack of resources and of active interest on the part of most of the patentees, together with the development of a Puritan interest in New England, led to the failure of this enterprise. No colony was established directly by the council itself, but that part of its vast territory which lay adjacent to the coast was parcelled out among the patentees and by them a few weak and struggling settlements were founded. They were all proprietary in character, and those along the northern coast were more or less connected with Anglican and royalist interests. But, as events proved, Plymouth Colony (founded in 1620), which was Puritan and Separatist to the core, became a patentee of the New England Council; and the colony of Massachusetts Bay (founded in 1628-1630), which was to become the citadel of Puritanism in America, procured the original title to its soil from the same source. At the outset both Massachusetts and Plymouth must be classed as proprietary settlements, though far different from such in spirit and destiny. Massachusetts soon (in 1629) secured a royal charter for its territory between the Merrimac and Charles rivers, and thus took a long step towards independence of the council. At the same time the Plymouth settlers were throwing aside the system of joint management of land which, as in the case of Virginia, had been imposed upon them by adventurers who had lent money for the enterprise; were paying their debts to these same adventurers and securing control of the trade of the colony; were establishing a system of self-government similar to that of Massachusetts. Thus a strong Puritan interest grew up in the midst of the domain which had been granted to the New England Council, and in connexion therewith the type of colony to which we have given the name corporate came into existence.

Corporate Colonies; the Virginia Company.

8. In order to understand the nature of the corporate colony, it is necessary to explain the internal organization of that type of company which, like the Virginia Company of London, was founded for purposes of trade and colonization. It was composed of stockholders, who became members as the result of the purchase of shares or of migration to the colony as planters, or of both acts combined. In the Virginia Company they were known as the "generality," in the Massachusetts and other companies as the "freemen." In them, when met as a democratically organized body under the name of "quarter court" or "general court," was vested the governing power of the company. It

elected the officers, chief among whom were a treasurer or governor, and a council or board of assistants. These, as well as the subordinate officers, held for annual terms only. Four times a year, at the law terms, the general courts met for the transaction of business, elections being held at the spring meeting. Membership in such companies might be indefinitely increased through the issue and sale of shares. They were, in other words, open companies, whereas the New England Council was a closed body, its membership being limited to forty. The Massachusetts Company was an open corporation of the type just described.

Massachusetts Company: Removal of Charter to Massachusetts.

9. In 1629 the prospects of Protestantism at large, and of Puritanism in England, were so dark that the founders of the Massachusetts Company, who were decidedly Puritan in spirit and inclined to nonconformity in practice, resolved to remove with their charter and the governing body of their company into New England. Preparatory to this, John Winthrop was elected governor and a settlement was made of their business relations in England. After the removal had been made, the assistants and general court met in New England and business was carried on there exclusively by planters. An order was soon passed that none should vote or hold office who were not members of some one of the churches within the colony. As all these churches were Independent or Congregationalist in form and doctrine, this order gave a wholly new definition to the term "freemen." It made of this colony something approximating to a biblical commonwealth, and subordinated trade, land-holding and settlement to the interests of the Puritan faith. The board of assistants now assumed political and judicial functions. As local settlements about Massachusetts Bay were founded, the general court, which before had been a primary assembly—simply the freemen of the company—came to consist partly of representatives elected by the freemen of the towns. In this way a second chamber—that of the deputies—was added to the assistants to form the general court of the colony. Taxes were levied by this body, and laws and orders proceeded from it which related to all functions of government. It elected or appointed the governor and other chief officials, and determined the times of its own meeting. The governor had no veto and the general court was the controlling organ in the system.

10. Of primary importance in the affairs of the colony was everything which concerned religious belief and church government. The churches and their relation to the civil power presented the great questions upon which hinged its policy. This was true not only in its internal affairs, but in its relations with other colonies and with the mother country. An ecclesiastical system was developed in which Independent and Presbyterian elements were combined. By a rigid system of tests this was upheld against Antinomians, Baptists, Quakers and dissenters of all sorts. The securing of revenue from land and trade was considered subordinate to the maintenance of the purity of the faith. It was this which gave a point and vigour to the spirit of self-government in the New England colonies which is not perceptible elsewhere.

Connecticut; New Haven Colony; Rhode Island.

As a consequence of the Puritan migration from England and of the expulsion of dissenters from Massachusetts, Plymouth, Connecticut (*q.v.*), the New Haven Colony, and the towns about Narragansett Bay which became the colony of Rhode Island (*q.v.*), were settled. These all were corporate colonies, organized upon fundamentally the same plan as Massachusetts but differing from it in minor particulars. Their settlers at the outset had no charters, but by means of plantation or town covenants assumed powers of government, which ultimately were vested in general courts similar to that of Massachusetts. Rhode Island was formed by a union of towns, but elsewhere the colony was coeval with or antedated the town. Connecticut and Rhode Island, the former in 1662 and the latter in 1663, secured royal charters by which they were incorporated within New England itself and the governments which they had established there were legalized. New Haven was absorbed by Connecticut in 1664 under the charter of 1662 (see CONNECTICUT), and Plymouth remained without a charter from the king until, toward the close of the 17th century, it became a part of the enlarged province of Massachusetts.

11. The most prominent feature of the New England land system was the "town grant," which in every case became the territorial basis of a group settlement. Throughout New England, and in the outlying districts which were colonized by New Englanders, settlement was effected by groups. The process began in Plymouth and was extended through the entire section. The Puritan migration from Europe was of the same general character. Groups of people, animated by a common religious or political ideal, broke away from their original or temporary abiding-places and pushed farther into the wilderness, where tracts of land were granted to them by the general court. The corporate colonies did not seek profit from their land, but granted it freely to actual settlers, and in such amounts as suited their needs. No distinct land office was established by any New England colony. Land was not sold by the colony; nor, as a general rule, was it leased or granted to individuals. Rent formed no appreciable part of the colony revenue.

12. Over the founding of towns the general courts, as a rule, exercised a watchful supervision. Not only did the courts fix and maintain their bounds, but they issued regulations for the granting of lands, for common fields, fences, herds, the punishment of trespass, the admission of inhabitants and freeholders, the requirement that records of land titles should be kept, and the like. But subject to these general regulations, the allotment and management of its land was left to each town. The colonies had no land system apart from the town. It was partly in order to manage their lands that the towns were made centres of local government and town meetings or boards of town proprietors were established. By means of town action, taken in town meetings and by local officials, the land of each settlement was laid off as house lots, common and common fields, meadow and pasture. Detailed regulations were made for the management of common fields and for their ultimate division and allotment among their proprietors. The same was true of fences and herds. The result was an organization similar to the English manor, but with the lord of the manor left out; for in the case of the New England town administrative authority resided in the body of the freeholders. To this peculiarity in the form of New England settlement is due the prominence of the town, as compared with the county, in its system of local government. The town was the unit for purposes of taxation and militia service as well as of elections. It was also an important ecclesiastical centre, the parish usually corresponding with it in extent.

13. As a result of the process thus sketched, southern New England was settled by a population of English origin, with similar instincts and a form of political organization which was common to them all. Gorges, meantime, had secured (1639) a royal charter for his province of Maine, but Mason had died before he obtained such a guaranty for his settlements on the Piscataqua river. The small communities along that entire coast remained weak and divided. In 1635 the New England Council surrendered its charter. The helplessness of the Gorges family was insured by its adherence to the royalist cause in the English Civil War. Massachusetts availed itself of a forced interpretation of the language of its charter respecting its northern boundary to extend its control over all the settlements as far north-east as the Kennebec river. This was accomplished soon after 1650, and for the time Anglican and royalist interests throughout New England seemed hopelessly wrecked. New England had thus developed into a clearly defined section under Puritan domination. This fact was also clearly indicated by the organization, in 1643, of the New England Confederacy, or the United Colonies of New England (see NEW ENGLAND), which comprised the orthodox Puritan colonies, whose leading magistrates, as annually elected commissioners, for twenty years exercised an advisory control over New England.

Middle and Southern Colonies.

14. The colonies of the middle and southern sections of the territory, which later became the United States, were wholly proprietary in form. This was true of New Netherland (founded by the Dutch West India Company in 1621) and of New Sweden (settled under the authority of the Swedish Royal Company in 1638), as well as of the English colonies which were established on that coast. In the case of Virginia and of the Dutch and Swedish settlements, trading companies were the proprietors. But the later English colonies, beginning with Maryland in 1632, and continuing with the Carolinas (1663), New York (1664), New Jersey (1665), Pennsylvania and the Lower Counties, afterwards Delaware (1681), were founded by individual proprietors or proprietary boards. Georgia (1732), the only English colony settled after 1681 on the continent, existed for twenty years under a proprietary board of trustees. By the efforts of adventurers of this class, put forth chiefly during the period of the Restoration, the entire coast-line from Florida to Acadia was permanently occupied by the English. But, unlike New England, the population of the other sections was of a mixed character, as were their economic and religious systems, and to an extent also their political institutions.

15. As has already been stated, in their internal structure and in the course of their history the proprietary provinces differed very materially from the corporate colonies. Those of later English origin also differed in some important respects from Virginia under the company and from New Netherland and New Sweden. The system of joint management of land and trade, which was so characteristic of early Virginia, was outgrown before the other proprietary provinces were founded. Neither did it prevail in the Dutch and Swedish provinces, but there the law and institutions of government of those nations existed, and no provision whatever was made for assemblies.

16. In the proprietary province the proprietor, or board of proprietors, was the grantee of powers, while in the corporate colony it was the body of the freemen organized as an assembly or general court. The proprietor might or might not be a resident of the province. He might exercise his powers in person, or, as was usually the case, delegate them to one or more appointees. In any case, the form of government of the proprietary province was essentially monarchical in character. The powers that were bestowed were fundamentally the same as those which were enjoyed during the middle ages by the counts palatine of Chester and Durham. In some charters express reference was made to Durham as a model. The normally developed provinces which resulted were miniature kingdoms, and their proprietors petty kings. As Coke said, their powers were king-like though not sovereign. This character arose from the fact that the grantee of power was the executive of the province. This branch of government was thereby brought into the forefront. At the beginning and for a long time thereafter it continued to bear the leading part in affairs. It was not so in the corporate colony, for there the freemen and the general court stood at the centre of the system, and their ultimate control, which no one dreamed of disputing, was maintained through a system of annual elections. In most of the corporate colonies the executive (*i. e.* the body of magistrates) was strong, but that was due to the political and social influence which its officials had gained, and not to their tenure of office. But the nature of the proprietary province demands further explanation.

Government of the Proprietary Province.

17. In every case, apart from the ordinary rights of trade and the guarantees of the liberties of the colonists, the powers which were bestowed on the proprietors were territorial and governmental. The territory of the provinces was granted under the conditions which by English law controlled private estates of land. An entire province, or any part of it, could be leased, sold or otherwise disposed of like a private estate. It was an estate of inheritance, descending to heirs. The attitude of proprietors toward it was that of landlords, investors or speculators in land. They advertised for settlers, and, in doing so, an ever present motive with them was the desire to secure more private income from land. In 1664 the duke of York sold New Jersey to Berkeley and Carteret, and the sale was effected by deeds of lease and release. In 1708 William Penn mortgaged Pennsylvania, and under his will devising the province legal complications arose which necessitated a suit in chancery. Thus proprietors and proprietary boards changed with every generation or oftener. All this, of course, was different in the corporate colony.

18. In all the later proprietary charters, except that of New York, the operation of the statute *Quia emptores* was suspended, so far as relations between the proprietor and his immediate grantees were concerned. By virtue of this provision each proprietor, or board, became the centre from which originated an indefinite number of grants. These were held directly of the proprietor and through him of the Crown. In practice the same was true also of New York. The proprietors were thus left free to make grants on such conditions as they chose—limited by the nature of their patents—to erect or permit the erection of manors, to devise the machinery necessary for surveying, issuing and recording grants, and collecting rents. Preparatory to the exercise of this power, the proprietors issued so-called "concessions" or "conditions of plantation," stating the terms on which they would grant lands to colonists. These were often accompanied by descriptions of the country, which were intended to be advertisements for settlers. Under a system of head rights, analogous to that which existed in Virginia, land was thus bestowed on settlers upon easy terms. Proportional amounts of land were granted upon the importation of servants, and in this way a traffic in servants and their head rights to land was encouraged among planters and masters of merchant vessels. In all the provinces, except New Netherland, a quit rent was imposed on all grants. In the Dutch province rents were sometimes imposed, but they varied in character and differed from the English quit rent. In Maryland fines were levied on alienations. In Maryland and Pennsylvania the demand for land became so great that it was sold. In most of the provinces manorial grants were made, but in none except New Netherland did the manor become an institution of government. In all the provinces territorial affairs were administered directly by the provincial authorities, and not by towns as in New England. In Maryland a land office was fully organized, towns developed only to a very limited extent, and when they did originate they were in no sense village communities. Lots in them were granted by provincial authorities and they were subject to a quit rent. They were simply more densely populated parts of the counties, and, unless incorporated as boroughs, had no distinct institutional life. In almost all cases land, in the provinces, was granted to individuals, and individual ownership, with direct relations between the owners or tenants and the proprietary authorities, was the rule. This was in marked contrast to the conditions which have been described as existing in the corporate colonies. In the corporate colony the elements of the fief had been eliminated, but in the provinces they still survived to a considerable degree.

19. Had governmental powers not accompanied the territorial grants which have been described, these grants would have been estates of land, unusually large, no doubt, but nothing more. In cases where the governmental rights of proprietors were suspended or resigned into the hands of the Crown, they remained thereafter only private landlords. But the fact that rights of government were bestowed with the land made the territory a province and the proprietor its political head. The bestowment of rights of land carried with it not only the obligation to pay quit rent, but to take to the proprietor the oath of fidelity.

20. In the discussion of the corporate colony it was necessary to dwell first and chiefly on the legislature. But in the case of the proprietary province the executive, for the reason already mentioned, demands first attention. The provincial charters made the proprietors the executives of their provinces and for the most part left it to them to determine how and under what forms the governmental powers which they had received should

be exercised. The powers which were definitely bestowed were executive and judicial in character—the ordinance power, the authority to appoint all officers, to establish courts, to punish and pardon, to organize a military force and defend the provinces, to bestow titles of honour, to found churches and present to livings. The executive thus became the centre from and around which development in the province chiefly occurred. It gave to the proprietor an importance, especially at the outset, which was comparable with that enjoyed by the general courts in the corporate colonies. It made him in a derived and inferior sense the source, within the province, of office and honour, the fountain of justice, the commander of the militia, the recipient of the provincial revenue, the constituent part of the legislature. But in most cases the proprietors did not attempt to exercise these powers in person. Even if resident in their provinces they needed the assistance of officials. By means of commissioners they appointed a group of leading officials for their provinces, as a governor, councillors, a secretary, surveyor-general, receiver-general or treasurer, and somewhat later an attorney-general. These all held office at the pleasure of the proprietor, and were subject to guidance by his instructions.

The Provincial Governor.

Altogether the chief place among these officials was held by the governor. He was *par excellence* the agent for the proprietor for all purposes of administration. He regularly corresponded with the proprietor and received the latter's directions. In making appointments the proprietor was usually guided by his recommendations. In some cases he was a relative of the proprietor, and family influence in Maryland after the Restoration came to dominate the government of the province. In all his important acts the governor was required to take the advice of his council, and that body was expected to co-operate closely with him in all matters; but the governor was not bound to follow their advice. The relations between the two was the same as that between the king and his privy council in England. As settlements multiplied and counties and other local subdivisions were formed, other and inferior offices were created, the right of appointment to which rested with the governor, though it was exercised in the name of the proprietor. By means of an executive, thus organized, land was granted and the revenue from it collected, counties and other local divisions were established, relations were developed with the Indians, early preparations were made for defence, courts were opened and the administration of justice begun.

21. But in the later proprietary charters generally, with the exception of that issued to the duke of York, provision was made for assemblies. It was made, however, in very general terms, and it was left to the option of the proprietors to determine when, where and how they would call them. These legislatures did not originate in the natural or pre-existent rights of Englishmen, nor did the existence of a parliament in England make them necessary, though it greatly increased the difficulties of governing the colonies without them. Though they were not original in the sense which attached to the executive, they were immediately proven to be indispensable and their activity in the provinces gradually opened the way for the growth of modern democratic institutions.

The Provincial Legislature.

22. When met in regular form, the provincial legislature consisted of the governor, the council or upper house, and the assembly or deputies. The latter, who were elected by the localities, constituted the only representative part of the legislature. In tenure and functions the governor and council were largely independent both of the deputies and of the electors. They were a part of the executive and were naturally swayed by a regard for the interests of the proprietor and by administrative traditions. Though a component of the legislature, the council was the legal advisor of the governor. In many cases the importance of the councils was increased by the fact that, with the governor, in early times they formed the highest judicial tribunal in the province. As the governor had the sole power of calling, proroguing and dissolving the general assembly, the council might advise him in such a way as to destroy the body itself or thwart its plans. The joint work of the council and assembly was subject to the veto of the proprietor, or of both the proprietor and his governor. The legislature of the province, therefore, differed materially from the general court, though in practice this was somewhat offset by the fact that in the New England colonies the magistrates were usually re-elected for a long series of terms.

23. In the province, as in the kingdom, the legislature was in a sense an expansion of the executive, developed out of it, and was to an extent controlled by it. Out of this relation arose the possibility of conflict between the two parts of the legislature—that which represented the people and that which represented the proprietor. In the history of the provinces this formed the central line of cleavage. From the first the assemblies largely controlled taxation. Using this as a lever, they endeavoured to limit and define the powers of the executive and to extend the sphere of legislation more widely. Fees, from which officials derived most of their support, were a favourite object of their regulation. Occasionally offices which had originally been appointive were made elective. Protests of various kinds were made against official cliques. British statutes which favoured liberty and the powers of parliament were often referred to as guides and ideals of the opposition. Now and again the lower house came to a deadlock with council or governor. Threatened or actual revolt was sometimes necessary to bring the executive to terms. By such tactics as these the popular elements in the constitutions of the provinces asserted themselves. The sphere of ordinance was gradually limited and that of statute extended, while incidentally the system of government became more complex.

Constitutions.

In a number of provinces—the Carolinas, New Jersey and Pennsylvania—the proprietors at various times initiated elaborate constitutions, in which not only a land system, but forms and functions of government were prescribed on a large scale. These were variously known as fundamental constitutions, concessions and agreements, frames of government, and in every case were submitted to the general assembly for its acceptance or rejection. Long struggles often ensued over the question of acceptance, which usually ended in the modification or rejection of the schemes as too cumbersome for use or because they reserved excessive powers to the provincial executive.

Course of Development.

24. Though the main features in the form and development of the proprietary provinces have thus been indicated, it should be noted that their history was by no means uniform. In New Netherland and New York occurred a struggle for the establishment of a legislature, which continued at intervals for forty years and was not permanently successful until after New York had become a royal province. The proprietors of New Jersey never secured a royal charter, and therefore were not able to establish satisfactorily their claim to rights of government. As grants of land had been made to the settlers in certain localities within that province before its purchase by Berkeley and Carteret, opposition was made to the collection of quit rents, as well as to the enforcement of rights of government, and disturbances, resulting from these causes, became chronic. The province was also divided into East and West Jersey, the boards of proprietors being greatly increased in both, and West Jersey attaining an organization which was almost democratic in character. Within the vast reaches of the Carolina grant developed two provinces. One of these—North Carolina—was almost entirely neglected by the proprietors, and the weakened executive repeatedly succumbed to popular violence. In South Carolina many violent controversies occurred, especially over the efforts of the proprietors to compel the acceptance of the Fundamental Constitutions, which originated with Locke and Shaftesbury. But in the end this failed, and a simple form of government, such as was adapted to the needs of the province, was developed. In Pennsylvania the liberal policy of the proprietor led at the beginning to unusual concessions

in favour of the colonists. One of the most characteristic of these was the grant of an elective Council, which was intended to be aristocratic and the chief institution in the province. But owing to conflicts between it and the governors, affairs came to a deadlock. The total neglect of provision for defence by the Quaker province led to the suspension of Penn's powers of government for about two years after the English Revolution and the outbreak of the war with France. This did away with the elective Council for the time, and an appointive Council was soon substituted. Finally, in 1701, the Council was deprived of its powers of legislation and thereafter the legislature of Pennsylvania consisted of only one house—the Assembly.

B.—*Development of Imperial Control, 1606–1760.*

The Crown.

25. Turning now to the exercise of imperial control over the colonies, it is to be noted that it proceeded chiefly from the English Crown. It was exercised through the secretary of state, the privy council and a succession of boards subordinate to it which were known as commissioners of plantations or the board of trade; by the treasury and admiralty boards and their subordinate bureaus; by the attorney-general and the solicitor-general and by the bishop of London. The more continuous and intimate supervision proceeded from the privy council and the commissioners subordinate to it, and from the treasury board. The latter caused the auditing of such revenue as came from the colonies, supervised expenditures for them and had an oversight over appointments in the colonial service. The privy council received letters and petitions on almost every kind of colonial business, caused hearings and inquiries to be held, and issued letters, instructions and orders in council on an equally great variety of matters. It also acted as the regular court of appeal for the plantations. As time advanced, more of the administrative business passed directly into the office of one of the secretaries of state and the privy council became less active. The admiralty was concerned with the equipment of the navy for service in the colonies, and the high court of admiralty with the trial of prize cases and of cases arising from violations of the acts of trade. The assistance of the law officers of the Crown was sought in the drafting of charters, in the prosecution of suits for their recall, and in all cases which required the interpretation of the law as affecting the colonies and the defence of the interests of the British government in relation thereto. The bishop of London had supervision over the appointment and conduct of clergymen of the English Church in the colonies and over parish schools there. Not all of these boards and officials were active from the first, but they were created or brought into service in colonial affairs as the importance of the dominions increased.

Parliamentary Control.

26. The parliament by mentioning the dominions in its statutes could extend their provisions to the colonies. The early acts of supremacy and uniformity contained such reference, but it was dropped after the Restoration and no serious attempt was ever made to enforce uniformity in the colonies. Parliament did not begin to legislate seriously for the colonies until after the Restoration. Then the acts of trade and navigation were passed, to which additions were made in the reign of William III. and from time to time during the 18th century. This body of legislation, including about fifty statutes, comprised the most important acts relating to the colonies which were passed by parliament. A few statutes relating to military affairs were passed about the middle of the 18th century. Certain other laws relating to currency and coinage, to naturalization, to the punishment of governors, to the post office, to the collection of debts, and to a few other miscellaneous subjects complete the colonial legislation of parliament prior to 1760. About one hundred statutes in all were passed. The colonists themselves imitated in a general way the organization and procedure of the English courts. The main features of the common law came spontaneously into force in the colonies. The legislatures of several of the colonies adopted large parts of the statute law of England. The colonists were always accustomed to avail themselves, as far as possible, of the great English statutes which guaranteed liberty. After about 1690 the obligation was very generally enforced upon the colonies of sending the acts of their assemblies to England for acceptance or rejection by the king in council. Thus a general agreement between colonial and English law was attained.

27. But this, though far-reaching, was only one of the objects which were sought through the exercise of imperial control. Its object was to maintain the rights of Great Britain over the colonies and her interests in them in all respects. The diplomacy of Great Britain concerned itself to an increasing extent, as the 18th century advanced, with the acquisition or losses of colonial territory, with the fixing of boundaries and with the securing of commercial interests. The interests of trade, more than any other subject, determined the colonial policy of England. The Church and her interests also demanded attention. In all these matters the English executive—the Crown—continuously, and for the most part exclusively, managed colonial affairs. During the Commonwealth in the 17th century parliament was the source of all activity, whether legislative or executive, but at other times, as we have seen, its legislation was confined chiefly to the subject of trade. The English courts also played a minor part except when, in conjunction with the executive, they were concerned in the revocation of colonial charters.

Isolation of the Colonies.

28. A natural condition which affected colonial administration as a whole and to a large extent determined its limits and character was the remoteness of the colonies from England. With this the conditions of sparse and scattered settlements in a new continent in the midst of savages were closely connected. At best three months were required for sending a despatch from London to America and procuring a return. This explains the large degree of self-government which the colonies possessed and the indifference with which their affairs were usually viewed, even by British officials. Only a relatively small part of colonial business came before English officials or received their serious attention. Only at long intervals and in summary fashion was it brought to the attention of parliament. It is believed that the affairs of the continental colonies were never seriously debated in parliament until after the beginning of the controversy which led to the American War of Independence. Social and political intercourse with the colonists and governmental control over them were therefore very imperfectly developed, as compared with that which existed within the realm. That is the real meaning of the distinction between the realm and the dominions. Over the counties and other local jurisdictions of the realm the control of Crown and central courts and parliament was continuously felt. In law and theory the same was true of the dominions; in fact, the control over them was almost wholly executive, and during most of the period it was to a degree unintelligent and weak. In theory the British Empire was a consolidated structure; in fact it was something more resembling a federation.

Development of the Chartered Colony.

29. The central fact in colonial history during the 17th century was the development of the chartered colonies. At their founding, as we have seen, the Crown delegated rights of settlement and subordinate rights of government to proprietors, who used them in a variety of ways. The effect of this was to introduce a number of mesne lords between the king and his colonial subjects, a phenomenon which centuries before had vanished from England itself. The patentees governed the colonists, and the Crown only interfered at intervals to adjust matters. And when the Crown did this, its dealings were far more with the patentees and their officials than with the body of the colonists. The king had no officials of his own in the colonies, and a practical system of immunity existed. Under the first two Stuarts some rather desultory efforts were made to check the development of such a system in the early stages. After a controversy over a contract for

the sole importation of tobacco, which became involved with the political struggles of the time in England, the charter of the Virginia Company of London was revoked (1624). A royal commission was appointed to readjust the affairs of Virginia and to inaugurate its government as a royal province, and the king declared that he desired the government of all his dominions to be monarchical in form. Several commissions were later appointed to manage the tobacco trade. In 1634 a board of commissioners of plantations was created and it received very large powers over the colonies. Of this body Archbishop Laud was the moving spirit. The year following the New England Council resigned its charter, a writ of *quo warranto* was issued against the Massachusetts charter, and a plan was nearly perfected for sending out Sir Ferdinando Gorges as royal governor, or rather governor-general, to New England. But means were lacking, the suit against the Massachusetts patent failed to accomplish its purpose, and troubles at home soon absorbed the attention of the government.

30. During the Great Rebellion in England New England was left practically to itself. Strife broke out in Maryland, over which the home government was scarcely able to exercise even a moderating influence. The Dutch from New Netherland and Europe were able to monopolize a large part of the carrying trade in tobacco and European goods. Virginia, with Barbadoes and a few other island colonies, assumed an attitude of distrust or hostility toward the new government in England. In 1651 and 1652 parliament sent out a commission, with an armed force, which reduced the island colonies to submission and adjusted affairs in Virginia by suspending government under Sir William Berkeley, the royalist governor, and leaving control in the hands of the Assembly. By a stretch of power the commissioners also took control of affairs in Maryland, but there they intensified rather than allayed the strife. Baltimore, however, managed to save his interests from total wreck, and at the Restoration was able fully to re-establish his authority.

Commercial Influences; Administrative Changes; Navigation Acts and other Restrictive Legislation.

31. During this period of unstable government in England the seeds were planted of a colonial policy which was henceforth to dominate imperial relations. It was then that England entered upon the period of commercial rivalries and wars. The Cromwellian government determined to wrest the control of the carrying trade from the Dutch, and the Navigation Act of 1651 and the first Dutch War were the result. General Robert Sedgwick was sent against New Netherland, but ended in attacking Acadia. At this time also the national hatred of Spain, which had so characterized the age of Elizabeth, reasserted itself and the Spanish seas were invaded, Hispaniola was attacked, and Jamaica was conquered. In connexion with these events plans were formed for a more systematic colonial administration, which Cromwell did not live to execute, but which were taken up by Clarendon, the duke of York, the earl of Shaftesbury and a large group of officials, lawyers and merchants who surrounded them. They took definite shape after the Restoration in the creation of a council for trade and a council for foreign plantations, in the passage of the acts of trade, in the conquest of New Netherland and the organization within it of three English provinces, in the settlement of the Carolinas, in a resolute attempt to remedy grievances and adjust disputes in New England. These events and their consequences give greater importance to the next three or four decades than to any later period until the colonial revolt.

32. The council for foreign plantations was continued, sometimes under a patent and sometimes as a committee of the privy council, until, in 1696, it was commissioned as the board of trade. As a board of inquiry and report, subordinate to the privy council, the most important business relating to the colonies was transacted before it. The acts of trade, in which the principles of the system were laid down, were passed in 1660, 1663, 1673 and 1696. They expanded and systematized the principles of mercantilism as they had long been accepted, and as in some particulars they had already been applied to the Virginia tobacco trade. The import and export trade of the colonies was required to be carried on in English and colonial built ships, manned and commanded by Englishmen. The policy of the staple was applied to the trade of the colonies by the enumeration of their chief products which could not be raised in England and the requirement that such of these as were exported should be brought to England and pay duties there, and that thence the supplies not needed for the English market should be sent to foreign countries. The same policy was applied to all colonial imports by the requirement that they should pass through English ports. In order to prevent intercolonial traffic in enumerated commodities, which might lead to smuggling, the act of 1673 provided for the levy of an export duty on them in the colonies in cases where a bond was not given to land them in the realm. In the 18th century severe restrictive measures were passed to prevent the growth of manufactures, especially of wool, hats and iron, in the colonies; but these acts proved mostly a dead letter, because the colonies had not reached the stage where such industries could be developed on any scale. Certain compensations, favourable to the colonies, also appear in the system, *e.g.* the measures to suppress the raising of tobacco in England and Ireland, in order that the colonists might have the monopoly of that market; the payment of bounties on the importation of naval stores and on the production of indigo by the colonists; the allowance, on the re-exportation of colonial products, of drawbacks of part or all of the duties paid on importation; the admission of colonial imports at lower rates of duty than were charged on the same products from foreign countries. In order to ensure the enforcement of these acts elaborate provisions became necessary for the issue of bonds, and this, with the collection of a duty in the colonies, led to the appointment of colonial customs officers who were immediately responsible to the commissioners of the customs and the treasury board in England. With them the governors were ordered to co-operate. Courts of vice-admiralty, with authority to try cases without a jury, were established in the colonies; and just before the close of the seventeenth century they were given jurisdiction over violations of the acts of trade, a power which they did not have in England. Naval officers were very generally provided for by colonial law, who were to co-operate with the customs officers in the entry and clearance of vessels; but in some cases their aim was rather to keep control over trade in colonial hands. It thus appears that the resolve to enforce the policy set forth in the acts of trade resulted in a noteworthy extension of imperial control over the colonies. How far it was successful in the immediate objects sought it is impossible to say. In some of the colonies and at some times the acts were practically nullified. Illegal trading was always carried on, especially in time of war. In such times it was closely allied with privateering and piracy. But in the large it is probable that the acts were effective, and their existence always furnished a standard to which officials were required by their instructions and oaths to conform. By the Act of Union of 1707 Scotland was admitted to the advantages of the English trade system. In 1733, in order to check the development of the French colonies and prevent the importation of their products into English possessions, the Molasses Act was passed. This provided for high specific duties on rum, molasses and sugar, when imported from foreign colonies into those of Great Britain. So high were these rates that they could not be collected, and therefore no serious attempt was made to enforce the act.

Molasses Act.

33. Returning again to the 17th century, in order to trace in other connexions the notable advance which was then made in colonial administration, we are to note that the conquest of New Netherland by the British in 1664 was an event of great importance. Taken in connexion with the settlement of the Carolinas, it completed the hold which the English had upon the North American coast and gave them for the first time an extent of territory which could be profitably developed.

The occupation of New Netherland was effected by a royal commission, which was also empowered to hear complaints and report a plan for the settlement of disputes in New England. Precedents for such a commission existed in the past, and a little more than ten years later a similar body, accompanied by a military force, was sent to Virginia to adjust matters at the close of Bacon's rebellion. But the commission of 1664 was the most noteworthy example of its kind. Yet, though it succeeded at New Amsterdam and in the southern colonies of New England, it failed at Boston. Massachusetts would not admit its right to hear appeals. It did not succeed in wresting from Massachusetts the territory of New Hampshire and Maine, which the heirs of Gorges and Mason claimed.

34. In 1676 Edward Randolph was sent as a special agent to Massachusetts, to require it to send agents to England. He returned to England the sworn enemy of that colony and continued to be its tireless prosecutor. A series of negotiations ensued which lasted for almost a decade, and ended in the revocation of the Massachusetts charter by a degree in chancery, 1684. New Hampshire had already been organized as a royal province. Government under the charters of Rhode Island and Connecticut was soon after suspended. All New England was then organized as a dominion or vice-royalty under Sir Edmund Andros. Assemblies were everywhere abolished and government was left wholly in the hands of the executive. New York—also without an assembly—and New Jersey were soon after incorporated with the Dominion of New England, its boundary being extended to the Delaware river (see NEW ENGLAND). After Bacon's rebellion in 1676 the lines of executive control were strengthened in Virginia, but the Assembly continued active. These rapid changes involved the downfall of the former system of chartered colonies and the substitution of royal provinces in their place. The effect of this was to introduce into the colonies a large number of officials of royal appointment—the governors, members of the council, judges, secretaries, surveyors-general, receivers-general and attorneys-general. The entire executive and judiciary in a royal province was appointed directly or indirectly by the king. Its members held under commissions subject to the king's pleasure and were controlled by his instructions. The exclusiveness of the chartered jurisdictions no longer obtained, but the Crown through its officials was brought into direct relations with the body of the colonists. Government could now be carried on under relations analogous to those between Crown and people in England.

Dominion of New England.

35. By the abolition of assemblies and the union of colonies on a large scale James II. did violence to the strongest feelings and traditions of the colónists. The New Englanders not only viewed the levy of taxes by prerogative with the utmost aversion, but they feared a general unsettlement of land titles, the destruction of much that was valuable in their system of town government, and the introduction of Anglican worship among them. They shared also in the fear, which was widespread among the colonists, that the Crown intended by an alliance with the French and Indians to force Roman Catholicism upon them. Therefore the fall of the Stuart government in England was the signal for an uprising at Boston (April 1689) followed by a less successful one at New York. The Dominion of New England at once collapsed and the old colony governments were generally restored. A revolt against the Catholic proprietor in Maryland resulted in the suspension of his powers of government and the organization of Maryland as a royal province. William III. granted a new charter to Massachusetts (1691) in which full provision was made for an assembly, but also for a governor and secretary of royal appointment. Rhode Island and Connecticut were allowed to remain under their corporate charters. New York and New Hampshire were organized as royal provinces with assemblies. Proprietary government struggled back into existence in New Jersey. In Pennsylvania the governmental powers of the proprietor were suspended for two years (1692–1694), because of his neglect of provision for defence; then they were restored and Pennsylvania continued under proprietary government until the War of Independence.

Colonial Reorganization.

36. The transition from the system of chartered colonies to that of royal provinces was thus begun and well advanced towards completion. But it was a gradual process, and the later stages of it were not reached until the second decade of the 18th century. South Carolina became provisionally a royal province in 1719, and a parallel change was completed in North Carolina a decade later. Georgia received a royal government in 1752. But in 1715 Maryland was permitted to resume its proprietary form. After the Revolution of 1689 the change to royal governments did not involve in any case the abolition of colonial assemblies. Henceforward the Crown had a fully equipped executive in every royal province, and for the maintenance of its rights could depend upon its efforts and the influence which it was able to exert upon the assemblies. The governors exercised the royal rights of calling, proroguing and dissolving the assemblies; they assisted in initiating legislation and exercised the right of veto. All bills passed by the assemblies were required to be submitted to the king in council, for acceptance or disallowance. The upper houses of the legislature were the councils of the provinces. These were small bodies and consisted, in every case except Massachusetts, of royal appointees. Their support was in most cases given to the governors, and by that means they were greatly assisted in resisting the encroachments of the lower houses of assembly, which were elected by the freeholders. But, as a rule, the Crown made no provision for the salaries of its governors and other officials, and left them largely dependent for support on appropriations by the assemblies. In very many cases the withholding of salaries was successfully resorted to by the assemblies as a means of thwarting the executive or forcing it into submission. Under this system of balanced forces, analogous in general to that which was reached after the Revolution in England, the colonies entered upon the long period of the French wars.

C.—*The Struggle with the French, 1690–1760.*

37. Early French discoveries and colonization in North America were confined chiefly to the valley and gulf of the St Lawrence. These led, in the early 17th century, to the establishment of the province of Canada. By 1610 the French had possessed themselves of the valley of the lower St. Lawrence, and the relations with the Indian tribes were being determined. During the next fifty years Canada grew slowly into an autocratically governed province, in which a mild form of feudalism existed and in which the Catholic Church was so strong as to contest supremacy at times with the civil power. The fur trade became from the first a most important industry in the province. The Jesuits and other priestly orders undertook missionary work on a large scale among the natives. The fur trader and the missionary soon extended French influence through the region of the Great Lakes and involved the province in intimate relations with the Indian tribes, and that throughout a large area of country. Between the Iroquois and the French wars were almost continuous, but with the other Indian tribes the French were in general on friendly terms. The Iroquois, on the other hand, maintained friendly relations with the Dutch and afterwards with the English. This deeply affected relations between the English and the French, as well as the entire development of the province of New York.

38. Exploration was a most important incident of both the fur trade and the missionary enterprises of the French. Between 1670 and 1690 their work culminated in the great exploring activity of Marquette, Joliet and La Salle. The Ohio and Mississippi rivers were discovered and their courses were mainly or wholly traced. Explorers also penetrated far into the regions beyond the Mississippi. Posts were established at various points along the Great Lakes. During the first two decades of the 18th century the French also established themselves on the Gulf of Mexico, Mobile being founded in 1702 and New Orleans in 1718.

French Expansion.

Quebec and the Gulf ports were then connected by a series of forts which, though few and weak, sufficed for communication and for the establishment of a claim to the Mississippi Valley. They were Niagara and Detroit, commanding the approaches to lakes Erie and Huron; Fort Miami, on the Maumee river; Fort St Joseph, at the southern end of Lake Michigan; Vincennes and French Fort, on the Wabash; Fort Chartres, on the Mississippi opposite St Louis; Michillimackinac and Ste Marie, which guarded the upper lakes. French zeal and enterprise had thus seized upon the heart of the continent, and was prepared to oppose any westward movement which the English might in the future attempt. It seemed possible that English settlements might be confined to the coast, for they expanded slowly and no genius for exploration or sympathy with Indian life was shown. The tendency of British commercial policy was likewise to confine them there, for in no other way did it seem possible to restrict the trade of the colonists to British markets. The Indian alliances of the English were also far less extensive than those of the French. The provinces of South Carolina and Georgia had conflicts with the Spanish on the Florida frontier, and in these the Indian tribes of the south were also involved. But these rivalries were slight and local in character, when compared with the struggle for supremacy which was preparing between the French and English.

39. The conflict with the French was precipitated by events in Europe. It was the English Revolution of 1689 that opened the great conflict between France and England. The question of Protestantism versus Catholicism was involved, but at bottom the struggle was one for the balance of power among European states. Rival claims between the two powers in America, Africa and Asia existed at the beginning of the conflict, or originated and were intensified as it progressed. Questions of commercial and naval supremacy world-wide in extent were involved, and the colonial possessions of the two states were necessarily drawn into the struggle. In America it involved four intercolonial wars, which were closed respectively by the treaties of Ryswick (1697), Utrecht (1713), Aix-la-Chapelle (1748), and Paris (1763). Between the second and third wars intervened thirty years of peace, the early period of Hanoverian and Whig ascendancy in England, the so-called Walpole era. On the American continent during the first two wars the struggle was confined to the northern frontier, and consisted of devastating raids by the French and Indians, which in turn provoked retaliatory efforts on the part of the English. These took the form in part of attacks on Acadia and of unsuccessful efforts to conquer Canada by means of joint expeditions by sea and land. The favourite land route was that from New York by way of Lake Champlain to Montreal, while the expeditions by sea were forced to make the long and perilous voyage round Nova Scotia and through the Gulf and River St Lawrence to Quebec. In 1690, and again in 1711, an enterprise of this kind was actually undertaken. Acadia, "with its ancient limits," and the claim of France to Newfoundland and the Hudson Bay territory were, however, ceded to England by the treaty of Utrecht.

Wars between British and French in America.

40. As the great world-conflict progressed the relative importance of the colonial and maritime issues which were involved increased. The first two wars had their origin primarily in European questions. The third war had its beginning in the Spanish West Indies, and clearly revealed the existence of the Bourbon Family Compact, which bound France and Spain together in active alliance. On the American continent its most striking event was the capture, in 1745, of Louisburg, a stronghold which the French had recently fortified on Cape Breton for the purpose of defending its interests in the Gulf of St Lawrence. This victory was secured largely by the efforts of the New England colonists. In the following year another plan for the conquest of Canada was thwarted by the necessities of war in Europe. At the close of the war Louisburg, too, was restored to the French. After this fashion did the world-struggle react upon the special interests of the English in North America, and perplex and irritate the colonists. In the fourth intercolonial war (1754-63) the struggle between the two nationalities in North America was decided. Events which immediately preceded this war—the occupation of the Ohio Valley and the building of Fort Duquesne—clearly revealed an intention on the part of the French to exclude the English from the Mississippi Valley and confine them to the Atlantic slope. A persistent effort was also made to recover Acadia. The western, as well as the northern, frontier was not threatened, and the war which followed affected all the colonies. Great Britain sent over a succession of commanders-in-chief. Great improvement was made upon the crude efforts at joint colonial action which had characterized the earlier wars. To as great a degree did the Albany Congress of 1754 (see ALBANY, NEW YORK) surpass in importance the meetings of governors and military officers which had occasionally been held in previous times, though its plan of colonial union failed to meet the approval both of the colonists and of the government of Great Britain. The campaigns of this war were all upon a comparatively large scale. Campaigns were carried on not merely along the line of Lake Champlain and in Acadia, but against Fort Duquesne (see PITTSBURG, PENN.), Oswego, and Fort Frontenac, Louisburg, and Quebec (*q.v.*) itself. The weak Spanish power was overthrown in Florida and expeditions were sent against the southern Indians. In all quarters, and especially after Pitt became secretary of state, the British assumed the offensive. The navy of Great Britain, as well as its army, was called into action on a much larger scale in America than ever before. The result was the conquest by the British of Canada, and with it of all North America east of the Mississippi river; the French claim to territory west of this river was ceded to Spain in 1762.

41. The wars with the French brought the problem of colonial defence among the English into greater prominence than ever before, and added it to the other questions which had been of practical moment from the first. Against the Indians the colonists in the 17th century had provided for their own defence. Chiefly with this object in view, each colony had developed a militia system, modelled in general after that of England. But such a force was not fitted for long campaigns or large operations. It was comparatively undisciplined; both officers and men were inexperienced and destitute of proper habits of command, as well as those of subordination; the commissariat was poor or totally lacking, and the men were able to remain away from their homes for only brief periods. The colonists possessed no navy, and for coast defence only a few rude forts. So poor were means of communication and so isolated were the colonies from one another, that co-operation in joint expeditions was very difficult. Equally difficult was it to secure proportional contributions of money from the colonies. Early in the French wars the British government prescribed quotas both of men and money to be raised by the colonies, but little attention was paid to these except by the colonies which were in immediate peril. Because of the limited amount of available money and the modest resources of the colonists heavy taxation was impossible, and the financing of the wars was a matter of great difficulty. The assemblies resorted to the issue of bills of credit, to which they gave the legal tender quality, and for the redemption of which in nearly all cases they made inadequate provision. The paper depreciated and in some colonies became worthless. Great confusion resulted, involving loss to all, and among the sufferers were British merchants. Strained relations were produced between the assemblies and the colonial executive, because the latter, acting under royal instructions, persisted in vetoing bills for additional issues of currency. For this reason, in addition to others, the assemblies withheld the salaries of governors and other officials, and in this way sought to coerce the executives into submission. In some colonies the Assembly secured the right of electing the treasurer, and in most of them appropriations were made specific. Thus by skilfully utilizing their control over the purse, and that during a long period of war, the colonial assemblies were able materially to limit the authority of the executives and to establish not a few privileges for

themselves and their constituents. It was in such ways as these that the constitutions of the provinces became developed and liberalized during the French wars. Many a precedent was then established which was utilized in the later struggle with the mother country. The home government on its part also became convinced that requisitions were altogether inadequate as a method of procuring revenue for general purposes.

42. The quality of the rank and file of the Canadian militia was not essentially different from that of the British colonies. But the Canadian government was autocratic. The power of the French was also concentrated in a single large province, and not distributed among thirteen or more colonies. These conditions greatly promoted military efficiency. When taken in connexion with their Indian alliances, they enabled the French to take the offensive in the earlier wars much oftener than did the English, and with much greater effect. The government at Quebec was not subject to the limitations of quotas and requisitions. There were no assemblies to thwart its will. The English frontier was also more accessible and more exposed than was the lower part of the valley of the St Lawrence. Quebec was in every sense a citadel to which additional security was given during a large part of every year by the intense cold of the Canadian winter. But so superior were the training and enterprise of the French *coureur de bois* that, with his Indian allies, he was far better able than the English farmer or artisan to penetrate the wilderness, whether in winter or in summer, and massacre the exposed dwellers on the frontier. It was this class which gave the French the superiority in the long succession of raids by which the English frontier was laid waste.

43. Though the French by their skill and boldness achieved a remarkable success, their defects and weaknesses were equally evident. The flow of population from France to America was never great, and even it was diminished by the exclusion of Huguenots. The natural growth of population within New France was not rapid. The result was that the French colonists did not become sufficiently numerous to maintain the interests to which their vast claims and possessions gave rise. The disparity between their numbers and those of the British colonists became greater with every generation. At the opening of the last intercolonial war the proportion of English to French colonists was approximately 15 to 1. New York alone had about the same population as that of all the French colonies on the North American continent combined. The resources of the British exceeded those of the French colonists to a corresponding degree. Had the decision of the questions at issue depended upon population and wealth alone, the issue could not long have remained doubtful. But the tendencies arising from these fundamental conditions were to such an extent offset by other circumstances, already alluded to, that the result of the struggle was for a long time uncertain. Had it been confined to the forces of the colonies alone, it would perhaps never have been decided. The English could have defended the territory which they occupied; so could the French. Moreover, with the French and English thus facing one another, it would have been impossible for the latter to have declared their independence. The French would never have desired to do this. Therefore, the two peoples must apparently have remained in the condition of colonists for an indefinite period. But the motherlands were to be the decisive factors in the problem, which thus depended to an extent on complications which existed in Europe or even on remoter seas and continents. When the climax of the struggle was reached the result might have been different if France at the time had not been so deeply involved in the politics of central Europe.

44. Of the first importance in reaching a decision were the fleets and armies of Great Britain and France, or those parts of them which were available for use on the continent of North America. During the larger part of the period under review the French neglected their fleet, while the English steadily advanced toward naval and commercial supremacy. But the first conspicuous service on the northern coasts was that which was rendered by Commodore Peter Warren and his squadron at the capture of Louisburg in 1745. In the next year a large French fleet was despatched to North America, but it accomplished nothing. In the last intercolonial war the operations before Louisburg in 1758 and at Quebec (*q.v.*) in 1759 decisively proved the superiority of the British navy. The colonies also, in the later stages of the struggle, contributed loyally toward the result. France failed to make her natural military superiority effective in North America, and therefore her power on that continent had to yield before the combined attacks of Great Britain and her colonies by land and sea.

D.—*The Colonial Revolt, 1763-1776.*

British Acquisitions of Territory.

45. The Treaty of Paris (1763), by which the period of colonial wars—but not the struggle between England and France—was concluded, added vast stretches of territory to the dominions of Great Britain in North America. The Floridas, Canada and Louisiana as far west as the Mississippi river now came into the possession of the English. Of the islands which were occupied, the two most important—Guadaloupe and Martinique—were restored to the French. The retention of Canada in preference to these involved an important change in the nature and objects of British colonization. Hitherto tropical colonies had been preferred to those in northern climes. The occasion of this had been the view that, as England was not over-populated, colonies were not needed as "homes for a surplus population." Instead, they were estimated in proportion to their commercial value. The ideal was a self-sufficing commercial empire. The supporters of this view now argued that the islands which had been conquered from the French were more valuable than Canada and should be retained in preference to the northern continental territories, which had yet produced nothing for export except furs. But the government did not hesitate. Following the lead of Pitt, it was now bent upon continental expansion. Canada and the West were retained and the most important French islands were given back. The development of modern industry—the so-called industrial revolution—had already begun in Great Britain. Its effect was vastly to increase the population of the British Isles and to necessitate an overflow into the unoccupied regions of the globe. Colonies therefore began to be regarded from this point of view, and the retention of Canada opened the way for the change. Henceforth, as time progressed, colonies were to be valued as homes for a surplus population quite as much as sources of raw materials and food supplies. The retention of Canada and the West also coincided exactly with the desires of the continental colonies. The chief gains of the war went therefore to them and not to the island colonies. They now possessed a continental domain which was adequate to their need for expansion, and their long-cherished desire to be rid of the French was gratified. Though, as expansion progressed, conflicts with the Indian tribes of the interior, and that on a large scale, were to be expected, the conquest of the French removed the sense of dependence on Great Britain for military aid which the northern colonies in particular had previously felt.

Changed Colonial Policy of Great Britain; Strengthening of Imperial Control.

46. In consequence of the policy thus adopted, largely increased burdens were devolved on the imperial government, while the conquest and the events which led to it strengthened imperialist sentiment and ambitions. The course of action which was at first favoured by leading officials, both in England and the colonies, was a more systematic administration of Indian affairs, the employment of sufficient regular troops under the commander-in-chief to defend the newly acquired territory, the maintenance of posts with English settlers in the interior on a scale sufficient to prevent the French or Spanish from securing the trade of the region. Improved methods of administration were urged through the press by Thomas Pownall, Henry McCulloh, Francis Bernard and Dr John Campbell. French methods were praised and

the shortcomings of the surviving chartered colonies were again emphasized. This all required additional revenue, as well as administrative vigour, and that at a time when Great Britain was specially burdened with debt and when several of the colonies had recently incurred heavy expenditures. The large acquisitions of territory also necessitated some changes in the acts of trade. The necessity for their more vigorous enforcement was revealed by the existence of a large contraband trade between the colonists and the enemy during the later years of the war and also of a considerable illegal trade with Europe. These conditions, together with the conviction that, as the continental colonies had reaped the chief advantages of the war, some favour should be extended to the islands, led to the passage of the Sugar Act by the Grenville ministry in 1764. It also caused a resort to writs of assistance in two of the colonies, and finally the legalization of them in all the colonies by act of parliament (1767). The aid of the navy was directly invoked in the enforcement of the trade laws, and the activity of the customs officials and of the admiralty courts in the colonies was increased. Garrisons of regular troops—numbering several thousand—with a commander-in-chief were now present in the colonies in time of peace, and their aid might possibly be invoked by the civil power to suppress disorder. The Sugar Act itself was a trade and revenue act combined, and the fact was expressed in the preamble of the measure. It was intended directly to affect the traffic between the northern colonies and the foreign West Indies in lumber and food-stuffs, molasses and rum. The duty on foreign molasses, for which provision had been made in the Molasses Act of 1733, was halved; but now it was proposed really to collect this duty. A cry was immediately raised in New England that, if the duty was collected, the manufacture of rum—of which molasses was the staple material—would be lessened or wholly prevented and a most important industry sacrificed. The fisheries would incidentally suffer. The supply of coin, with which colonial balances were paid in England, they also said, would be lessened. Another act of parliament, passed about this time, prohibited the bestowment of the legal tender quality on colonial bills of credit. Though parliament regarded this act as a necessary remedy for the excesses of which many of the colonies had been guilty in the issue of paper money, it was generally regarded in America as a blow at a necessary system of credit. In spite, however, of the opposition and criticism which it provoked in the northern colonies, it is probable that the Sugar Act could have been permanently enforced. The Act of Trade of 1673 and the Molasses Act—though the latter was not fully executed—were two early instances of the exercise by parliament of the right to tax the colonies. Had the Sugar Act been enforced, a clear and decisive precedent in favour of this right would have been established. In view of the general situation, that was probably as far as the British government should have gone at that time. But it immediately committed itself to another and still more significant measure, and the two acts combined caused an outburst of protest and resistance from the colonists.

Stamp Act.

47. Repeatedly in earlier years the imposition of a stamp duty upon the colonies had been suggested. Archibald Cummings, William Keith, ex-governor of Pennsylvania, and Governor George Clinton of New York had prominently urged this policy. With the outbreak of the fourth intercolonial war comprehensive plans of parliamentary taxation were repeatedly proposed. The cost of the regular troops which must be stationed in America was estimated at about £300,000 annually. The Sugar Act was expected to yield about £45,000 a year. It was thought that the colonies should raise about £100,000 more as their reasonable share of the cost. George Grenville resolved to secure this by means of a stamp duty. This would fall upon the island colonies equally with those of the continent, though it would be expended chiefly for the enlarged military force on the mainland. Though its simplicity and ease of collection recommended it, the Stamp Act was a purely fiscal measure, and its character was not concealed by any features which allied it to the earlier acts for the regulation of trade. It involved an extension of the British system of stamp duties to the colonies, and was intended to draw revenue directly from many lines of their activity. It was passed by parliament in 1765, almost without debate and with scarcely a thought that it would be resisted. It provided for the appointment of officials to distribute the stamped papers in the colonies and further extended the power of the admiralty courts by giving them jurisdiction over violations of this act. The legal theory upon which the act was based was that of the unqualified sovereignty of parliament as the representative body for the whole empire, and that its authority, if it chose to use it, was as effective for purposes of taxation as for the regulation of trade or other objects of legislation. But never before, during the century and a half of colonial history, had the taxing power been so unqualifiedly exercised or in such trenchant force as by this statute. It followed close on the heels of the Sugar Act, which itself had aroused much hostile criticism. The two measures also came at a time when the consciousness of strength among the colonists had been increased by the defeat and expulsion of the French. Moreover, at the time when the policy was initiated, George III. had undertaken to crush the Whig party and to revive the latent prerogatives of his office. This resulted in the formation of a series of coalition ministries. Vacillation and uncertainty were thus introduced into the colonial policy of the government. The royal policy also brought into the public service in England and kept there an unusually large group of inferior men who persistently blundered in the treatment of colonial questions. It was only with the accession of the North ministry, in 1770, that permanence and a certain consistency were secured. But, in the view of the colonists, the prestige of the government had by that time been seriously lowered, and the stubborn self-will of the king became the only available substitute for broad and intelligent statesmanship.

48. Determined opposition to the Stamp Act was shown in all the colonies, by or before the time (Nov. 1) when it was to go into effect. The forms assumed by this opposition were such as characterized the entire controversy with Great Britain until the opening of hostilities in 1775. It consisted in the passage of resolutions of protest by the lower houses of some of the colonial legislatures; in the calling of a congress at New York, which was attended by delegates from nine of the colonies; in the activity of mobs organized under the name of the "Sons of Liberty" in all the large seaports and in some smaller inland towns; and, finally, in a somewhat widely extended movement against the importation of British, or even foreign, goods and in favour of frugality and the encouragement of home manufactures. The newspaper press also sprang into much greater activity than ever before, and many notable pamphlets were published in defence of the colonial cause. The most important resolutions at the outset were those adopted by the Virginia House of Burgesses and by the House of Representatives of Massachusetts. Through the first-named body the dramatic eloquence of Patrick Henry (*q.v.*) forced five resolutions. Two others, which threatened resistance and the coercion of any who should venture to uphold the home government, failed to pass, but the whole seven were published broadcast through the colonies. The calling of a general congress was proposed by the House of Representatives of Massachusetts. Prominent among its members was James Otis, who had already distinguished himself by radical opposition to measures of the government, especially in the case against writs of assistance which was argued before the superior court in 1761. Samuel Adams (*q.v.*), already a prominent man, was now elected a member of the house from Boston. He almost immediately became its leader, drafting its most important resolutions and papers, and to a large extent directing its policy. With the aid of others he was able greatly to increase the activity of the town-meeting in Boston, and in the course of a few years to develop it on occasion into a great popular convention, which could be utilized to overawe the government. Throughout New England the town and its institutions served well the purposes of opposition and

facilitated its extension over large areas. The county system of the provinces along the middle and southern coast was not so well adapted to these purposes, and their population was more dispersed. The intense Puritan spirit, with its century and a half of pronounced independence, both in polity and temper, was also lacking outside New England; though on the frontiers of the provinces from Pennsylvania southward was a Scottish-Irish population which exhibited many of the New England characteristics. But the tenant farmers of New York, the German pietist sects of Pennsylvania, the Quakers wherever they had settled, and in general the adherents of the English Church were inclined toward indifference or, as the controversy progressed, toward positive loyalism. Hence the mixture of nationalities in the Middle Colonies greatly increased the difficulty of rousing that section to concerted action. In Pennsylvania the issues were obscured by a struggle on the part of the western counties to secure equal representation with those of the east. This helped to make loyalists of the Quakers. Special grievances also produced among the frontier settlements of North and South Carolina quite as much dislike of the officials and social leaders of the tide-water region as they could possibly feel toward Crown and parliament. Throughout the struggle New England and Virginia exhibited a unity and decision in action which were not equalled elsewhere.

Colonial Opposition.

49. But to return to the Stamp Act. Before the meeting of the Congress at New York outbreaks of mob violence in Boston had forced the stamp distributor there to resign, and had wrecked the house of Thomas Hutchinson, the chief justice. Owing largely to the indecision of the elective council, the government had proved powerless to check the disorder. The resolutions passed by the Congress, as well as its petitions to the home government, gave authoritative form to the claims of the colonial opposition in general, though the body which issued them, like all the congresses which followed until 1776, was extra-legal and, judged by the letter of the law, was revolutionary. In these utterances, as later, the colonists sought to draw their arguments from British precedents and their own history. As they owed allegiance in common with subjects within the realm, so the rights of the two were the same. The two British rights which, it was claimed, were violated by the Stamp Act were the right to trial by jury and the right to be taxed only by an assembly in which they were represented. The former grievance was simply an incident of the latter, and was occasioned by the extension of the jurisdiction of the admiralty courts. The tax was a direct grievance. Therefore, for purposes of legislation like this these bodies denied that parliament was representative of the whole empire (so-called virtual representation), and asserted that it represented only the realm. For purposes of taxation, their assemblies, they affirmed, were the only representative bodies they had known. Therefore, ignoring the earlier and tentative measures by which parliament had actually taxed the colonies, and falling back upon the sweeping declarations of their assemblies, they denied the right of parliament to tax them. They declared that the recent policy of parliament was wholly an innovation and insisted upon a return to the Constitution as it was before 1763. The doctrine of natural right and compact was also resorted to with increasing emphasis in New England utterances. For purposes of government they had all along acknowledged—and now did so expressly—that parliament bound them; and the inference would have been fair that they were represented in it. But they did not draw this inference, nor did they seek by any scheme of reform to secure representation in the imperial legislature. James Otis was the only colonial leader who ever contemplated the possibility of such a solution. Adams early declared it to be undesirable. The British never proposed it, and therefore it played practically no part in the discussion.

50. The decisive blows, however, were struck by the mobs in the colonies and by the government itself in England. As the time for the execution of the Stamp Act approached, more or less violent demonstrations occurred in New York and in many other localities. The stamp distributors were forced to resign. Everywhere in the original continental colonies the use of stamped papers was prevented, except to a slight extent in Georgia. Business requiring the use of stamps was in part suspended, but far more generally it was carried on without their use. Without the aid of the militia, which in no case was invoked, the colonial executives proved indisposed or powerless to enforce the act and it was effectively nullified. In England the petitions of the colonists produced little effect. There the decisive events were the accession of the Rockingham ministry to power and the clamours of the merchants which were caused by the decline in American trade. What might have happened if Grenville had remained in office, and if the duke of Cumberland had not been suddenly removed by death, it would be impossible to tell. But the serious lack of adjustment between British politics and colonial government is illustrated by the fact that, more than three months before the Stamp Act was to go into effect, the ministry whose measure it was resigned, and a cabinet which was indifferent, if not hostile, to it was installed in office. Preparations were soon made for its repeal. The slight extent to which relations with the colonies had been defined is indicated by the fact that the debates over the repeal contain the first serious discussion in parliament of the constitution of the British Empire. While the colonies were practically united in their views a great variety of opinions was expressed in parliament. On the question of right Lord Mansfield affirmed the absolute supremacy of parliament in realm and dominions, while Camden and Pitt drew the same sharp line of distinction between taxation and legislation upon which the colonists insisted, and denied the right of parliament to tax the colonies. The debates at this time gave rise to the fancied distinction between internal and external taxes, of which much was made for a few months and then it was dropped. But motives of expediency, arising both from conditions in the colonies and in England, proved decisive, and in the spring of 1766 the Stamp Act was repealed, while its repeal was accompanied with the passage of a statute (The Declaratory Act) affirming the principle that Great Britain had the right to bind the colonies in all cases whatsoever. This measure was received with demonstrations of joy in the colonies, but the prestige of the home government had received a severe blow, and the colonists were quick to resent further alleged encroachments.

Repeal of the Stamp Act; the Declaratory Act.

Townshend Acts.

51. These soon came in the form of a colonial Mutiny Act and of the so-called Townshend Acts (1767). The former was intended largely to meet the needs of the troops stationed in the West and in the new colonies, but it also affected the older colonies where garrisons of regular soldiers existed. The act provided for a parliamentary requisition for barrack supplies, and partly because it included certain articles which were not required for the soldiers in Europe, the New York legislature at first refused to make the necessary appropriation. Partly through the influence of the governor, it later came to think better of it and in a non-committal way appropriated the supplies required. But meantime in England the Pitt-Grafton ministry had come into office, in which the brilliant but reckless Charles Townshend was chancellor of the exchequer. Pitt himself was disabled by illness, and the ministry, lacking his control, steadily disintegrated. Townshend availed himself of this situation to spring upon his colleagues and upon parliament a new measure for colonial taxation, and with it a bill legalizing writs of assistance and establishing a board of commissioners of the customs in America, and a third bill suspending the functions of the assembly of New York until it should comply with the terms of the Mutiny Act. These Bills all became law. Before the last-mentioned one reached the colonies, the New York Assembly had complied, and therefore the necessity for executing this act of parliament was avoided. The establishment of a customs board at Boston, of itself, did not provoke much criticism. But the Act of Trade and Revenue, which provided for the collection in the colonies of duties on glass, lead, painters' colours, paper and tea, and that out of the revenue

raised therefrom salaries should be paid to the governors and judges in America, opened anew the controversy over taxation.

52. John Dickinson, in his *Letters of a Farmer* (1767–1768), denied *in toto* the authority of parliament to tax the colonies, and his argument was widely accepted. Massachusetts petitioned the home government, and in a circular letter conveyed its views to the other colonies and asked an expression of theirs in return. This provoked Hillsborough, the incumbent of the new colonial secretaryship, to order the Massachusetts house to rescind its action and the other colonies to treat the letter with contempt. The Massachusetts assembly refused to rescind and was dissolved by the governor. The activity of the customs officials at Boston in seizing John Hancock's sloop, "Liberty," occasioned rioting, which in turn was followed by the transfer of two regiments to Boston. Several vessels of war were also stationed in its harbour (autumn of 1768). Deprived of their assembly, the towns of Massachusetts chose deputies, who met in convention, but without important result. Favourable replies to its circular letter were, however, received from a majority of the colonies. Resolutions against the new act were passed by many colonial assemblies, and in several cases petitions were sent to England. But, either because these addresses were not sent through the regular constitutional channels, or because they expressed views inconsistent with the Declaratory Act, they were laid on the table or rejected outright. The king and ministers expressed the view that the Americans were opposed to all restrictions, and that in Massachusetts treason or misprision of treason had already been committed. In this they had the support of large majorities in parliament. The statute of 35 Henry VIII., for the punishment in England of such offences when committed outside the realm, was now revived, and the royal officials in Massachusetts were instructed to collect evidence against suspected popular leaders with a view to their deportation across sea for trial. Though sufficient evidence was not found, nothing could have been better calculated to increase the exasperation of the colonists than a threat of this kind. It drew from the Virginia burgesses strong addresses and resolutions of protest. Fear lest the English Church would induce the government to establish a colonial episcopate caused much discussion at this time, especially in New England, and led to plans for joint action on the part of Dissenters, in self-defence. Though the government never sanctioned the plan, the fears which were aroused by its discussion contributed appreciably to the general agitation. In the course of 1769 the policy of commercial non-intercourse was again revived, and resolutions in favour of its enforcement were passed by many local bodies. But it was found difficult to enforce these, and, as the colonies were prosperous, trade, open and illicit, with Europe continued to be large. The British merchants did not clamour for relief, as they had done at the time of the Stamp Act, but gave loyal support to the policy of the government. The king was also steadily gaining an ascendancy, which in 1770 was permanently established by the accession of Lord North to the premiership. Thus, on both sides of the ocean, parties were bracing themselves for a struggle, the one for and the other against the principle of the Declaratory Act. The question of revenue was now largely obscured by that of right and power.

Tea Tax.

53. It cannot be said that the Townshend Revenue Act was nullified, for to a certain limited extent it was executed. But in 1770, on the specious plea that the duties were uncommercial because they were levied on British manufactures, all except the duty on tea—3d. per lb—were repealed, and a drawback of one-fourth and later of three-fifths of this duty was granted on the re-exportation of tea to the colonies. But the preamble of the act was retained, and with it the principle of taxation. For this reason opposition continued and non-importation agreements, especially against tea, were maintained. But after the collision which occurred between the troops and the people in Boston, in March 1770, the soldiers were removed from that town and affairs became more quiet. For more than a year it seemed as if the controversy was wearing itself out and that the old relations would be restored. But the conduct of certain naval officers and small vessels of war which had been trying to suppress illegal trade in Narragansett Bay led, in June 1772, to the destruction of the schooner "Gaspee." The inquiry which necessarily followed this, together with legislation for the protection of the royal dockyards, ships and supplies, again revealed the possibility that colonists might be removed to England for trial. About the same time provision was made for the payment by the home government of the salaries of the governors and of the judges of the superior court of Massachusetts while those officials continued to hold at the pleasure of the Crown. These events occasioned a movement in Massachusetts and Virginia which led at once to the organization of committees of correspondence, and these ultimately extended far and wide throughout the colonies. At the same time in England the East India Company appealed to parliament for relief from the losses caused by the transfer of the American trade so largely to the Dutch, and in response the Tea Act was passed authorizing the company to import its teas into the colonies and providing that the English duties should be wholly drawn back on exportation, and that no compensation need be made to the government for consequent loss of revenue. This, it was expected, would enable the company to out-compete the Dutch. But popular uprisings prevented the reception or sale of the tea at any of the ports and culminated in the destruction (Dec. 16, 1773) of 340 chests at Boston. As the king and the North ministry were now fully intrenched in power, coercion was at once resorted to and affairs were thus brought to a crisis.

Quebec Act.

54. Those among the colonists who were intelligent enough to watch the course of events had long felt that they were being enveloped in a network of relations over which they had no control. This was a result of the development of the empire, with its world-wide interests and its policies the motives for which had their origin in conditions which by the colonists were dimly perceived, if perceived at all. They were particularists whose views and resources were alike narrow, but whose perception of their interests was clear. The Quebec Act, which was passed by parliament near the close of the session of 1774, furnished a case in point. Owing to the failure of the imperial government to secure the revenue which it had hoped to collect under the Stamp Act and the later statutes, it had been forced to abandon its plans for the vigorous administration of Indian affairs and of the West. In view of these facts, it was thought wisest and cheapest to commit the immediate charge of the West to the province of Quebec, and therefore to extend its bounds southward to the Ohio. The Roman Catholic religion was recognized as legal within Quebec, and no provision was made for an assembly. Its extension also indicated a purpose to prevent the westward movement of population across the mountains, which was already beginning from the Middle and Southern colonies. It is true that this act involved the possibility of danger to the colonies, but exaggerated inferences were drawn respecting it and the motives which probably impelled its passage. So it had been with the distinctively imperialist measures from the first and so it was to continue.

55. But the acts of the session of 1774 which were of most immediate importance were those which directly affected Massachusetts, where lay the centre of disturbance. One of these closed the port of Boston, another substituted an appointed for an elected council in Massachusetts and took the selection of jurors out of the hands of the people, and a third made possible the removal from Massachusetts of the trials of persons indicted for capital offences committed in support of the government into neighbouring colonies or to Great Britain, where a fair hearing was considered possible. General Thomas Gage, who had been commander-in-chief in America, was now appointed governor of Massachusetts, with authority to uphold the new acts with military force. As soon as knowledge of the fate impending over Boston reached the other colonies, conventions, local and provincial, were held, and the plan of a general congress, as proposed by Massachusetts and Virginia, was adopted. Delegates were chosen from all the colonies except Georgia, though that province fell into line when the

second Congress met. The members were instructed to the general effect that they should consult together and adopt such measures as were best calculated to secure the just rights of the colonists and redress their grievances. Voting by colonies, but occasionally listening to utterances which implied that Americans were now thrown into a single mass, this body sent addresses to the king, to the people of the colonies, of Quebec and of Great Britain, and prepared a declaration of rights. It is a significant fact that an address was not sent to either of the houses of parliament. In its statement of rights the Congress (known as the First Continental Congress) limited itself to those which it believed had been infringed since 1763. These acts they described as innovations, and claimed themselves to be the true conservatives who only desired peace on the basis of the former Constitution. Even Joseph Galloway's elaborate plan of union (see GALLOWAY) between Great Britain and the colonies was debated at great length and was laid on the table by a majority of only one, though later all reference to it was expunged from the record. But, on the other hand, the warlike "Suffolk Resolves" (see MILTON, Mass.) were approved, as was the opposition which Massachusetts was making to the recent acts of parliament; and the view was expressed that, if an attempt were made to execute them by force, all America should support Massachusetts. Though the work of this Congress was deliberative, it performed one positive act which contained the germ out of which new governments were to develop. That was the issue of the Association, or non-importation and non-exportation agreement, accompanied with resolutions for the encouragement of agriculture and home manufactures and for the organization of committees to carry these measures into effect. Coercion, according to the principle of the boycott, was to be applied by the colonies and other local bodies to all who declined to accept and obey the terms of the Association. This policy had been followed at intervals since the time of the Stamp Act. It had been revived and urged by very many local and provincial bodies during the past few months. The Congress had been called with a view to its enforcement throughout the continent. Its issue of the Association gave this policy wide extension, and at the same time strengthened the system of committees, whose energies were henceforth to be chiefly devoted to its enforcement. The Association became the touchstone by which loyalty to the colonies, or loyalty to the king, was determined. Those whose loyalty to the king forbade their submission to the new regulations now felt the coercive power of committees, even to the extent of virtual trial, imprisonment or banishment. Local bodies, acting under general regulations of Congress, and all revolutionary in character, accomplished these results and thus laid the foundation of the new governments. From this action the First Continental Congress derived its chief significance.

First Continental Congress.

The Association, or Non-Importation and Non-Exportation Agreement.

56. The line of policy thus indicated was not such as would conciliate the home government, though it is doubtful if at that time anything short of an acknowledgment of the principle of the Declaratory Act would have been effective. All measures of congresses and committees, everything which did not emanate from the assemblies and come through legal channels, savoured of sedition and was little likely to secure a hearing. The Association, with its threats and coercive spirit, and depending as it did upon extra-legal bodies for enforcement, was a direct blow at the commercial system of the empire and could scarcely help provoking retaliation. When the Congress adjourned, some of its members predicted war. In New England the impression that war was inevitable was widespread. In Massachusetts a provincial congress was at once organized, which assumed the reins of government and began to prepare for defence. A committee of safety was chosen to carry on the work during recesses of the Congress. Thomas Gage, the governor, began fortifying Boston, while he looked about for opportunities to seize military stores which the colonists were accumulating. The raising of voluntary militia companies was soon begun in Virginia. In South Carolina, as earlier in Boston and New York, a quantity of tea was now actually destroyed, and a general committee assumed practical control of the province. From New York City and Philadelphia as centres the process of revolutionizing the two most conservative provinces was carried on. When parliament met, at the close of 1774, the king and ministers declared that a most daring spirit of resistance existed in Massachusetts, which was countenanced by the other colonies, where unlawful combinations against the trade of Great Britain were already widely extended. In these opinions the government had the support of the majority in the two houses, and in a joint address the rebellion in Massachusetts was declared to be a fact. As a conciliatory measure Chatham proposed that parliament agree by resolution not to levy any tax upon the colonies, but that the Continental Congress be required to make a free grant of a perpetual revenue which should be fully at the disposition of parliament, the Congress fixing the quota which should be paid by each province. But the imperialist and mercantilist ideas of Chatham were expressed in the further provisions that the system of trade and navigation should not be changed and that the army might be lawfully kept in any part of the dominions where it was deemed necessary, though it should never be used to violate the just rights of the people. Edmund Burke, in his great speech on conciliation, advocated a return to the system of requisitions and did not consider a representation of the colonists in parliament as a possibility. But these motions were rejected, and a resolution introduced by Lord North was passed. This contained no recognition of extra-legal bodies, but provided that when the assembly of any colony should engage to support civil government within the colony and contribute according to its ability to the common defence, the king and parliament would then forbear to levy any more taxes on that province except what were necessary for the regulation of trade. The colonies, with the exception of New York, North Carolina and Georgia, were excluded from the fisheries, as a counterstroke to the Association. North's resolution proved utterly futile, and the two parties drifted steadily toward war, though, as Burke never tired of asserting, the British government in its military estimates made no adequate provision for meeting the crisis.

Outbreak of Hostilities; Lexington and Concord; Bunker Hill.

57. On the 19th of April 1775 hostilities began in Massachusetts. They had been narrowly escaped two months before, when, on a Sunday, Gage had sent an expedition by water to Salem in search of powder. Now, on a week-day, a force was sent overland to Concord, 20 m. from Boston, to seize or destroy the military stores which the colonists had brought together at that village. The minute-men were warned to oppose the approaching force, and at Lexington (*q.v.*), a village situated on the road to Concord, occurred a skirmish in which the first blood of the American War of Independence was shed. The troops marched on to Concord (*q.v.*) and destroyed such of the stores as had not been removed or concealed. On their return march they were pursued by a galling fire from behind fences and buildings, and had it not been for the arrival of a relieving force the command would have been destroyed before it reached the protection of the British vessels of war at Boston. The "Lexington alarm" brought in throngs of militiamen from all parts of New England. Officers were appointed by the provincial congress of Massachusetts and by similar bodies in the other colonies, and immediately the so-called siege of Boston began. Cannon, as well as every other form of military equipment, were now in great demand. In order to secure a supply of the former and at the same time strike a telling blow at British authority in the north, Ticonderoga (*q.v.*) was surprised and taken on the 10th of May. Men from Connecticut, Massachusetts, and the New Hampshire Grants (later Vermont) co-operated in this enterprise. It was soon followed by a dash into Canada, by steps which involved New York in the affair, and by the organization of a military force under General Philip Schuyler for permanent service on the northern frontier.

Meantime reinforcements reached Boston, led by Howe, Clinton and Burgoyne, and it was resolved to extend the British lines by occupying the heights of Dorchester on the south and those of Charlestown on the north. The Americans, hearing of this, seized Breed's Hill, overlooking Charlestown, where they hastily threw up a redoubt on the night of the 16th of June. The British might easily have entrapped them, but instead on the next day the American position was assaulted on the left and carried, though with much difficulty and after a loss to the assailants of more than 1000 men. Such was the battle of Bunker Hill (*q.v.*), one of the most dramatic encounters in the war which was then beginning. In connexion with all these events the Americans, as in their earlier conventions and manifestoes, claimed to be acting on the defensive. But it was not difficult to perceive that, especially in New England, this claim only imperfectly concealed an intensely aggressive spirit. (For military events of the war, see American War of Independence.)

58. The news of the outbreak of hostilities aroused strong feeling throughout the colonies. The Second Continental Congress met under its influence. Its members, however, had been chosen and instructed before the clash of arms, and for that reason the course which had been worked out for them differed only slightly, if at all, from that which had been followed by their predecessors. To a certain extent the new body adhered to the former course of action. But a state of war now existed in New England and on the Canadian border. Troops were expected soon to arrive at New York. Reports of these events were thrust upon the attention of Congress at once, and the provinces involved asked for advice as to what course they should pursue. The northern frontier especially demanded attention. As a result of these events in the colonies generally the Association was being changed from a system of co-operation against British trade into a union for purposes of defence. This new situation the Congress was forced to meet. This it did largely by resolutions of advice to the colonies, but also by positive orders. Of the former class were the resolutions about the procuring of military supplies, the assumption of powers of government by the various colonies, and concerning defence at New York City, on the northern frontier and, later, in the Highlands of the Hudson. Of a more decisive character was the appointment of officers for the army, George Washington being made commander-in-chief, the prescribing of their pay, the issue of continental bills of credit, the issue of articles of war, the regulation of trade and of Indian affairs, and the establishment of postal communication. As the colonies were passing through a strong reaction against executive authority, the Congress did its business with the help of temporary committees and did not seek to establish a permanent executive. The same was true for a time of the congresses and conventions in the different colonies. As the movement progressed through 1775 and the early months of 1776, executive authority in the royal and proprietary provinces collapsed. The assemblies were either dissolved or ceased to meet. The governors, their authority gone, retired on board British vessels of war, returned to England or, perchance, found themselves prisoners in the hands of the revolutionists. This gradual fall of the old governments, imperial and colonial, was the revolution on its negative side. The rise of the system of congresses, conventions and committees, deriving their authority from the people, was the revolution on its positive side, and foreshadowed the new federal system which was rising on the ruins of the half-federated empire. The process in the different colonies was as varied as were their social and political conditions.

Second Continental Congress.

59. In Connecticut and Rhode Island the corporate system of government, which they had inherited from the 17th century, necessitated no change. The general assemblies always had been the centres of power, and the leading officials were elective for short terms and were subject to the control of the electorate. So far as the internal organization of the colonies was concerned that was all which the revolution demanded. In the two proprietary provinces—Pennsylvania and Maryland—the executives were not so directly interested and pledged to support the imperial government as were those of the royal provinces. But Governor Robert Eden of Maryland was so tactful that, though the last Assembly met in 1774, he was able, with the courts, to keep up some form of government there in the name of the Crown and proprietor until the early summer of 1776. In Pennsylvania the proprietors, though in sympathy with the British government, never sought actively to influence events in their province. So strong was the conservative spirit there that the proprietary Assembly even met—though without a quorum—as late as September 1776, at the time when the convention was completing the first constitution of the state. In the royal provinces the prorogation of the legislatures for indefinite or prolonged periods caused them early to disappear—that of Massachusetts in October 1774. The burgesses of Virginia last met for business in May 1774. They were prorogued to several later dates, but the governor was never again able to meet them. The long and important session of January–March 1775 was the last ever held by the New York Assembly. In April 1775 Governor John Martin of North Carolina met the Assembly for the last time, and even then the Provincial Convention was in session at the same time and place and the membership of the two bodies was the same. In May 1775 disappeared the Assembly of Georgia; in June those of New Hampshire and South Carolina met for the last time. Governor William Franklin was able to meet the Assembly of New Jersey as late as November, but months before that date the Provincial Convention had practically assumed the control of affairs. The royal courts and executives continued some form of activity a few months longer and then totally vanished.

Collapse of the Royal Governments.

60. After Bunker Hill the command at Boston had been transferred from Gage to Sir William Howe. In July Washington took command of the colonists and gradually established some degree of order and discipline among them. Though the American levies were raw and ever fluctuating in numbers, the British never seriously attempted to break through their lines. Indeed, it was not the plan of the British to make New England the chief seat of war. As early as the 2nd of August 1775 Lord Dartmouth wrote to General Gage on "the obvious advantages that would attend the taking Possession of New York and the hazard of the Army's continuing at Boston." On the 5th of September he wrote to Howe that every day's intelligence exhibited this fact in a clearer light. Rhode Island was considered as a convenient naval station, and steps were soon taken to secure possession of it and its surrounding waters. This indicates what was necessarily the fact, that the British would so plan the war as to secure the maximum of advantage from their fleet. This would give them an easy command of the entire coast, and enable them to secure a foothold at strategic centres. Hence it was that, though the arrival of a fresh supply of cannon enabled Washington to fortify Dorchester Heights, this simply enabled him to hasten a process for which Howe had long been preparing. The evacuation occurred on the 17th of March 1776, and the British force withdrew temporarily to Halifax. Meantime the bold expeditions of Arnold and Montgomery against Canada—suggesting the joint efforts of the French wars—had met with only a partial success. Montreal had been occupied, but the assault upon Quebec had failed. A small American force awaited the return of spring in Canada, in order that they might renew the struggle for that colony.

Evacuation of Boston; American Expedition against Canada.

61. The view, as it was now repeatedly expressed by king and parliament, was that the colonists were in open rebellion. North's offer of conciliation was peremptorily rejected by Congress. The acts of parliament were being openly resisted, and Congress in its manifestoes had ignored the two houses. Therefore the British government stood committed to coercion. That was the meaning of the legislation of the winter of 1776—the prohibition of trade with the rebellious colonies, the increase

of the estimates for the army and navy, the employment of German auxiliaries for service in America. Preparations were made to send a large military and naval force against the colonies the following season, and that it should operate in part against the insurgents in New York and the southern colonies and in part through Canada. New England was no longer to be the direct object of attack. The Howes, as commanders of the royal army and navy, were appointed commissioners to grant assurance of peace and pardon and the repeal of the obnoxious acts, provided submission was made and some way could be found by parliament in which an imperial revenue for purposes of defence could be secured from the colonies. Military operations, meanwhile, should be directed against points of least resistance, and in that way, if possible, the union of the colonies should be broken. The trend of British policy indicated that an invasion from Canada might be attempted and the effort be made to hold Charleston, Philadelphia, and especially New York as strategic points on the coast.

62. The course of events in the colonies by which this situation was met was the erection of a system of feeble defences about New York and the removal thither of the army of about 9000 men in the spring of 1776; the fitting out of privateers to prey on British commerce and of a few small armed vessels by the colonies and the general government to watch the coast and procure supplies; the disarming of loyalists; the opening of American ports to the trade of all peoples who were not subject to the British Crown; and the tentative opening of relations with France. As the result of a combination of ill luck, bad management and American energy the British suffered a repulse at Charleston, South Carolina, in June, which was analogous to the affair of the year before at Bunker Hill, and which necessitated a postponement of their plans in the South. The Congress and the various revolutionary bodies in the colonies were forced to carry on war upon a constantly increasing scale. They had to assume powers of government and gradually to perfect their organization for the purpose. Committees in Congress became more permanent. Conditions approximating to those which existed the year before in New England extended through the colonies generally. On the 15th of May 1776, as the result of various earlier applications on the subject, and especially of one from certain Whigs in New York, the Congress recommended to the assemblies and conventions of the colonies where no government sufficient to the exigencies of their affairs had been established, "to adopt such government as shall, in the opinion of the representatives of the people, best conduce to the happiness of their constituents in particular and of America in general." The preamble to this resolution set forth as facts the statements that the colonies had been excluded from the protection of the Crown, that no answer had been given to their petitions for redress, and that the whole force of the kingdom was to be used for their destruction, and therefore that it was no longer reasonable or honest for the colonists to take the oaths or affirmations necessary for the support of government under the Crown. Though the preamble was warmly debated, it was adopted. And this act marked a turning-point, for the progress of events from that time to the declaration of independence was rapid and decisive. The colonies—now becoming states—one after another, in response to letters from Philadelphia, empowered their delegates to concur in declaring independence. On the 7th of June R. H. Lee of Virginia introduced in Congress a resolution "that these United Colonies are and of right ought to be free and independent states," that it was expedient forthwith to take effectual measures for securing foreign allies, and that a plan of confederation should be formed. John Dickinson and others, speaking for the Middle Colonies, argued that the order of procedure should be reversed. But John Adams and the more aggressive party insisted that the proposed declaration would simply state the facts and would open the way for foreign alliances; that it was useless to wait for unanimity. The debate showed that the delegates from the Middle Colonies and South Carolina could not act, and so the decision was postponed for three weeks. In the interval steps were taken to draft a plan of treaties and articles of confederation. A board of war and ordnance, the earliest germ of an executive department, was also created by Congress. At the end of the three weeks the delegates from all the colonies except Georgia, South Carolina and New York had received instructions favourable to independence. The two former left their delegates free, and under the influence of the British attack on Charleston they voted for independence. News had just come that Howe had landed with a large force at Sandy Hook—as events proved, it was an admirably equipped army of 30,000 men, supported by a fleet. Under the impression of these stirring events Dickinson and his leading supporters ceased their opposition, and the Declaration, substantially in the form given to it by Thomas Jefferson, was agreed to (July 4, 1776), only three adverse votes being cast. The delegates from New York took no part, but a few days later the act was approved by the convention of that state. The signing of the document by the members took place at a later time. Thus triumphed the tendencies toward self-government which had been predominant in the continental colonies from the first, and which the system of imperial control had only superficially modified and restrained. But the most significant part of the document for the future was the preamble, in which the democratic aspirations of the new nation were set forth, the spirit to which Thomas Paine had just made so powerful an appeal in his *Common Sense*. Governments, it was said, derive their just powers from the consent of the governed, and when any system becomes destructive of these ends it is the right of the people to abolish it and to institute a new government, establishing it upon such principles and under such forms as seem most likely to effect their safety and happiness. (See INDEPENDENCE, DECLARATION OF.)

Organization of State Governments; Declaration of Independence.

E.—*The Struggle to Maintain Independence, 1776–1783.*

Finance: Weaknesses and Defects of the American General Government.

63. Viewed from one standpoint, the declaration of independence was apparently an act of the utmost recklessness. The people were by no means a unit in its support, and in several of the states widespread indifference to it, or active sympathy with the British, prevailed. In New York, South Carolina and Georgia a condition of civil war came sooner or later to exist. The United States, as yet, had no international status, and it would seem that that must be secured, if at all, by a series of victories which would ensure independence. But how could these be won against the greatest naval power on the globe, supported by veteran armies of continental and British troops? The colonies had no money; the few vessels which, as a collective body, they did send out, were more like privateers than anything else. Their army was an undisciplined throng of militiamen, serving on short enlistments, without organized commissariat, and for the most part under inexperienced officers. Its numbers, too, were far inferior to those of the British. Taxation by the Continental Congress for the support of the war was not among the possibilities of the case. The colonies were struggling against taxation by one imperial body, and it was not likely that they would submit to similar impositions at the hands of another. The Congress, moreover, as has truly been said, was little more than a general committee or interstate council of safety, and had to proceed largely by way of advice. A strong tendency also toward the provision for immediate needs by the issue of bills of credit had been inherited from the period of the French wars, and resort was again had to that device. The battle of Bunker Hill had been immediately followed by an order of Congress for the issue of $2,000,000 in that form of currency. Issues followed in rapidly increasing amounts, until by the close of 1779 $241,000,000 had been authorized. The states put out nearly as much ($209,000,000), Virginia and the two Carolinas issuing the largest amounts. All that Congress could do to secure the redemption of its issues was to recommend to the states to provide the means therefor; but this they failed to do, or even to provide for the redemption of their own issues. The continental paper money depreciated until it became

worthless, as to a large extent did that of the states also. The states decreed it to be legal tender, and dire threats were uttered against those who refused to receive the bills; but all to no purpose. The Congress also tried to induce the states to tax themselves for the general cause and was forced to rely on requisitions for the purpose. The colonies had insisted that the system of requisitions was good enough for the mother country, but when applied by Congress it proved as complete a failure as when resorted to by the Crown. The revolution was therefore never financed. It early became necessary to resort to loans and that chiefly from foreign sources. It was therefore an absolute necessity that the colonies should secure international recognition and status. Then loans were obtained from the governments of France and Spain and from private bankers in Holland to the amount of about $7,830,000.

64. The collapse of royal government left the colonies in a chaotic state. The old institutions had disappeared and new ones could not be immediately developed to take their place. But the institutions of local government, the town and county systems, were left intact, and upon these as a basis the new fabrics were erected. It was therefore easier to construct the governments of the states than to define and develop the general government. At first little else was intended than that the Congress should be the mouthpiece of the patriot party. It proceeded mainly by way of recommendation, and looked to the states, rather than to itself, as the ultimate sources of authority. Upon them it depended for the execution of its measures. The common will, as well as enactment, was lacking which would have given the force of positive law to the measures of Congress. As the war proceeded the states grew jealous of the central body and tried to prevent appeals to it from the state courts in prize cases. Under the pressure of war, moreover, the enthusiasm, which had been strong at the outset, declined, and it became increasingly difficult to secure co-operation or sacrifice toward any general enterprise. At the same time, war devolved upon Congress an enormous burden of work. It was forced to devise general policies and provide for their execution, and also to attend to an infinite number of administrative details. This was due not only to the exigencies of the time, but to the fact that no general executive was developed. As was characteristic not only of this revolution, but of all others, the committee system underwent an enormous development. "The whole congress," wrote John Adams, "is taken up, almost, in different committees, from seven to ten in the morning. From ten to four or sometimes five we are in congress, and from six to ten in committees again." "Out of a number of members," writes another, "that varied from ten dozen to five score, there were appointed committees for a hundred varying purposes." Upon its president and secretary the Congress was forced to depend not a little for the diligence and ability which was requisite to keep the machine going. But as the war progressed most of the able members were drawn off into the army, into diplomatic service or into official service in the states. Sectional and state jealousies also developed and became intense. By many the New Englanders were regarded with aversion, and members from that section looked with dislike upon the aristocrats from the South. As the Congress voted by states the smaller commonwealths were often moved by jealousy of their larger rivals to thwart important measures. But, above all, the conduct of the war and foreign relations occasioned infinite jealousies and cabals, while many of the most important measures seemed to meet with downright indifference. Washington's correspondence abounds in evidence of these facts, while it is well known that he was the object against whom one of the cabals of the time was directed. Benjamin Franklin was the object of somewhat similar jealousies. But, as time passed, rudimentary executive departments, beginning with the board of war and the postmaster-general, were developed, and some advance was made toward a working and permanent system. In 1781 the offices of foreign secretary, superintendent of finance, secretary of war and secretary of marine were created.

65. For a time, and indeed during most of the struggle, the course of the land war seemed to justify these criticisms and gloomy fears. Until its very close the campaign of 1776, from the American standpoint, was a dismal failure. The battle of Long Island was lost by the Americans and, as at Bunker Hill, it would have been quite possible for the British to have captured the entire force which opposed them on Long Island. Howe compelled Washington to evacuate New York City. On the 16th of November the practical abandonment of the state of New York by the main army was necessitated by the capture of Fort Washington. Earlier in the year the Americans had been compelled to retire from Canada, while the Tories in northern New York were contributing valuable aid to the British.

Fort Washington.

66. But there was another side to the picture, and already certain faint outlines of it might be discerned. The British commander was proceeding slowly, even according to established European methods. At almost every step he was failing to seize the advantages that were within his reach, while Washington was learning to play a losing game with consummate patience and tact. Although he was constantly trying to rouse Congress and the states to more vigorous action, he showed no disposition to break with the civil power. Already, too, the physical obstacles arising from the wooded and broken character of the country, and from the extremely poor means of communication, were becoming apparent to the British; while the Americans always had the alternative, if too hard pressed, of withdrawing beyond the mountains. After Washington had crossed the Delaware, Howe, instead of seizing Philadelphia and driving Congress and the American army to some remote places of refuge, as he might have done, prepared for winter quarters. Washington seized the opportunity to return across the Delaware and surprise the British outposts at Trenton (Dec. 26, 1776) and Princeton (Jan. 3, 1777), and thus secured a safe post of observation for the winter at Morristown. Confidence was to an extent restored, the larger part of New Jersey was regained, and many loyalists were compelled to take the oath of allegiance. Howe's plan for the next campaign involved the strengthening of his army by large reinforcements from home and by all the men who could be spared from Canada. With this force he proposed to capture Philadelphia and thereby to bring the War of Independence to an end in Pennsylvania, New Jersey and New York. New England and the states farther south could then be dealt with in detail. But Howe was overruled by Lord George Germain, the colonial secretary, whose plan included an invasion from Canada, in which Tories and Indians should share, while Howe should advance up the Hudson and meet the northern forces at Albany. If this ambitious scheme should succeed, the British would occupy the valley of the Hudson and New England would be cut off from the rest of the colonies. General Burgoyne was appointed to command the northern expedition. But the failure of the plan was almost ensured from the outset by neglect on the part of British officials to instruct General Howe as to his part in its execution, while Burgoyne was forced to surrender near Saratoga on the 17th of October. Meanwhile, Howe, who had long waited for instructions respecting the northern expedition, was finally informed that he might undertake the Pennsylvania campaign, but with the hope that at its close he would still be able to march up the Hudson. Thereupon, embarking his army, Howe sailed for Chesapeake Bay, at the head of which he landed and advanced towards Philadelphia. Washington's army opposed his march at the Brandywine (Chad's Ford), but was defeated (Sept. 11, 1777) and forced to retire beyond Philadelphia. The British then entered the city (Sept. 26) and the Congress withdrew to Lancaster, and later to York, in the interior of Pennsylvania. The British fleet had in the meantime arrived in Delaware Bay, and, after a prolonged and brave defence, had captured Forts Mercer and Mifflin. When the winter began the Delaware, as well as lower New York and Rhode Island, was in the possession of the British. With the fragments of an army Washington retired to Valley Forge (*q.v.*).

French-American Alliance.

67. But the influence of Burgoyne's surrender in Europe was to prove a turning-point in the war. Since 1763 a strong sentiment at the French court had been favourable to a resumption of war with Great Britain. An opportunity was now presented by the colonial revolt. In November 1775 the Congress created a committee of secret correspondence, which, in April 1777, was developed into a committee of foreign affairs, and this continued until 1781, when the office of foreign secretary was established. To Congress, and to the members who were serving on its secret committee, the possible attitude of France was known from an early date. The necessity of securing supplies and loans from Europe was also imperative, though the United States had nothing to pledge in repayment except the future products of her soil. In February 1776 Silas Deane (*q.v.*) was sent to Paris, ostensibly as a business agent, and with the connivance of the French government supplies were sent to America and American vessels were received into French ports. Soon American privateers were bringing their prizes into French harbours, and British commerce began to suffer from these attacks. On the French side Beaumarchais and others actively co-operated in this. In the autumn of 1776 Congress appointed three commissioners to France, and resolved that Spain, Prussia, Austria and other European states should be approached with a view to securing recognition and aid. In December 1776 Franklin, who, with Deane and Arthur Lee, had been appointed commissioner to France, arrived at Paris, bringing with him proposals for treaties of commerce and alliance. But, though the attitude of the French court toward the Americans was friendly, and though it continued to send secret aid, and to exert a favourable influence upon Spain, yet it could not be induced to abandon its outward appearance of neutrality until after the news of Burgoyne's surrender arrived. Then the real purpose of the French government was revealed. On the 6th of February 1778 the treaties were signed, and in the following summer war between France and England began. The influence of France under the Family Compact was also persistently used to bring Spain into the alliance. The latter was naturally hostile to England, but her aversion to colonial revolts and her desire to substitute mediation for war kept her from declaring against England until April 1779. In October 1779 Henry Laurens (*q.v.*) was elected minister to the Netherlands, and sailed for Europe, taking with him a plan of a commercial treaty. But Laurens and his papers were captured by the British at sea, and partly by that event the Netherlands were forced into war with England. With the other states of northern Europe they undertook to defend the interests of neutrals against the arrogant enforcement by Great Britain of the rights of search at sea. Thus the conflict expanded into a commercial and naval war, Great Britain being confronted by the larger part of Europe.

68. The conclusion of the treaty of alliance by France was immediately followed by the equipment of a fleet under the comte d'Estaing, which sailed from Toulon in April 1778, having on board M Conrad Alexandre Gérard de Rayneval, who had been accredited as minister to the United States, and Silas Deane, who was returning to report to Congress. Sir Henry Clinton had now succeeded Howe in command of the British army. The certainty that a French fleet would soon appear in American waters made it necessary for the British to evacuate Philadelphia and return to a point on the coast where the army could be in easy communication with the fleet. This fact shows how the French alliance had changed the nature of the war. It now became to a large extent a contest between the two navies, the principal evolutions of which occurred in West Indian and European seas. (See AMERICAN WAR OF INDEPENDENCE.) In the north the British now relatively neglected the land war, and refrained from sending such forces to the eastern coast as had supported Howe in 1776. The Americans, on the other hand, had a naval force upon which they relied, in the hope that the blockade of their coasts might be raised and trade routes opened more freely. On the evacuation of Philadelphia in June Washington's army pursued the British as they retired toward New York, and the indecisive battle of Monmouth was fought on the 28th of June. It did not prevent Clinton from reaching New York, and that city continued to be the centre of British power and operations in the north until the close of the war. The Congress returned to Philadelphia, where Gérard was received, and where he was soon exercising an influence favourable to the policies of Washington and opposed to the clique of which General Horatio Gates was the leader. Washington's army came gradually to occupy a line of forts, of which West Point in the Highlands of the Hudson was the citadel. From there as a centre it was possible to communicate with Newport on the east and with the Delaware region on the south, and at the same time to prevent the British from gaining access to the interior of the country. Though the fleet of D'Estaing carried a heavier equipment of cannon than did that of Admiral Howe, the French commander did not choose to risk an attack on New York, but passed eastward to Newport. Howe followed him, while Washington and his generals planned active co-operation with the new allies by land. But a sudden storm so dispersed and injured the fleets that the French admiral retired to Boston for repairs and later sailed for the West Indies.

State Constitutions.

69. While the war and foreign relations were thus developing, the states were organizing their governments and Congress was beginning to consider articles of confederation between the states. In this way an effort was made to gather up and make permanent the positive results of the revolution. As under the chartered and royal governments of the colonial period the source of political authority had been the Crown, now by a necessary reaction this was sought in the people. This principle had been stated in the Declaration of Independence, and had been implied throughout the earlier controversy and in much of the history of the colonies as well. The colonies had insisted on a more precise definition of the powers of government; they had opposed parliament because its powers were undefined and therefore dangerous. Following these ideas, the states now described their institutions of government and defined their powers by means of written constitutions. These were formulated by the provincial congresses—which had now become the legislatures—or, as they came to insist upon a more specific expression of the popular will, by conventions chosen for the purpose by the electors. Connecticut and Rhode Island retained their colonial charters. In the earlier days of hasty and temporary devices, the constitutions, like statutes, had been promulgated by the legislatures which formed them and had been put into force by their authority alone. But as time passed and more permanent arrangements became necessary an express popular approval of the instruments was insisted upon and was obtained before they were put into force. The establishment of state governments in this way began before the issue of the Declaration of Independence. It was actively continued during 1776 and the early months of the following year, by which time all of the states had secured at least a temporary constitution. South Carolina and New Hampshire revised theirs before the close of the war. Massachusetts did not secure a constitution which suited her until 1780, but then her procedure corresponded in all particulars with what was to be later American practice in such matters. Of the constitutions of the revolutionary period the two most striking features were the bills of rights and the provisions which were made concerning the executives and their relations to the legislatures. The men of that generation were jealous of government. They insisted upon individual rights, not as acquired and guaranteed by the state, but as original, natural and inhering in time prior to all governments. Governments were instituted for the common benefit, protection and security. Officials were trustees and were accountable to the people. There should be no hereditary title to office or power. There should be no titles of nobility, and in Virginia the system of entails was swept away. Monopolies were declared to be inconsistent with the spirit of a free state. The doctrine that it was unlawful to resist

arbitrary power was declared to be absurd. Freedom of the press and of conscience was asserted, and no obstacles to fair and speedy jury trials were to be tolerated. Elections should be free and frequent, and a preference was expressed for short terms of office. The legislature was universally regarded as the most important department of government. Although the principle of the separation of powers was recognized, in eight states provision was made that the executives should be elected by the legislatures, eleven withheld from them the veto, and the states generally provided for a council to advise them. So manifold and important, however, were the restrictions on suffrage that the states were as yet far from being democracies. On the other hand, many wild and impractical ideas were cherished, and there were anarchic tendencies, which were revealed soon after the war and still later, under the influence of the French Revolution.

The Articles of Confederation.

70. The first draft of the Articles of Confederation between the states was prepared by John Dickinson in the early summer of 1776 and was reported. The report was debated for some weeks after the issue of the Declaration of Independence. Owing to the pressure of war it was then laid aside until the autumn of 1777. By that time the feeling in favour of state sovereignty had so increased that the impossibility of securing assent to the articles in any form had begun to be feared. But the document was completed and submitted to the states in November 1777, when all were encouraged by the news of Burgoyne's surrender. The system for which provision was made in this document was a "confederacy," or "firm league of friendship" between the states, for their common defence, security and general welfare. The Congress was to be continued, and was to consist of delegates annually appointed by the legislature of each state and paid by their states. No attempt was made to create an executive for the confederacy, though authority was given to Congress to appoint a council of state which should manage general affairs, especially during recesses of Congress. To Congress various general powers were entrusted, as deciding on peace and war and superintending the conduct of the same, building a navy, controlling diplomatic relations, coining money and emitting bills of credit, establishing post offices, regulating Indian trade, adjusting boundary disputes between the states. The financial powers entrusted to Congress included those of borrowing money and determining necessary expenditures, but not the power to tax. For supplies the general government had to depend on requisitions from the states. The same system also had to suffice for the raising and equipment of troops. Congress could not make its laws or orders effective in any matter of importance. This was simply a continuation of the policy under which the revolution was being conducted. The Americans had thought that the military and financial concerns of the British Empire could be managed under a system of requisitions, and now they were bent upon trying it in their own imperial relations. The control of trade was also practically left with the states, the Americans in this matter failing to live up to the requirements of the British system. The predominance of the states was further ensured by the provision that no votes, except those for daily adjournment, could be carried without the assent of a majority of all the states, and no important measure without the consent of nine states. But a common citizenship was declared to exist, and Congress received authority to establish a court of appeal which might pass finally on all disputes between states. Taken as a whole, the Articles of Confederation would bear favourable comparison with other schemes of their kind, and they fairly represented the stage of development to which the American states had then attained. The defects which existed in them were reflections of the immaturity, political and social, which had always been apparent in the Americans as colonists and which was to characterize them as a nation for generations to come.

The West.

71. We have seen that, on the whole, the attitude of Great Britain, after the peace of 1763, was not favourable to the colonization of the Mississippi Valley. To the colonists the Quebec Act gained in offensiveness by seeming to imply that it was intended to exclude them from the West. But all such plans were swept away by the outbreak of the War of Independence. Already, before the beginning of hostilities, emigrants had begun to flock across the mountains. Plans were on foot for the establishment of a number of commonwealths, or proprietary provinces, as the case might be. Vandalia was planned in western Virginia, Watauga in western North Carolina. Daniel Boone and his associates pushed farther west into the Kentucky region, and there it was proposed to establish the commonwealth of Transylvania. Other similar projects were started, all repeating in one form or another the political methods which were used when the seaboard colonies were first settled. The backwoodsmen who managed these enterprises were extreme individualists, believed in the propriety of resistance to governments, and were in full sympathy with the War of Independence. They desired to escape to the free land and life of the West and be rid of the quit-rents and other badges of dependence which still lingered in the East. The states which had claims in the West opposed the founding of independent settlements there and, if possible, induced the settlers to be content with the status of counties within some one of the eastern states. After the beginning of the War of Independence, the British from Detroit incited Indian raids for the purpose of destroying or driving out the settlers, especially in Kentucky. These provoked the expeditions of George Rogers Clark (*q.v.*), in 1778 and 1779. With a force of Virginians he seized Kaskaskia and later, after a long march, captured Vincennes and compelled General Henry Hamilton, who had come with a relief force from Detroit, to surrender. This secured to the Americans a permanent hold upon the North-West. But Spain, after she entered upon the war, was determined, if possible, to wrest the valley of the Mississippi from the British and to keep all, or the larger part of it, for herself. To that end, operating from New Orleans, her troops took possession of Natchez, and other posts on the lower Mississippi, and occupied Mobile and Pensacola. These events prevented the possibility of the expulsion of the Americans from the West, but devolved upon their representatives at Paris the necessity of engaging in a diplomatic contest against Spain for the purpose of securing the Mississippi as the western boundary of the United States. But meanwhile the occupation of the West by Americans had a notable influence upon the ratification of the Articles of Confederation.

Articles of Confederation Ratified.

72. Within the Confederacy a fundamental line of cleavage was that between the large and small states. It was jealousy on the part of the latter, their fear lest they might be absorbed by their larger neighbours, which had necessitated the adoption of the plan that in the Congress the delegates should vote by states. When the articles were referred to the states for ratification, the difficulty reappeared. Massachusetts, Connecticut and New York, with Virginia and the three states to the south of it, had large claims to territory between the Appalachians and the Mississippi. New Hampshire, Rhode Island, New Jersey, Delaware and Maryland, which were without hope of westward extension, hesitated to enter the Confederacy, if the large states were to be still further increased by additions to their areas of vast stretches of western country. They insisted that before ratification the states which had claims to western lands should surrender these for the common benefit of the United States. Maryland insisted upon this until, in the end, the cause of state equality and of nationality triumphed. Congress declared that the ceded lands should be formed into states, which should become members of the union with the same rights as other states. When, in 1781, this course of action had become possible, Maryland ratified the articles and they came into effect. The possibility of the expansion of the United States through the development of territories was thus ensured.

73. So far as the North American continent was concerned, the character of the last stage of the struggle with Great Britain

The War in the South.

was determined by the fact that the British resolved to transfer the main seat of war to the Southern states, in the hope that Georgia and South Carolina might be detached from the Union. At the close of 1778 Savannah was captured. In September 1779 D'Estaing returned and assaulted Savannah, but, failing to capture it, sailed for France. In 1780 Clinton sailed from New York, besieged Charleston with a force much superior to that of Lincoln, and captured it (May 12). State government in South Carolina ceased. But the chance of detaching those states from the Union and of bringing the war in that region to an end was finally lost by the British. This was chiefly due to an order which recalled the paroles of many of those who had surrendered at Charleston and required that they should perform military service under the British. The attempt to enforce this order, with the barbarities of Colonel Banastre Tarleton and certain Tory bands, provoked a bloody partisan conflict in the upper districts, especially of South Carolina, which contributed more than any other cause to turn the scale against the British in the remote South. By the winter of 1781 they were forced back to Charleston and Savannah. (See American War of Independence.)

Yorktown.

74. During the summer of 1780 Washington was prevented from accomplishing anything in the North by the demoralized condition of the finances and by the decline of public spirit. It was very difficult to secure recruits or supplies. The pay of the troops had fallen so into arrears that some of them had already begun mutiny. A second French squadron and military force, under De Ternay and Rochambeau, landed at Newport, but they were at once shut up there by the British. Clinton and Cornwallis were now planning that the latter, having put down resistance in the remote South, should march through North Carolina and Virginia to Baltimore and Philadelphia and that a junction of the two British forces should be effected which, it was believed, would complete the ruin of the American cause. This, too, was the period of Arnold's treason and the death of André. But the turn of the tide in favour of the Americans began with the partisan warfare in South Carolina, which delayed the northward march of Cornwallis, who retired to Wilmington and thence marched north with a small force into Virginia, and in July retired to Yorktown, in the peninsula of Virginia. Washington and Rochambeau had meantime been planning a joint move against the British at New York, or possibly in Virginia, and a letter was sent to De Grasse, the French admiral in the West Indies, suggesting his co-operation. De Grasse replied that he would sail for the Chesapeake. This confirmed Washington and Rochambeau in the opinion that they should march at once for Virginia and, after junction with the force of Lafayette, co-operate with De Grasse against Cornwallis. By well-timed movements the forces were brought together before Yorktown (*q.v.*), and Cornwallis was forced to surrender on the 19th of October 1781.

Treaty of Peace.

75. As the effect of this event was to drive Lord North from power in England, it proved to be the last important operation of the war in America. The king was compelled to give way. Rockingham was called into office at the head of a cabinet which considered the recognition of American independence to be indispensable. The negotiations fell into the hands of Shelburne, the friend of Franklin and disciple of Adam Smith. Richard Oswald was the leading British agent, while Franklin, Jay, John Adams and Henry Laurens were the American negotiators. From the first the acknowledgment of independence, the settlement of the boundaries and the freedom of fishing were insisted on as necessary terms by the Americans. Free commercial intercourse and the cession of Canada to the United States, partly in payment of war claims and partly to create a fund for the compensation of loyalists, were also put forward as advisable conditions of peace. The first three points were early conceded by the British. They also agreed to restrict Canada to its ancient limits. But discussions later arose over the right to dry fish on the British coasts, over the payment of debts due to British subjects prior to the war, and over the compensation of the loyalists. Adams vigorously insisted upon the right to dry and cure fish on British coasts, and finally this concession was secured. Franklin was opposed to the demands of the loyalists, and they had to be content with a futile recommendation by Congress to the states that their claims should be adjusted. It was also agreed that creditors on either side should meet with no lawful impediment to the collection of their debts. Both France and Spain considered the claims of the Americans to be excessive, and were not inclined to yield to them. But the Americans negotiated directly with the British and the articles were signed without consultation with the French government. This course was offensive to Vergennes, but it was insisted upon as necessary, especially by Jay and Adams, while the diplomatic skill of Franklin prevented a breach with France. Peace was formally ratified on the 3rd of September 1783.

76. The American army was now disbanded. Since the close of active military operations both officers and men had been striving to secure their pay, which was hopelessly in arrears. Congress had voted half-pay to the officers for life, and many had agreed to accept a commutation of this in the form of full pay for a certain number of years. Certificates for these amounts were issued. But in this, as in other cases, it was found impossible to procure the money for the purpose from the states. Parts of the army repeatedly mutinied, and it was only the influence of Washington which prevented a general outbreak against Congress and the civil government. When the disbandment was finally effected the officers found their certificates depreciated in value and the states indisposed to honour them. They consequently received only a small part of their due, and the privates scarcely anything. This deplorable result was due in part to poverty, but quite as much to bad faith. The country was left in a most demoralized condition, the result of the long war and the general collapse of public and private credit which had accompanied it. It should not be forgotten that the conflict had taken to a considerable extent the form of a civil war. In many of the states Loyalists and Whigs had been arrayed against one another, and had been more or less fully incorporated with the two contending armies. In general the Loyalists showed less capacity for combined action than did their opponents, and in the end they were everywhere defeated. The real tragedy of the conflict will be found, not in the defeat of the British, but in the ruin of the Loyalists. It was accompanied by wholesale confiscations of property in many quarters, and by the permanent exile of tens of thousands of the leading citizens of the republic. These were the *émigrés* of the War of American Independence, and their removal deeply affected property relations and the tone and structure of society in general. Many of those who had been social and political leaders were thus removed, or, if they remained, their influence was destroyed (see Loyalists). New men and new families rose in their places, but of a different and in some ways of an inferior type. By this process sympathizers with the War of Independence gained and kept the ascendancy. British and monarchical influences were weakened, and in the end the permanence of republican institutions was ensured. But, as had been foreseen, society in this period of transition exhibited so many repulsive features as almost to cause the stoutest hearts to despair.

Bibliography.—*Sources*: The records in which are contained the materials for the internal history of any one of the British colonies are the land papers, the minutes of the executive council, the journals of the upper and lower houses of the legislature, the laws and the correspondence and miscellaneous papers which originated from the intercourse between the colonial authorities—especially the governor—and the home government or other colonies and states. Every one of the original states has published these records in part, in series which are known under the general names of colonial records or archives or documents, or provincial papers. The first seven volumes of the *Provincial Papers of New Hampshire* (Concord) contain general records, while other volumes are filled with local and miscellaneous records. Massachusetts has published *Records of the Colony of New Plymouth* (12 vols., Boston, 1885-1887), the *Records of the Governor and Company of Massachusetts Bay in New England, 1628-1686* (5 vols., Boston, 1853-1854), the *Records of the Court of Assistants* (1 vol.), and its laws for the entire colonial period. Connecticut has printed *The Colonial Records of Connecticut* (15 vols., Hartford, 1850–1890), and the *Records of the Colony of New Haven, 1638–1665* (2 vols., Hartford, 1857–1858). *The Records of the Colony of Rhode Island* fill 10 vols. (Providence, 1856–1865). New York has published the *Laws and Ordinances of New Netherland* (1 vol.), the *Colonial Laws of New York from 1664 to the Revolution* (5 vols., Albany, 1894), *The Journal of the Legislative Council, 1691–1775* (2 vols., 1861), the *Journal of the Votes and Proceedings of the General Assembly, 1691–1765* (2 vols., 1764–1766), the *Documents relating to the Colonial History of New York* (15 vols., 1853–1883), *Minutes of the Albany Commissioners for Detecting Conspiracies* (3 vols., 1909–1910) and the *Documentary History of the State of New York* (4 vols., 1849–1851). New Jersey has published the *Grants and Concessions* (1 vol.), edited by Leaming and Spier, and 28 vols. of *The Archives of the State of New Jersey* (Newark, 1880 sqq.). Pennsylvania has published 16 vols. of *Colonial Records, 1683–1700* (Philadelphia, 1852) and four series of *Pennsylvania Archives* (1852–1856, 1874–1893, 1894–1895, &c.), the latter containing miscellaneous records relating to the colonies and the War of Independence. Under the title of *Statutes at Large* (11 vols.) its laws to the close of the War of Independence have been published. *The Archives of Maryland* (27 vols., Baltimore) contain the proceedings of the council, the assembly and the provincial court, with the laws, for a part of the colonial period. The *Records of the Virginia Company of London* (2 vols., Washington, 1906) have been printed; also Henning's *Statutes at Large* (13 vols., 1819–1823), and the *Journal of the House of Burgesses* for the later provincial period. Under the titles of *Colonial Records* (1886–) and *State Records*, North Carolina has published the sources of her early history very fully, except the land papers and laws. Thomas Cooper's *Statutes of South Carolina* (4 vols., to 1782) contain practically all of its sources which that state has published. Georgia has published 12 vols. of *Colonial Records*, containing minutes of the trustees and of the governor and council. The *Calendar of State Papers, Colonial Series, 1574–1660* (London, 1860), and for 1661–1700 (13 vols., London, 1880–1910), the *Acts of the Privy Council Colonial, 1613–1720* (2 vols., London, 1908–1910), and the *Calendars of Treasury Papers* (for the 18th century) cover relations between the British government and the colonies. Additional matter may also be found in many of the reports of the British Historical MSS. Commission. Hazard's *Historical Collections* (2 vols., Philadelphia, 1792–1794) is still valuable. B. Perley Poore's *Federal and State Constitutions* (2 vols., Washington, 1877) contains the texts of the colonial charters and state constitutions; and a similar collection was edited by F. N. Thorpe (7 vols., ibid., 1909). The records of many New England towns have been printed, as also those of New York City, Philadelphia and Albany. *The Original Narratives of Early American History* (1906–1910), edited by J. F. Jameson, contain reprints of much source material.

Cobbett's *Parliamentary History*, Almon's *Remembrancer* (17 vols., London, 1775–1784), and the writings of the British statesmen of the period, contain much material which is indispensable to the history of the War of Independence on its British side. Of official matters relating to the period of the War of Independence, special reference should be made to the *Public Journals of the Continental Congress* (13 vols.), and the *Secret Journals* (4 vols.). A new and improved edition (1908 sqq.) has been edited by W. C. Ford and G. Hunt. Indispensable to the student is Peter Force's *American Archives* (9 vols., Washington, 1837–1853), covering the years 1774 to 1776 inclusive. Francis Wharton's *Revolutionary Diplomatic Correspondence of the United States* (6 vols., Washington, 1889), and the earlier and less complete edition of the same by Jared Sparks (12 vols., Boston, 1829–1830), are also of great value. Alden Bradford's *Massachusetts State Papers* is valuable for that province. The journals of committees of safety, provincial congresses, conventions and early state legislatures are also for the most part in print. The colonial and revolutionary newspapers contain material of great variety. Semi-official also are the writings of the statesmen of the War of Independence—John and Samuel Adams, Jefferson, Dickinson, Franklin, Washington, Jay, all of which exist in very satisfactory editions Henri Doniol's *Histoire de la participation de la France à l'établissement des États-Unis d'Amérique* (5 vols., Paris, 1886–1900) is a diplomatic history of the War of Independence and the peace, dealing chiefly with France.

The states all have historical societies, and there are many private and local societies in addition. Of these the most prominent are the societies of Massachusetts, New York, Pennsylvania, Maryland and Virginia. In addition, mention should be made of the Prince Society of Boston, the American Antiquarian Society of Worcester, Mass., the Essex Institute of Salem, Mass., the Narragansett Club of Providence, R.I., and the Colonial Society of Massachusetts. The American Historical Association (Washington, D.C.) publishes valuable monographs; the second volume of the Report of the Association for 1905 is a detailed *Bibliography of American Historical Societies* (Washington, 1907).

Standard Histories: Of these the histories of the states first demand attention. Jeremy Belknap's *History of New Hampshire* (3 vols., 1784–1792; enlarged, 3 vols., Boston, 1813); Thomas Hutchinson's *History of the Province of Massachusetts Bay* (3 vols., Boston, 1767, and vol. iii., London, 1828); Samuel Greene Arnold's *History of the State of Rhode Island and Providence Plantations, 1636–1790* (2 vols., New York, 1859–1860); Benjamin Trumbull's *Complete History of Connecticut, Civil and Ecclesiastical, to 1764* (New Haven, 1818; revised, 2 vols., New London, 1898); John Romeyn Brodhead's *History of the State of New York* (2 vols., New York, 1853–1871); William Smith's *History of the Late Province of New York, from its Discovery to 1762* (2 vols., New York, 1829–1830); Samuel Smith's *History of the Colony of Nova Cæsaria, or New Jersey, to 1721* (Burlington, N.J., 1765; 2nd ed., Trenton, 1877); Robert Proud's *History of Pennsylvania from 1681 till after the year 1742* (2 vols., Philadelphia, 1797–1798); John Leeds Bozman's *History of Maryland, 1633–1660* (2 vols., Baltimore, 1837); John V. L. McMahon's *A Historical View of the Government of Maryland from its Colonisation to the Present Day* (Baltimore, 1833); William Stith's *History of the First Discovery and Settlement of Virginia* (Williamsburg, 1747); John Daly Burk's *History of Virginia* (3 vols., Petersburg, 1804–1805); François Xavier Martin's *History of North Carolina* (2 vols., New Orleans, 1829); William James Rivers's *Sketch of the History of South Carolina to the Close of the Proprietary Government by the Revolution of 1719* (Charleston, 1856); Edward McCrady's *South Carolina* (4 vols., New York, 1897–1902)—covering the period from 1670 to 1783—and Charles Colcock Jones's (jun.) *History of Georgia* (2 vols., Boston, 1883) are especially noteworthy. William Bradford's *History of Plimouth Plantation* (latest edition, Boston, 1898), and John Winthrop's *History of New England, 1630–1640* (2 vols., Boston, 1825–1826), are essentially original sources, as are the *Writings of Captain John Smith* (Arber's ed.) for early Virginia. So are Alexander Brown's *Genesis of the United States* (2 vols., Boston, 1890), and the *First Republic in America* (Boston, 1898). Philip Alexander Bruce's *Economic History of Virginia in the Seventeenth Century* (2 vols., New York, 1896) and W. B. Weeden's *Economic and Social History of New England* (2 vols., Boston, 1890) are of great value. Edmund B. O'Callaghan's *History of New Netherland* (2 vols., New York, 1846–1848), John Gorham Palfrey's *History of New England* (5 vols., Boston, 1858–1890) and I. B. Richman's *Rhode Island, its Making and its Meaning* (New York, 1902), are valuable for colonial New York, New England and Rhode Island respectively. George Bancroft's *History of the United States* (6 vols., 1884–1885) still has a great reputation, though it is altogether inadequate for the colonial period. Richard Hildreth's *History of the United States* (6 vols., New York, 1849–1852) is dry but accurate. John Andrew Doyle's *English in America* (5 vols., New York, 1882–1907) is valuable for the 17th century. Herbert L. Osgood's *American Colonies in the Seventeenth Century* (3 vols., New York, 1904–1907) discusses the institutional history of the period. John Fiske has popularized the history of the times in a number of excellent works, some of them of decided originality. Francis Parkman's *France and England in North America* (12 vols., latest ed., Boston, 1898) is a classic on the history of Canada and its relations with the British colonies. William Kingsford's *History of Canada* (10 vols., Toronto, 1887–1898), and François Xavier Garneau's *Histoire du Canada* (4 vols., Quebec, 1845–1852), may be cited as holding places of special authority. Justin Winsor's *Christopher Columbus* (Boston, 1891), *Cartier to Frontenac* (ibid., 1894), and later volumes, are especially valuable for the history of exploration, discovery and cartography. *The American Nation* (22 vols., New York, 1903–1907), a co-operative history, edited by A. B. Hart, outlines the political history of the country as a whole. Edward Channing's *History of the United States* (8 vols., New York, 1905 sqq.), and Elroy McKendree Avery's *History of the United States and Its People* (15 vols., Cleveland, Ohio, 1905 sqq.) devote much space to the colonies and War of Independence. Sir George Otto Trevelyan's *American Revolution* (3 vols., London, 1899–1904) is a brilliant literary performance. 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1897) is of unique interest. Lorenzo Sabine's *Biographical Sketches of Loyalists of the American Revolution* (2 vols., Boston, 1864), and Claude Halstead Van Tyne's *The Loyalists in the American Revolution* (New York, 1902); Herbert Friedenwald's *The Declaration of Independence* (New York, 1904), and John Hampden Hazelton's the *Declaration of Independence—Its History* (New York, 1906), are valuable special studies. Many important monographs have appeared in the "Johns Hopkins University Studies," "the Columbia University Studies," the "Harvard Historical Studies," and among the publications of the universities of Wisconsin and Pennsylvania. The Carnegie Institution has issued the first volume of a report, edited by C. M. Andrews and F. G. Davenport, on materials in British archives for the period before 1783. The bibliography of American history receives adequate treatment in Justin Winsor's *Narrative and Critical History of America* (8 vols., Boston, 1886-1889) and in J. N. Larned's *Literature of American History* (Boston, 1902). (H. L. O.)

F.—*The Struggle for National Government, 1783-1789.*

77. The long struggle to secure the ratification of the Articles of Confederation had given time for careful consideration of the new scheme of government. Maryland's persistent criticism had prepared men to find defects in them. Conventions of New England states, pamphlets, and private correspondence had found flaws in the new plan; but a public trial of it was a necessary preliminary to getting rid of it. The efforts of the individual states to maintain the war, the disposition of each state to magnify its own share in the result, the popular jealousy of a superior power, transferred now from parliament to the central government, were enough to ensure the articles some lease of life. A real national government had to be extorted through the "grinding necessities of a reluctant people."

Territorial Cessions.

78. Congress and its committees had already begun to declare that it was impossible to carry on a government efficiently under the articles. Its expostulations were to be continued for several years before they were heard. In the meantime it did not neglect the great subject which concerned the essence of nationality—the western territory. Virginia had made a first offer to cede her claims, but it was not accepted. A committee of Congress now made a report (1782) maintaining the validity of the rights which New York had transferred to Congress; and in the next year Virginia made an acceptable offer. Her deed was accepted (March 1, 1784); the other claimant states followed; and Congress, which was not authorized by the articles to hold or govern territory, became the sovereign of a tract of some 430,000 sq. m., covering all the country between the Atlantic tier of states and the Mississippi river, from the British possessions nearly to the Gulf of Mexico.

Territorial Government.

The Ordinance of 1787.

79. In this territory Congress had now on its hands the same question of colonial government in which the British parliament had so signally failed. The manner in which Congress dealt with it has made the United States the country that it is. The leading feature of its plan was the erection, as rapidly as possible, of states, similar in powers to the original states. The power of Congress over the Territories was to be theoretically absolute, but it was to be exerted in encouraging the development of thorough self-government, and in granting it as fast as the settlers should become capable of exercising it. Copied in succeeding acts for the organization of Territories, and still controlling the spirit of such acts, the Ordinance of 1787 (July 13, 1787) is the foundation of almost everything which makes the modern American system peculiar.

80. The preliminary plan of Congress was reported by a committee of which Thomas Jefferson (*q.v.*) was chairman, and was adopted by Congress on the 23rd of April 1784. It provided for the erection of seventeen states, north and south of the Ohio, with some odd names, such as Sylvania, Assenisipia, Metropotamia, Polypotamia and Pelisipia. These states were for ever to be a part of the United States, and to have republican governments. The provision, "After the year 1800 there shall be neither slavery nor involuntary servitude in any of the said states, other than in the punishment of crimes whereof the party shall have been duly convicted," represented Jefferson's feeling on this subject, but was lost for want of seven states in its favour.

81. The final plan of 1787 was reported by a committee of which Nathan Dane, of Massachusetts, was chairman. The prohibition of slavery was made perpetual, and a fugitive slave clause was added. The ordinance covered only the territory north of the Ohio, and provided for not less than three nor more than five states. Ohio, Indiana, Illinois, Michigan and Wisconsin have been the resultant states. At first Congress was to appoint the governor, secretary, judges and militia generals, and the governor and judges were, until the organization of a legislature, to make laws subject to the veto of Congress. When the population reached 5000 free male adult inhabitants the Territory was to have an assembly of its own, to consist of the governor, a legislative council of five, selected by Congress from ten nominations by the lower house, and a lower House of Representatives of one delegate for every 500 free male inhabitants.[1] This assembly was to choose a delegate to sit, but not to vote, in Congress, and was to make laws not repugnant to "the principles and articles" established and declared in the ordinance. These were as follows: the new states or Territories were to maintain freedom of worship, the benefits of the writ of *habeas corpus*, trial by jury, proportionate representation, bail, moderate fines and punishments, and the preservation of liberty, property and private contracts; they were to encourage education and keep faith with the Indians; they were to remain for ever a part of the United States; and they were not to interfere with the disposal of the soil by the United States, or to tax the lands of the United States, or to tax any citizen of the United States for the use of the navigable waters leading into the Mississippi or St Lawrence rivers. These articles were to be unalterable unless by mutual consent of a state and the United States. The transformation of the Territory, with its limited government, into a state, with all the powers of an original state, was promised by Congress as soon as the population should reach 60,000 free inhabitants, or, under certain conditions, before that time.

82. The Constitution, which was adopted almost immediately afterwards, provided merely (art. iv, § 3) that "Congress shall have power to dispose of, and make all needful rules and regulations respecting, the territory or other property belonging to the United States," and that "new states may be admitted by the Congress into this Union." Opinions have varied as to the force of the Ordinance of 1787. The Southern school of writers have been inclined to consider it *ultra vires* and void; and they adduce the fact that the new Congress under the Constitution thought it necessary to re-enact the ordinance (Aug. 7, 1789). The opposite school have inclined to hold the ordinance as still in force. Even as to the Territorial provision of the Constitution, opinions have varied.

Difficulties of the Confederation.

83. In the interval of the settlement of the territorial question the affairs of the "league of friendship," known as the United States, had been going from bad to worse, culminating in 1786. The public debt amounted in 1783 to about $42,000,000, of which $8,000,000 was owed abroad—in Holland, France and Spain. Congress had no power to levy taxes for the payment of interest or principal; it could only make requisitions on the states. In the four years ending in 1786 requisitions had been made for $10,000,000 and the receipts from them had amounted to but one-fourth of what had been called for. Even the interest on the debt was falling into arrears, and the first instalment of the principal fell due in 1787. To pay this, and subsequent annual instalments of $1,000,000, was quite impossible. Robert Morris, the financier of the War of Independence, resigned in 1783 rather than "be the minister of injustice," hoping thus to force upon the states the necessity of granting taxing powers to Congress. Washington, on retiring from the command-in-chief, wrote a circular letter to the governors of all the states, urging the necessity of granting to Congress some power to provide a national revenue. Congress (April 18, 1783) appealed to the states for power to levy specific duties on certain enumerated articles, and 5% on others. It was believed that with these duties and the requisitions, which were now to be met by internal taxation, $2,500,000 per annum could be raised. Some of the states ratified the proposal; others ratified it with modifications; others rejected it, or changed their votes; and it never received the necessary ratification of all the states. The obedience to the requisitions grew more lax. In 1786 a committee of Congress reported that any further reliance on requisitions would be "dishonourable to the understandings of those who entertain such confidence."

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[1] When the total number should reach 25, the legislature itself was to have the power of regulating the number and proportion. Property qualifications were prescribed for electors, representatives and members of the council.

Of the States.

Of Congress.

84. In the states the case was even worse. Some of them had been seduced into issuing paper currency in such profusion that they were almost bankrupt. Great Britain, in the treaty of peace, had recognized the independence of the individual states, naming them in order; and her government followed the same system in all its intercourse with its late colonies. Its restrictive system was maintained, and the states, vying with each other for commerce, could adopt no system of counteracting measures. Every possible burden was thus shifted to American commerce; and Congress could do nothing, for, though it asked for the power to regulate commerce for fifteen years, the states refused it. The decisions of the various state courts began to conflict, and there was no power to reconcile them or to prevent the consequences of the divergence. Several states, towards the end of this period, began to prepare or adopt systems of protection of domestic productions or manufactures, aimed at preventing competition by neighbouring states. The Tennessee settlers were in insurrection against the authority of North Carolina; and the Kentucky settlers were disposed to cut loose from Virginia. Poverty, with the rigid execution of process for debt, drove the farmers of western Massachusetts into an insurrection (Shays's Insurrection) which the state had much difficulty in suppressing; and Congress was so incompetent to aid Massachusetts that it was driven to the expedient of imagining an Indian war in that direction, in order to transfer troops thither. Congress itself was in danger of disappearance from the scene. The necessity for the votes of nine of the thirteen states for the passage of important measures made the absence of a state's delegation quite as effective as a negative vote. Congress even had to make repeated appeals to obtain a quorum for the ratification of the treaty of peace with Great Britain. In 1784 Congress actually broke up in disgust, and the French minister reported to his government—"There is now in America no general government—neither Congress, nor president, nor head of any one administrative department." Everywhere there were symptoms of a dissolution of the Union.

Proposals for a Convention.

85. Congress was evidently incompetent to frame a new plan of national government; its members were too dependent on their states, and would be recalled if they took part in framing anything stronger than the articles. The idea of a convention of the states, independent of Congress, was in the minds and mouths of many; Thomas Paine had suggested it as long ago as his *Common Sense* pamphlet: "Let a continental conference be held . . . to frame a continental charter . . . fixing the number and manner of choosing members of Congress, members of assembly . . . drawing the line of business and jurisdiction between them." To a people as fond of law and the forms of law as the Americans there was a difficulty in the way. The articles had provided that no change should be made in them but by the assent of every state legislature. If the work of such a convention was to be subject to this rule, its success would be no greater than that of Congress; if its plan was to be put into force on the ratification of less than the whole number of states, the step would be more or less revolutionary. In the end the latter course was taken, though not until every other expedient had failed; but the act of taking it showed the underlying consciousness that union, independence and nationality were now inextricably complicated, and that the thirteen had become one in some senses.

Convention of 1786.

86. The country drifted into a convention by a roundabout way. The navigation of Chesapeake Bay and the Potomac needed regulation; and the states of Maryland and Virginia, having plenary power in the matter, appointed delegates to arrange such rules. The delegates met (1785) at Alexandria, Va. (*q.v.*), and at Washington's house, Mount Vernon. Maryland, in adopting their report, proposed that Pennsylvania and Delaware be asked to nominate commissioners, and Virginia went further and proposed a meeting of commissioners from all the states to frame commercial regulations for the whole. The convention met (1786) at Annapolis (*q.v.*), Maryland, but only five states were represented, and their delegates adjourned, after recommending another convention at Philadelphia in May 1787.

Convention of 1787.

87. Congress had failed in its last resort—a proposal that the states should grant it the impost power alone; New York's veto had put an end to this last hope. Confessing its helplessness, Congress approved the call for a second convention; twelve of the states (all but Rhode Island) chose delegates; and the convention met at Philadelphia (May 25, 1787), with an abler body of men than had been seen in Congress since the first two Continental Congresses. Among others, Virginia sent Washington, James Madison, Edmund Randolph, George Mason and George Wythe; Pennsylvania: Franklin, Robert and Gouverneur Morris and James Wilson; Massachusetts: Rufus King, Elbridge Gerry and Caleb Strong; Connecticut: William S. Johnson, Roger Sherman and Oliver Ellsworth; New York: Alexander Hamilton; New Jersey: William Paterson; and South Carolina the two Pinckneys and John Rutledge. With hardly an exception the fifty-five delegates were clear-headed, moderate men, with positive views of their own and firm purpose, but with a willingness to compromise.

The Virginia Plan.

The New Jersey Plan.

88. Washington was chosen to preside, and the convention began the formation of a new Constitution, instead of proposing changes in the old one. Two parties were formed at once. The Virginia delegates offered a plan (see RANDOLPH, EDMUND), proposing a Congress, of two houses, having power to legislate on national subjects, and to compel the states to fulfil their obligations. This is often spoken of as a "national" plan, but very improperly. It was a "large-state" plan, proposed by those states which had or hoped for a large population. It meant to base representation in both houses on population, so that the large states could control both of them, and it left the appointment of the president or other executive and the Federal judges to Congress—so that the whole administration of the new government would fall under large-state control. On behalf of the "small states" Paterson of New Jersey brought in another plan.[1] It continued the old Confederation, with its single house and equal state vote, but added the power to regulate commerce and raise a revenue, and to compel the states to obey requisitions. The large states had a general majority of six to five, but the constant dropping off of one or more votes, on minor features, from their side to that of the small states prevented the hasty adoption of any radical measures. Nevertheless, the final collision could not be evaded; the basis of the two plans was in the question of one or two houses, of equal or proportionate state votes, of large-state supremacy or of state equality. In July the large states began to show a disposition to force their plan through, and the small states began to threaten a concerted withdrawal from the convention.

The Compromise.

89. The Connecticut delegates, from their first appearance in the convention, had favoured a compromise. They had been trained under the New England system, in which the assemblies were made up of two houses, one representing the people of the whole state, according to population, and the other giving an equal representation to the towns. They proposed that the new Congress should be made up of two houses, one representing the states in proportion to their population, the other giving an equal vote to each state. At a deadlock the convention referred the proposition to a committee, and it reported in favour of the Connecticut compromise. Connecticut had been voting in the large-state list, and the votes of her delegates could not be spared from their slender majority; now another of the large states, North Carolina, came over to Connecticut's proposal, and it was adopted. Thus the first great struggle of the convention resulted in a compromise, which took shape in an important feature of the Constitution, the Senate.

90. The small states were still anxious, in every new question, to throw as much power as possible into the hands of their

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[1] A third plan was introduced by Charles Pinckney; for a discussion of this plan see the separate article on PINCKNEY.

The Work of the Convention.

special representative, the Senate; and that body thus obtained its power to act as an executive council as a restraint on the president in appointments and treaties. This was the only survival of the first alignment of parties; but new divisions arose on almost every proposal introduced. The election of the president was given at various times to Congress and to electors chosen by the state legislatures; and the final mode of choice, by electors chosen by the states, was settled only two weeks before the end of the convention, the office of vice-president coming in with it. The opponents and supporters of the slave trade compromised by agreeing not to prohibit it for twenty years. Another compromise included three-fifths of the slaves in enumerating population for representation. This provision gave the slaveholders abnormal power as the number of slaves increased.

91. Any explanation of the system introduced by the Constitution must start with the historical fact that, while the national government was practically suspended, from 1776 until 1789, the only power to which political privileges had been given by the people was the states, and that the state legislatures were, when the convention met, politically omnipotent, with the exception of the few limitations imposed on them by the early state constitutions. The general rule, then, is that the Federal government has only the powers granted to it by the Federal Constitution, while the state has all governmental powers not forbidden to it by the state or the Federal Constitution. But the phrase defining the Federal government's powers is no longer "expressly granted," as in the Articles of Confederation, but merely "granted," so that powers necessary to the execution of granted powers belong to the Federal government, even though not directly named in the Constitution. This question of the interpretation or "construction" of the Constitution is at the bottom of real national politics in the United States: the minimizing parties have sought to hold the Federal government to a strict construction of granted powers, while their opponents have sought to widen those powers by a broad construction of them. The strict-construction parties, when they have come into power, have regularly adopted the practice of their opponents, so that construction has pretty steadily broadened.

The Constitution.

92. Popular sovereignty, then, is the basis of the American system. But it does not, as does the British system, choose its legislative body and leave unlimited powers to it. It makes its "Constitution" the permanent medium of its orders or prohibitions to all branches of the Federal government and to many branches of the state governments: they must do what the Constitution directs and leave undone what it forbids. The people, therefore, are continually laying their commands on their governments; and they have instituted a system of Federal courts to ensure obedience to their commands. A British court must obey the act of parliament; the American court is bound and sworn to obey the Constitution first, and the act of Congress or of the state legislature only so far as it is warranted by the Constitution. But the American court does not deal directly with the act in question; it deals with individuals who have a suit before it. One of these individuals relies on an act of Congress or of a state legislature; the act thus comes before the court for examination; and it supports the act or disregards it as "unconstitutional," or in violation of the Constitution. If the court is one of high rank or reputation, or one to which a decision may be appealed, as the United States Supreme Court, other courts follow the precedent, and the law falls to the ground. The court does not come into direct conflict with the legislative body; and, where a decision would be apt to produce such a conflict, the practice has been for the court to regard the matter as a "political question" and refuse to consider it.

93. The preamble states that "we, the people of the United States," establish and ordain the Constitution. Events have shown that it was the people of the whole United States that established the Constitution, but the people of 1787 seem to have inclined to the belief that it was the people of each state for itself. This belief was never changed in the South; and in 1861 the people of that section believed that the ordinances of secession were merely a repeal of the enacting clause by the power which had passed it, the people of the state. An account of the form of government established by the Constitution appears elsewhere (see UNITED STATES: VII.—*Constitution and Government*, pp 646 sqq.).

Its Power over Individuals.

94. The Constitution's leading difference from the Confederation is that it gives the national government power over individuals. The Federal courts are the principal agent in securing this essential power; without them, the Constitution might easily have been as dismal a failure as the Confederation. It has also been a most important agent in securing to the national government its supremacy over the states. From this point of view the most important provision of the Constitution is the grant of jurisdiction to Federal courts in cases involving the construction of the Constitution or of laws or treaties made under it. The 25th section of the Judiciary Act of 1789 permitted any Supreme Court justice to grant a writ of error to a state court in a case in which the constitutionality of a Federal law or treaty had been denied, or in which a state law objected to as in violation of the Federal Constitution had been maintained. In such cases, the defeated party had the right to carry the "Federal question" to the Federal courts. It was not until 1816 that the Federal courts undertook to exercise this power; it raised a storm of opposition, but it was maintained, and has made the Constitution what it professed to be—"the supreme law of the land." Treason was restricted to the act of levying war against the United States, or of adhering to their enemies, giving them aid and comfort. The states, however, have always asserted their power to punish for treason against them individually. It has never been fully maintained in practice; but the theory had its effect in the secession period.

Treason.

The Sovereignty.

95. The system of the United States is almost the only national system, in active and successful operation, as to which the exact location of the sovereignty is still a mooted question. The contention of the Calhoun school—that the separate states were sovereign before and after the adoption of the Constitution, that the Union was purely voluntary, and that the whole people, or the people of all the other states, had no right to maintain or enforce the Union against any state—has been ended by the Civil War. But that did not decide the location of the sovereignty. The prevalent opinion is still that first formulated by Madison: that the states were sovereign before 1789; that they then gave up a part of their sovereignty to the Federal government; that the Union and the Constitution were the work of the states, not of the whole people; and that reserved powers are reserved to the people of the states, not to the whole people. The use of the bald phrase "reserved to the people," not to the people of the several states, in the 10th amendment, seems to argue an underlying consciousness, even in 1789, that the whole people of the United States was already a political power quite distinct from the states, or the people of the states; and the tendency of later opinion is in this direction. The restriction to state lines seems to be a self-imposed limitation by the national people, which it might remove, as in 1789, if an emergency should make it necessary.

Details of the System.

96. By whatever sovereignty the Constitution was framed and imposed, it was meant only as a scheme in outline, to be filled up afterwards, and from time to time, by legislation. The idea is most plainly carried out in the Federal judiciary: the Constitution only directs that there shall be a Supreme Court, and marks out the general jurisdiction of all the courts, leaving Congress, under the restriction of the president's veto power, to build up the system of courts which shall best carry out the design of the Constitution. But the same idea is visible in every department, and it has carried the Constitution safely through a century which has radically altered every other civilized government. It has combined elasticity with the limitations necessary to make democratic government successful over a vast territory, having infinitely diverse interests, and needing, more than almost anything else, positive opportunities for sober second thought by the people. A sudden revolution of popular thought or feeling is enough to change the House of Representatives from top to bottom; it must continue for several years before it can make a radical change in the Senate, and for years longer before it can carry this change through the judiciary, which holds for life; and all these changes must take place before the full effects upon the laws or Constitution are accomplished. But minor changes are reached in the meantime easily and naturally in the course of legislation. The members of the Convention of 1787 showed their wisdom most plainly in not trying to do too much; if they had done more they would have done far less.

Submission to Congress.

97. The convention adjourned on the 17th of September 1787, having adopted the Constitution. Its last step was a resolution that the Constitution be sent to the Congress of the Confederation, with the recommendation that it be submitted to conventions elected by the people of each state for ratification or rejection; that, if nine states should ratify it, Congress should appoint days for the popular election of electors, and that then the new Congress and president should, "without delay, proceed to execute this Constitution." Congress resolved that the report of the convention be sent to the several legislatures, to be submitted to conventions; and this was all the approval the Constitution ever received from Congress. Both Congress and the convention were careful not to open the dangerous question, How was a government which was not to be changed but by the legislatures of all the states to be entirely supplanted by a different system through the approval of conventions in three-fourths of them? They left such questions to be opened, if at all, in the less public forum of the legislatures.

98. Before the end of the year Delaware, Pennsylvania and

Federalists and Anti-Federalists.

New Jersey had ratified; and Georgia, Connecticut and Massachusetts followed during the first two months of 1788. Thus far the only strong opposition had been in Massachusetts, a "large state." In it the struggle began between the friends and the opponents of the Constitution, with its introduction of a strong Federal power; and it raged in the conventions, legislatures, newspapers and pamphlets. In a classic series of papers, the *Federalist*, Alexander Hamilton, with the assistance of James Madison and John Jay, explained the new Constitution and defended it. As it was written before the Constitution went into force, it speaks much for the ability of its writers that it has passed into a standard textbook of American constitutional law.

Ratification.

Inauguration.

99. The seventh and eighth states—Maryland and South Carolina—ratified in April and May 1788; and, while the conventions of Virginia and New York were still wrangling over the great question, the ninth state, New Hampshire, ratified, and the Constitution passed out of theory into fact. The Anti-Federalists of the Virginia and New York conventions offered conditional ratifications of all sorts; but the Federalists stubbornly refused to consider them, and at last, by very slender majorities, these two states ratified. North Carolina refused to ratify the Constitution, and in Rhode Island it was referred to the several towns instead of to a convention and was rejected by an overwhelming majority, the Federalists, who advocated the calling of a convention, refraining from voting (§112). Congress named the first Wednesday of January 1789 as the day for the choice of electors, the first Wednesday in February for the choice of president and vice-president, and the first Wednesday in March for the inauguration of the new government, at New York City. The last date fell on the 4th of March, which has been the limit of each president's term since that time.

Fall of the Confederation.

100. When the votes of the electors were counted before Congress, it was found that Washington had been unanimously elected president, and that John Adams, standing next on the list, was vice-president. Long before the inauguration the Congress of the Confederation had expired of mere inanition; its attendance simply ran down until (Oct. 21, 1788) its record ceased, and the United States got on without any national government for nearly six months. The struggle for nationality had been successful, and the old order faded out of existence.

Slavery in the United States.

Abolition in the North.

101. The first census (1790) followed so closely upon the inauguration of the Constitution that the country may fairly be said to have had a population of nearly four millions in 1789. Something over half a million of these were slaves, of African birth or blood. Slavery of this sort had taken root in almost all the colonies, its original establishment being everywhere by custom. When the custom had been sufficiently established statutes came in to regulate a relation already existing. But it is not true, as the Dred Scott decision held long afterwards (§215), that the belief that slaves were chattels simply, things, not persons, held good at the time of the adoption of the Constitution. Times had changed somewhat. The peculiar language of the Constitution itself, describing a slave as a "person held to service or labour," under the laws of any state, puts the general feeling exactly: slaves were persons from whom the laws of some of the states withheld personal rights for the time. In accordance with this feeling most of the Northern states were on the high road towards abolition of slavery. Vermont had never allowed it. In Massachusetts it was swept out by a summary court decision that it was irreconcilable with the new state constitution. Other states soon began systems of gradual abolition, which finally extinguished slavery north of Maryland, but so gradually that there were still 18 apprentices for life in New Jersey in 1860, the last remnants of the former slave system. In the new states north of the Ohio slavery was prohibited by the ordinance of 1787 (§81), and the prohibition was maintained in spite of many attempts to get rid of it and introduce slavery.

Feeling in the South

102. The sentiment of thinking men in the South was exactly the same, or in some cases more bitter from their personal entanglement with the system. Jefferson's language as to slavery is irreconcilable with the chattel notion; no abolitionist agitator ever used warmer language than he as to the evils of slavery; and the expression, "our brethren," used by him of the slaves, is conclusive. Washington, George Mason and other Southern men were almost as warm against slavery as Jefferson, and there were societies for the abolition of slavery in the South. In the Constitutional convention of 1787 the strongest opposition to an extension of the period of non-interference with the slave trade from 1800 to 1808 came from Virginia, whereas every one of the New England states, in which the trade was an important source of profit, voted for this extension. No thinking man could face with equanimity the future problem of holding a separate race of millions in slavery. Like most slave laws, the laws of the Southern states were harsh: rights were almost absolutely withheld from the slave, and punishments of the severest kind were legal; but the execution of the system was milder than its legal possibilities might lead one to imagine. The country was as yet so completely agricultural that Southern slavery kept all the patriarchal features possible to such a system.

Agriculture, Commerce and Manufactures.

103. Indeed, the whole country was almost exclusively agricultural, and, in spite of every effort to encourage manufactures by state bounties, they formed the meagrest element in the national production. Connecticut, which now teems with manufactures, was just beginning the production of tinware and clocks; Rhode Island and Massachusetts were just beginning to work in cotton from models of jennies and Arkwright machinery surreptitiously obtained from England; and other states, beyond local manufactures of paper, glass and iron, were almost entirely agricultural, or were engaged in industries directly dependent on agriculture. Commerce was dependent on agriculture for export and manufactured imports were enough to drown out every other form.

Changes since 1790.

104. There were but five cities in the United States having a population of more than 10,000—New York (33,000), Philadelphia (28,500), Boston (18,000), Charleston (16,000) and Baltimore (13,000). The population of the city of New York is now greater than that of the original thirteen states in 1790; the state of New York has now about twice as many inhabitants as the thirteen had in 1790; and the new states of Ohio and Illinois, which had hardly any white inhabitants in 1789, have each a larger population than the whole thirteen then had. Imports have swollen from $23,000,000 to $1,475,612,580 (1909); exports from $20,000,000 to $1,728,203,271 (1909), since 1790. The revenues of the new government in 1790 were $4,000,000; the expenditures, excluding interest on the public debt, but $1,000,000; now both the revenues and the expenditures are about $1,000,000,000. It is not easy for the modern American to realize the poverty and weakness of his country at the inauguration of the new system of government, however he may realize the simplicity of the daily life of its people.

The West.

105. Outside the cities communication was slow. One stage a week was enough for the connexion between the great cities; and communication elsewhere depended on private conveyance. The Western settlements were just beginning to make the question more serious. Enterprising land companies were the moving force which had impelled the passage of the Ordinance of 1787; and the first column of their settlers was pouring into Ohio and forming connexion with their predecessors in Kentucky and Tennessee. Marietta and Cincinnati had been founded. But the intending settlers were obliged to make the journey down the Ohio river from Pittsburg in bullet-proof flat-boats, for protection against the Indians, and the return trip depended on the use of oars. For more than twenty years these flat-boats were the chief means of river commerce in the West; and in the longer trips, as to New Orleans, the boats were generally broken up at the end and sold for lumber,

the crew making the trip home on foot or on horseback. John Fitch and others were already experimenting on what was soon to be the steamboat; but the statesman of 1789, looking at the task of keeping under one government a country of such distances, with such difficulties of communication, may be pardoned for having felt anxiety as to the future. To almost all thinking men of the time the Constitution was an experiment, and the unity of the new nation a subject for very serious doubt.

Literature.

106. The comparative isolation of the people everywhere, the lack of books, the poverty of the schools and newspapers, were all influences which worked strongly against any pronounced literary development. Poems, essays and paintings were feeble imitations of European models; history was annalistic, if anything; and the drama hardly existed. In two points the Americans were strong, and had done good work. Such men as Jonathan Edwards had excelled in various departments of theology, and American preaching had reached a high degree of quality and influence; and, in the line of politics, the American state papers rank among the very best of their kind. Having a very clear perception of their political purposes, and having been restricted in study and reading to the great masters of pure and vigorous English, and particularly to the English translators of the Bible, the American leaders came to their work with an English style which could hardly have been improved. The writings of Franklin, Washington, the Adamses, Hamilton, Jefferson, Madison, Jay and others show the secret of their strength in every page. Much the same reasons, with the influences of democracy, brought oratory, as represented by Patrick Henry, Fisher Ames, John Randolph and others, to a point not very far below the mark afterwards reached by Daniel Webster. The effect of these facts on the subsequent development of the country is not often estimated at its full value. All through an immigration of every language and dialect under heaven the English language has been protected in its supremacy by the necessity of going back to the "fathers of the republic" for the first, and often the complete, statement of principles in every great political struggle, social problem or lawsuit.

Limits of Settlement.

107. The cession of the "North-West Territory" by Virginia and New York had been followed up by similar cessions by Massachusetts (1785), Connecticut (1786) and South Carolina (1787). North Carolina did not cede Tennessee until early in 1790, nor Georgia her western claims until 1802. Settlement in all these regions was still very sparse. The centres of Western settlement, in Tennessee and Kentucky, had become more firmly established, and a new one, in Ohio, had just been begun. The whole western limits of settlement of the old thirteen states had moved much nearer their present boundaries; and the acquisition of the Western title, with the liberal policy of organization and government which had been begun, was to have its first clear effects during the first decade of the new government. Almost the only obstacle to its earlier success had been the doubts as to the attitude which the Spanish authorities, at New Orleans and Madrid, would take towards the new settlements. They had already asserted a claim that the Mississippi was an exclusively Spanish stream from its mouth up to the Yazoo, and that no American boat should be allowed to sail on this part of it. To the Western settler the Alleghanies and bad roads were enough to cut him off from any other way to a market than down the Mississippi; and it was not easy to restrain him from a forcible defiance of the Spanish claim. The Northern states were willing to allow the Spanish claim for a period of years in return for a commercial treaty; the Southern states and the Western settlers protested angrily; and once more the spectre of dissolution appeared, not to be laid again until the new government had made a treaty with Spain in 1795 (see PINCKNEY, THOMAS), securing common navigation of the Mississippi.

The Mississippi River.

Social Conditions.

108. Contemporary authorities agree that a marked change had come over the people since 1775, and few of them seem to think the change one for the better. Many attribute it to the looseness of manners and morals introduced by the French and British soldiers; others to the general effects of war; a few, Tories all, to the demoralizing effects of rebellion. The successful establishment of nationality would be enough to explain most of it; and if we remember that the new nation had secured its title to a vast western territory, of unknown but rich capacities, which it was now moving to reduce to possession by emigration, it would seem far more strange if the social conditions had not been somewhat disturbed.

G.—*The Development of Democracy, 1789–1801.*

Democracy in the United States.

109. All the tendencies of political institutions in the United States had certainly been towards democracy; but it cannot be said that the leading men were hearty or unanimous in their agreement with this tendency. Not a few of them were pronounced republicans even before 1775, but the mass of them had no great objections to a monarchical form of government until the war-spirit had converted them. The Declaration of Independence had been directed rather against *the* king than against *a* king. Even after popular sovereignty had pronounced against a king, class spirit was for some time a fair substitute for aristocracy. As often happens, democracy at least thought of a Caesar when it apprehended class control. Certain discontented officers of the Continental Army proposed to Washington that he become king, but he promptly and indignantly put the offer by. The suggestion of a return to monarchy in some form, as a possible road out of the confusion of the Confederation, occurs in the correspondence of some of the leading men; and while the Convention of 1787 was holding its secret sessions a rumour went out that it had decided to offer a crown to an English prince.

110. The state constitutions were democratic, except for property or other restrictions on the right of suffrage, or provisions carefully designed to keep the control of at least one house of the state legislature "in the hands of property." The Federal Constitution was so drawn that it would have lent itself kindly either to class control or to democracy. The electoral system of choosing the president and vice-president was altogether anti-democratic, though democracy has conquered it: not an elector, since 1796, has disobeyed the purely moral claim of his party to control his choice. Since the Senate was to be chosen by the state legislatures, "property," if it could retain its influence in those bodies, could control at least one house of Congress. The question whether the Constitution was to have a democratic or an anti-democratic interpretation was to be settled in the next twelve years.

Influence of Immigration.

111. The states were a strong factor in the final settlement, from the fact that the Constitution had left to them the control of the elective franchise: they were to make its conditions what each of them saw fit. Religious tests for the right of suffrage had been quite common in the colonies; property tests were almost universal. The former disappeared shortly after the War of Independence; the latter survived in some of the states far into the constitutional period. But the desire to attract immigration was always a strong impelling force to induce states, especially frontier states, to make the acquisition of full citizenship and political rights as easy and rapid as possible. This force was not so strong at first as it was after the great stream of immigration began about 1848, but it was enough to tend constantly to the development of democracy. In later times, when state laws allow the immigrant to vote even before the period assigned by Federal laws allows him to become a naturalized citizen, there have been demands for the modification of the ultra state democracy; but no such danger was apprehended in the first decade.

Organization of the New Government.

112. The Anti-Federalists had been a political party, but a party with but one principle. The absolute failure of that principle deprived the party of all cohesion; and the Federalists controlled the first two Congresses almost entirely. Their pronounced ability was shown in their organizing measures, which still govern the American system very largely. The departments of state, of the treasury, of war, of justice, and of the post-office were rapidly and successfully organized; acts were passed for the regulation of seamen, commerce, tonnage duties, lighthouses, intercourse with the Indians, Territories, and the militia; a national capital was selected; a national bank was chartered; the national debt was funded, and the state debts were assumed as

part of it. The first four years of the new system showed that the states had now to deal with a very different power from the impotent Congress of the Confederation. The new power was even able to exert pressure upon the two states which had not ratified the Constitution, though the pressure was made as gentle as possible. As a first step, the higher duties imposed on imports from foreign countries were expressly directed to apply to imports from North Carolina and Rhode Island. North Carolina having called a second convention, her case was left to the course of nature; and the second convention ratified the Constitution (November 21, 1789). The Rhode Island legislature asked that their state might not be considered altogether foreigners, made their duties agree with those of the new government, and reserved the proceeds for "continental" purposes. Still no further steps were taken. A bill was therefore introduced, directing the president to suspend commercial intercourse with Rhode Island, and to demand from her her share of the continental debt. This was passed by the Senate, and waited but two steps further to become law. Newspaper proposals to divide the little state between her two nearest neighbours were stopped by her ratification of the Constitution (May 29, 1790). The "old thirteen" were thus united under the Constitution; and yet, so strong is the American prejudice for the autonomy of the states that these last two were allowed to enter in the full conviction that they did so in the exercise of sovereign freedom of choice. Their entrance, however, was no more involuntary than that of others. If there had been real freedom of choice, nine states would never have ratified: the votes of Pennsylvania, Massachusetts, New Hampshire, Virginia and New York were only secured by the pressure of powerful minorities in these states, backed by the almost unanimous votes of the others.

Completion of the Union.

Hamiltonian Protection.

113. Protection was begun in the first Tariff Act, whose object, said its preamble, was the protection of domestic manufactures. The duties, however, ranged only from 7½ to 10%, averaging about 8½%. The system, too, had rather a political than an economic basis. Until 1789 the states had controlled the imposition of duties. The separate state feeling was a factor so strong that secession was a possibility which every statesman had to take into account. Hamilton's object, in introducing the system, seems to have been to create a class of manufacturers, running through all the states, but dependent for prosperity on the new Federal government and its tariff. This would be a force which would make strongly against any attempt at secession, or against the tendency to revert to control by state legislatures, even though it based the national idea on a conscious tendency towards the development of classes. The same feeling seems to have been at the bottom of his establishment of a national bank, his assumption of state debts, and most of the general scheme which his influence forced upon the Federalist party. (See HAMILTON, ALEXANDER; and FEDERALIST PARTY.)

The First Cabinet.

114. In forming his cabinet Washington had paid attention to the opposing elements which had united for the temporary purpose of ratifying the Constitution. The national element was represented by Hamilton, secretary of the treasury, and Henry Knox, secretary of war; the particularist element (using the term to indicate support of the states, not of a state) by Jefferson, secretary of state, and Edmund Randolph, attorney-general. At the end of 1792 matters were in train for the general recognition of the existence of two parties, whose struggles were to decide the course of the Constitution's development. The occasion came in the opening of the following year, when the new nation was first brought into contact with the French Revolution.

The Jefferson School of Politics.

115. The controlling tendency of Jefferson and his school was to the maintenance of individual rights at the highest possible point, as the Hamilton school was always ready to assert the national power to restrict individual rights for the general good. Other points of difference are rather symptomatic than essential. The Jefferson school supported the states, in the belief that they were the best bulwarks for individual rights. When the French Revolution began its usual course in America by agitation for the "rights of man," it met a sympathetic audience in the Jefferson party and a cold and unsympathetic hearing from the Hamilton school of Federalists. The latter were far more interested in securing the full recognition of the power and rights of the nation than in securing the individual against imaginary dangers, as they thought them. For ten years the surface marks of distinction between the two parties were to be connected with the course of events in Europe; but the essence of distinction was not in the surface marks.

The Hamilton School.

116. The new government was not yet four years old; it was not familiar, nor of assured permanency. The only national governments of which Americans had had previous experience were the British government and the Confederation: in the former they had had no share, and the latter had had no power. The only places in which they had had long-continued, full, and familiar experience of self-government were their state governments: these were the only governmental forms which were then distinctly associated in their minds with the general notion of republican government. The governing principle of the Hamilton school, that the construction or interpretation of the terms of the Constitution was to be such as to broaden the powers of the Federal government, necessarily involved a corresponding trenching on the powers of the states. It was natural, then, that the Jefferson school should look on every feature of the Hamilton programme as "anti-republican," meaning, probably, at first no more than opposed to the state system, though the term soon came to imply something of monarchical and, more particularly, of English tendencies. The disposition of the Jefferson school to claim for themselves a certain peculiar title to the position of "republicans" developed into the appearance of the first Republican, or the Democratic-Republican, party, about 1793.

Party Differences.

The National Capital.

Genet's Mission.

The Whisky Insurrection.

Admission of Vermont, Kentucky and Tennessee.

117. Many of the Federalists were shrewd and active business men, who naturally took prompt advantage of the opportunities which the new system offered. The Republicans therefore believed and asserted that the whole Hamilton programme was dictated by selfish or class interest; and they added this to the accusation of monarchical tendencies. These charges, with the fundamental differences of mental constitution, exasperated by the passion which differences as to the French Revolution seemed to carry with them everywhere, made the political history of this decade a very unpleasant record. The provision for establishing the national capital on the Potomac (1790) was declared to have been carried by a corrupt bargain; and accusations of corruption were renewed at every opportunity. In 1793 a French agent, Edmond Charles Edouard Genet (1765–1834), appeared to claim the assistance of the United States for the French republic, and went to the length of commissioning privateers and endeavouring to secure recruits, especially for a force which he expected to raise for the conquest of Louisiana from Spain. Washington decided to issue a proclamation of neutrality, the first act of the kind in American history. It was the first indication, also, of the policy which has made the course of every president, with the exception of Polk, a determined leaning to peace, even when the other branches of the government have been intent on war. Genet, however, continued his activities, and made outrageous demands upon the government, so that finally Washington demanded and secured (1794) his recall.[1] The proclamation of 1793 brought about the first distinctly party feeling; and it was intensified by Washington's charge that popular opposition in western Pennsylvania (1794) to the new excise law (see WHISKY INSURRECTION) had been fomented by the extreme French party. Their name, Democrat, was applied by the Federalists to the whole Republican party as a term of contempt, but it was not accepted by the party for some twenty years; then the compound title "Democratic-Republican" became, as it

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[1] Genet, fearing the fate of his fellow Girondists in France, remained in the United States and became a naturalized American citizen.

still is, the official title of the party. There was no party opposition, however, to the re-election of Washington in 1792, or to the admission of Vermont (1791), Kentucky (1792) and Tennessee (1796) as new states.

Jay's Treaty.

Election of 1796.

118. The British government had accredited no minister to the United States, and it refused to make any commercial treaty or to give up the forts in the western territory of the United States, through which its agents still exercised a commanding influence over the Indians. In the course of its war with France, the neutral American vessels, without the protection of a national navy, fared badly. A treaty negotiated in 1794 by Chief-Justice John Jay (*q.v.*) settled these difficulties for the following twelve years. But, as it engaged the United States against any intervention in the war on behalf of France, was silent on the subject of the right of search, and agreed to irksome limitations on the commercial privileges of the United States, the Republicans, who were opposed to the negotiation of any treaty at this time with Great Britain, made it very unpopular, and the bitter personal attacks on Washington grew out of it. In spite of occasional Republican successes, the Federalists retained a general control of national affairs; they elected John Adams president in 1796, though Jefferson was chosen vice-president with him; and the national policy of the Federalists kept the country out of entangling alliances with any of the European belligerents. To the Republicans, and to the French republic, this last point of policy was only a practical intervention against France and against the rights of man.

The "X.Y.Z." Mission.

Quasi-war with France.

119. At the end of Washington's administration the French Directory broke off relations with the United States, demanding the abrogation of Jay's treaty and a more pronounced sympathy with France. Adams sent three envoys, C. C. Pinckney (*q.v.*), John Marshall and Elbridge Gerry (*q.v.*), to endeavour to re-establish the former relations; they were met by demands for "money, a great deal of money," as a prerequisite to peace. They refused, their letters home were published,[1] and the Federalists at last had the opportunity of riding the whirlwind of an intense popular desire for war with France. Intercourse with France was suspended by Congress (1798); the treaties with France were declared at an end; American frigates were authorized to capture French vessels guilty of depredations on American commerce, and the president was authorized to issue letters of marque and reprisal; and an American army was formed, Washington being called from his retirement at Mount Vernon to command it. The war never went beyond a few sea-fights, in which the little American navy did itself credit, and Napoleon, seizing power the next year, renewed the peace which should never have been broken. But the quasi-war had internal consequences to the young republic which surpassed in interest all its foreign difficulties: it brought on the crisis which settled the development of the United States towards democracy.

Error of the Federalists.

120. The reaction in Great Britain against the indefinite "rights of man" had led parliament to pass an alien law, a sedition law suspending the writ of *habeas corpus*, and an act giving wide and loosely defined powers to magistrates for the dispersion of meetings to petition for redress of grievances. The Federalists were in control of a Congress of limited powers; but they were strongly tempted by sympathies and antipathies of every sort to form their programme on the model furnished from England. The measures which they actually passed were based only on that construction of the Constitution which is at the bottom of all American politics; they only tended to force the Constitution into an anti-democratic direction. But it was the fixed belief of their opponents that they meant to go farther, and to secure control by some wholesale measure of political persecution.

The Alien and Sedition Laws.

121. Three alien laws were passed in June and July 1798. The first (repealed in April 1802) raised the number of years necessary for naturalization from five to fourteen. The third (still substantially in force) permitted the arrest or removal of subjects of any foreign power with which the United States should be at war. The second, which is usually known as the Alien Law, was limited to a term of two years; it permitted the president to arrest or order out of the country any alien whom he should consider dangerous to the country. As many of the Republican editors and local leaders were aliens, this law really put a large part of the Republican organization in the power of the president elected by their opponents. The Sedition Law (to be in force until March 1801 and not renewed) made it a crime, punishable by fine and imprisonment, to publish or print any false, scandalous and malicious writings against the government of the United States, either house of Congress, or the president, or to stir up sedition or opposition to any lawful act of Congress or of the president, or to aid the designs of any foreign power against the United States. In its first form the bill was even more sweeping than this and alarmed the opposition thoroughly.

The Republican Opposition.

122. Most of the ability of the country was in the Federalist ranks; the Republicans had but two first-rate men—Jefferson and Madison. In the sudden issue thus forced between individual rights and national power, Jefferson and Madison could find but one bulwark for the individual—the power of the states; and their use of it gave their party a pronounced list to state sovereignty from which it did not recover for years. They objected to the Alien Law on the grounds that aliens were under the jurisdiction of the state, not of the Federal government; that the jurisdiction over them had not been transferred to the Federal government by the Constitution, and that the assumption of it by Congress was a violation of the Constitution's reservation of powers to the states; and, further, because the Constitution reserved to every "person," not to every citizen, the right to a jury trial. They objected to the Sedition Law on the grounds that the Constitution had specified exactly the four crimes for whose punishment Congress was to provide; that criminal libel was not one of them; and that amendment I. forbade Congress to pass any law restricting freedom of speech or of the press. The Federalists asserted a common-law power in Federal judges to punish for libel, and pointed to a provision in the Sedition Law permitting the truth to be given in evidence, as an improvement on the common law, instead of a restriction on liberty.

Virginia and Kentucky Resolutions.

123. The Republican objections might have been made in court, on the first trial. But the Republican leaders had strong doubts of the impartiality of the Federal judges, who were Federalists. They resolved to entrench the party in the state legislatures. The Virginia legislature in 1798 passed a series of resolutions prepared by Madison, and the Kentucky legislature in the same year passed a series prepared by Jefferson (see KENTUCKY: *History*). Neglected or rejected by the other states, they were passed again by their legislatures in 1799, and were for a long time a documentary basis of the Democratic party. The leading idea expressed in both was that the Constitution was a "compact" between the states, and that the powers (the states) which had made the compact had reserved the power to restrain the creature of the compact, the Federal government, whenever it undertook to assume powers not granted to it. Madison's idea seems to have been that the restraint was to be imposed by a second convention of the states. Jefferson's idea is more doubtful; if it meant that the restraint should be imposed by any state which should feel aggrieved, his scheme was merely Calhoun's idea of nullification; but there are some indications that he agreed with Madison.

Effects of the Laws.

124. The first Congress of Adams's term of office ended in 1799. Its successor, elected in the heat of the French war excitement, kept the Federalist policy up to its first pitch. Out of Congress the execution of the objectionable laws had taken the shape of political persecution. Men were arrested, tried and punished for writings which the people had

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[1] In these letters as published the letters X, Y and Z were substituted for the names of the French agents with whom the American envoys dealt; and the letters are known as the X Y Z correspondence.

been accustomed to consider within legitimate political methods. The Republican leaders made every trial as public as possible, and gained votes constantly, so that the Federalists began to be shy of the very powers which they had sought. Every new election was a storm-signal for the Federalist party; and the danger was increased by schism in their own ranks.

Federalist Schism.

125. Hamilton was now a private citizen of New York; but he had the confidence of his party more largely than its nominal head, the president, and he maintained close and confidential relations with the cabinet which Adams had taken unchanged from Washington. The Hamilton faction saw no way of preserving and consolidating the newly acquired powers of the Federal government but by keeping up and increasing the war feeling against France; Adams had the instinctive leaning of an American president towards peace. Amid cries of wrath and despair from his party he accepted the first overtures of the new Napoleonic government, sent envoys to negotiate a peace, and ordered them to depart for France when they delayed too long. Then, discovering flat treachery in his cabinet, he dismissed it and blurted out a public expression of his feeling that Hamilton and his adherents were "a British faction." Hamilton retorted with a circular letter to his party friends, denouncing the president; the Republicans intercepted it and gave it a wider circulation than its author had intended; and the Hamilton faction tried so to arrange the electoral vote that C. C. Pinckney should be chosen president in 1800 and Adams should be shelved into the vice-presidency. The result depended on the electoral vote of New York; and Aaron Burr, who had introduced the drill and machinery of a modern American political party there, had made the state Republican and secured a majority for the Republican candidates. These (Jefferson and Burr) received the same number of electoral votes (73),[1] and the House of Representatives (controlled by the Federalists) was thus called upon to decide which should be president. There was an effort by the Federalists to disappoint the Republicans by making Burr president; but Jefferson obtained that office, Burr becoming vice-president for four years. This disputed election, however, led to the adoption in 1804 of the 12th amendment to the Constitution, which prescribed that each elector should vote separately for president and vice-president, and thus prevent another tie vote of this kind; this amendment, moreover, made very improbable the choice in the future of a president and a vice-president from opposing parties.

Election of 1800.

"Revolution of 1800."

126. The "Revolution of 1800" decided the future development of the United States. The new dominant party entered upon its career weighted with the theory of state sovereignty; and a civil war was necessary before this dogma, put to use again in the service of slavery, could be banished from the American system. But the democratic development never was checked. From that time the interpretation of the Federal Constitution has generally favoured individual rights at the expense of governmental power. As the Republicans obtained control of the states they altered the state constitutions so as to cut out all the arrangements that favoured property or class interests, and reduced political power to the dead level of manhood suffrage. In most of the states outside of New England this process was completed before 1815; but New England tenacity was proof against the advancing revolution until about 1820. For twenty years after its downfall of 1800 the Federalist party maintained its hopeless struggle, and then it faded away into nothing, leaving as its permanent memorial the excellent organization of the Federal government, which its successful rival hardly changed. Its two successors—the Whig and the second Republican party—have also been broad-constructionist parties, but they have admitted democracy as well; the Whig party adopted popular methods at least, and the Republican went further in the direction of individual rights, securing the emancipation of enslaved labour.

The New Capital.

127. The disputed election of 1800 was decided in the new capital city of Washington, to which the government had just been removed, after having been for ten years at Philadelphia. Its streets and parks existed only on paper. The Capitol had been begun; the Executive Mansion was unfinished, and its audience room was used by Mrs Adams as a drying room for clothes; and the congressmen could hardly find lodgings. The inconveniences were only an exaggeration of the condition of other American cities. Their sanitary conditions were bad, and yellow fever and cholera from time to time reduced several of them almost to depopulation. More than once, during this decade, the fever visited Philadelphia and New York, drove out most of the people, and left grass growing in the streets. The communication between the cities was still wretched. The traveller was subject to every danger or annoyance that bad roads, bad carriages, bad horses, bad inns and bad police protection could combine to inflict upon him. But the war with natural obstacles had fairly begun, though it had little prospect of success until steam was brought into use as the ally of man.

The West.

128. About this time the term "the West" appears. It meant then the western part of New York, the new territory north of the Ohio, and Kentucky and Tennessee. In settling land boundaries New York had transferred (1786) to Massachusetts, whose claims crossed her territory, the right to (but not jurisdiction over) a large tract of land in central New York, and to another large tract in the Erie basin. The sale of this land had carried population considerably west of the Hudson. After other expeditions against the Ohio Indians had been defeated, one under General Anthony Wayne had compelled them in 1794–95 to give up all the territory now in the state of Ohio. Settlement received a new impetus. Between 1790 and 1800 the population of Ohio had risen from almost nothing to 45,000, that of Tennessee from 36,000 to 106,000, and that of Kentucky from 74,000 to 221,000—the last-named state now exceeding six of the "old thirteen" in population. The difficulties of the western emigrant, however, were still enormous. He obtained land of his own, fertile land and plenty of it, but little else. The produce of the soil had to be consumed at home, or near it; ready money was scarce and distant products scarcer; and comforts, except the very rudest substitutes of home manufacture, were unobtainable. The new life bore most hardly upon women; and, if the record of woman's share in the work of American colonization could be fully made up, the price paid for the final success would seem enormous.

Post Office.

129. The number of post offices rose during these ten years from 75 to 903, the miles of post routes from 1900 to 21,000, and the revenue from $38,000 to $231,000. These figures seem small in comparison with the 61,158 post offices, 430,738 m. of post routes (besides 943,087 m. of rural delivery routes), and a postal revenue of $191,478,663 in 1908, but the comparison with the figures of 1790 shows a development in which the new Constitution, with its increased security, must have been a factor.

Patents.

130. The power of Congress to regulate patents was already bearing fruit. Until 1789 this power was in the hands of the states, and the privileges of the inventor were restricted to the territory of the patenting state. Now he had a vast and growing territory within which all the profits of the invention were his own. Twenty patents were issued in 1793, and 23,471 one hundred years afterwards; but one of the inventions of 1793 was Eli Whitney's cotton gin.

Cotton.

131. When the Constitution was adopted it was not known that the cultivation of cotton could be made profitable in the Southern states. The "roller gin" could clean only 6 lb a day by slave labour. In 1784 eight bags of cotton, landed in Liverpool from an American ship, were seized on the ground that so much cotton could not be the produce of the United States. Eli Whitney (*q.v.*) invented the saw-gin, by which the cotton was dragged through parallel wires with openings too narrow to allow the seeds to pass; and one slave could now clean 1000 lb a day. The exports of cotton leaped from 189,000 lb in

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[1] Adams received 65, Pinckney 64 and John Jay 1.

1791 to 21,000,000 ℔ in 1801, and doubled in three years more. The influence of this one invention, combined with the wonderful series of British inventions which had paved the way for it, can hardly be estimated in its commercial aspects. Its political influences were even wider, but more unhappy. The introduction of the commercial element into the slave system of the South robbed it at once of the patriarchal features which had made it tolerable; while it developed in slave-holders a new disposition to defend a system of slave labour as a "positive good." The abolition societies of the South began to dwindle as soon as the results of Whitney's invention began to be manifest.

Slavery and Democracy.

132. The development of a class whose profits were merely the extorted natural wages of the black labourer was certain; and its political power was as certain, though it never showed itself clearly until after 1830. And this class was to have a peculiarly distorting effect on the political history of the United States. Aristocratic in every sense but one, it was ultra-Democratic (in a purely party sense) in its devotion to state sovereignty, for the legal basis of the slave system was in the laws of the several states. In time, the aristocratic element got control of the party which had originally looked to state rights as a bulwark of individual rights; and the party was finally committed to the employment of its original doctrine for an entirely different purpose—the suppression of the black labourer's wages.

H.—*Democracy and Nationality, 1801-1829*

Democracy and Nationality.

133. When Jefferson took office in 1801 he succeeded to a task larger than he imagined. His party, ignoring the natural forces which tied the states together even against their wills, insisted that the legal basis of the bond was in the power of any state to withdraw at will. This was no nationality; and foreign nations naturally refused to take the American national coin at any higher valuation than that at which it was current in its own country. The urgent necessity was for a reconciliation between democracy and nationality; and this was the work of this period. An underlying sense of all this has led Democratic leaders to call the war of 1812-15 the "Second War of Independence"; the result was as much independence of past ideas as of Great Britain.

Louisiana.

134. The first force in the new direction was the acquisition of Louisiana in 1803. Napoleon had acquired it from Spain, and, fearing an attack upon it by Great Britain, offered it to the United States for $15,000,000. The Constitution gave the Federal government no power to buy and hold territory, and the party was based on a strict construction of the constitution. Possession of power forced the strict-construction party to broaden its ideas, and Louisiana was bought, though Jefferson quieted his conscience by talking for a time of a futile proposal to amend the Constitution so as to grant the necessary power. (See LOUISIANA PURCHASE; and JEFFERSON, THOMAS.) The acquisition of the western Mississippi basin more than doubled the area of the United States, and gave them control of all the great river-systems of central North America. The difficulties of using these rivers were removed almost immediately by Robert Fulton's utilization of steam in navigation (1807). Within four years steamboats were at work on western waters; and thereafter the increase of steam navigation and that of population stimulated one another. The "centre of population" has been carefully ascertained by the census authorities for each decade, and it represents the westward movement of population very closely. During this period it advanced from about the middle of the state of Maryland to its extreme western limit; that is, the centre of population was in 1830 nearly at the place which had been the western limit of population in 1770.

The Steamboat.

Centre of Population.

135. Jefferson also laid the basis for a further acquisition in the future by sending an expedition under Meriwether Lewis (*q.v.*) and William Clark to explore the territory north of the then Spanish territory of California and west of the Rocky Mountains—the "Oregon country" as it was afterwards called. The explorations of this party (1804-1806), with Captain Robert Gray's discovery of the Columbia river (1792), made the best part of the claims of the United States to the country forty years later.

The Oregon Country.

Election of 1804.

136. Jefferson was re-elected in 1804,[1] serving until March, 1809; his party now controlled almost all the states outside of New England, and could elect almost any one whom it chose to the presidency. Imitating Washington in refusing a third term of office, Jefferson established more firmly the precedent, not since violated, restricting a president to two terms, though the Constitution contains no such restriction. The great success of his presidency had been the acquisition of Louisiana, which was a violation of his party principles; but all his minor successes were, like this, recognitions of the national sovereignty which he disliked so much. After a short and brilliant naval war the Barbary pirates were reduced to submission (1805). The long-continued control of New Orleans by Spain, and the persistent intrigues of the Spanish authorities, looking towards a separation of the whole western country from the United States, had been ended by the acquisition of Louisiana, and the full details concerning them will probably remain for ever hidden in the secret history of the early West. They had left behind a dangerous ignorance of Federal power and control, of which Aaron Burr (*q.v.*) took advantage (1806-07). Organizing an expedition in Kentucky and Tennessee, probably for the conquest of the Spanish colony of Mexico, he was arrested on the lower Mississippi and brought back to Virginia. He was acquitted; but the incident opened up a vaster view of the national authority than democracy had yet been able to take. It had been said, forty years before, that Great Britain had long arms, but that three thousand miles was too far to extend them; it was something to know now that the arms of the Federal government were long enough to reach from Washington city to the Mississippi.

Difficulties with Great Britain.

137. All the success of Jefferson was confined to his first four years; all his heavy failures were in his second term, in which he and his party as persistently refused to recognize or assert the inherent power of the nation in international affairs. The Jay treaty expired in 1806 by limitation, and American commerce was thereafter left to the course of events, Jefferson refusing to accept the only treaty which the British government was willing to make. All the difficulties which followed may be summed up in a few words: the British government was then the representative of the ancient system of restriction of commerce, and had a powerful navy to enforce its ideas; the American government was endeavouring to force into international recognition the present system of neutral rights and unrestricted commerce, but its suspicious democracy refused to give it a navy sufficient to command respect. The American government apparently expected to gain its objects without the exhibition of anything but moral force.

Neutral Commerce.

138. Great Britain was now at war, from time to time, with almost every other nation of Europe. In time of peace European nations followed generally the old restrictive principle of allowing another nation, like the United States, no commercial access to their colonies; but, when they were at war with Great Britain, whose navy controlled the ocean, they were very willing to allow the neutral American merchantmen to carry away their surplus colonial produce. Great Britain had insisted for fifty years that the neutral nation, in such cases, was really intervening in the war as an ally of her enemy; but she had so far modified her claim as to admit that "transhipment," or breaking bulk, in the United States was enough to qualify the commerce for recognition. The neutral nation thus gained a double freight, and grew rich in the traffic; the belligerent nations no longer had commerce afloat for British vessels to capture; and the "frauds of the neutral flags" became a standing subject of complaint among British merchants and naval officers. About 1805 British prize courts

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[1] Jefferson received 162 electoral votes and his opponent, C. C. Pinckney, only 14.

began to disregard transhipment and to condemn American vessels which made the voyage from a European colony to the mother country by way of the United States. This was really a restriction of American commerce to purely American productions, or to commerce with Great Britain direct, with the payment of duties in British ports.

Expatriation.

Impressment.

139. The question of expatriation, too, furnished a good many burning grievances. Great Britain maintained the old German rule of perpetual allegiance, though she had modified it by allowing the right of emigration. The United States, founded by immigration, was anxious to establish what Great Britain was not disposed to grant, the right of the subject to divest himself of allegiance by naturalization under a foreign jurisdiction. Four facts thus tended to break off friendly relations: (1) Great Britain's claim to allegiance over American naturalized subjects; (2) her claim to the belligerent right of search of neutral vessels; (3) her claim of right to impress for her vessels of war her subjects who were seamen wherever found; and (4) the difficulty of distinguishing native-born American from British subjects, even if the right to impress naturalized American subjects were granted. British naval officers even undertook to consider all who spoke the English language as British subjects, unless they could produce proof that they were native-born Americans. The American sailor who lost his papers was thus open to impressment. A particularly flagrant case of seizure of Americans occurred in 1807. On the 27th of June the British ship "Leopard" fired upon the American frigate "Chesapeake," which, after having lost 3 men killed and 18 wounded, hauled down its flag; the British commander then seized four of the "Chesapeake's" crew. This action aroused intense anger throughout the country, and but for the impotence of the government would undoubtedly have led to immediate war. The American government in 1810 published the cases of such impressments since 1803 as numbering over 4000, about one-third of the cases resulting in the discharge of the impressed man; but no one could say how many cases had never been brought to the attention of a government which never did anything more than remonstrate about them.

Orders in Council.

Berlin and Milan Decrees.

140. In May 1806 the British government, by orders in council, declared a blockade of the whole continent of Europe from Brest to the Elbe, about 800 m. In November, after the battle of Jena, Napoleon answered by the "Berlin decree," in which he assumed to blockade the British Isles, thus beginning his "continental system." A year later the British government answered by further orders in council, forbidding American trade with any country from which the British flag was excluded, allowing direct trade from the United States to Sweden only, in American products, and permitting American trade with other parts of Europe only on condition of touching in England and paying duties. Napoleon retorted with the "Milan decree," declaring good prize any vessel which should submit to search by a British ship; but this was evidently a vain fulmination.

The Navy.

141. The Democratic party of the United States was almost exclusively agricultural and had little knowledge of or sympathy with commercial interests; it was pledged to the reduction of national expenses and the debt, and did not wish to take up the responsibility for a navy; and, as the section of country most affected by the orders in council, New England, was Federalist, and made up of the active and irreconcilable opposition, a tinge of political feeling could not but colour the decisions of the dominant party. Various ridiculous proposals were considered as substitutes for a necessarily naval war; and perhaps the most ridiculous was adopted. Since the use of non-intercourse agreements as revolutionary weapons against Great Britain, an overweening confidence in such measures had sprung up, and one of them was now resorted to—the embargo of the 22nd of December 1807, forbidding foreign commerce altogether. It was expected to starve Great Britain into a change of policy; and its effects may be seen by comparing the $20,000,000 exports of 1790, $49,000,000 of 1807 and $9,000,000 of 1808. It does not seem to have struck those who passed the measure that the agricultural districts also might find the change unpleasant; but that was the result, and their complaints reinforced those of New England, and closed Jefferson's second term in a cloud of recognized misfortune. The pressure had been slightly relieved by the substitution of the Non-Intercourse Law of the 1st of March 1809 for the embargo; it prohibited commercial intercourse with Great Britain and France and their dependencies, leaving other foreign commerce open, prohibited the importation from any quarter of British and French goods, and forbade the entrance of British or French vessels, public or private, into any port of the United States. Madison, Jefferson's secretary of state, who succeeded Jefferson in 1809, having defeated the Federalist candidate C. C. Pinckney in the election of 1808, assumed in the presidency a burden which was not enviable. New England was in a ferment, and was suspected of designs to resist the restrictive system by force; and the administration did not face the future with confidence.

The Embargo.

Non-intercourse Law.

Election of 1808.

142. The Non-Intercourse Law was to be in force only "until the end of the next session of Congress" and was to be abandoned as to either belligerent which should abandon its attacks on neutral commerce, and maintained against the other. In 1810 the American government was led to believe that France had abandoned its system. Napoleon continued to enforce it in fact; but his official fiction served its purpose of limiting the non-intercourse for the future to Great Britain, and thus straining relations between that country and the United States still further. The elections of 1811-1812 resulted everywhere in the defeat of "submission men" and in the choice of new members who were determined to resort to war against Great Britain. Henry Clay, John C. Calhoun, William H. Crawford and other new men seized the lead in the two houses of Congress, and forced Madison, it is said, to agree to a declaration of war as a condition of his renomination in 1812 when he defeated De Witt Clinton by an electoral vote of 128 to 89. (See MADISON.) Madison sent to Congress a confidential "war message" on the 1st of June and on the 18th war was declared. The New England Federalists always called it "Mr Madison's war," but the president was about the most unwilling participant in it.

Election of 1812.

War with England.

143. The national democracy meant to attack Great Britain in Canada, partly to gratify its western constituency, who had been harassed by Indian attacks, asserted to have been instigated from Canada. Premonitions of success were drawn from the battle of Tippecanoe, in which William Henry Harrison had defeated in 1811 the north-western league of Indians formed by Tecumseh (*q.v.*). Between the solidly settled Atlantic states and the Canadian frontier was a wide stretch of unsettled or thinly settled country, which was itself a formidable obstacle to war. Ohio had been admitted as a state in 1802, and Louisiana was admitted in 1812; but their admission had been due to the desire to grant them self-government rather than to their full development in population and resources. Cincinnati was a little settlement of 2500 inhabitants; the fringe of settled country ran not very far north of it; and all beyond was a wilderness of which little was known to the authorities. The case was much the same with western New York; the army which was to cross the Niagara river must journey almost all the way from Albany through a very thinly peopled country. It would have been far less costly, as events proved, to have entered at once upon a naval war; but the crusade against Canada had been proclaimed all through Kentucky and the West, and their people were determined to wipe out their old scores before the conclusion of the war. (For the military and naval events of the war see AMERICAN WAR OF 1812.)

Tippecanoe.

Theatre of the War.

144. The war opened with disaster—General William Hull's surrender of Detroit; and disaster attended it for two years. Political appointments to positions in the regular army were

Disaster by Land. **Chippewa and Lundy's Lane.** **Washington Burnt.**

numerous, and such officers were worse than useless. The war department showed no great knowledge, and poverty put its little knowledge out of service. Futile attempts at invasion were followed by defeat or abortion, until the political officers were weeded out at the end of the year 1813, and Jacob Brown, Winfield Scott, E. W. Ripley and others who had fought their way up were put in command. Then for the first time the men were drilled and brought into effective condition; and two successful battles in 1814—Chippewa and Lundy's Lane—threw some glory on the end of the war. So weak were the preparations even for defence that a British expedition in 1814 met no effective resistance when it landed and burned Washington. For some of the disasters the responsibility rested as much, or more, upon the war department as upon the officers and soldiers in the field.

State of the Navy.

145. The American navy was but a puny adversary for the British navy, which had captured or shut up in port all the other navies of Europe. But the small number of American vessels, with the superabundance of trained officers, gave them one great advantage: the training and discipline of the men, and the equipment of the vessels, had been brought to the very highest point. Captains who could command a vessel but for a short time, yielding her then to another officer who was to take his sea service in rotation, were all ambitious to make their mark during their term. "The art of handling and fighting the old broadside sailing frigate" had been carried in the little American navy to a point which unvarying success and a tendency to fleet-combats had now made far less common among British captains. Altogether the American vessels gave a remarkably good account of themselves.

Feeling in New England. **Hartford Convention.**

146. The home dislike to the war had increased steadily with the evidence of incompetent management by the administration. The Federalists, who had always desired a navy, pointed to the naval successes as the best proof of folly with which the war had been undertaken and managed. New England Federalists complained that the Federal government utterly neglected the defence of their coast, and that Southern influence was far too strong in national affairs. They showed at every opportunity a disposition to adopt the furthest stretch of state sovereignty, as stated in the Kentucky Resolutions; and every such development urged the national democracy unconsciously further on the road to nationality. When the New England states sent delegates to meet at Hartford, Conn. (*q.v.*), and consider their grievances and the best remedies—a step perfectly proper on the Democratic theory of a "voluntary Union"—treason was suspected, and a readiness to suppress it by force was plainly shown. The recommendations of the convention came to nothing; but the attitude of the dominant party towards it is one of the symptoms of the manner in which the trials of actual war were steadily reconciling democracy and nationality. The object which Hamilton had sought by high tariffs and the development of national classes had been attained by more natural and healthy means.

Peace.

147. In April 1814 the first abdication of Napoleon took place, and Great Britain was able to give more attention to her American antagonist. The main attack was to be made on Louisiana, the weakest and most distant portion of the Union. A fleet and army were sent thither, but the British assault was completely repulsed (Jan. 8, 1815) by the Americans under Andrew Jackson. Peace had been made at Ghent fifteen days before the battle was fought, but the news of the battle and the peace reached Washington almost together, the former going far to make the latter tolerable.

148. The United States really secured a fairly good treaty. It is true that it said not a word about the questions of impressment, search and neutral rights, the grounds of the war; Great Britain did not abandon her position on any of them. But everybody knew that circumstances had changed. The new naval power whose frigates alone in the past twenty years had shown their ability to fight English frigates on equal terms was not likely to be troubled in future with the question of impressment; and in fact, while not renouncing the right, the British government no longer attempted to enforce it. The navy, it must be confessed, was the force which had at last given the United States a recognized and cordial acceptance in the family of nations; it had solved the problem of the reconciliation of democracy and nationality.

Extinction of the Federalist Party.

149. The remainder of this period is one of the barrenest in American history. The opposition of the Federalist party to the war completed the measure of its unpopularity, and it had only a perfunctory existence for a few years longer. Scandal, intrigue and personal criticism became the most marked characteristics of American politics until the dominant party broke at the end of the period, and real party conflict was renewed. But the seeds of the final disruption are visible from the peace of 1814. The old-fashioned Republicans looked with intense suspicion on the new form of Republicanism generated by the war, a type which instinctively bent its energies toward the further development of national power. Clay was the natural leader of the new Democracy; but John Quincy Adams and others of Federalist antecedents or leanings took to the new doctrines kindly; and even Calhoun, Crawford and others of the Southern interest were at first strongly inclined to support them. One of the first effects was the revival of protection and of a national bank.

Bank of the United States.

150. The charter of the national bank had expired in 1811, and the dominant party had refused to recharter it. The attempt to carry on the war by loans resulted in almost a bankruptcy and in a complete inability to act efficiently. As soon as peace gave time for consideration, a second bank was chartered (April 10, 1816) for twenty years, with a capital of $35,000,000, one-fifth of which was to be subscribed for by the national government. It was to have the custody of the government revenues, but the secretary of the treasury could divert the revenues to other custodians, giving his reasons for such action to Congress.

Protection. **Manufactures.**

151. Protection was advocated again on national grounds, but not quite on those which had moved Hamilton. The additional receipts were now to be expended for fortifications and other national defences, and for national roads and canals, the latter to be considered solely as military measures, with an incidental benefit to the people. Business distress among the people gave additional force to the proposal. The war and blockade had been an active form of protection, under which American manufactures had sprung up in great abundance. As soon as peace was made English manufacturers drove their American rivals out of business or reduced them to desperate straits. Their cries for relief had a double effect. They gave the spur to the nationalizing advocates of protection, and, as most of the manufacturers were in New England or New York, they developed in the citadel of Federalism a class which looked for help to a Republican Congress, and was therefore bound to oppose the Federalist party. This was the main force which brought New England into the Republican fold before 1825. An increase in the number of spindles from 80,000 in 1811 to 500,000 in 1815, and in cotton consumption from 500 bales in 1800 to 90,000 in 1815, the rise of manufacturing towns, and the rapid development of the mechanical tendencies of a people who had been hitherto almost exclusively agricultural, were influences which were to be reckoned with in the politics of a democratic country.

Tariff of 1816.

152. The tariff of 1816 imposed a duty of about 25% on imports of cotton and woollen goods, and specific duties on iron imports, except pig-iron, on which there was an *ad valorem* duty of 20%. In 1818 this duty also was made specific (50 cents a cwt.). The *ad valorem* duties carried most of the manufacturers through the financial crisis of 1818–1819, but the iron duties were less satisfactory. In English manufacture the substitution of coke for charcoal in iron production led to continual decrease in price. As the price went down the specific duties were continually increasing the absolute amount of protection. Thus spared the necessity for improvements

in production, the American manufacturers felt English competition more keenly as the years went by, and called for more protection.

"Era of Good Feeling."

153. James Monroe (*q.v.*) succeeded Madison as president in 1817, and, re-elected with hardly any opposition in 1820, he served until 1825.[1] So complete was the supremacy of the Republican party that this is often called "the era of good feeling." It came to an end when a successor to Monroe was to be elected; the two sections of the dominant party then had their first opportunity for open struggle. During Monroe's two terms of office the nationalizing party developed the policy on which it proposed to manage national affairs. This was largely the product of the continually swelling western movement of population. The influence of the steamboat was felt more and more every year, and the want of a similar improvement in land transport was correspondingly evident. The attention drawn to western New York by the war had filled that part of the state with a new population. The southern Indians had been completely overthrown by Andrew Jackson during the War of 1812, and forced to cede their lands. The admission of the new states of Indiana (1816), Mississippi (1817), Illinois (1818), Alabama (1819), Maine (1820) and Missouri (1821)—all but Maine the product and evidence of western growth—were the immediate results of the development consequent upon the war. All the territory east of the Mississippi, except the northern part of the North-West Territory, was now formed into self-governing states; the state system had crossed the Mississippi; all that was needed for further development was the locomotive engine. The four millions of 1790 had grown into thirteen millions in 1830; and there was a steady increase of one-third in each decade.

Admission of New States.

Erie Canal.

The "American System."

Tariffs of 1824 and 1828.

154. The urgent demand of western settlers for some road to a market led to a variety of schemes to facilitate intercourse between the East and the West—the most successful being that completed in New York in 1825, the Erie Canal. The Hudson river forms the great natural breach in the barrier range which runs parallel to the Atlantic coast. When the traveller has passed up the Hudson through that range he sees before him a vast champaign country extending westward to the Great Lakes, and perfectly adapted by nature for a canal. Such a canal, to turn western traffic into the lake rivers and through the lakes, the canal, and the Hudson to New York City, was begun by the state through the influence of De Witt Clinton, was derisively called "Clinton's big ditch" until its completion, and laid the foundations for the great commercial prosperity of New York state and city. Long before it was finished the evident certainty of its success had seduced other states into far less successful enterprises of the kind and had established as a nationalizing policy the combination of high tariffs and expenditures for internal improvements which was long known as the "American system."[2] The tariffs of duties on imports were to be carried as high as revenue results would justify; within this limit the duties were to be defined for purposes of protection; and the superabundant revenues were to be expended on enterprises which would tend to aid the people in their efforts to subdue the continent. Protection was now to be for national benefit, not for the benefit of classes. Western farmers were to have manufacturing towns at their doors, as markets for the surplus which had hitherto been rotting on their farms; competition among manufacturers was to keep down prices; migration to all the new advantages of the West was to be made easy at national expense; and Henry Clay's eloquence was to commend the whole policy to the people. The old Democracy, particularly in the South, insisted that the whole scheme really had its basis in benefits to classes, that its communistic features were not such as the Constitution meant to cover by its grant of power to Congress to levy taxation for the general welfare, and that any such legislation would be unconstitutional. The dissatisfaction in the South rose higher when the tariffs were increased in 1824 and 1828. The proportion of customs revenue to dutiable imports rose to 37% in 1825 and to 44% in 1829; and the ratio to aggregate imports to 33% in 1825 and 37% in 1829. As yet, Southern dissatisfaction showed itself only in resolutions of state legislatures.

155. In the sudden development of the new nation circumstances had conspired to give social forces an abnormally materialistic cast, and this had strongly influenced the expression of the national life. Its literature and its art had amounted to little, for the American people were still engaged in the fiercest of warfare against natural difficulties, which absorbed all their energies.

The Monroe Doctrine.

156. In international relations the action of the government was strong, quiet and self-respecting. Its first weighty action took place in 1823. It had become pretty evident that the Holy Alliance, in addition to its interventions in Europe to suppress popular risings, meant to aid Spain in bringing her revolted South American colonies to obedience. Great Britain had been drifting steadily away from the alliance, and George Canning, the new secretary, determined to call in the weight of the transatlantic power as a check upon it. A hint to the American minister was followed by a few pregnant passages in Monroe's annual message in December. "We could not view," he said, "any interposition for the purpose of oppressing them [the South American states], or controlling in any other manner their destiny by any European power, in any other light than as the manifestation of an unfriendly disposition towards the United States." If both the United States and Great Britain were to take this ground the fate of a fleet sent by the Alliance across the Atlantic was not in much doubt, and the project was at once given up.

157. It was supposed at the time that Spain might transfer her colonial claims to some stronger power; and Monroe therefore said that "the American continents, by the free and independent condition which they have assumed and maintained, are henceforth not to be considered as subjects for future colonization by any European powers." This declaration and that quoted above constitute together the "Monroe doctrine" as originally proclaimed. The doctrine has remained the rule of foreign intercourse for all American parties. Added to the already established refusal of the United States to become entangled in any European wars or alliances, it has separated Europe and America to their common advantage. (See MONROE DOCTRINE.)

The North-west Boundary.

158. By a treaty with Russia (1825) that power gave up all claims on the Pacific coast south of the present limits of Alaska. The northern boundary of the United States had been defined by the treaty of 1783; and, after the acquisition of Louisiana, a convention with Great Britain (1818) settled the boundary on the line of 49° N. lat. as far west as the Rocky Mountains. West of these mountains the so-called Oregon country, on whose limits the two powers could not agree, was to be held in common possession for ten years. This common possession was prolonged by another convention (1827) indefinitely, with the privilege to either power to terminate it, on giving twelve months' notice. This arrangement lasted until 1846 (see OREGON: *History*).

159. Monroe's term of office came to an end in March 1825. He had originally been an extreme Democrat, who could hardly speak of Washington with patience; he had slowly modified his views, and his tendencies were now eagerly claimed by

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[1] In 1816 Monroe received 183 electoral votes and his opponent, Rufus King, 34; in 1820 Monroe received 231 and his opponent, John Quincy Adams, 1.

[2] For a generation the making of "internal improvements" by the Federal government was an issue of great political importance. In 1806 Congress made an appropriation for the National or Cumberland Road, eventually constructed from Fort Cumberland, Md., to Vandalia, Ill. The policy of making such improvements was opposed on the ground that the Constitution gave to the Federal government no power to make them, that it was not an "enumerated power," and that such improvements were not a "necessary and proper" means of carrying out any of the enumerated powers. Others argued that the Federal government might constitutionally make such improvements, but could not exercise jurisdiction over them when made.

Election of 1824.

the few remaining Federalists as identical with their own. The nationalizing faction of the dominant party had scored almost all the successes of the administration, and the divergence between it and the opposing faction was steadily becoming more apparent. All the candidates for the presidency in 1824—Andrew Jackson, a private citizen of Tennessee; William H. Crawford, Monroe's secretary of the treasury; John Quincy Adams, his secretary of state; and Henry Clay, the speaker of the House of Representatives—claimed to be Republicans alike; but the personal nature of the struggle was shown by the tendency of their supporters to call themselves "Adams men" or "Jackson men," rather than by any real party title. Calhoun was supported by all groups for the vice-presidency, and was elected without difficulty. The choice of a president was more doubtful.

Party Divergence.

160. None of the four candidates had anything like a party organization behind him. Adams and Clay represented the nationalizing element, as Crawford and Jackson did not; but there the likeness among them stopped. The strongest forces behind Adams were the new manufacturing and commercial interests of the East; behind Clay were the desires of the West for internal improvements at Federal expense as a set-off to the benefits which the seaboard states had already received from the government; and the two elements were soon to be united into the National Republican or Whig party (*q.v.*). Crawford was the representative of the old Democratic party, with all its Southern influences and leanings. Jackson was the personification of the new democracy—not very cultured, perhaps, but honest, and hating every shade of class control instinctively. As he became better known the whole force of the new drift of things turned in his direction. Crawford was taken out of the race, just after the electors had cast their votes, by physical failure, and Adams, later, by the revival of ancient quarrels with the Federalists of New England; and the future was to be with Clay or with Jackson. But in 1824 the electors gave no one a majority; and the House of Representatives, voting by states, gave the presidency to Adams.

The Adams Administration 1825-29.

161. Adams's election in 1825 was due to the fact that Clay's friends in the House—unable to vote for him, as he was the lowest in the electoral vote, and only three names were open to choice in the House—very naturally gave their votes to Adams. As Adams appointed Clay to the leading position in his cabinet, the defeated party at once raised the cry of "bargain and intrigue," one of the most effective in a democracy, and it was kept up throughout Adams's four years of office. Jackson had received the largest number of electoral votes, though not a majority,[1] and the hazy notion that he had been injured because of his devotion to the people increased his popularity. Though demagogues made use of it for selfish purposes, this feeling was an honest one, and Adams had nothing to oppose to it. He tried vigorously to uphold the "American system," and succeeded in passing the tariff of 1828; he tried to maintain the influence of the United States on both the American continents; but he remained as unpopular as his rival grew popular. In 1828 Adams was easily displaced by Jackson, the electoral vote being 178 to 83. Calhoun was re-elected vice-president.

Election of 1828. Democracy and Nationality.

162. Jackson's inauguration in 1829 closes this period, as it ends the time during which a disruption of the Union by the peaceable withdrawal of any state was even possible. The party which had made state sovereignty its bulwark in 1798 was now in control of the government again; but Jackson's proclamation in his first term, in which he warned South Carolina that "disunion by armed force is treason," and that blood must flow if the laws were resisted, speaks a very different tone from the speculations of Jefferson on possible future divisions of the United States. And even the sudden attempt of South Carolina to exercise independent action (§§ 172-173) shows that some interest dependent upon state sovereignty had taken alarm at the drift of events, and was anxious to lodge a claim to the right before it should slip from its fingers for ever. Nullification was only the first skirmish between the two hostile forces of slavery and democracy.

Slavery.

163. When the vast territory of Louisiana was acquired in 1803 the new owner found slavery already established there by custom recognized by French and Spanish law. Congress tacitly ratified existing law by taking no action; slavery continued legal, and spread further through the territory; and the state of Louisiana entered as a slave state in 1812. The next state to be carved out of the territory was Missouri, admitted in 1821. A Territory, on applying for admission as a state, brings a constitution for inspection by Congress; and when it was found that the new state of Missouri proposed to recognize and continue slavery, a vigorous opposition spread through the North and West, and carried most of the senators and representatives from those sections with it. In the House of Representatives these two sections had a greatly superior number of members; but, as the number of Northern and Southern states had been kept about equal, the compact Southern vote, with one or two Northern allies, generally retained control of the Senate. Admitted by the Senate and rejected by the House, Missouri's application hung suspended for two years until it was successful by the admission of Maine, a balancing Northern state,[2] and by the following arrangement, known as the Missouri Compromise of 1820: Missouri was to enter as a slave state; slavery was for ever prohibited throughout the rest of the Louisiana Purchase north of lat. 36° 30′, the main southern boundary of Missouri; and, though nothing was said of the territory south of the compromise line, it was understood that any state formed out of it was to be a slave state, if it so wished (see MISSOURI COMPROMISE and MISSOURI, § *History*). Arkansas entered under this provision in 1836.

The Missouri Compromise.

Sectional Divergence.

164. The question of slavery was thus set at rest for the present, though a few agitators were roused to more zealous opposition to the essence of slavery itself. In the next decade these agitators succeeded only in the conversion of a few recruits, but these recruits were the ones who took up the work at the opening of the next period and never gave it up until slavery was ended. It is plain now, however, that North and South had already drifted so far apart as to form two sections, and it became evident during the next forty years that the wants and desires of these two sections were so divergent that it was impossible for one government to make satisfactory laws for both. The chief cause was not removed in 1820, though one of its effects was got out of the way for the time.

The Settled Area.

165. The vast flood of human beings which had been pouring westward for years had now pretty well occupied the territory east of the Mississippi, while, on the west side of that stream, it still showed a disposition to hold to the river valleys. The settled area had increased from 240,000 sq. m. in 1790 to 633,000 sq. m. in 1830, with an average of 20·3 persons to the square mile. There was still a great deal of Indian territory in the Southern states of Georgia, Alabama, Mississippi, and Florida, for the Southern Indians were among the finest of their race; they had become semi-civilized, and were formidable antagonists to the encroaching white race. The states interested had begun preparations for their forcible removal, in public defiance (see GEORGIA: *History*) of the attempts of the Federal government to protect the Indians (1827); but the removal was not completed until 1835. In the North, Wisconsin and Michigan, with the northern halves of Illinois and Indiana, were still very thinly settled, but everything indicated early increase of population. The first lake steamboat, the "Walk-in-the-Water," had appeared at Detroit in 1818, and the opening of the Erie Canal in 1825 added to the number

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[1] Jackson received 99, Adams 84, Crawford 41, and Clay 37; in the House of Representatives Adams received the votes of 13 states, Jackson of 7, and Crawford of 4. For vice-president Calhoun received 182 electoral votes, and his principal competitors, Nathan Sanford, of New York, and Nathaniel Macon, of North Carolina, received 30 and 24 respectively.

[2] A prompt admission of Missouri would have balanced the slave and free states, but Alabama's admission as a slave state balanced them in 1819.

The Steamboat.

of such vessels. Lake Erie had seven in 1826; and in 1830, while the only important lake town, Detroit, was hardly yet more than a frontier fort, a daily line of steamers was running to it from Buffalo, carrying the increasing stream of emigrants to the western territory.

The Land System.

166. The land system of the United States had much to do with the early development of the West. From the first settlement, the universally recognized rule had been that of absolute individual property in land, with its corollary of unrestricted competitive or "rack" rents; and this rule was accepted fully in the national land system, whose basis was reported by Jefferson, as chairman of a committee of the Confederation Congress (1785). The public lands were to be divided into "hundreds" each ten miles square and containing one hundred mile-square plots. The hundred was called a "township," and was afterwards reduced to six miles square, of thirty-six mile-square plots of 640 acres each. From time to time principal meridians and east and west base lines have been run, and townships have been determined by their relations to these lines. The sections (plots) have been subdivided, but the transfer describes each parcel from the survey map, as in the case of "the south-west quarter of section 20, township 30, north, range 1 east of the third principal meridian." The price fixed in 1790 as a minimum was $2 per acre; it has tended to decrease, and no effort has ever been made to gain a revenue from it. When the nation acquired its western territory it secured its title to the soil, and always made it a fundamental condition of the admission of a new state that it should not tax United States lands. To compensate the new states for the freedom of unsold public lands from taxation, one township in each thirty-six was reserved to them for educational purposes; and the excellent public school systems of the Western states have been founded on this provision. The cost of obtaining a quarter section (160 acres), under the still later homestead system of granting lands to actual settlers, has come to be only about $26; the interest on this, at 6%, represents an annual rent of one cent per acre—making this, says F. A. Walker, as nearly as possible the "no-rent land" of the economists.

167. The bulk of the early westward migration was of home production; the great immigration from Europe did not begin until about 1847. The West as well as the East thus had its institutions fixed before being called upon to absorb an enormous foreign element.

I.—*Industrial Development and Sectional Divergence, 1829–1850.*

New Political Methods.

168. The eight years 1829–1837 have been called "the reign of Andrew Jackson"; his popularity, his long struggle for the presidency, and his feeling of his official ownership of the subordinate offices gave to his administration at least an appearance of Caesarism. But it was a strictly constitutional Caesarism; the restraints of written law were never violated, though the methods adopted within the law were new to national politics. Since about 1800 state politics in New York and Pennsylvania had been noted for the systematic use of the offices and for the merciless manner in which the office-holder was compelled to work for the party which kept him in place. The presence of New York and Pennsylvania politicians in Jackson's cabinet taught him to use the same system. Removals, except for cause, had been relatively rare before; but under Jackson men were removed almost exclusively for the purpose of installing some more serviceable party tool; and a clean sweep was made in the civil service. Other parties adopted the system, and it remained the rule at a change of administration until comparatively recent years.

The New Organization of Parties.

169. The system brought with it a semi-military reorganization of parties. Hitherto nominations for the more important offices had been made mainly by legislative caucuses; candidates for president and vice-president were nominated by caucuses of congressmen, and candidates for the higher state offices by caucuses of the state legislatures. Late in the preceding period "conventions" of delegates from the members of the party in the state were held in New York and Pennsylvania; and in 1831–1832 this became the rule for presidential nominations. It rapidly developed into systematic state, county, and city "conventions"; and the result was the appearance of that complete political machinery, the American political party, with its local organizations, and its delegates to county, state and national conventions. The Democratic machinery was the first to appear, in Jackson's second term (1833–1837). Its workers were paid in offices, or hopes of office, so that it was said to be built on the "cohesive power of public plunder"; but its success was immediate and brilliant. The opposing party, the Whig party (*q.v.*), had no chance of victory in 1836; and its complete overthrow drove its leaders into the organization of a similar machinery of their own, which scored its first success in 1840. Since that time these strange bodies, unknown to the law, have governed the country by turns; and their enormous growth has steadily made the organization of a third piece of such machinery more difficult or hopeless.

Bank of the United States.

The Whig Party.

Removal of the Deposits.

170. The Bank of the United States had hardly been heard of in politics until the new Democratic organization came into hostile contact with it. A semi-official demand upon it for a political appointment was met by a refusal; and the party managers called Jackson's attention to an institution which he could not but dislike the more he considered it. His first message spoke of it in unfriendly terms, and every succeeding message brought a more open attack. The old party of Adams and Clay had by this time taken the name of Whigs, probably from the notion that they were struggling against "the reign of Andrew Jackson," and they adopted the cause of the bank with eagerness. The bank charter did not expire until 1836, but in 1832 Clay brought up a bill for a new charter. It was passed and vetoed; and the Whigs made the veto an important issue of the presidential election of that year. They were beaten; Jackson was re-elected, receiving 219 electoral votes, and Clay, his Whig opponent, only 49, and the bank party could never again get a majority in the House of Representatives for the charter. The insistence of the president on the point that the charter was a "monopoly" bore weight with the people. But the president could not obtain a majority in the Senate. He determined to take a step which would give him an initiative, and which his opponents could not induce both houses to unite in overriding or punishing. Taking advantage of the provision that the secretary of the treasury might order the public funds to be deposited elsewhere than in the bank or its branches, he directed the secretary to deposit *all* the public funds elsewhere. Thus deprived of its great source of dividends, the bank fell into difficulties, became a state bank after 1836, and then went into bankruptcy. (See BANKS AND BANKING: *United States*; and JACKSON, ANDREW.)

Opposition to the "American System."

171. All the political conflicts of Jackson's terms of office were close and bitter. Loose in his ideas before 1829, Jackson showed a steady tendency to adopt the strictest construction of the powers of the Federal government, except in such official perquisites as the offices. He grew into strong opposition to all traces of the "American system," and vetoed bills for internal improvements unsparingly; and his feeling of dislike to all forms of protection is as evident, though he took more care not to make it too public. There are many reasons for believing that his drift was the work of a strong school of leaders—Martin Van Buren, Thomas H. Benton, Edward Livingston, Roger B. Taney, Levi Woodbury, Lewis Cass, W. L. Marcy and others—who developed the policy of the party, and controlled it until the great changes of parties about 1850 took their power from them. At all events, some persistent influence made the Democratic party of 1830–1850 the most consistent and successful party which had thus far appeared in the United States.

Calhoun and Jackson.

172. Calhoun (*q.v.*) and Jackson were of the same stock—Scottish-Irish—much alike in appearance and characteristics, the former representing the trained and educated logic of the race, the latter its instincts and passions. Jackson was led to break off his friendly relations with

Calhoun in 1830, and he had been led to do so more easily because of the appearance of the doctrine of nullification (*q.v.*), which was generally attributed, correctly enough, to the authorship of Calhoun. Asserting, as the Republican party of 1798 had done, the sovereign powers of each state, Calhoun held that, as a means of avoiding secession and violent struggle upon every occasion of the passage of an act of Congress which should seem unconstitutional to any state, the state might properly suspend or "nullify" the operation of the law within its jurisdiction, in order to protect its citizens against oppression. The passage of the Tariff Act of 1832, which organized and systematized the protective system, forced the Calhoun party into action. A state convention in South Carolina (*q.v.*) on the 24th of November 1832 declared the Tariff Act null, and made ready to enforce the declaration.

Nullification.

173. But the time was past when the power of a single state could withdraw it from the Union. The president issued a proclamation, warning the people of South Carolina against any attempt to carry out the ordinance of nullification; he ordered a naval force to take possession of Charleston harbour to collect the duties under the act; he called upon Congress for additional executive powers, and Congress passed what nullifiers called the "bloody bill," putting the land and naval forces at the disposal of the president for the collection of duties against "unlawful combinations"; and he is said to have announced, privately and profanely, his intention of making Calhoun the first victim of any open conflict. Affairs looked so threatening that an unofficial meeting of "leading nullifiers" agreed to suspend the operation of the ordinance until Congress should adjourn; whence it derived the right to suspend has never been stated.

Tariff of 1833.

174. The president had already asked Congress to reduce the duties; and many Democratic members of Congress, who had yielded to the popular clamour for protection, were very glad to use "the crisis" as an excuse for now voting against it. A compromise Tariff Act, scaling down all duties over 20% by one-tenth of the excess every two years until 1842, when the remaining excess over 20% should be dropped, was introduced by Clay and became law. Calhoun and his followers claimed this as all that the nullification ordinance had aimed at; and the ordinance was formally repealed. But nullification had received its death-blow; even those Southern leaders who maintained the right of secession refused to recognize the right of a state to remain in the Union while nullifying its laws; and, when protection was reintroduced by the tariff of 1842, nullification was hardly thought of.

The Locomotive.

175. All the internal conditions of the United States were completely altered by the introduction of railways. For twenty years past the Americans had been pushing in every direction which offered a hope of the means of reconciling vast territory with enormous population. Stephenson's invention of the locomotive came just in time, and Jackson's two terms of office marked the outburst of modern American life. The miles of railway were 23 in 1830, 1098 in 1835, some 2800 in 1840, and thereafter they about doubled every five years until 1860.

Railways of 1840.

Anthracite.

Iron.

176. A railway map of 1840 shows a fragmentary system, designed mainly to fill the gaps left by the means of communication in use in 1830. One or two short lines run back into the country from Savannah and Charleston; another runs north along the coast from Wilmington to Baltimore; several lines connect New York with Washington and other points; and short lines elsewhere mark the openings which needed to be filled at once—a number in New England and the Middle states, three in Ohio and Michigan, and three in Louisiana. Year after year new inventions came in to increase and aid this development. The anthracite coal of the Middle states had been known since 1790, but no means had been devised to put the refractory agent to work. It was now successfully applied to railways (1836), and to the manufacture of iron (1837). Hitherto wood had been the best fuel for iron-making; now the states which relied on wood were driven out of competition, and production was restricted to the states in which nature had placed coal alongside of iron. Steam navigation across the Atlantic was established in 1838. The telegraph came next, S. F. B. Morse's line being erected in 1844. The spread of the railway system brought with it, as a natural development, the rise of the American system of express companies, whose first phases of individual enterprise appeared in 1839. No similar period in American history is so extraordinary for material development as the decade 1830–1840. At its beginning the country was an overgrown type of colonial life; at its end American life had been shifted to entirely new lines, which it has since followed. Modern American history had burst in with the explosiveness of an Arctic summer.

Ocean Navigation. The Telegraph.

Western Settlement.

Admission of Arkansas and Michigan.

177. The steamboat had aided Western development, but the railway aided it far more. Cities and states grew as if the oxygen of their surroundings had been suddenly increased. The steamboat influenced the railway, and the railway gave the steamboat new powers. Vacant places in the states east of the Mississippi were filling up; the long lines of emigrant waggons gave way to the new and better methods of transport; and new grades of land were made accessible. Chicago was but a frontier fort in 1832; within a half-dozen years it was a flourishing town, with eight steamers connecting it with Buffalo, and dawning ideas of its future development of railway connexions. The maps change from decade to decade, as mapmakers hasten to insert new cities which have sprung up. Two new states, Arkansas and Michigan, were admitted (1836 and 1837). The population of Ohio grew from 900,000 to 1,500,000, that of Michigan from 32,000 to 212,000, and that of the country from 13,000,000 to 17,000,000, between 1830 and 1840.

Social Conditions.

178. With the change of material surroundings and possibilities came a steady amelioration of social conditions and a development of social ideals. Such features of the past as imprisonment for debt and the cruel indifference of old methods of dealing with crime began to disappear; the time was past when a state could use an abandoned copper mine as its state prison, as Connecticut had formerly done (see SIMSBURY, Connecticut). The domestic use of gas and anthracite coal, the introduction of expensive aqueducts for pure water, and the changing life of the people forced changes in the interior and exterior of American dwellings. Wood was still the common building material; imitations of Greek architecture still retained their vogue; but the interiors were models of comfort in comparison with the houses even of 1810. In the "new" regions this was not yet the case, and here social restraints were still so few that society seemed to be reduced almost to its primitive elements. Western steamers reeked with gambling, swindling, duelling and every variety of vice. Public law was almost suspended in some regions; and organized associations of counterfeiters and horse-thieves terrorized whole sections of country. But this state of affairs was altogether temporary, as well as limited in its area; the older and more densely settled states had been well prepared for the change and had never lost command of the social forces, and the process of settling down went on, even in the newer states, with far more rapidity than could reasonably have been expected. Those who took part in the movements of population in 1830–1840 had been trained under the rigid forms of the previous American life; and these soon re-asserted themselves. The rebound was over before 1847, and the Western states were then as well prepared to receive and digest the great immigration which followed as the older states would have been in 1830.

Literature.

179. A distinct American literature dates from this period. Most of the publications in the United States were still cheap reprints of foreign works; but native productions no longer followed foreign models with servility. Between 1830 and 1840 Whittier, Longfellow, Holmes, Poe, Hawthorne, Emerson, Bancroft and Prescott joined the advance-guard of American writers—Bryant, Dana, Halleck, Drake,

Irving and Cooper; and even those writers who had already made their place in literature showed the influence of new conditions by their growing tendency to look less to foreign models and methods. (See AMERICAN LITERATURE.) Popular education was improved. The new states had from the first endeavoured to secure the best possible system of common schools. The attempt came naturally from the political instincts of the class from which the migration came; but the system which resulted was to be of incalculable service during the years to come. Their absolute democracy and their universal use of the English language have made the common schools most successful machines for converting the raw material of immigration into American citizens. This supreme benefit is the basis of the system and the reason for its existence and development, but its incidental advantage of educating the people has been beyond calculation. It was an odd symptom of the general change that American newspapers took a new form during these ten years. The old "blanket-sheet" newspaper, cumbrous to handle and slow in all its ways, met its first rival in the type of newspaper which appeared first in New York City, in the *Sun*, the *Herald* and the *Tribune* (1833, 1835 and 1841). Swift and energetic in gathering news, and fearless, sometimes reckless, in stating it, they brought into American life, with very much that is evil, a great preponderance of good.

Common School System.

Newspapers.

Land Sales.

Speculation.

180. The chaos into which a part of American society had been thrown had a marked effect on the financial institutions of the country, which went to pieces before it for a time. It had not been meant to make the public lands of the United States a source of revenue so much as a source of development. The sales had touched their high-water mark during the speculative year 1819, when receipts from them had amounted to $3,274,000; in other years they seldom went above $2,000,000. When the railway set the stream of migration moving faster than ever, and cities began to grow like mushrooms, it was natural that speculation in land should feel the effects. Sales rose to $3,200,000 in 1831, to $4,000,000 in 1833, to $5,000,000 in 1834, to $15,000,000 in 1835, and to $25,000,000 in 1836. In 1835 the president announced to Congress that the public debt was extinguished, and that some way of dealing with the surplus should be found. Calhoun's proposal, that after the year 1836 any surplus in excess of $5,000,000 should be divided among the states as a loan, was adopted, as regards the surplus (almost $37,000,000) of that year; and some $28,000,000—still carried on the books of the treasury as unavailable funds—were actually distributed before the crisis of 1837 put an end to the surplus and to the policy. The states had already taken a hand in the general speculation by beginning works of public improvement. Foreign, particularly English, capital was abundant; and states which had been accustomed to think a dozen times over a tax of a hundred thousand dollars now began to negotiate loans of millions of dollars and to appropriate the proceeds to the digging of canals and the construction of railways. Their enterprises were badly conceived and badly managed, and only added to the confusion when the crash came. If the Federal government and the states felt that they were rich, the imaginations of individuals ran riot. Every one wanted to buy; prices rose, and every one was growing richer on paper. The assessed value of real estate in New York City in 1832 was $104,000,000; in 1836 it had grown to $253,000,000. In Mobile the assessed value rose from $1,000,000 to $27,000,000. Fictitious values were the rule.

181. When Jackson in 1833 ordered the government revenues to be deposited elsewhere than in the Bank of the United States, there was no government agent to receive them. The secretary of the treasury selected banks at various points in which the revenue should be deposited by the collecting officers; but these banks were organized under charters from their states, as were all banks except that of the United States. The theory of the dominant party denied the constitutional power of Congress to charter a bank, and the states had not yet learned how to deal with such institutions. Their grants of bank charters had been based on ignorance, intrigue, favouritism or corruption, and the banks were utterly unregulated. The Democratic feeling was that the privilege of forming banking corporations should be open to all citizens, and it soon became so. Moreover, it was not until after the crash that New York began the system of compelling such deposits as would really secure circulation, which was long afterward further developed into the present national bank system. In most of the states banks could be freely organized with or without tangible capital, and their notes could be sent to the West for the purchase of government lands, which needed to be held but a month or two to gain a handsome profit. (See BANKS AND BANKING: *United States*.) "Wild-cat banks" sprang up all over the country; and the "pet banks," as those chosen for the deposit of government revenues were called, went into speculation as eagerly as the banks which hardly pretended to have capital.

Corporations.

The "Specie Circular."

Panic of 1837.

Repudiation.

182. The Democratic theory denied the power of Congress to make anything but gold or silver coin legal tender. There have been "paper-money heresies" in the party; but there was none such among the new school of Democratic leaders which came in in 1829; they were "hard-money men." In July 1836 Jackson's secretary of the treasury ordered land agents to take nothing in payment for lands except gold or silver. In the following spring the full effects of the order became evident; they fell on the administration of Van Buren, Jackson's successor.[1] Van Buren had been Jackson's secretary of state, the representative man of the new Democratic school, and, in the opinion of the opposition, the evil genius of the Jackson administration; and it seemed to the Whigs poetic justice that he should bear the weight of his predecessor's errors. The "specie circular" turned the tide of paper back to the East, and when it was presented for payment most of the banks suspended specie payment with hardly a struggle. There was no longer a thought of buying; every one wanted to sell; and prices ran down with a rapidity even more startling than that with which they had risen. Failures, to an extent and on a scale unprecedented in the United States, made up the "panic of 1837." Many of the states had left their bonds in the hands of their agents, and, on the failure of the latter, found that the bonds had been hypothecated or disposed of, so that the states got no return from them except a debt which was to them enormous. Saddled suddenly with such a burden, and unable even to pay interest, some of the states "repudiated" their obligations; and repudiation was made successful by the fact that a state could not be sued by its creditors except by its own consent. Even the Federal government felt the strain, for its revenues were locked up in suspended banks. A little more than a year after Congress had authorized the distribution of its surplus revenues among the states Van Buren was forced to call it into special session to provide some relief for the government itself.

Sub-treasury Scheme.

183. Van Buren held manfully to the strictest construction of the powers of the Federal government. He insisted that the panic would best right itself without government interference, and, after a four years' struggle, he succeeded in making the "sub-treasury scheme" law (1840). It cut off all connexion of the government with banks, putting collecting and disbursing officers under bonds to hold money safely and to transfer it under orders from the treasury, and restricting payments to or by the United States to gold and silver coin. Its passage had been preceded by another commercial crisis (1839), more limited in its field, but more discouraging to the people. It is true that Jackson, in dealing with the finances, had "simply smashed things," leaving his successor to repair damages; but it is far from certain that this was not the best way available at the time. The wisest scheme of financial reform would have had small chance

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[1] In the election of 1836 Van Buren received 170 electoral votes, W. H. Harrison (Whig) 73, Hugh L. White 26, Daniel Webster 14 and W. P. Mangum 11.

of success with the land-jobbers in Congress, and Van Buren's firmness found the way out of the chaos.

Election of 1840.

184. Van Buren's firmness was unpopular, and the Whig party now adopted methods which were popular if somewhat demagogical. It nominated William H. Harrison in 1840; it contrasted his homely frontier virtues with Van Buren's "ostentatious indifference to the misfortunes of the people" and with the supposed luxury of his life in the White House; and, after the first of the modern "campaigns" of mass meetings and processions, Harrison was elected, receiving 234 electoral votes and Van Buren only 60. He died on the 4th of April 1841, only a month after his inauguration, and the vice-president, John Tyler, became president. Tyler was of the extreme Calhoun school, which had shown some disposition to grant to Van Buren a support which it had refused to Jackson; and the Whigs had nominated Tyler to retain his faction with them. Now he was the nominal leader of the party, while his politics were opposite to theirs, and the real leader of the party, Clay, was ready to force a quarrel upon him. The quarrel took place; the Whig majority in Congress was not large enough to pass any measures over Tyler's veto; and the first two years of his administration were passed in barren conflict with his party. The "sub-treasury" law was repealed (1841); the tariff of 1842 introduced a modified protection; and there the Whigs were forced to stop. Their dissensions made Democratic success comparatively easy, and Tyler had the support of a Democratic House behind him during the last two years of his term.

Tariff of 1842.

185. The success of the Democratic machinery, and the reflex of its temporary check in 1840, with the influences brought to bear on it by the returning Calhoun faction, were such as to take the control of the party out of the hands of the leaders who had formed it. They had had high regard for political principle, even though they were willing to use doubtful methods for its propagation; these methods had now brought out new men, who looked mainly to success, and to close connexion with the controlling political element of the South as the easiest means of attaining success. When the Democratic convention of 1844 met it was expected to renominate Van Buren. A majority of the delegates had been sent there for that purpose, but many of them would have been glad to be prevented from doing so. They allowed a resolution to be passed making a two-thirds vote necessary for nomination; Van Buren was unable to command so many votes; and, when his name was withdrawn, James K. Polk was nominated. The Whigs nominated Clay.

Abolitionist Movement.

186. The beginning of the abolitionist movement in the United States, the establishment of the *Liberator* (1831), and of the American Anti-Slavery Society (1833), and the subsequent divisions in it, are dealt with elsewhere (see Garrison, William Lloyd). Up to that time "abolition" had meant *gradual* abolition; it was a wish rather than a purpose. Garrison called for *immediate* abolition. The basis of the American system was in the reserved rights of the states, and slavery rested on their will, which was not likely to be changed. But the cry was kept up. The mission of the Abolitionists was to force the people to think of the question; and, in spite of riots, assaults and persecution of every kind, they fulfilled it manfully. In truth, slavery was more and more out of harmony with the new economic conditions which were taking complete control of the North and West, but had hardly been felt in the South. Thus the two sections, North and South, were more and more disposed to take opposite views of everything in which slavery was involved, and it had a faculty of involving itself in almost everything. The status of slavery in the Territories had been settled in 1820; that of slavery in the states had been settled by the Constitution; but even in minor questions the intrusive element had to be reckoned with. The Abolitionists sent their documents through the mails, and the South wished the Federal government to interfere and stop the practice. The Abolitionists persisted in petitioning Congress for the passage of various measures which Congress regarded as utterly unconstitutional; and the disposition of Congress to deny or regulate the right of petition in such matters (see Adams, John Quincy) excited the indignation of Northern men who had no sympathy with abolition. But the first occasion on which the views of the two sections came into flat contrast was on the question of the annexation of Texas.

Texas.

Oregon.

187. The United States had had a vague claim to Texas until 1819, when the claim was surrendered to Spain in part compensation for Florida. On the revolt of Mexico Texas became a part of that republic. It was colonized by Americans, mainly southerners and slave-holders, seceded from Mexico in 1835, and defeated the Mexican armies and established its independence in the following year. Southern politicians desired its annexation to the United States for many reasons. Its people were kindred to them; its soil would widen the area of slavery; and its territory, it was hoped, could be divided into several states, to reinforce the Southern column in the Senate. People in the North were either indifferent or hostile to the proposal; Van Buren had declared against it, and his action was a reason for his defeat in the Democratic convention. On the other hand, there were indications that the joint occupation of the Oregon country could not last much longer. American immigration into it had begun, while the Hudson's Bay Company, the British tenant of the soil, was the natural enemy of immigration. To carry the sentiment of both sections, the two points were coupled; and the Democratic convention declared for the reannexation of Texas and the reoccupation of Oregon.

Liberty Party.

Election of 1844.

Admission of Texas.

188. One of the cardinal methods of the political Abolitionists was to nominate candidates of their own against a doubtful friend, even though this secured the election of an open enemy. Clay's efforts to guard his condemnation of the Texas annexation project were just enough to push the Liberty party (*q.v.*), the political Abolitionists, into voting for candidates of their own in New York; on a close vote their loss was enough to throw the electoral votes of that state to Polk, and its votes decided the result. Polk was elected (November 1844);[1] and Texas was annexed to the United States in the following spring. At the next meeting of Congress (1845) Texas was admitted as a state.

189. West of Texas the northern prolongation of Mexico ran right athwart the westward movement of American population; and, though the movement had not yet reached the barrier, the Polk administration desired further acquisitions from Mexico. The western boundary of Texas was undefined; a strip of territory claimed by Texas was settled exclusively by Mexicans; but the Polk administration directed General Zachary Taylor, the American commander in Texas, to cross the Nueces river and seize the disputed territory. Collisions with Mexican troops followed; they were beaten in the battles of Palo Alto and Resaca de la Palma, and were chased across the Rio Grande. Taylor followed and took the city of Monterey.

War with Mexico.

Peace.

190. On the news of the first bloodshed Congress declared war against Mexico, over the opposition of the Whigs. A land and naval force took possession of California, and a land expedition occupied New Mexico, so that the authority of Mexico over all the soil north of her present boundaries was abruptly terminated (1846). At the opening of 1847 Taylor fought the last battle in northern Mexico (Buena Vista), defeating the Mexicans, and General Winfield Scott, with a new army, landed at Vera Cruz for a march upon the city of Mexico. Scott's march was marked by one successful battle after another, usually against heavy odds; and in September he took the capital city and held it until peace was made (1848) by the treaty of Guadalupe Hidalgo. Among the terms of peace was the cession of the present California, Utah, Arizona and New Mexico, the consideration being a payment of $15,000,000 by the United States and the assumption of some $3,000,000 of debts due by Mexico to American citizens. With a subsequent rectification of frontier (1853) by the Gadsden Treaty (see Gadsden, James), this cession

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[1] Polk received 170 electoral votes and Clay 105.

added some 500,000 sq. m. to the area of the United States; Texas itself made up a large additional area. The settlement of the north-east and north-west boundaries (see MAINE and OREGON) by the Webster-Ashburton and Buchanan-Pakenham treaties (1842, 1846) with the Texas and Mexican cessions, gave the United States the complete territorial form retained until the annexation of Alaska in 1867.

Slavery in the New Territory.

191. In the new territory slavery had been forbidden under Mexican law; and its annexation brought up the question of its status under American law. He who remembers the historical fact that slavery had never been more than a custom, ultimately recognized and protected by state law, will not have much difficulty in deciding about the propriety of forcing such a custom by law upon any part of a territory. But, if slavery was to be excluded from the new territory, the states which should ultimately be formed out of it would enter as free states, and the influence of the South in the Senate would be decreased. For the first time the South appears as a distinct *imperium in imperio* in the territorial difficulties which began in 1848.

"Squatter Sovereignty."

Wilmot Proviso.

Free Soil Party.

192. The first appearance of these difficulties brought out in the Democratic party a solution which was so closely in line with the prejudices of the party, and apparently so likely to meet all the wishes of the South, that it bade fair to carry the party through the crisis without the loss of its Southern vote. This was "squatter sovereignty," the notion that it would be best for Congress to leave the people of each Territory to settle the question of the existence of slavery for themselves. The broader and democratic ground for the party would have been that which it at first seemed likely to take—the "Wilmot Proviso," a condition proposed to be added to the act authorizing acquisitions of territory, providing that slavery should be forbidden in all territory to be acquired under the act (see WILMOT, DAVID). In the end apparent expediency carried the dominant party off to "squatter sovereignty," and the Democratic adherents of the Wilmot Proviso, with the Liberty party and the anti-slavery Whigs, united in 1848 under the name of the Free Soil party (*q.v.*). The Whigs had no solution to offer; their entire programme, from this time to their downfall as a party, consisted in a persistent effort to evade or ignore all difficulties connected with slavery.

Election of 1848.

193. Taylor, after the battle of Buena Vista, resigned and came home, considering himself ill-used by the administration. He refused to commit himself to any party; and the Whigs were forced to accept him as their candidate in 1848. The Democrats nominated Lewis Cass; and the Free Soil party, or "Free-Soilers," nominated Van Buren. By the vote of the last-named party the Democratic candidate lost New York and the election, and Taylor was elected president, receiving 163 electoral votes, while Cass received 127. Taking office in March 1849, he had on his shoulders the whole burden of the territorial difficulties, aggravated by the discovery of gold in California and the sudden rise of population there. Congress was so split into factions that it could for a long time agree upon nothing; thieves and outlaws were too strong for the semi-military government of California; and the Californians, with the approval of the president, proceeded to form a constitution and apply for admission as a state. They had so framed their constitution as to forbid slavery; and this was really the application of the Wilmot Proviso to the richest part of the new territory, and the South felt that it had been robbed of the cream of what it alone had fought cheerfully to obtain.

Admission of California.

Compromise of 1850.

Fugitive Slave Law.

Personal Liberty Laws.

194. The admission of California was not secured until September 1850, soon after Taylor's sudden death (July 9), and then only by the addition of a bonus to Texas, the division of the rest of the Mexican cession into the Territories of Utah and New Mexico without prohibition of slavery, and the passage of a fugitive slave law. The slave trade, but not slavery, was forbidden in the District of Columbia. The whole was generally known as the Compromise Measures of 1850 (*q.v.*). Two of its features need notice. As has been said, slavery was not mentioned in the act; and the status of slavery in the Territories, was thus left uncertain. Congress can veto any legislation of a territorial legislature, but, in fact, the two houses of Congress were hardly ever able to unite on anything after 1850, and both these Territories did establish slavery before 1860, without a Congressional veto. The advantage here was with the South. The other point, the Fugitive Slave Law (*q.v.*), was a special demand of the South. The Constitution contained clauses directing that fugitive criminals and slaves should be delivered up, on requisition, by the state to which they had fled. In the case of criminals the delivery was directed to be made by the executive of the state to which they had fled; in the case of slaves no delivering authority was specified, and an act of Congress in 1793 had imposed the duty on Federal judges or on local state magistrates. Some of the states had passed "Personal Liberty Laws," forbidding or limiting the action of their magistrates in such cases, and the act of 1850 transferred the decision of such cases to United States commissioners, with the assistance of United States marshals. It imposed penalties on rescues, and denied a jury trial.

Tariff of 1846.

195. The question of slavery had taken up so much time in Congress that its other legislation was comparatively limited. The rates of postage were reduced to five and ten cents for distances less and greater than 300 m. (1845); and the naval school at Annapolis was established in the same year. The military academy at West Point had been established as such in 1802. When the Democratic party had obtained complete control of the government, it re-established (by act of 6th August, 1846), the "sub-treasury," or independent treasury, which is still the basis of the treasury system. In the same year, after an exhaustive report by Robert J. Walker, Polk's secretary of the treasury, the tariff of 1846 was passed; it reduced duties, and moderated the application of the protective principle. Apart from a slight reduction of duties in 1857, this remained in force till 1861.

Admission of Florida, Iowa and Wisconsin.

Railways and Telegraphs.

196. Five states were admitted during the last ten years of this period: Florida (1845), Texas (1845), Iowa (1846), Wisconsin (1848) and California (1850). The early entrance of Iowa, Wisconsin and Florida had been due largely to Indian wars—the Black Hawk War (see BLACK HAWK) in Iowa and Wisconsin (1832), and the Seminole War in Florida (1835-37), after each of which the defeated Indians were compelled to cede lands as the price of peace. The extinction of Indian titles in northern Michigan brought about the discovery of the great copper fields of that region, whose existence had been suspected long before it could be proved. Elsewhere settlement followed the lines already marked out, except in the new possessions on the Pacific coast, whose full possibilities were not yet known. Railways in the Eastern states were beginning to show something of a connected system; in the South they had hardly changed since 1840; in the West they had only been prolonged on their original lines. The telegraph was brought into use in 1844; but it is not until the census of 1860 that its effects are seen in the fully connected network of railways which then covers the whole North and West.

Invention.

197. The sudden development of wealth in the country gave an impetus to the spirit of invention. Charles Goodyear's method of vulcanizing rubber (1839) had come into use. Cyrus Hall M'Cormick had made an invention whose results have been hardly less than that of the locomotive in their importance to the United States. He had patented a reaping machine in 1834, and this, further improved and supplemented by other inventions, had brought into play the whole system of agricultural machinery, whose existence was scarcely known elsewhere until the London "World's Fair" of 1851 brought it into notice. A successful sewing-machine came in 1846; the power-loom and the surgical use of anaesthetics in the same year; and the rotary press for printing in 1847.

The Mormons.

198. All the conditions of life were changing so rapidly that it was natural that the minds of men should change with them or become unsettled. This was the era of new sects, of communities, of fantastic proposals of every kind, of transcendentalism in literature, religion, and politics. Not the most fantastic or benevolent, but certainly the most successful, of these was the sect of Mormons or Latter-day Saints. They settled in Utah in 1847, calling their capital Salt Lake City, and spreading thence through the neighbouring Territories. They became a menace to the American system; their numbers were so great that it was against American instincts to deprive them of self-government; while their polygamy and total submission to their hierarchy made it impossible to erect them into a state having complete control of marriage and divorce. The difficulty was lessened by their renunciation of polygamy in 1890 (see MORMONS).

The South.

199. The material development of the United States since 1830 had been extraordinary, but every year made it more evident that the South was not sharing in it. It is plain now that the fault was in the labour system of the South: her only labourers were slaves, and a slave who was fit for anything better than field labour was prima facie a dangerous man. The divergence had as yet gone only far enough to awaken intelligent men in the South to its existence, and to stir them to efforts as hopeless as they were earnest, to find some artificial stimulus for Southern industries. In the next ten years the process was to show its effects on the national field.

J.—*Tendencies to Disunion, 1850–1861.*

Slavery and the Sections.

200. The Abolitionists had never ceased to din the iniquity of slavery into the ears of the American people. Calhoun, Webster and Clay, with nearly all the other political leaders of 1850, had united in deploring the wickedness of these fanatics, who were persistently stirring up a question which was steadily widening the distance between the sections. They mistook the symptom for the disease. Slavery itself had put the South out of harmony with its surroundings. Even in 1850, though they hardly yet knew it, the two sections had drifted so far apart that they were practically two different countries.

The "Slave Power."

201. The South remained much as in 1790; while other parts of the country had developed, it had stood still. The remnants of colonial feeling, of class influence, which advancing democracy had wiped out elsewhere, retained all their force here, aggravated by the effects of an essentially aristocratic system of employment. The ruling class had to maintain a military control over the labouring class, and a class influence over the poorer whites. It had even secured in the Constitution provision for its political power in the representation given to three-fifths of the slaves. The twenty additional members of the House of Representatives were not simply a gain to the South; they were still more a gain to the "black districts," where whites were few, and the slave-holder controlled the district. Slave-owners and slave-holders together, there were but 350,000 of them; but they had common interests, the intelligence to see them, and the courage to contend for them. The first step of a rising man was to buy slaves; and this was enough to enrol him in the dominant class. From it were drawn the representatives and senators in Congress, the governors, and all the holders of offices over which the "slave power," as it came to be called, had control. Not only was the South inert; its ruling class, its ablest and best men, united in defence of tendencies hostile to those of the rest of the country.

Immigration.

202. Immigration into the United States was not an important factor in its development until about 1847. The immigrants, so late as 1820, numbered but 8000 per annum; their number did not touch 100,000 until 1842, and then it fell for a year or two almost to half that number. In 1847 it rose again to 235,000, in 1849 to 300,000, and in 1850 to 428,000; all told, more than two and a quarter million persons from abroad settled in the United States between 1847 and 1854. Leaving out the dregs of the immigration, which settled down in the seaboard cities, its best part was a powerful nationalizing force. It had not come to any particular state, but to the United States; it had none of the traditional prejudices in favour of a state, but a strong feeling for the whole country; and the new feelings which it brought in must have had their weight not only on the gross mass of the people, but on the views of former leaders. And all the influences of this enormous immigration were confined to the North and West. The immigration avoided slave soil as if by instinct. So late as 1880 the census reported that the Southern states, except Florida, Louisiana and Texas, are "practically without any foreign element"; but it was only in 1850–1860 that this differentiating circumstance began to show itself plainly. And, as the sections began to differ further in aims and policy, the North began to gain heavily in ability to ensure its success.

The Sections in Congress.

203. Texas was the last slave state ever admitted; and, as it refused to be divided, the South had no further increase of numbers in the Senate. Until 1850 the admission of a free state had been so promptly balanced by the admission of a slave state that the senators of the two sections had remained about equal in number; in 1860 the free states had 36 senators and the slave states only 30. As the representation in the House had changed from 35 free state and 30 slave state members in 1790 to 147 free state and 90 slave state in 1860, and as the number of presidential electors is the sum of the numbers of senators and representatives, political power had passed away from the South in 1850. If at any time the free states should unite they could control the House of Representatives and the Senate, elect the president and vice-president, dictate the appointment of judges and other Federal officers, and make the laws what they pleased. If pressed to it, they could even control the interpretation of the laws by the Supreme Court. No Federal judge could be removed except by impeachment, but an act of Congress could at any time increase the number of judges to any extent, and the appointment of the additional judges could reverse the opinion of the court.

Tendencies to Disunion.

204. In circumstances so critical a cautious quiescence and avoidance of public attention was the only safe course for the "slave power," but that course had become impossible. The numbers interested had become too large to be subject to complete discipline; all could not be held in cautious reserve; and, when an advanced proposal came from any quarter of the slave-holding lines, the whole army was shortly forced up to the advanced position. Every movement of the mass was necessarily aggressive; and aggression meant final collision. If collision came it must be on some question of the rights of the states; and on such a question the whole South would move as one man.

Sectarian Division.

205. The Protestant churches of the United States had reflected in their organization the spirit of the political institutions under which they lived. Acting as purely voluntary associations, they had been organized into governments by delegates, much like the "conventions" which had been evolved in the political parties. The omnipresent slavery question intruded into these bodies, and split them. The Methodist Episcopal Church was thus divided into a Northern and a Southern branch in 1844, and the equally powerful Baptist Church met the same fate in the following year. Two of the four great Protestant bodies were thus no longer national; it was only by the most careful management that the integrity of the Presbyterian Church was maintained until 1861, when it also yielded; and only the Episcopal and Roman Catholic Churches retained their national character.

Party Changes.

206. The political parties showed the same tendency. Each began to shrivel up in one section or the other. The notion of "squatter sovereignty," attractive at first to the Western democracy, and not repudiated by the South, enabled the Democratic party to pass the crisis of 1850 without losing much of its Northern vote, while Southern Whigs began to drift in, making the party continually

Election of 1852.

more pro-slavery. This could not continue long without beginning to decrease its Northern vote, but this effect did not become plainly visible until after 1852. The efforts of the Whig party to ignore the great question alienated its anti-slavery members in the North, while they did not satisfy its Southern members. The Whig losses were not at first heavy, but, as the electoral vote of each state is determined by the barest plurality of the popular vote, they were enough to defeat the party almost everywhere in the presidential election of 1852. The Whigs nominated General Winfield Scott and the Democrats Franklin Pierce; and Pierce carried all but four of the thirty-one states, and was elected, receiving 254 out of the 296 electoral votes. This revelation of hopeless weakness was the downfall of the Whig party; it maintained its organization for four years longer, but the life had gone out of it. The future was with the Free Soil party, though it had polled but few votes in 1852.

Changes in Leadership.

207. During the administration of Taylor (and Vice-President Millard Fillmore, who succeeded him) Clay, Webster, Calhoun, Polk and Taylor were removed by death, and there was a steady drift of other political leaders out of public life. New men were pushing in everywhere, and in both sections they showed the prevailing tendency to disunion. The best of them were unprecedentedly radical. Charles Sumner, William H. Seward, and Salmon P. Chase came into the Senate, bringing the first accession of recognized force and ability to the anti-slavery feeling in that body. The new Southern men, such as Jefferson Davis, and the Democratic recruits from the Southern Whig party, such as Alexander H. Stephens, were ready to take the ground on which Calhoun had always insisted—that Congress was bound not merely to the negative duty of not attacking slavery in the Territories, but to the positive duty of protecting it. This, if it should become the general Southern position, was certain to destroy the notion of "squatter sovereignty," and thus to split the Democratic party, which was almost the last national ligament that now held the two fragments of the Union together.

Social Divergence.

208. The social disintegration was as rapid. Northern men travelling in the South were naturally looked upon with increasing suspicion, and were made to feel that they were on a soil alien in sympathies. Some of the worst phases of democracy were called into play in the South; and, in some sections, law openly yielded supremacy to popular passion in the cases of suspected Abolitionists. Southern conventions, on all sorts of subjects, became common; and in these meetings, permeated by a dawning sense of Southern nationality, hardly any proposition looking to Southern independence of the North was met with disfavour.

Progress of Disunion.

209. Calhoun, in his last and greatest speech, called attention to the manner in which one tie after another was snapping. But he ignored the real peril of the situation—its dangerous facts: that the South was steadily growing weaker in comparison with the North, and more unable to secure a wider area for the slave system; that it was therefore being steadily forced into demanding active Congressional protection for slavery in the Territories; that the North would never submit to this; and that the South must submit or bring about a collision by attempting to secede.

Fugitive Slave Law.

Kansas-Nebraska Act.

210. Anti-slavery feeling in the North was stimulated by the manner in which the Fugitive Slave Law was enforced immediately after 1850. The chase after fugitive slaves was prosecuted in many cases with circumstances of revolting brutality, and features of the slave system which had been tacitly looked upon as fictitious were brought home to the heart of the free states. (See FUGITIVE SLAVE LAWS.) The added feeling showed its force when the Kansas-Nebraska Act was passed by Congress (1854). It organized the two new Territories of Kansas and Nebraska. Both of them were for ever free soil by the terms of the Missouri Compromise (*q.v.*). But the success of the notion of squatter sovereignty in holding the Democratic party together while destroying the Whig party had intoxicated Stephen A. Douglas (*q.v.*), and other Northern Democrats; and they now applied the doctrine to these Territories. They did not desire "to vote slavery up or down," but left the decision to the people of the two Territories and the essential feature of the Missouri Compromise was specifically repealed.

The "American Party."

The Republican Party.

211. This was the grossest political blunder in American history. The status of slavery had been settled, by the Constitution or by the compromises of 1820 and 1850, on every square foot of American soil; right or wrong, the settlement was made. The Kansas-Nebraska Act took a great mass of territory out of the settlement and flung it into the arena as a prize for which the sections were to struggle. The first result of the act was to throw parties into chaos. An American or "Know-Nothing" (*q.v.*) party, a secret oath-bound organization, pledged to oppose the influence or power of foreign-born citizens, had been formed to take the place of the defunct Whig party. It had been quite successful in state elections for a time, and was now beginning to have larger aspirations. It, like the Whig party, intended to ignore slavery, but, after a few years of life, the questions complicated with slavery entered its organization and divided it also. Even in 1854 many of its leaders in the North were forced to take position against the Kansas-Nebraska Act, while hosts of others joined in the opposition without any party organization. No American party ever rose so swiftly as this latter; with no other party name than the awkward title of "Anti-Nebraska men," it carried the Congressional elections of 1854 at the North, forced many of the former Know-Nothing leaders into union with it, and controlled the House of Representatives of the Congress which met in 1855. The Democratic party, which had been practically the only party since 1852, had now to face the latest and strongest of its broad-constructionist opponents, one which with the nationalizing features of the Federalist and Whig parties combined democratic feelings and methods, and, above all, had a democratic purpose at bottom. It acknowledged, at first, no purpose aimed at slavery, only an intention to exclude slavery from the Territories; but, under such principles, it was the only party which was potentially an anti-slavery party, the only party to which the enslaved labourer of the South could look with the faintest hope of aid in reaching the status of a man. The new party had grasped the function which belonged of right to its great opponent, and it seized with it its opponent's original title. The name Democrat had quite taken the place of that first used—Republican—but the latter had never passed out of popular remembrance and liking at the North. The new party took quick and skilful advantage of this by assuming the old name (see REPUBLICAN PARTY), and early in 1856 the two great parties of the present—Democratic and Republican—were drawn up against one another.

Koszta Case.

Japan.

Ostend Manifesto; Filibustering.

212. The foreign relations of the United States during Pierce's term of office were overshadowed by the domestic difficulties, but were of importance. In the Koszta case (1853) national protection had been afforded on foreign soil to a person who had only taken the preliminary steps to naturalization (see MARCY, W. L.). Japan had been opened to American intercourse and commerce (1854). But the question of slavery was more and more thrusting itself even into foreign relations. A great Southern republic, to be founded at first by the slave states, but to take in gradually the whole territory around the Gulf of Mexico and include the West Indies, was soon to be a pretty general ambition among slave-holders, and its first phases appeared during Pierce's administration. Efforts were begun to obtain Cuba from Spain; and the three leading American ministers abroad, meeting at Ostend, united in declaring the possession of Cuba to be essential to the well-being of the United States (1854). (See BUCHANAN, JAMES.) "Filibustering" expeditions against Cuba or the smaller South American states, intended so to revolutionize them as to lay a basis for an

application to be annexed to the United States, became common, and taxed the energies of the Federal government. But these yielded in importance to the affairs in Kansas

Kansas.

213. Nebraska was then supposed to be a desert, and attention was directed almost exclusively to Kansas. No sooner had its organization left the matter of slavery to be decided by its "people." than the anti-slavery people of the North and West felt it to be their duty to see that the "people" of the Territory should be anti-slavery in sympathy. Emigrant associations were formed, and these shipped men and families to Kansas, arming them for their protection in the new country. Southern newspapers called for similar measures in the South, but the call was less effective. Southern men without slaves, settling a new state, were uncomfortably apt to prohibit slavery, as in California. Only slaveholders were trusty pro-slavery men; and such were not likely to take slaves to Kansas and risk their ownership on the result of the struggle. But for the people of Missouri, Kansas would have been free soil at once. Lying across the direct road to Kansas, the Missouri settlers blockaded the way of free-state settlers, crossed into Kansas, and voted profusely at the first Territorial election. The story of the contest between the free-state and pro-slavery settlers is told elsewhere (see KANSAS: § *History*); here it need only be said that the struggle passed into a real civil war, the two powers mustering considerable armies, fighting battles, capturing towns and paroling prisoners. The struggle was really over in 1857, and the South was beaten. There were, however, many obstacles yet to be overcome before the new state of Kansas was recognized by Congress, after the withdrawal of the senators of the seceding states (1861).

Election of 1856.

214. In the heat of the Kansas struggle came the presidential election of 1856. The Democrats nominated James Buchanan, declaring, as usual, for the strictest limitations of the powers of the Federal government on a number of points specified, and reaffirming the principle of the Kansas-Nebraska Act—the settlement of slavery by the people of a Territory. The remnant of the Whig party, including the Know-Nothings of the North and those Southern men who wished no further discussion of slavery, nominated the president who had gone out of office in 1853, Millard Fillmore. The Republican party nominated John C. Frémont; the bulk of its manifesto was taken up with protests against attempts to introduce slavery into the Territories; but it showed its broad-construction tendencies by declaring for appropriations of Federal moneys for internal improvements. The Democrats were successful in electing Buchanan;[1] but the position of the party was quite different from the triumph with which it had come out of the election of 1852. It was no longer master of twenty-seven of the thirty-one states; all New England and New York, all the North-West but Indiana and Illinois, all the free states but five, had gone against it; its candidate no longer had a majority of the popular vote. For the first time in the history of the country a distinctly anti-slavery candidate had obtained an electoral vote, and had even come near obtaining the presidency. Fillmore had carried but one state, Maryland; Buchanan had carried the rest of the South, with a few states in the North, and Frémont the rest of the North and none of the South. If things had gone so far that the two sections were to be constituted into opposing political parties, it was evident that the end was near.

The Dred Scott Decision.

215. Oddly enough the constitutionality of the Compromise of 1820 had never happened to come before the Supreme Court for consideration. In 1856–1857 it came up for the first time. One Dred Scott, a Missouri slave who had been taken in 1834 to Illinois, a free state, and in 1836 to Minnesota, within the territory covered by the Compromise, and had some years after being taken back to Missouri in 1838 sued for his freedom, was sold (1852) to a citizen of New York. Scott then transferred his suit from the state to the Federal courts, under the power given them to try suits between citizens of different states, and the case came by appeal to the Supreme Court. Its decision, announced on the 6th of March 1857, put Scott out of court on the ground that a slave, or the descendant of slaves, could not be a citizen of the United States or have any standing in Federal courts. The opinion of Chief Justice Taney went on to attack the validity of the Missouri Compromise, for the reasons that one of the Constitutional functions of Congress was the protection of property; that slaves had been recognized as property by the Constitution, and that Congress was bound to protect, not to prohibit, slavery in the Territories.[2] The mass of the Northern people held that slaves were looked upon by the Constitution, not as property, but as "persons held to service or labour" by state laws; that the Constitutional function of Congress was the protection of liberty as well as of property; and that Congress was thus bound to prohibit, not to protect, slavery in the Territories. A large part of the North flouted the decision of the Supreme Court, and the storm of angry dissent which it aroused did the disunionists good service at the South. From this time the leading newspapers in the South maintained that the radical Southern view first advanced by Calhoun, and but slowly accepted by other Southern leaders, as to the duty of Congress to protect slavery in the Territories, had been confirmed by the Supreme Court; that the Northern Republicans had rejected it; even the "squatter sovereignty" of Northern Democrats could no longer be submitted to by the South.

Admission of Minnesota and Oregon.

John Brown's Raid.

216. The population of the United States in 1860 was over 31,000,000, an increase of more than 8,000,000 in ten years. As the decennial increases of population became larger, so did the divergence of the sections in population, and still more in wealth and resources. Two more free states came in during this period—Minnesota (1858) and Oregon (1859)—and Kansas was clamouring loudly for the same privilege. The free and slave states, which had been almost equal in population in 1790, stood now as 19 to 12. And of the 12,000,000 in slave states, the 4,000,000 slaves and the 250,000 free blacks were not so much a factor of strength as a possible source of weakness and danger. No serious slave rising had ever taken place in the South; but John Brown's attack (1859) on Harper's Ferry as the first move in a project to rouse the slaves (see BROWN, JOHN), and the alarm which it carried through the South, were tokens of a danger which added a new horror to the chances of civil war. It was not wonderful that men, in the hope of finding some compromise by which to avoid such a catastrophe, should be willing to give up everything but principle, nor that offers of compromise should urge Southern leaders further into the fatal belief that "the North would not fight."

Division of the Democratic Party.

217. Northern Democrats, under the lead of Douglas, had been forced already almost to the point of revolt by the determination of Southern senators to prevent the admission of Kansas as a free state, if not to secure her admission as a slave state. When the Democratic convention of 1860 met at Charleston the last strand of the last national political organization parted; the Democratic party itself was split at last by the slavery question. The Southern delegates demanded a declaration in favour of the duty of Congress to protect slavery in the Territories. It was all that the Douglas Democrats could then do to maintain themselves in a few Northern states; such a declaration meant political suicide everywhere, and they voted it down. The convention divided into two bodies. The Southern body adjourned to Richmond, and the Northern and Border state convention to Baltimore. Here the Northern delegates, by seating some delegates friendly to Douglas,

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[1] Buchanan received 174 electoral votes, Frémont 114 and Fillmore 8. The popular vote was: for Buchanan, 1,838,169; for Frémont, 1,341,264; for Fillmore, 874,534.

[2] In his decision Taney, referring to the period before the adoption of the Constitution, wrote: "They (negroes) had for more than a century before been regarded as beings of an inferior order, and altogether unfit to associate with the white race, either in social or political relations; and so far inferior that they had no rights which the white man was bound to respect." This was intended to be merely a historical statement, but it is often incorrectly quoted as if it referred to the status of the negro in 1857.

provoked a further secession of border state delegates, who, in company with the Richmond body, nominated John C. Breckinridge (*q.v.*) and Joseph Lane for president and vice-president. The remainder of the original convention nominated Douglas and H. V. Johnson.

Constitutional Union Party; Republican Party.

The Parties and Slavery in the Territories.

218. The remnant of the old Whig and Know-Nothing parties, now calling itself the Constitutional Union party, met at Baltimore and nominated John Bell (*q.v.*) and Edward Everett. The Republican convention met at Chicago. Its "platform" of 1856 had been somewhat broad-constructionist in its nature and leanings, but a strong Democratic element in the party had prevented it from going too far in this direction. The election of 1856 had shown that, with the votes of Pennsylvania and Illinois, the party would have then been successful, and the Democratic element was now ready to take almost anything which would secure the votes of these states. This state of affairs will go to explain the nomination of Abraham Lincoln, of Illinois, for president, with Hannibal Hamlin, a former Democrat, for vice-president, and the declaration of the platform in favour of a protective tariff. The mass of the platform was still devoted to the necessity of excluding slavery from the Territories. To sum up: the Bell party wished to have no discussion of slavery; the Douglas Democrats rested on "squatter sovereignty" and the Compromise of 1850, but would accept the decision of the Supreme Court; the Republicans demanded that Congress should legislate for the prohibition of slavery in the Territories; and the Southern Democrats demanded that Congress should legislate for the protection of slavery in the Territories.

Election of 1860.

219. No candidate received a majority of the popular vote, Lincoln standing first and Douglas second. But Lincoln and Hamlin had a clear majority of the electoral vote, and so were elected, Breckinridge and Lane coming next.[1] It is worthy of mention that, up to the last hours of Lincoln's first term of office, Congress would always have contained a majority opposed to him but for the absence of the members from the seceding states. The interests of the South and even of slavery were thus safe enough under an anti-slavery president. But the drift of events was too plain. Nullification had come and gone, and the nation feared it no longer. Even secession by a single state was now almost out of the question; the letters of Southern governors in 1860, in consultation on the state of affairs, agree that no state would secede without assurances of support by others. If this crisis were allowed to slip by without action, even a sectional secession would soon be impossible.

Secession.

220. In October 1860 Governor W. H. Gist, of South Carolina, sent a letter to the governor of each of the other cotton states except Texas, asking co-operation in case South Carolina should resolve upon secession, and the replies were favourable. The democratic revolution which, since 1829, had compelled the legislature to give the choice of presidential electors to the people of the states had not affected South Carolina; her electors were still chosen by the legislature. That body, after having chosen the state's electors on the 6th of November, remained in session until the telegraph had brought assurances that Lincoln had secured a sufficient number of electors to ensure his election; it then (on the 10th) summoned a state convention and adjourned. The state convention, which is a legislative body chosen for a special purpose, met first at Columbia and then at Charleston, and on the 20th of December unanimously passed an "ordinance of secession," repealing the acts by which the state had ratified the Constitution and its amendments, and dissolving "the union now subsisting between South Carolina and other states, under the name of the 'United States of America.'" The convention took all steps necessary to prepare for war, and adjourned. Similar ordinances were passed by conventions in Mississippi (Jan. 9, 1861), Florida (Jan. 10), Alabama (Jan. 11), Georgia (Jan. 19), Louisiana (Jan. 26) and Texas (Feb. 1).

The Argument for Secession.

Action at the State Conventions.

221. The opposition in the South did not deny the right to secede, but the expediency of its exercise. Their effort was to elect delegates to the state conventions who would vote not to secede. They were beaten, says A. H. Stephens, by the cry, originally uttered by T. R. R. Cobb before his state legislature (Nov. 12, 1860), "we can make better terms out of the Union than in it." That is, the states were to withdraw individually, suspend the functions of the Federal government within their jurisdiction for the time, consider maturely any proposals for guarantees for their rights in the Union, and return as soon as satisfactory guarantees should be given. A second point to be noted is the difference between the notions of a state convention prevalent in the North and in the South. The Northern state convention was generally considered as a preliminary body, whose action was not complete or valid until ratified by a popular vote. The Southern state convention was looked upon as the incarnation of the sovereignty of the state, and its action was not supposed to need a popular ratification. When the conventions of the seceding states had adopted the ordinances of secession, they proceeded to other business. They appointed delegates, who met at Montgomery, the capital of Alabama, formed a provisional constitution (Feb. 8) for the "Confederate States," chose a provisional president and vice-president (Jefferson Davis and A. H. Stephens), and established an army, treasury, and other executive departments. The president and vice-president were inaugurated on the 18th of February. The permanent constitution, adopted on the 11th of March, was copied from that of the United States, with variations meant to maintain state sovereignty, to give the cabinet seats in Congress, and to prevent the grant of bounties or any protective features in the tariff or the maintenance of internal improvements at general expense; and it expressly provided that in all the territory belonging to the Confederacy but lying without the limits of the several states "the institution of negro slavery, as it now exists in the Confederate States, shall be recognized and protected by Congress and by the Territorial government" (see CONFEDERATE STATES OF AMERICA).

The "Confederate States."

Constitutional Rights.

222. Under what claim of Constitutional right all this was done passes comprehension. That a state convention should have the final power of decision on the question which it was summoned to consider is quite as radical doctrine as has yet been heard of; that a state convention, summoned to consider the one question of secession, should go on, with no appeal to any further popular authority or mandate, to send delegates to meet those of other states and form a new national government, which could only exist by warring on the United States, is a novel feature in American Constitutional law. It was revolution or nothing. Only in Texas, where the call of the state convention was so irregular that a popular vote could hardly be escaped, was any popular vote allowed. Elsewhere the functions of the voter ceased when he voted for delegates to the state convention; he could only look on helplessly while that body went on to constitute him a citizen of a new nation.

The Border States.

223. The Border states were in two tiers—North Carolina, Tennessee and Arkansas next to the seceding states, and Delaware, Maryland, Virginia, Kentucky and Missouri next to the free states. None of these was willing to secede. There was, however, one force which might draw them into secession. A state which did not wish to secede, but believed in state sovereignty and the abstract right of secession, would be inclined to take up arms to resist any attempt by the Federal government to coerce a seceding state. In this way, in the following spring, the original seven seceding states were reinforced by four of the Border states.

224. In the North and West surprisingly little attention was given to the systematic course of procedure along the

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[1] Lincoln received 180 electoral votes, Breckinridge 72, Bell 39 and Douglas 12. Their popular votes were 1,866,352, 847,514, 587,830 and 1,375,157 respectively.

Feeling in the North.

Gulf. The people of those sections were very busy; they had heard much of this talk before, and looked upon it as a kind of stage-thunder, the inevitable accompaniment of recent presidential elections. Republican politicians, with the exception of a few, were inclined to refrain from public declarations of intention. Some of them such as Seward, showed a disposition to let the "erring sisters" depart in peace, expecting to make the loss good by accessions from Canada. A few, like Senator Zachariah Chandler, believed that there would be "blood-letting," but most of them were still doubtful as to the future. In the North the leaders and the people generally shrank from the prospect of war, and many were prepared to make radical concessions to avert hostilities. Among the various proposals to this end that offered in the Senate by John J. Crittenden, of Kentucky, and known as the Crittenden Compromise, was perhaps received with most favour. This took the form of six proposed amendments to the Constitution, of which two were virtually a rephrasing of the essential feature of the Missouri Compromise and of the principle of popular or squatter sovereignty, and others provided that the national government should pay to the owner of any fugitive slave, whose return was prevented by opposition in the North, the full value of such slave, and prohibited the abolition of slavery in the District of Columbia" so long as it exists in the adjoining states of Virginia and Maryland or either." This proposed compromise was rejected by the Senate by a close vote on the 2nd of March 1861. A Peace Congress, called by Virginia, met in Washington from the 4th to the 27th of February 1861, 21 states being represented, and proposed a constitutional amendment embodying changes very similar to those of the Crittenden Compromise, but its proposal was not acted upon by Congress. Democratic politicians were hide-bound by their repetition of the phrase "voluntary Union"; they had not yet hit upon the theory which carried the War Democrats through the final struggle, that the sovereign state of New York could make war upon the sovereign state of South Carolina for the unfriendly act of secession, and that the war was waged by the non-seceding against the seceding states. President Buchanan publicly condemned the doctrine of secession, though he added a confession of his inability to see how secession was to be prevented if a state should be so wilful as to attempt it. Congress did nothing, except to admit Kansas as a free state and adopt the protective Morrill tariff; even after its members from the seceding states had withdrawn, those who remained made no preparations for conflict, and, at their adjournment in March 1861, left the Federal government naked and helpless.

Admission of Kansas; Morrill Tariff of 1861.

The "War Governors."

225. The only sign of life in the body politic, the half-awakened word of warning from the Democracy of the North and West, was its choice of governors of states. A remarkable group of men, soon to be known as the "war governors"—Israel Washburn of Maine, Erastus Fairbanks of Vermont, Ichabod Goodwin of New Hampshire, John Albion Andrew of Massachusetts, William Sprague of Rhode Island, William Alfred Buckingham of Connecticut, Edwin Dennison Morgan of New York, Charles Smith Olden of New Jersey, Andrew Gregg Curtin of Pennsylvania, William Dennison of Ohio, Oliver Perry Morton of Indiana, Richard Yates of Illinois, Austin Blair of Michigan, Alexander Williams Randall of Wisconsin, Samuel Jordan Kirkwood of Iowa, and Alexander Ramsey of Minnesota—held the executive powers of the Northern states in 1861–1862. Some of these governors, such as Andrew and Buckingham, as they saw the struggle come nearer, went so far as to order the purchase of warlike material for their states on their private responsibility, and their action saved days of time.

Seizure of United States Property.

226. The little army of the United States had been almost put out of consideration; wherever its detachments could be found in the South they were surrounded and forced to surrender and were transferred to the North. After secession, and in some of the states even before it, the forts, arsenals, mints, custom-houses, ship-yards and public property of the United States had been seized by authority of the state, and these were held until transferred to the new Confederate States organization. In the first two months of 1861 the authority of the United States was paralysed in seven states, and in at least seven more its future authority seemed of very doubtful duration.

Position of the Remaining Forts.

227. Only a few forts, of all the magnificent structures with which the nation had dotted the Southern coast, remained to it—the forts near Key West, Fortress Monroe at the mouth of Chesapeake Bay, Fort Pickens at Pensacola and Fort Sumter in Charleston harbour. Both the last-named were beleaguered by hostile batteries, but the administration of President Buchanan, intent on maintaining the peace until the new administration should come in, instructed their commanding officers to refrain from any acts tending to open conflict. The Federal officers, therefore, were obliged to look idly on while every preparation was made for their destruction, and even while a vessel bearing supplies for Fort Sumter was driven back by the batteries between it and the sea.

Slavery and Disunion.

228. The divergence between the two sections of the country had thus passed into disunion, and was soon to pass into open hostility. The legal recognition of the custom of slavery, acting upon and reacted upon by every step in their economic development and every difference in their natural characteristics, surroundings and institutions, had carried North and South further and faster apart, until the elements of a distinct nationality had appeared in the latter. Slavery had had somewhat the same effect on the South that democracy had had on the colonies. In the latter case the aristocracy of the mother-country had made a very feeble struggle to maintain the unity of its empire. It remained to be seen, in the American case, whether democracy would do better.

K.—*The Civil War, 1861–1865.*

Embarrassments of the Government.

229. Secession had taken away many of the men who had for years managed the Federal government, and who understood its workings. Lincoln's party was in power for the first time; his officers were new to the routine of Federal administration; and the circumstances with which they were called upon to deal were such as to daunt any spirit. The government had become so nearly bankrupt in the closing days of Buchanan's administration that it had only escaped by paying double interest, and that by the special favour of the New York banks, which obtained in return the appointment of John A. Dix as secretary of the treasury. The army had been almost broken up by captures of men and material and by resignations of competent and trusted officers. The navy had come to such a pass that, in February 1861, a House committee reported that only two vessels, one of twenty, the other of two guns, were available for the defence of the entire Atlantic coast. And, to complicate all difficulties, a horde of clamorous office-seekers crowded Washington.

Fort Sumter. Rising in the North.

230. Before many weeks of Lincoln's administration had passed, the starting of an expedition to provision Fort Sumter brought on an attack by the batteries around the fort, and after a bombardment of 36 hours the fort surrendered (April 14, 1861). It is not necessary to rehearse the familiar story of the outburst of feeling which followed this event and the proclamation of President Lincoln calling for volunteers. The 75,000 volunteers called for were supplied three or four times over, and those who were refused felt the refusal as a personal deprivation.

The North-West.

231. There had been some belief in the South that the North-West would take no part in the impending conflict, and that its people could be persuaded to keep up friendly relations with the new nationality until the final treaty of peace should establish all the fragments of the late Union upon an international basis. In the spring months of 1861 Douglas, who had long been

denounced as the tool of the Southern slave-holders, was spending the closing days of life in expressing the determination of the North-West that it would never submit to have "a line of custom-houses" between it and the ocean. The batteries which Confederate authority was erecting on the banks of the Mississippi were fuel to the flame. Far-off California, which had been considered neutral by all parties, pronounced as unequivocally for the national authority.

"Following the State."

232. The shock of arms put an end to opposition in the South as well. The peculiar isolation of life in the South precluded the more ignorant voter from any comparisons of the power of his state with any other; to him it was almost inconceivable that his state should own or have a superior. The better educated men, of wider experience, had been trained to think state sovereignty the foundation of civil liberty, and, when their state spoke, they felt bound to "follow their state." The president of the Confederate States issued his call for men, and it also was more than met.

The Border States.

233. Lincoln's call for troops met with an angry reception wherever the doctrine of state sovereignty had a foothold. The governors of the Border states generally returned it with a refusal to furnish any troops. Two states, North Carolina and Arkansas, seceded and joined the Confederate States. In two others, Virginia and Tennessee, the state politicians formed "military leagues" with the Confederacy, allowing Confederate troops to take possession of the states, and then submitted the question of secession to "popular vote." The secession of these states was thus accomplished, and Richmond became the Confederate capital. The same process was attempted in Missouri, but failed, and the state remained loyal. The politician class in Maryland and Kentucky took the extraordinary course of attempting to maintain neutrality; but the growing power of the Federal government soon enabled the people of the two states to resume control of their governments and give consistent support to the Union. Kentucky, however, had troops in the Confederate armies; and one of her citizens, the late vice-president, John C. Breckinridge, left his place in the Senate and became an officer in the Confederate service. Delaware cast her lot from the first with the Union.

Civil War.

The Blockade.

234. The first blood of the war was shed in the streets of Baltimore, when a mob attempted to stop Massachusetts troops on their way to Washington (April 19). For a time there was difficulty in getting troops through Maryland because of the active hostility of a part of its people, but this was overcome, and the national capital was made secure. The Confederate lines had been pushed up to Manassas Junction, about 30 m. from Washington. When Congress, called into special session by the president for the 4th of July, came together, the outline of the Confederate States had been fixed. Their line of defence held the left bank of the Potomac from Fortress Monroe nearly to Washington; thence, at a distance of some 30 m. from the river, to Harper's Ferry; thence through the mountains of western Virginia and the southern part of Kentucky, crossing the Mississippi a little below Cairo; thence through southern Missouri to the eastern border of Kansas; and thence south-west through the Indian Territory and along the northern boundary of Texas to the Rio Grande. The length of the line, including also the Atlantic and Gulf coasts, has been estimated at 11,000 m. The territory within it comprised about 800,000 sq. m., with a population of over 9,000,000 and great natural resources. Its cotton was almost essential to the manufactories of the world; in exchange for it every munition of war could be procured; and it was hardly possible to blockade a coast over 3000 m. in length, on which the blockading force had but one port of refuge, and that about the middle of the line. Nevertheless President Lincoln issued his first call for troops on the 15th of April. President Davis then issued a proclamation (on the 17th) offering letters of marque and reprisal against the commerce of the United States to private vessels, and on the 19th Lincoln answered with a proclamation announcing the blockade of the Southern coast. The news brought out proclamations of neutrality from Great Britain and France, and, according to subsequent decisions of the Supreme Court, made the struggle a civil war, though the minority held that this did not occur legally until the act of Congress of the 13th of July 1861, authorizing the president, in case of insurrection, to shut up ports and suspend commercial intercourse with the revolted district.

Suspension of "Habeas Corpus."

235. The president found himself compelled to assume powers never granted to the executive authority, trusting to the subsequent action of Congress to validate his action. He had to raise and support armies and navies; he even had to authorize seizures of necessary property, of railroad and telegraph lines, arrests of suspected persons, and the suspension of the writ of habeas corpus in certain districts. Congress supported him, and proceeded in 1863 to give the president power to suspend the writ anywhere in the United States; this power he promptly exercised. The Supreme Court, after the war, in the Milligan case (4 Wallace, 133) decided that no branch of the government had power to suspend the writ in districts where the courts were open—that the *privilege* of the writ might be suspended as to persons properly involved in the war, but that the writ was still to issue, the court deciding whether the person came within the classes to whom the suspension applied. This decision, however, did not come until "arbitrary arrests," as they were called, had been a feature of the entire war. A similar suspension took place in the Confederate States.

Congress.

Bull Run.

The "Trent" Case.

236. When Congress met (July 4, 1861) the absence of Southern members had made it heavily Republican. It decided to consider no business but that connected with the war, authorized a loan and the raising of 500,000 volunteers, and made confiscation of property a penalty of rebellion. While it was in session the first serious battle of the war—Bull Run, or Manassas—took place (July 21), and resulted in the defeat of the Federal army. (For this and the other battles of the war see AMERICAN CIVIL WAR, and the supplementary articles dealing with particular battles and campaigns.) The over-zealous action of a naval officer in taking the Confederate envoys James M. Mason and John Slidell out of the British steamer "Trent" sailing between two neutral ports almost brought about a collision between the United States and Great Britain in November. But the American precedents were all against the United States, and the envoys were given up.

Paper Currency; Slavery.

237. The broad-construction tendencies of the Republican party showed themselves more plainly as the war grew more serious; there was an increasing disposition to cut every knot by legislation, with less regard to the constitutionality of the legislation. A paper currency, commonly known as "greenbacks" (*q.v.*), was adopted and made legal tender (Feb. 25, 1862). The first symptoms of a disposition to attack slavery appeared: slavery was prohibited (April 16) in the District of Columbia and the Territories (June 19); the army was forbidden to surrender escaped slaves to their owners; and slaves of insurgents were ordered to be confiscated. In addition to a homestead act (see HOMESTEAD AND EXEMPTION LAWS) giving public lands to actual settlers at reduced rates, Congress began a further development of the system of granting public lands to railways. Another important act (1862) granted public lands for the establishment of agricultural and mechanical colleges (see MORRILL, J. S.).

Railways in 1850.

238. The railway system of the United States was but twenty years old in 1850, but it had begun to assume some consistency. The day of short and disconnected lines had passed, and the connexions which were to develop into railway systems had appeared. Consolidation of smaller companies had begun; the all-rail route across the state of New York was made up of more than a dozen original companies at its consolidation in 1853. The Erie railway, chartered in 1832, was completed from

Piermont to Dunkirk, New York, in 1851; and another line—the Pennsylvania—was completed from Harrisburg to Pittston, Pennsylvania, in 1854. These were at least the germs of great trunk lines. The cost of American railways has been only from one-half to one-fourth of the cost of European railways; but an investment in a Far Western railway in 1850-1860 was an extra-hazardous risk. Not only did social conditions make any form of business hazardous; the new railway often had to enter a territory bare of population, and there create its own towns, farms and traffic. Whether it could do so was so doubtful as to make additional inducements to capital necessary. The means attempted by Congress in 1850, in the case of the Illinois Central railroad, was to grant public lands to the corporation, reserving to the United States the alternate sections. At first grants were made to the states for the benefit of the corporations; the act of 1862 made the grant directly to the corporation.

Land Grants.

The Pacific Railways.

239. The vital military and political necessity of an immediate railway connexion with the Pacific coast was hardly open to doubt in 1862; but the necessity hardly justified the terms which were offered and taken. The Union Pacific railroad was incorporated; the United States government was to issue to it bonds, on the completion of each 40 m., to the amount of $16,000 per mile, to be a first mortgage; through Utah and Nevada the aid was to be doubled, and for some 300 m. of mountain building to be trebled; and, in addition to this, alternate sections of land were granted. The land-grant system, thus begun, was carried on extensively, the largest single grants being those of 47,000,000 acres to the Northern Pacific (1864) and of 42,000,000 to the Atlantic & Pacific line (1866).

Prices in Paper.

240. Specie payments had been suspended almost everywhere towards the end of 1861; but the price of gold was but 102·5 at the beginning of 1862. About May its price in paper currency began to rise. It touched 170 during the next year, and 285 in 1864; but the real price probably never went much above 250. Other articles felt the influence in currency prices. Mr D. A. Wells, in 1866, estimated that prices and rents had risen 90% since 1861, while wages had not risen more than 60%.

Tariff and Internal Revenue Taxation.

241. The duties on imports were driven higher than the original Morrill tariff had ever contemplated. The average rates, which had been 18% on dutiable articles and 12% on the aggregate in 1860-1861, rose, before the end of the war, to nearly 50% on dutiable articles and 35% on the aggregate. Domestic manufactures sprang into new life under such hothouse encouragement; every one who had spare wealth converted it into manufacturing capital. The probability of such a result had been the means of getting votes for an increased tariff; free traders had voted for it as well as protectionists. For the tariff was only a means of getting capital into positions in which taxation could be applied to it, and the "internal revenue" taxation was merciless beyond precedent. The annual increase of wealth from capital was then about $550,000,000; the internal revenue taxation on it rose in 1866 to $310,000,000, or nearly 60%.

Bonds.

242. The stress of all this upon the poor must have been great, but it was relieved in part by the bond system on which the war was conducted. While the armies and navies were shooting off large blocks of the crops of 1880 or 1890, work and wages were abundant for all who were competent for them. It is true, then, that the poor paid most of the cost of the war; it is also true that the poor had shared in that anticipation of the future which had been forced on the country, and that, when the drafts on the future came to be redeemed, it was done mainly by taxation on luxuries. The destruction of a Northern railway meant more work for Northern iron mills and their workmen. The destruction of a Southern road was an unmitigated injury; it had to be made good at once, by paper issues; the South could make no drafts on the future, by bond issues, for the blockade had put cotton out of the game, and Southern bonds were hardly saleable. Every expense had to be met by paper issues; each issue forced prices higher; every rise in prices called for an increased issue of paper, with increased effects for evil. *A Rebel War-Clerk's Diary* gives the following as the prices in the Richmond market for May 1864: "Boots, $200; coats, $350; pantaloons, $100; shoes, $125; flour, $275 per barrel; meal, $60 to $80 per bushel; bacon, $9 per pound; no beef in market; chickens, $30 per pair; shad, $20; potatoes, $25 per bushel; turnip greens, $4 per peck; white beans, $4 per quart or $120 per bushel; butter, $15 per pound; lard, same; wood, $50 per cord." How the rise in wages, always far slower than other prices, could meet such prices as these one must be left to imagine. Most of the burden was sustained by the women of the South.

Paper Issues in the South.

Manufactures.

243. The complete lack of manufactures told heavily against the South from the beginning. As men were drawn from agriculture in the North and West, the increased demand for labour was shaded off into an increased demand for agricultural machinery; every increased percentage of power in reaping-machines liberated so many men for service at the front. The reaping-machines of the South—the slaves—were incapable of any such improvement, and, besides, required the presence of a portion of the possible fighting-men at home to watch them. There is an evident significance in the exemption from military duty in the Confederate States of "one agriculturist on such farm, where there is no white male adult not liable to duty, employing 15 able-bodied slaves between ten and fifty years of age." But, to the honour of the enslaved race, no insurrection took place.

Confederate Congress and President.

244. The pressing need for men in the army made the Confederate Congress utterly unable to withstand the growth of executive power. Its bills were prepared by the cabinet, and the action of Congress was quite perfunctory. The suspension of the writ of *habeas corpus*, and the vast powers granted to President Davis, or assumed by him under the plea of military necessity, with the absence of a watchful and well-informed public opinion, made the Confederate government by degrees almost a despotism. It was not until the closing months of the war that the expiring Confederate Congress mustered up courage enough to oppose the president's will. (See CONFEDERATE STATES OF AMERICA.) The organized and even radical opposition to the war in the North, the meddlesomeness of Congress and its "committees on the conduct of the war," were no doubt unpleasant to Lincoln but they carried the country through the crisis without the effects visible in the South.

National Banking System.

245. Another act of Federal legislation — the National Bank Act (Feb. 25, 1863; supplemented by the act of June 3, 1864)—should be mentioned here, as it was closely connected with the sale of bonds. The banks were to be organized, and, on depositing United States bonds at Washington, were to be permitted to issue notes up to 90% of the value of the bonds deposited. As the redemption of the notes was thus assured, they circulated without question all over the United States. By a subsequent act (1865) the remaining state bank circulation was taxed out of existence. (See BANKS AND BANKING: *United States*.)

Admission of West Virginia.

246. At the beginning of 1862 the lines of demarcation between the two powers had become plainly marked. The western part of Virginia had separated itself from the parent state, and was admitted as a state (1863) under the name of West Virginia. It was certain that Delaware, Maryland, Kentucky and Missouri had been saved to the Union, and that the battle was to be fought out in the territory to the south of them.

247. At the beginning of the war the people and leaders of the North had not desired to interfere with slavery, but circumstances had been too strong for them. Lincoln had declared that he meant to save the Union as he best could—by preserving slavery, by destroying it, or by destroying part

The Emancipation Proclamation.

and preserving part of it. Just after the battle of Antietam (17 Sept. 1862) he issued his proclamation calling on the revolted states to return to their allegiance before the next year, otherwise their slaves would be declared free men. No state returned, and the threatened declaration was issued on the 1st of January 1863. As president, Lincoln could issue no such declaration; as commander-in-chief of the armies and navies of the United States he could issue directions only as to the territory within his lines; but the Emancipation Proclamation applied only to territory outside of his lines. It has therefore been debated whether the proclamation was in reality of any force. It may fairly be taken as an announcement of the policy which was to guide the army, and as a declaration of freedom taking effect as the lines advanced. At all events, this was its exact effect. Its international importance was far greater. The locking up of the world's source of cotton supply had been a general calamity, and the Confederate government and people had steadily expected that the English and French governments, or at least one of them, would intervene in the war for the purpose of raising the blockade and releasing the Southern cotton. The conversion of the struggle into a crusade against slavery made intervention impossible for governments whose peoples had now a controlling influence on their policy and intelligence enough to understand the issue.

Confederate Privateers.

248. Confederate agents in England were numerous and active. Taking advantage of every loophole in the British Foreign Enlistment Act, they built and sent to sea the "Alabama" and "Florida," which for a time almost drove Federal commerce from the ocean. Whenever they were closely pursued by United States vessels they took refuge in neutral ports until a safe opportunity occurred to put to sea again. Another, the "Georgia," was added in 1863. All three were destroyed in 1864. (See ALABAMA ARBITRATION.) Confederate attempts to have ironclads equipped in England and France were unsuccessful.

The Current of Success changes.

249. The turning-point of the war was evidently in the early days of July 1863, when the victories of Vicksburg and Gettysburg came together. The national government had at the beginning cut the Confederate States down to a much smaller area than might well have been expected; its armies had pushed the besieging lines far into the hostile territory, and had held the ground which they had gained; and the war itself had developed a class of generals who cared less for the conquest of territory than for attacking and destroying the opposing armies. The great drafts on the future which the credit of the Federal government enabled the North to make gave it also a startling appearance of prosperity; so far from feeling the war, it was driving production of every kind to a higher pitch than ever before.

250. The war had not merely developed improved weapons and munitions of war; it had also spurred the people on to a more careful attention to the welfare of the soldiers, the fighting men drawn from their own number. The sanitary commission, the Christian commission, and other voluntary associations for the physical and moral care of soldiers, received and disbursed very large sums. The national government was paying an average amount of $2,000,000 per day for the prosecution of the war, and, in spite of the severest taxation, the debt grew to $500,000,000 in June 1862, to twice that amount a year later, to $1,700,000,000 in June 1864, and reached its maximum on the 31st of August 1865—$2,845,907,626. But this lavish expenditure was directed with energy and judgment. The blockading fleets were kept in perfect order and with every condition of success. The railway and telegraph were brought into systematic use for the first time in modern warfare. Late in 1863 Edwin M. Stanton, the secretary of war, moved two corps of 23,000 men from Washington to Chattanooga, 1200 m., in seven days. A year later he moved another corps, 15,000 strong, from Tennessee to Washington in eleven days, and within a month had collected vessels and transferred it to North Carolina.

Conscription.

251. On the other hand, the Federal armies now held almost all the great southern through lines of railroad, except the Georgia lines and those which supplied Lee from the South. The want of the Southern people was merely growing in degree, not in kind. The conscription, sweeping from the first, had become omnivorous; towards the end of the war every man between seventeen and fifty-five was legally liable to service, and in practice the only limit was physical incapacity. In 1863 the Federal government also was driven to conscription. The first attempts to carry it out resulted in forcible resistance in several places, the worst being the "draft riots" in New York (July), when the city was in the hands of the mob for several days. All the resistance was put down; but exemptions and substitute purchases were so freely permitted that the draft in the North had little effect except as a stimulus to the states in filling their quotas of volunteers by voting bounties.

Election of 1864.

Admission of Nevada.

252. In 1864 Lincoln was re-elected with Andrew Johnson as vice-president. The Democratic Convention had declared that, after four years of failure to restore the Union by war, during which the Constitution had been violated in all its parts under the plea of military necessity, a cessation of hostilities ought to be obtained, and had nominated General George B. McClellan and G. H. Pendleton. Farragut's victory in Mobile Bay (Aug. 5), by which he sealed up the last port, except Wilmington, of the blockade-runners, and the evidently staggering condition of the Confederate resistance in the East and the West, were the sharpest commentaries on the Democratic platform; and its candidates carried only three of the twenty-five states which took part in the election.[1] The thirty-sixth state—Nevada—had been admitted in 1864.

Surrender of Lee.

Surrender of Johnston.

253. The actual fighting of the war may be said to have ended with the surrender of General Robert E. Lee to General U.S. Grant at Appomattox, Va., on the 9th of April 1865. All the terms of surrender named by Grant were generous: no private property was to be surrendered; both officers and men were to be dismissed on parole, not to be disturbed by the United States government so long as they preserved their parole and did not violate the laws; and he instructed the officers appointed to receive the paroles "to let all the men who claim to own a horse or mule take the animals home with them to work their little farms." It should be stated, also, to Grant's honour that, when the politicians afterwards undertook to repudiate some of the terms of surrender, he personally intervened and used the power of his own name to force an exact fulfilment. General Joseph E. Johnston, with the only other considerable army in the field, surrendered on much the same terms at Durham Station, N.C. (April 26), after an unsuccessful effort at a broader settlement. All organized resistance had now ceased; Union cavalry were ranging the South, picking up government property or arresting leaders; but it was not until May that the last detached parties of Confederates gave up the contest.

Death of Lincoln.

254. Just after Lee's surrender President Lincoln died by assassination (April 15), the crime of a half-crazed enthusiast. Even this event did not impel the American people to any vindictive use of their success for the punishment of individuals. In the heat of the war, in 1862, Congress had so changed the criminal law that the punishment of treason and rebellion should no longer be death alone, but death or fine and imprisonment. Even this modified punishment was not inflicted. There was no hanging; some of the leaders were imprisoned for a time, but never brought to trial.

The Opposing Armies.

255. The armies of the Confederacy are supposed to have been at their strongest (700,000) at the beginning of 1863; and it is doubtful whether they contained 200,000 men in March 1865. The dissatisfaction of the southern people at the manner in which Davis

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[1] Lincoln received 212 electoral votes and McClellan only 21; but Lincoln's popular vote was only about 407,000 in excess of McClellan's, out of about 4,000,000.

Cost of the War.

had managed the war seems to have been profound; and it was only converted into hero-worship by the ill-advised action of the Federal government in arresting and imprisoning him. Desertion had become so common in 1864, and the attempts of the Confederate government to force the people into the ranks had become so arbitrary, that the bottom of the Confederacy, the democratic elements which had given it all the success it had ever obtained, had dropped out of it before Sherman moved northward from Savannah; in some parts the people had really taken up arms against the conscripting officers. On the contrary, the numbers of the Federal armies increased steadily until March 1865, when they were a few hundreds over a million. As soon as organized resistance ceased, the disbanding of the men began; they were sent home at the rate of about 300,000 a month, about 50,000 being retained in service as a standing army. The cost of the Civil War has been variously estimated: by Mulhall (*Dictionary of Statistics*, 4th ed., 1899, p. 541) at £555,000,000 and (p. 586) at £740,000,000; by Nicolay and Hay (*Abraham Lincoln*, vol. x., p. 339) at $3,250,000,000 to the North and $1,500,000,000 to the South; by Edward Atkinson (the *Forum*, October 1888, p. 133), including the first three years of Reconstruction at $5,000,000,000 to the North and $3,000,000,000 to the South. The last alone of these estimates is an approximation to the truth. The ordinary receipts of the government for the four fiscal years 1862 to 1865 totalled $729,458,336, as compared with $196,963,373 for the four preceding years, 1858–1861; the difference representing the effort of the treasury to meet the burden of war. In the same period more than $2,600,000,000 was secured in loans upon the credit of the nation; and this total was raised by later borrowings on account of the war to more than $2,800,000,000. The immediate and direct cost of the struggle to the North was therefore about $3,330,000,000. To this sum must be added, in order to obtain the final and total cost: (1) the military pensions paid on account of the war since 1861—about $3,600,000,000 up to 1909, inclusive; (2) the interest on the war debt, approximately $3,024,000,000 in the same period; (3) the expenditures made during the war by state and local governments, which have never been totalled, but may be put at $1,000,000,000; and (4) the abnormal expenditures for army and navy during some years following the war, which may be put, conservatively, at $500,000,000. The result is a total of some $11,450,500,000 for the North alone. But the cost to the South also was enormous; $4,000,000,000 cannot be an exaggeration. It follows that, up to 1909, the cost of the war to the nation had approximated the tremendous total of $15,500,000,000.

Results of the War.

256. In return for such an expenditure, and the death of probably 300,000 men on each side, the abiding gain was incalculable. The rich section, which had been kept back in the general development by a single institution, and had been a clog on the advance of the whole country, had been dragged up to a level with the rest of the country. Free labour was soon to show itself far superior to slave labour in the South; and the South was to reap the largest material gain from the destruction of the Civil War. The persistent policy of paying the debt immediately resulted in the higher taxation falling on the richer North and West. As a result of the struggle the moral stigma of slavery was removed. The power of the nation, never before asserted openly, had made a place for itself; and yet the continuing power of the states saved the national power from a development into centralized tyranny. And the new power of the nation, by guaranteeing the restriction of government to a single nation in central North America, gave security against any introduction of international relations, international armament, international wars, and continual war taxation into the territory occupied by the United States. Finally, democracy in America had certainly shown its ability to maintain the unity of its empire.

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L.—*History, 1865–1910.*

257. The capitulation of Lee (April 9, 1865), followed by the assassination of Lincoln (April 15) and the surrender of the last important Confederate army, under J. E. Johnston, marked the end of the era of war and the beginning of that of Reconstruction, a problem which involved a revolution in the social and political structure of the South, in the relation of state and nation in the American Federal Union, and in the economic life of the whole country.

258. Economically the condition of the South was desperate. The means of transport were destroyed; railways and bridges were ruined; Southern securities were valueless; the Confederate currency system was completely disorganized. Great numbers of the emancipated negroes wandered idly from place to place, trusting the Union armies for sustenance, while their former masters toiled in the fields to restore their plantations.

Social and Economic Condition of the South.

259. The social organization of the South had been based on negro slavery. Speaking generally, the large planters had constituted the dominant class, especially in the cotton states; and in the areas of heaviest negro population these planters had belonged for the most part to the old Whig party. Outside of the larger plantation areas, especially in the hill regions and the pine barrens, there was a population of small planters and poor whites who belonged in general to the Democratic party. In the mountain regions, where slavery had hardly existed, there were Union areas, and from the poor whites of this section had come Andrew Johnson, senator and war governor of Tennessee, who was chosen vice-president on the Union ticket with Lincoln in 1864 as a recognition of the Union men of the South. Accidental as was Johnson's elevation to the presidency, there was an element of fitness in it, for the war destroyed the former ruling class in the Southern States and initiated a democratic revolution which continued after the interregnum of negro government. Of this rise of the Southern masses Johnson was representative.

Distrust of President Johnson.

260. The importance of personality in history was clearly illustrated when the wise and sympathetic Lincoln, who had the confidence of the masses of the victorious North, was replaced by Johnson, opinionated and intemperate, whose antecedents as a Tennessean and Democrat, and whose state rights' principles and indifference to Northern ideals of the future of the negro made him distrusted by large numbers of the Union Republican party.

Union Republican Party.

261. The composition of this party was certain to endanger its stability when peace came. It had carried on the war by a coalescence of Republicans, War Democrats, Whigs, Constitutional Unionists and Native Americans, who had rallied to the cause of national unity. At the outset it had asserted that its purpose was not to interfere with the established institutions in slave states, but to defend the Constitution, and to preserve the Union with all the dignity, equality and rights of the several states unimpaired. But the war had destroyed slavery, as well as preserved the Union, and the civil status of the negro and the position of the revolted states now became burning questions, reviving old antagonisms and party factions. To the extremists of the Radical wing it seemed in accordance with

the principles of human liberty that the negro should not only be released from slavery but should also receive full civil rights, including the right to vote on an equality with the whites. This group was also ready to revolutionize Southern society by destroying the old ascendancy of the great planter class. Of this idealistic school of radical Republicans, Charles Sumner, of Massachusetts, was the spokesman in the Senate, and Thaddeus Stevens, of Pennsylvania, in the House.

262. For many years before the war parties had differed on such important questions as the tariff, internal improvements and foreign policy; and the South had used its alliance with the Northern Democracy to resist the economic demands of the industrial interests of the North. A return of Southern congressmen, increased in numbers by the inapplicability to the new conditions of the constitutional provision by which they had representation for only a fraction of the slaves, might mean a revival of the old political situation, with the South and the Northern Democracy once more in the saddle.

Northern Attitude towards the South.

263. Any attempt to restore the South to full rights, therefore, without further provision for securing for the freedmen the reality of their freedom, and without some means of establishing the political control of the victorious party, would create party dissension. Even Lincoln had aroused the bitter opposition of the radical leaders by his generous plan of Reconstruction. Johnson could have secured party support only by important concessions to the powerful leaders in Congress; and these concessions he was temperamentally unable to make. The masses of the North, especially in the first rejoicings over the peace, were not ungenerous in their attitude; and the South, as a whole, accepted the results of defeat in so far as to acquiesce in the permanence of the Union and the emancipation of the slaves, the original issues of the war.

264. In the settlement of the details of Reconstruction, however, there were abundant opportunities for the hatred engendered by the war to flame up once more. As it became clear that the Northern majority was determined to exclude the leaders of the South from political rights in the reconstruction of the Union, and especially as the radicals disclosed their purpose to ensure Republican ascendancy by subjecting the section to the rule of the loyalist whites and, later, to that of the emancipated negroes, good will disappeared, and the South entered upon a fight for its social system. The natural leaders of the people, men of intelligence and property, had been the leaders of the section in the war. Whatever their views had been at first as to secession, the great majority of the Southern people had followed the fortunes of their states. To disfranchise their leaders was to throw the control into the hands of a less able and small minority of whites; to enfranchise the blacks while disfranchising the white leaders was to undertake the task of subordinating the former political people of a section to a different race, just released from slavery, ignorant, untrained, without property and fitted only to follow the leadership of outside elements. The history of this attempt and its failure constitutes much of that of the Reconstruction.

265. These underlying forces were in reality more influential than the constitutional theories which engaged so much of the discussion in Congress, theories which, while they afford evidence of the characteristic desire to proceed constitutionally were really urged in support of, or opposition to, the interests just named.

Theories Regarding the Status of the Southern States.

266. The most extreme northern Democrats, and their southern sympathizers, starting from the premise that constitutionally the Southern states had never been out of the Union, contended that the termination of hostilities restored them to their former rights in the Federal Union unimpaired and without further action. This theory derived support from President Lincoln's view that not states, but assemblages of individuals, had waged war against the government. The theory of the extreme Republican Radicals was formulated by Sumner and Stevens. The former contended that, while the states could not secede, they had by waging war reduced themselves to mere Territories of the United States, entitled only to the rights of Territories under the Constitution. Stevens went further and, appealing to the facts of secession, declared the Southern states conquered provinces, subject to be disposed of under international law at the will of the conqueror. In the end Congress adopted a middle ground, holding that while the states could not leave the Union, they were, in fact, out of normal relations, and that the constitutional right of the Federal government to guarantee republican governments to the various states gave to Congress the power to impose conditions precedent to their rehabilitation.

President Lincoln's Policy.

267. It is necessary to recall the initiation of Reconstruction measures by President Lincoln rightly to understand the position which was taken by President Johnson. Impatient of theoretical discussion, Lincoln laid down practical conditions of restoration in his proclamation of the 8th of December 1863. In this he offered amnesty to those who would take an oath of loyalty for the future and accept the acts of Congress and the proclamation of the president with reference to slaves. From the amnesty he excepted the higher military, civil and diplomatic officers of the Confederacy as well as those who had relinquished judicial stations, seats in Congress, or commissions in the army or navy to aid the rebellion, and those who had treated persons in the Federal service otherwise than lawfully as prisoners of war. The proclamation provided, further, that when in any of the seceding states (except Virginia, where the president had already recognized the loyal government under Governor Francis H. Pierpont) a number of persons not less than one-tenth of the voters in 1860 should have taken the above described oath, and, being qualified voters under the laws of the state in 1860, should have established a state government, republican in form, it should be recognized. Lincoln's comprehension of Southern difficulties was shown in his declaration in this proclamation that the president would not object to such provisions by the states regarding the freedmen as should, while declaring their freedom and providing for their education, recognize their condition as a labouring, landless and homeless class.

Attitude of Congress; the First Reconstruction Bill.

268. Although Lincoln expressly pointed out that the admission of the restored states to representation in Congress rested exclusively with the respective houses, and announced his readiness to consider other plans for Reconstruction, heated opposition by the radicals in Congress was called out by this proclamation. They feared that it did not sufficiently guarantee the abolition of slavery, which up to this time rested on the war powers of the president, and they asserted that it was the right of Congress, rather than that of the president, to determine the conditions and the process of Reconstruction. In a bill which passed the House by a vote of 73 to 59 and was concurred in by the Senate, Congress provided that Reconstruction was to be begun only when a majority of the white male citizens of any one of the Confederate States should take oath to support the Constitution of the United States. The president should then invite them to call a constitutional convention. The electors of this convention would be required to take an oath of allegiance which excluded a much larger class than those deprived of the benefit of the amnesty proclamation, for it eliminated all who had voluntarily borne arms against the United States, or encouraged hostility to it, or voluntarily yielded support to any of the Confederate governments. In addition to entrusting the formation of a constitution to the small minority of thorough-going loyalists, the bill required that the state constitution should exclude a large proportion of the civil and military officers of a Confederate government from the right of voting, and that it should provide that slavery be for ever abolished and that state and Confederate debts of the war period should never be paid. In July 1864 Lincoln gave a "pocket veto" to the bill and issued a proclamation explaining his reasons for refusing to sign, whereupon Benjamin F. Wade and Henry W. Davis (*q.v.*), leaders of

the radicals, violently attacked the president. The triumph of Lincoln in the election of 1864 did not clearly signify the will of the people upon the conditions of Reconstruction, or upon the organ of government to formulate them, for the declaration of the Democratic convention that the war was a failure overshadowed the issue, and the Union party which supported Lincoln was composed of men of all parties.

Thirteenth Amendment.

269. On January 31st 1865 the House concurred in the vote of the Senate in favour of the Thirteenth Amendment to the Constitution abolishing slavery throughout the Union. Four years earlier Congress had submitted to the states another Thirteenth Amendment by the terms of which no amendment should ever authorize Congress to interfere with slavery within the states. But owing to the war this amendment had remained unratified, and now Congress proposed to place beyond constitutional doubt, or the power of states to change it, the emancipation of slaves. By the 18th of December 1865 the amendment had been ratified and was proclaimed in force.

270. In the meantime, Louisiana, in accordance with Lincoln's proclamation, had adopted a constitution and abolished slavery within the state. Owing to the obstructive tactics of Sumner, aided by Democrats in the Senate, Congress adjourned on the 4th of March 1865 without having recognized this new state government as legitimate. "If we are wise and discreet," said Lincoln, "we shall reanimate the states and get their governments in successful operation with order prevailing and the Union re-established before Congress comes together in December."

271. Such was the situation when Johnson took up the presidency upon Lincoln's death. After an interval of uncertainty, in which he threatened vengeance against various Southern leaders and gave the radicals some hope that he would favour negro suffrage, President Johnson accepted the main features of Lincoln's policy. Congress not being in session, he was able to work out an executive Reconstruction on the lines of Lincoln's policy during the summer and autumn of 1865. On the 29th of May he issued a proclamation of amnesty, requiring of those who desired to accept its provisions an oath to support the Constitution and Union, and the laws and proclamations respecting the emancipation of slaves. Certain specified classes of persons were excepted, including certain additions to those excluded by Lincoln, especially "all persons who have voluntarily participated in said rebellion and the estimated value of whose taxable property is over twenty thousand dollars." This provision was characteristic of Johnson, who disliked the Southern planting aristocracy, and aimed at placing the preponderant power in the hands of the Democratic small farmers, who had been his supporters. To those of the excepted classes who would ask pardon from the president, he promised a liberal clemency. As part of his system he issued another proclamation in which he appointed a governor for North Carolina and laid down a plan for Reconstruction. By this proclamation it was made the duty of the governor to call a convention chosen by the loyal people of the state, for the purpose of altering the state constitution and establishing a state government. The right to vote for delegates to this convention was limited to those who had taken the oath of amnesty and who had been qualified to vote prior to the secession of the state. To the state itself was to be left the determination of the future qualifications of electors and office-holders.

Policy of President Johnson.

272. Already Virginia, Tennessee, Louisiana and Arkansas had governments which had been recognized by Lincoln. Between the 13th of June and the 13th of July 1865 Johnson applied the same process which he had outlined for North Carolina to the remaining states of the Confederacy. Before Congress met in December all the Confederate states, except Texas (which delayed until the spring of 1866), had formed constitutions and elected governments in accordance with the presidential plan. All of their legislatures, except that of Mississippi, ratified the Thirteenth Amendment abolishing slavery.

273. Gradually, however, the South turned to its former leaders to shape its policy, and the radical Republicans of the North were alarmed at the rapidity of the process of restoration on these principles. The disorganized and idle condition of the former slaves constituted a serious element in the Southern situation, as Lincoln had foreseen. The negroes expected a grant of land from confiscated Southern estates, and it was difficult to preserve order and to secure a proper labour supply.

274. Under these conditions the efforts of the South to provide security for their communities by bodies of white militia were looked upon with apprehension by the North, and there was sufficient conflict between the two races to give colour to charges that the South was not accepting in good faith the emancipation of the slaves. Especially irritating to Northern sentiment were the so-called "black codes" or "peonage laws," passed by the newly elected Southern legislatures. They rested on the belief that it was necessary that the former slaves should be treated as a separate and dependent class, and varied in severity in the different states. Some of these imposed special disabilities upon the negro in the matter of carrying weapons and serving as witnesses. Vagrancy laws and provisions regarding labour contracts which had precedents in colonial and English legislation, but were specifically framed to restrain the negroes only, were common. Mississippi denied them the right to own land, or even to rent it outside of incorporated towns; South Carolina restricted them to husbandry and to farm or domestic service, unless specially licensed. Although several of the Southern states, perceiving that their course was likely to arouse the North to drastic measures, repealed or mitigated the most objectionable laws, the North had received the impression that an attempt had been made to restore slavery in disguised form.

Southern "Black Codes."

275. The problem of succouring and protecting the negroes had forced itself upon the attention of the North from the beginning of the war, and on the 3rd of March 1865 Congress had created the Freedmen's Bureau (*q.v.*), with the power to assign abandoned lands, in the states where the war had existed, to the use of the freedmen; to supervise charitable and educational activities among them; to exercise jurisdiction over controversies in which a freedman was a party; and to regulate their labour contracts. The local agents of the bureau were usually Northern men; some of them gave the worst interpretation to Southern conditions and aroused vain hopes in the negroes that the lands of the former masters would be divided among them; and later many of them became active in the political organization of the negro.

The Freedmen's Bureau.

276. Although the national government itself had thus recognized that special treatment of the freedmen was necessary, Congress, on assembling in December 1865, was disposed to regard the course of the South in this respect with deep suspicion. Moreover, as the Thirteenth Amendment was now ratified, it was seen that the South, if restored according to the presidential policy, would return to Congress with added representatives for the freed negroes. Only three-fifths of the negro slaves had been counted in apportioning representatives in Congress; though now free they were not allowed to vote.

277. Under the leadership of the Radicals Congress refused, therefore, to receive the representatives of the states which had met the conditions of the president's proclamations. A joint committee of fifteen took the whole subject of Reconstruction under advisement, and a bill was passed continuing the Freedmen's Bureau indefinitely. When this was vetoed by President Johnson (Feb. 19, 1866) Congress retaliated by a concurrent resolution (March 2) against admitting any reconstructed state until Congress declared it entitled to recognition, thus asserting for the legislative body the direction of Reconstruction.

278. While the measure was under consideration the president in an intemperate public address stigmatized the leaders of the radicals by name as labouring to destroy the principles

of the government and even intimated that the assassination of the president was aimed at. It was hardly possible to close the breach after this, and the schism between the president and the leaders of the Union Republican party was completed when Congress passed (April 9, 1866) the Civil Rights Bill over Johnson's veto. The act declared the freedmen to be citizens of the United States with the same civil rights as white persons and entitled to the protection of the Federal government. It provided punishment for those who, relying upon state authority, should discriminate against the negroes.

Breach between the President and Congress; the Civil Rights Bill.

The Fourteenth Amendment.

279. To place this measure beyond the danger of overthrow by courts, or by a change of party majority, on the 13th of June 1866 Congress provided for submitting to the states a Fourteenth Amendment to the Constitution. This gave constitutional guarantee of citizenship and equal civil rights to freedmen, and, in effect, provided that when in any state the right to vote should be denied to any of the male inhabitants twenty-one years of age and citizens of the United States, except for participation in rebellion or other crime, the basis of representation in the state should be reduced in the proportion which the number of such citizens bore to the whole number of male citizens twenty-one years of age in the state. This section of the amendment, therefore, left the states the option between granting the suffrage to the negro or suffering a proportionate reduction in the number of representatives in Congress. It was a fair compromise which might have saved the South from a long period of misrule and the North from the ultimate breakdown of its policy of revolutionizing Southern political control by enfranchisement of the blacks and disfranchisement of the natural leaders of the whites. But the South especially resented that section of the amendment which disqualified for Federal or state office those who, having previously taken an oath to support the Constitution of the United States, afterwards engaged in rebellion, which involved the repudiation of their leaders. The amendment further safeguarded the validity of the United States debt and declared null the war debt of the seceding states and the Confederacy and forbade the payment of claims for emancipation.

280. In order to ensure the passage of this amendment the Radical leaders proposed bills which declared that, after its adoption, any of the seceding states which ratified it should be readmitted to representation. But it also provided that the higher classes of officials of the Confederacy should be ineligible to office in the Federal government. These bills were allowed to await the issue of the next election.

281. For further protection of the rights of the negro, Congress succeeded in passing, over President Johnson's veto, an act continuing the Freedmen's Bureau for two years. Tennessee having ratified the Fourteenth Amendment was (July 24, 1866) restored to representation and Congress adjourned, leaving the issue between the president and the legislative body to the people in the Congressional elections.

Party Realignments.

282. The campaign brought with it some realignment of party. President Johnson having broken with the leaders of the Union Republican party was more and more forced to rely upon Democratic support, although his executive appointments were still made from the ranks of the Republicans. The so-called National Union Convention, which met in Philadelphia in midsummer in an effort to abate sectionalism, and to endorse the president's policy, included a large number of War Democrats who had joined the Union party after the secession of the South, many moderate Southerners, a fragment of the Republican party, and a few Whigs, especially from the Border states. They claimed that the southern States had a right to be represented in Congress. Other meetings friendly to the Radicals were called, and under the designation of Union-Republican party they declared for the Congressional policy. While the campaign for elections to Congress was in progress the president made a journey to Chicago, speaking at various cities *en route* and still further alienating the Republicans by coarse abuse of his opponents. As a result of the autumn elections two-thirds of the members of the House of Representatives were opposed to him. Almost contemporaneously every seceding state except Tennessee rejected the Fourteenth Amendment, and thereby paved the way for the entire triumph of the Northern extremists, who favoured negro suffrage on idealistic grounds or as a means for forcing the South to agree to the Republican policy.

Tenure of Office Act.

283. In the ensuing winter and spring Congress completed the conquest of the president, awed the Supreme Court, and provided a drastic body of legislation to impose negro suffrage on the South. By the Tenure of Office Act (March 2, 1867) Congress forbade the president to remove civil officers without the consent of the Senate, and at the same time by another act required him to issue military orders only through the general of the army (Grant), whom the president was forbidden to remove from command or to assign to duty at another place than Washington, unless at the request of the officer or by the prior assent of the Senate. These extraordinary invasions of the presidential authority were deemed necessary to prevent Johnson from securing control of the military arm of the government, and to protect Edwin Stanton, the secretary of war, and General Grant. Fearing lest the president might take advantage of the interim during which Congress would not be in session, the Fortieth Congress was required to meet on the 4th of March immediately following the expiration of the thirty-ninth.

Reconstruction Act of March 2, 1867.

284. The Reconstruction Act of the 2nd of March 1867 provided for the military government of the Southern states while the drastic policy of Congress was being carried out. It was passed over the veto of the president and declared that no legal governments or adequate protection for life or property existed in the seceding states, except Tennessee. These states it divided into five military districts, each to be placed under the command of a general of the army, whose duty it was to preserve law and order, using at discretion either local civil tribunals or military commissions. But the existing civil governments were declared provisional only and subject to the paramount authority of the United States to abolish, modify, control, or supersede them. The act further provided that a constitutional convention might be elected by the adult male citizens of the state, of whatever race, colour or previous condition, resident in the state for a year, except such as might be disfranchised for rebellion or felony. No persons excluded from holding office under the Fourteenth Amendment were eligible for election to the convention or entitled to vote for its members.

285. When the convention, thus chosen under negro suffrage, and with the exclusion of Confederate leaders, should have framed a state constitution conforming to the Federal Constitution and allowing the franchise to those entitled to vote for the members of the convention, the constitution was to be submitted for the approval of Congress. If this were obtained and if the state adopted the Fourteenth Amendment, and this amendment became a part of the Federal Constitution, then the state should be entitled to representation in Congress; but the senators and representatives sent to Congress were required to take the "ironclad oath," which excluded those who had fought in the Confederate service, or held office under any government hostile to the United States, or given support to any such authority.

Supplementary Acts.

286. By the pressure of military control Congress thus aimed at forcing the adoption of the Fourteenth Amendment, as well as the acceptance of negro suffrage in the state constitutions of the South. A supplementary act of the 23rd of March 1867 and an act of interpretation passed on the 19th of July completed this policy of "thorough." In the registration of voters the district commanders were required to administer an oath which excluded those disfranchised for rebellion and those who after holding state or Federal office had given aid and comfort to the enemies of the United States.

287. Against this use of military power to govern states in

time of peace the Supreme Court interposed no effective obstacle. Like the executive it was subordinated to Congress. It is true that in the case *ex parte Milligan*, decided in December 1866, the court held military commissions unlawful where the ordinary civil tribunals were open. In the case of *Cummings* v. *Missouri* (Jan. 14, 1867) it decided also that a state test oath excluding Confederate sympathizers from professions was a violation of the prohibition of *ex post facto* laws; and the court (*ex parte Garland*) applied the same rule to the Federal test oath so far as the right of attorneys to practise in Federal courts was concerned.

Supreme Court Decisions.

288. But threats were made by the radicals in Congress to take away the appellate jurisdiction of the court, and even to abolish the tribunal by constitutional amendment. The judges had been closely divided in these cases and, when the real test came, the court refused to set itself in opposition to Congress. When Mississippi attempted to secure an injunction to prevent the president from carrying out the Reconstruction acts, and when Georgia asked the court to enjoin the military officers from enforcing these acts in that state, the Supreme Court refused (April and May 1867), pleading want of jurisdiction. Chief Justice Salmon P. Chase argued that if the president refused to obey the court could not enforce its decree, while if he complied with the order of the court, and if the House of Representatives impeached him for refusing to enforce the law, the Supreme Court would be forced to the vain attempt to enjoin the Senate from sitting as a court of impeachment.

McCardle Case.

Texas v. White.

289. In one instance it seemed inevitable that the court would clash with Congress; the *McCardle case* involved an editor's arrest by military authority for criticizing that authority and the Reconstruction policy. But Congress, apprehending that the majority of the court would declare the Reconstruction acts unconstitutional, promptly repealed that portion of the act which gave the court jurisdiction in the case, and thus enabled the judges to dismiss the appeal. Afterwards, when the Reconstruction policy had been accomplished, the court, in the case of *Texas* v. *White* (1869), held that the Constitution looked to "an indestructible Union composed of indestructible states"; and that although the secession acts were null, and the Federal obligations of the seceding states remained unimpaired, yet their rights were suspended during the war. It also held that in re-establishing the broken relations of the state with the Union, Congress, under the authority to guarantee to every state a republican form of government, was obliged to regard the freedmen as part of the people of the state, and was entitled to decide what government was the established one. This decision, though it did not involve the direct question of the constitutionality of the Reconstruction acts, harmonized with the general doctrines of the Congressional majority.

Impeachment of President Johnson.

290. The powerful leaders of the Republicans in Congress had been awaiting their opportunity to rid themselves of President Johnson by impeachment. After various failures to convince a majority of the House that articles should be preferred against him, an opportunity seemed to present itself when Johnson, in the summer recess of 1867, suspended Secretary Stanton and made General Grant the acting secretary of war. The Senate, on reassembling, refused to consent to the suspension, and General Grant yielded his office to Stanton, thus spoiling the president's plan to force Stanton to appeal to the courts to obtain his office and so test the constitutionality of the Tenure of Office Act. This proved to be a turning-point in Grant's political career, for by his break with Johnson he gained new support among the masses of the Republican party. To Johnson's foes it seemed that the president had delivered himself into their hands when he next defied Congress by taking the decisive step of removing Stanton in defiance of the Tenure of Office Act, and the House announced to the Senate (Feb. 25, 1868) its decision to bring articles of impeachment against the president. But careful reading of the law showed that it could not be relied on as conclusive ground for impeachment, for it provided that cabinet officers should hold office during the term of the president by whom they were appointed and for one month thereafter, subject to removal with the consent of the Senate. As Stanton had been appointed by President Lincoln and had merely continued under Johnson, a doubtful question was raised. The leaders, therefore, incorporated additional charges in the articles of impeachment which they pushed through the House of Representatives. By these the president was accused of attempting to bring the legislative branch into disgrace by his public utterances and of stigmatizing it as a Congress of only part of the states. This raised the question whether it was necessary to show a legal, technical crime or misdemeanour as the necessary ground of impeachment. Had the theory of the leaders that this was not the case been successful, the executive would have been reduced to an obvious dependence upon Congress. In the spring of 1868, however, the trial by the Senate resulted in a verdict of acquittal. (See JOHNSON, ANDREW.)

Acquittal by the Senate.

"Carpet-baggers" and "Scalawags"; the Union League.

291. Meanwhile the military Reconstruction of the South and the organization of the negro vote progressed effectively. The party management of the negroes was conducted by "carpet-baggers," as the Northern men who came South to try their fortunes under these new conditions were nicknamed, and by the white loyalists of the South, to whom was given the name "scalawags." In the work of marshalling the freedmen's vote for the Republican party secret societies like the Loyal League, or Union League (*q.v.*), played an important part. As the newly enfranchised mass of politically untrained negroes passed under Northern influence politically, the Southern whites drew more and more together in most of the former Confederate States, and although they were unable under the existing conditions to take control, they awaited their opportunity. A "Solid South" was forming in which old party divisions gave way to the one dominant antagonism to Republican ascendancy by negro suffrage; and a race antagonism developed which revealed the fact that underneath the slavery question was the negro question.

292. Politically the important fact was that the Republicans had rejected the possibility of reviving the old party lines in the South, and had gambled upon the expectation of wielding the united coloured vote with such leadership and support as might be gained from former Northerners and loyal whites. In the end negro rule failed, as was inevitable when legal disabilities and military force were removed; but the masses of the Southern whites emerged with a power which they had not possessed under the old rule of the planting aristocracy. For the time being, however, negro votes gave control to the Republicans. In South Carolina, Florida, Alabama, Mississippi and Louisiana the negroes were in a majority; in Virginia, North Carolina, Arkansas and Texas they were in the minority; while in Georgia the two races were nearly evenly balanced.

Policy of the South; the Ku-Klux Klan.

293. The white leaders of the South were divided as to the best means of meeting the problem. Some advocated that those entitled to vote should register, and then refrain from the polls, in order to defeat the constitutions made under negro suffrage, for the law required them to be ratified by a majority of the qualified voters. Others would have the white race bear no part in the process. Societies such as the "Ku-Klux Klan" and the "Knights of the White Camelia" were organized to intimidate or restrain the freedmen. But for the present the Republicans carried all before them in the South. Some of the new state constitutions imposed severe disfranchisement upon the former dominant class, and before the end of July 1868 all of the former Confederate States, except Virginia, Mississippi and Texas, had ratified the Fourteenth Amendment, which was proclaimed in effect. By the beginning of 1870 these three states had also ratified the amendment, as had

Georgia a second time, because of her doubtful status at the time of her first ratification.

Six Southern States Restored to the Union.

294. By the summer of 1868 Arkansas, South Carolina, North Carolina, Georgia, Alabama, Louisiana and Florida, having satisfied the requirements of the Reconstruction acts, were entitled to representation in Congress. But Georgia did not choose her senators until after the adjournment of Congress, and, inasmuch as the state excluded the negro members of the legislature in September, Congress on reassembling returned the state to military rule until its submission. Alabama was restored in spite of the fact that her white voters had remained away from the polls in sufficient numbers to prevent a majority of all the voters registered from having ratified the constitution of the state, as the Reconstruction acts had required. The nominating conventions and the campaign of 1868 gave interesting evidence of the trend of political and economic events. Party lines, which had broken down in the North when all united in saving the Union, were once more reasserting themselves. President Johnson, who had been elected by the Union Republican party, had found his most effective support among the Democrats. The Republicans turned to General Grant, a Democrat before the outbreak of the war. His popularity with the Republicans was due not only to his military distinction, but also to his calm judgment in the trying period of the struggle between the president and Congress. He was seriously considered by the Democrats until he broke with Johnson in the Stanton episode.

National Republican Convention; Grant Nominated for the Presidency.

295. The Republican nominating convention met on the 20th of May 1868, a few days after the failure of the impeachment proceedings, and it chose Grant as the candidate for the presidency. The platform supported the Congressional Reconstruction measures. Upon the vital question whether universal negro suffrage should be placed beyond the power of states to repeal it by a new constitutional amendment, the platform declared: "The guarantee by Congress of equal suffrage to all loyal men at the South was demanded by every consideration of public safety, of gratitude and of justice, and must be maintained; while the question of suffrage in all the loyal states properly belongs to the people of those states." Nowhere in the North was the negro an important element in the population, but the North had shown an unwillingness to apply to itself the doctrines of negro rights which had been imposed upon the South. Between 1865 and 1868 Connecticut, Wisconsin, Minnesota, Kansas, Ohio and Michigan had refused to give the negro the right to vote within their own bounds, and this plank was evidence of the unwillingness of the party to make a direct issue of universal negro suffrage. Although the platform failed to indicate the future proposals of the Republican leaders on the negro question, on the topics of finance and currency it clearly showed that the party was controlled by economic interests which were to exercise increasing influence upon it. It pronounced in favour of payment of the public debt, not only according to the letter but the spirit of the laws under which it was contracted. The significance of this lay in its challenge to the Democratic agitation on the currency question.

296. It was this question which gave the tone to the proceedings of the Democracy at their convention in July 1868. The situation can best be presented by a brief review of the financial history just preceding the convention. Together with the discussion over political Reconstruction in the South, Congress and the administration had been obliged to deal with the reconstruction of debt, taxation and currency in the nation at the close of four years of expensive war. At its maximum point the debt had risen to $2,758,000,000, of a complicated variety of forms. and of the total less than one-half was funded. The problems of funding, readjustment of taxation, and resumption of specie payments proved to be so complicated with the industrial growth of the nation that they led to issues destined to exert a long continued influence.

Finance; the Tariff; Internal Revenue.

297. The various war tariffs, passed primarily for the sake of increased revenue, had been shaped for protection under the influence of the manufacturing interests, and they had been framed also with reference to the need of compensating the heavy internal taxes which were imposed upon the manufacturers. When the war ended public sentiment demanded relief from these heavy burdens, and especially from the irksome internal taxes. The rapidly growing grain-raising districts of the Middle West exhibited a lively discontent with the protective tariff, but this did not prevent the passage in 1867 of the Wool and Woollens Act, which discriminated in favour of the woollen manufacturers and raised the *ad valorem* duty on wool. In spite of several large reductions of internal revenue, the national debt was being extinguished with a rapidity that only a prosperous and growing nation could have endured.

The Currency Question: "Greenbacks."

298. The currency question, however, furnished the economic issue which was most debated in the period of Reconstruction. One set of interests aimed at rapidly reducing the volume of the currency by retiring the legal tender notes, or "greenbacks," issued during the war, on the ground that they had been provided only as a war measure, that the country needed a contraction of this currency, and that specie payments would be hastened by the withdrawal of the greenbacks. The secretary of the treasury, Hugh McCulloch, pressed this policy to the foreground, and desired authority to issue bonds to retire these notes. Another set of interests demanded the retention of the greenbacks, supporting their views by arguments varying according to the degree of radicalism of the speakers. The more moderate, like Senator John Sherman, of Ohio, who reflected the views of parts of the West, argued that the recuperation of the nation and the rapid increase of business would absorb the existing currency, while gold would cease to go abroad. Thus, by the increasing credit of the government, specie payment would be automatically resumed, and the holders of currency certificates would convert them into coin obligations at a lower interest rate. Others wished to use the greenbacks to pay the principal of such of the bonds as did not explicitly specify coin as the medium of payment; the most extreme, so far from contracting the currency by retiring the greenbacks, wished to increase this form of money, while diminishing the circulation of the notes of the national banks. The discussion tended to produce a sectional issue with the West against the East, and a social issue with bondholders and the creditor class in general arrayed against the less well-to-do. Congress agreed with Secretary McCulloch, and in the Funding Act of 1866 not only provided for converting short-time securities into long-term bonds, but also for retiring ten million dollars of greenbacks in six months and thereafter not more than four millions monthly. But the agricultural depression of 1866 produced a reaction. Loud demands were made that bonds should be paid in greenbacks instead of coin, that United States securities should be taxed, and the national bank notes suppressed. In 1868, on the eve of the presidential campaign, Congress, alarmed by the extent of these popular demands, suspended the process of contraction by decisive majorities in both houses, after forty million dollars in greenbacks had been retired by the secretary of the treasury.

The "Ohio Idea."

299. Ohio was the storm centre of the agitation. The "Ohio idea" that greenbacks should become the accepted currency of the country was championed by George H. Pendleton, of that state, and his friends now brought him forward for the Democratic nomination for president on this issue. In the national convention of that party they succeeded in incorporating into the platform their demands that there should be one currency for the government and the people, the bondholder and the producer, and that where the obligations of the government did not expressly provide for payment in coin, they should be paid in lawful money (*i.e.* greenbacks) of the United States.

300. But another wing of the Democratic party desired to

make prominent the issue against the Reconstruction measures of the Republicans. This wing added to the platform and declaration that these acts were unconstitutional and void, and the demand that the Southern states should be restored to their former rights and given control over their own elective franchise.

National Democratic Convention; Seymour Nominated for the Presidency.

301. Although the followers of Pendleton had shaped the financial plank of the platform, they could not nominate their leader. The opposition was at first divided between the various candidates. New York, which feared the effect upon the conservative financial interests of the East if Pendleton were nominated, attempted to break the deadlock by proposing an Ohio man, Chief Justice Chase. But eager as Chase was for the presidency he had flatly refused to abandon the views which he held in favour of negro suffrage. Ohio was, therefore, able to retaliate by stampeding the convention in favour of Horatio Seymour, of New York, chairman of the convention. As the war governor of his state he had been a consistent critic of the extremes to which the Federal administration had carried its interpretation of the war power. For vice-president the convention nominated Francis P. Blair, jun., of Missouri, who had denounced the unconstitutionality of the Reconstruction acts in unmeasured terms.

Grant Elected.

302. But the popularity of Grant in the North, together with the Republican strength in the states of the South which had been reconstructed under negro suffrage, gave an easy victory to the Republicans in the election of 1868. Seymour carried only Delaware, New Jersey, New York and Oregon, of the North; and Maryland, Kentucky, Georgia and Louisiana of the South. Tennessee, and five of the former Confederate States, upon which negro suffrage had been imposed under military Reconstruction (North Carolina, South Carolina, Florida, Alabama and Arkansas) voted for Grant. Virginia, Mississippi and Texas had not yet been restored.

Fifteenth Amendment.

303. This decisive victory and the knowledge that it had been won by the advantage of the negro vote in the restored states led the Republican leaders to ignore their recent platform declaration in regard to negro suffrage. Shortly after Congress assembled propositions were made to place the freedman's right to vote beyond the power of the states to change. To do this by constitutional enactment it was necessary to make the provision universal, and Congress, therefore, submitted for ratification the Fifteenth Amendment declaring that "the right of citizens of the United States to vote shall not be denied or abridged by the United States or by any state on account of race, color or previous condition of servitude." Congress was given power to enforce the amendment by appropriate legislation. By the 30th of March 1870 the amendment had been ratified; but it is doubtful whether this could have been accomplished by legislatures chosen on the issue. As it was, the states of Virginia, Mississippi, Texas and Georgia were required to ratify it as a condition of their readmittance to representation in Congress, and the three former states, having been permitted to vote separately on the obnoxious provisions of their constitutions in regard to the disfranchisement of former Confederates, rejected those clauses, adopted the Fifteenth Amendment and were restored in 1870. Georgia, after a new experience of military rule, likewise ratified the amendment, and her representatives were likewise admitted to Congress.

Georgia Re-admitted.

New Congressional Measures.

304. As soon as the Fifteenth Amendment was proclaimed in effect, and the military governments of the South were superseded, the dominant party proceeded to enact measures of enforcement. These seemed especially necessary in view of the fact that, partly by intimidation of the coloured vote, Louisiana (1868) and Tennessee (1869) broke away from the Republican column; while in the election of 1870 Tennessee, North Carolina, Georgia, Virginia and Alabama went Democratic. The enforcement legislation of 1870 provided penalties for violating the Fourteenth and Fifteenth amendments and re-enacted the Civil Rights Act of 1866. Jurisdiction was given to the Federal courts to maintain the equality of the races before the law. The underlying doctrine of the acts was that the amendments guaranteed the freedmen against invasion of their rights by the acts of individuals as well as by explicit legislation of the states. In the next two years (1871 and 1872) acts were passed providing for effective Federal supervision of Congressional elections, and the "Ku-Klux Acts" (1871 and 1872) still further increased the power of the Federal courts to enforce the amendments and authorized the president to suspend the writ of *habeas corpus* and use military force to suppress the public disorders occasioned by the attempts to intimidate negro voters. But these stern measures were accompanied by some efforts to restore harmony, such as the repeal of the "iron-clad oath" for ex-Confederates, in 1871, and the passage of the General Amnesty Act of 1872. The North was becoming restive under the long continued use of the Federal military arm within state borders in time of peace, and especially with the results of negro rule under "carpet-bag" leadership.

Extravagance of Reconstruction Governments.

305. In any case the cost of rehabilitating the public works and providing education and the political and judicial institutions which should equally apply to the hitherto non-political class of the blacks, would have been a heavy one. But the legislatures, especially of Louisiana, South Carolina, Tennessee, Arkansas and Alabama, plunged into an extravagance made possible by the fact that the legislatures contained but few representatives who paid considerable taxes, and that they were controlled by Northern men who were sometimes corrupt, and often indifferent to the burdens laid upon the propertied classes of the South. In 1872 it was estimated that the public debts of the eleven reconstructed states amounted to nearly $132,000,000, two-thirds of which was composed of guarantees to corporations, chiefly railway companies. Legislative expenses were grotesquely extravagant, the coloured members in some states engaging in a saturnalia of corrupt expenditure. Gradually this alienated from the so-called Radical party the support of Southern whites, because they resented the concessions of the carpet-bag leaders to the negro vote, because they suffered from the burden of taxation, and above all because race friction increased, drawing the whites together, in spite of former antagonisms between localities and classes.

306. By 1872 a coalition had been formed under the name of Conservatives. But the control of electoral machinery in the strongly centralized state executives chosen by negro votes, and coercion by the Federal authority, still upheld Republican rule in various Southern states. Virginia and North Carolina were practically bankrupt, the capitals of Louisiana, Arkansas and Alabama, where rival state officers claimed possession, were occupied by Federal troops, and many of the governments were so corrupt that only the contemporaneous revelations of rottenness in New York City and in certain branches of the Federal government afford a parallel.

307. It was a time of lax public morals after war, which was ill suited to the difficult experiment of transferring political power to a race recently enslaved. Only the strong arm of the Federal authority sufficed to prevent the whites of the South from overthrowing a condition of things which it was impossible under American political ideas permanently to maintain.

Economic Changes in the South.

308. An important economic reorganization was in progress in the South. White districts were recovering from the war and were becoming the productive cotton areas by the use of fertilizers and by the more intelligent white labour. Cities were rising, and the mines and manufactures of the southern Appalachians were developing. In the black belt, or region of denser negro settlement, the old centres of cotton production and the citadels of the Southern political aristocracy, the blacks became tenant farmers, or workers on shares, but the white farmer in other areas raised his cotton at less cost than the planter who lived in the rich soils of the former cotton areas. The effective and just direction of negro labour was a difficult problem and was aggravated by

the political agitation which intensified race friction. It became evident that there was a negro problem as well as a slavery question, and that the North was unable to solve it.

Foreign Relations.

Maximilian.

Alaska.

309. In the meantime important foreign relations had been dealt with by Secretary William H. Seward, under Johnson, and by Secretary Hamilton Fish, under Grant. Not only were many treaties of commerce and extradition, including one with China, negotiated by Seward, but he also brought about a solution of more important diplomatic problems. The relations of the United States with France and England had been strained in the course of the war, by the evident friendliness of the governments of France and England for the South. Not only had Napoleon III. been inclined to recognize the Confederacy, but he had also taken advantage of the war to throw into Mexico a French army in support of the emperor Maximilian. The temptation to use force while American military prestige was high appealed even to General Grant; but Seward by firm and cautious diplomatic pressure induced France to withdraw her troops in 1867; the power of Maximilian collapsed, and the United States was not compelled to appeal to arms in support of the Monroe Doctrine. Russia's friendly attitude throughout the war was signalized by her offer to sell Alaska to the United States in 1867. Seward promptly accepted it and the treaty was ratified by the Senate and the purchase money ($7,200,000) was voted by the reluctant House, which saw little in the acquisition to commend it. Later years revealed it as one of the nation's treasure houses, particularly of gold and coal.

The "Alabama" Claims.

San Juan Island.

310. With England affairs were even more threatening than with France. Confederate cruisers (notably the "Alabama"), built in England and permitted by the negligence of the British government to go to sea, had nearly swept the American merchant marine from the ocean. Unsettled questions of boundary and the fisheries aggravated the ill feeling, and England's refusal in 1865 to arbitrate made a serious situation. Prolonged negotiations followed a change of attitude of England with regard to arbitration, and in 1870 President Grant recommended to Congress that the United States should pay the claims for damages of the Confederate cruisers, and thus assume them against England. However, in 1871, the treaty of Washington was negotiated under Secretary Fish, by the terms of which England expressed regret for the escape of the cruisers and for their depredations, and provided for arbitration of the fisheries, the north-western boundary, and the "Alabama" claims. Senator Sumner had given fiery expression to demands for indirect damage done by the destruction of our merchant marine and our commerce, and for the expenses of prolonging the war. For a time this so aroused the passions of the two nations as to endanger a solution. But Sumner, who quarrelled with the president, was deposed from the chairmanship of the committee on foreign relations, and Secretary Fish so arranged matters that the Geneva arbitration tribunal ruled these indirect claims out. Thus limited, the case of the United States was victorious, the tribunal awarding damages against Great Britain to the amount of $15,500,000. Two months later the German emperor gave to the United States the disputed north-west boundary, including the San Juan island in Puget Sound. The fisheries controversy was not settled until 1877.

Danish West Indies; Santo Domingo.

The "Virginius" Affair.

311. In the West Indies also important questions were presented. Seward had negotiated a treaty of purchase of the Danish West Indies, but the Senate refused to ratify it, nor did Grant's attempt to acquire Santo Domingo meet with a different fate at the hands of that body (1870). In Cuba another insurrection was in progress. Secretary Fish "pigeon-holed" a proclamation of President Grant recognizing the Cubans as belligerents, and secured a policy of neutrality which endured even the shock of the "Virginius affair" in 1873, when fifty of the men of the filibustering steamer flying the American flag were shot by the Spanish authorities (see SANTIAGO, CUBA). It was shown that the vessel had no right to the flag. Negotiations about an isthmian canal resulted only in a treaty with Nicaragua in 1868 giving to the United States a right of way across the isthmus and in provisions for a government survey of the Panama route. Foreign relations in this period were chiefly significant in that they were conducted in a spirit of restraint and that peace was preserved.

312. It was in the field of domestic concerns, in economic and social development, that the most significant tendencies appeared. The old issues were already diminishing in importance before the other aspect of Reconstruction which came from the revived expansion of the nation toward the West and the new forms taken by the development of American industrial society.

Financial Measures.

313. The Republican party, following the traditions of the Whigs, was especially responsive to the demands of the creditor class, who demanded legislation to conserve their interests. Its victory in 1868 was signalized by the passage in the spring of the following year of an act pledging the faith of the United States to pay in coin or its equivalent all the obligations of the United States, except in cases where the law authorizing the issue had expressly provided otherwise. In 1870 and 1871 refunding acts were passed, providing for the issue of bonds to the total amount of $1,800,000,000, one billion of which was to run for thirty years at 4%. This abandonment of the doctrine of early convertibility was made in order to render the bonds acceptable to capitalists, but in fact they soon went to a premium of over 25%. Long before their maturity the government had a surplus, but although it could then borrow at 2½% these bonds could not be retired. While the legislature was thus scrupulous of the credit of the nation and responsive to the views of capital, the Supreme Court was engaged in deciding the question of whether the legal tender notes (greenbacks) were constitutional. Successive decisions in 1868 determined that they were not legal tender for state taxes, that they were exempt from taxation, and that they were not legal tender in the settlement of contracts providing for payment in specie. In the case of *Hepburn* v. *Griswold* (1870) Chief Justice Chase, under whom, as secretary of the treasury, the notes were first issued, gave the opinion of the court denying that they were legal tender in settlement of contracts made before the first Legal Tender Act, and intimating that they were not legal tender for later contracts. The judges had divided, four to three. Within a year the court was changed by the appointment of one new judge to fill a vacancy, and the addition of another in accordance with a law enlarging the court. In 1871 the former decision was reversed and the constitutionality of the Legal Tender Acts sustained on loose-construction reasoning. In 1884 the court went to the extent of affirming the right of Congress to pass legal tender acts in time of peace, in accordance with the usage of sovereign governments, as an incident to the right of coinage, and it declared that the power to borrow money includes the power to issue obligations in any appropriate form. In 1871 and 1872 Secretary George S. Boutwell illustrated the power of the administration to change the volume of the currency, by issuing in all over six million dollars of legal tender notes; and, following the practice of his predecessors, he sold gold from the treasury to check speculations in that part of the currency. The most noteworthy instance of this was in 1869, when two Wall Street speculators, Jay Gould and James Fisk, jun., attempting to corner the gold market and relying upon a supposed influence in the councils of President Grant, ran up the premium on gold until Secretary Boutwell ordered the sale of gold by the government. The result was the financial crash of "Black Friday."

314. Speculation and the rapid growth of great fortunes were characteristic of the period. The war itself had furnished means for acquiring sudden riches; the reorganization of taxation, currency and banking increased the opportunities as well as the uncertainties; and the opening of new fields of speculative enterprise in the oil fields of Pennsylvania and Ohio and the gold and silver mines of the mountains of the Far West tended in the

Manufactures.

same direction. An enormous development of manufactures resulted from the diminished commerce and increased demand for manufactured goods, the protection afforded by the tariff, the stimulus due to rising prices, and the consumption of the rapidly growing West. It was officially reported in 1869 that "within five years more cotton spindles had been put in motion, more iron furnaces erected, more iron smelted, more bars rolled, more steel made, more coal and copper mined, more lumber sawn and hewn, more houses and shops constructed, more manufactories of different kinds started, and more petroleum collected, refined and exported, than during any equal period in the history of the country."

Pacific Railways.

315. Between the Civil War and 1872 the extension of the nation's activity to the industrial conquest of the great West, as well as the economic reorganization of the East, had a profound effect upon the development of the United States. Between 1862 and 1872 grants were made to the Union Pacific and Central Pacific companies, and to other connecting corporations, for railways from the Missouri to the Pacific, amounting to nearly 33,000,000 acres, and in the same period large loans of funds were made by the general government for this enterprise. Construction advanced rapidly after 1866, and by 1869 an all-rail connexion had been established on the line of the Union Pacific and Central Pacific railways between the East and San Francisco. Various grants were made in these years to other roads, both transcontinental and Middle Western. Between 1850 and 1871 Congress granted about 155,000,000 acres for railway construction, but not all these grants were perfected. It is estimated that some $500,000,000 were invested in the construction of Western railways between 1868 and the panic of 1873, and about 30,000 m. of railway had been added.

Effects of Railway Extension.

316. The effects of this extraordinary extension of railway transportation were immediately apparent. In the Far West the railway lines rapidly made possible the extinction of the bison herds which had occupied the great plains. Divided into the northern and southern herds by the Union Pacific railway in 1869, the southern herds were slaughtered in the period between 1871 and 1879, and the northern herds between 1880 and 1883. This opened the way for the great extension of the cattle country, following the retreat of the Indians. Upon the plains Indians the effect was revolutionary. Their domain had been penetrated by the railways, at the same time that their means of subsistence had been withdrawn. During the Civil War most of these Western tribes had engaged in hostilities against the Federal government. In 1866 and 1867 General George Crook was reducing the Indians of the South-West to submission, while other generals trained in the Civil War were fighting the Indians in the northern plains and Kansas, Nebraska and Oklahoma. By the Peace Commission Act of the 20th of July 1867 commissioners, including General William T. Sherman, were sent to negotiate treaties. As a result the tribes of the Indian Territory were so concentrated as to permit the transfer of other Western tribes to the same region, while the Sioux of the northern plains were given a reservation embracing the western portions of the Dakotas. Discontent with these treaties resulted, however, in hostilities following 1867. Between the close of the war and 1880 some $22,000,000 were expended in Indian wars, although the act of 1871 inaugurated the change of policy whereby the Indians were no longer dealt with by treaty, but were regarded as wards of the nation, to be concentrated on reservations and fed at the expense of the nation under the supervision of Indian agents.

Mining.

317. Part of these Indian difficulties were due to the opening up of new mining areas in the Rocky Mountains, some of them within the Indians' choicest hunting grounds. At the beginning of the Civil War a preliminary mining boom struck Colorado; the rich Comstock lode was opened in Nevada; Arizona was the scene of mining rushes; the Idaho mines were entered; and the Montana ores were discovered; so that in the period of the Civil War itself the Territories of Nevada, Idaho and Montana had been organized and the mountains provisionally occupied from the northern to the southern limit. The discovery of gold in the Black Hills in 1874 continued the same movement. In 1860 the nation produced $156,000 worth of silver, in 1861 over $2,000,000 and in 1873 nearly $36,000,000. In the last-mentioned year the production of gold amounted also to $36,000,000, although in 1860 it had been $46,000,000. Capital in mines and quarries of the United States was over $65,000,000 in 1860, over $245,000,000 in 1870, and nearly $1,500,000,000 in 1880.

Development of the Middle West.

318. This revolution in the life of the great plains and the Rocky Mountains, opening the way to agriculture and to cattle raising, and preparing for the exploitation of the precious metals of that great area, was contemporaneous with the important development of the farming regions of the Middle West. Even during the Civil War the agricultural development of the northern half of the Mississippi Valley had continued. This was aided by the demand for food products to supply the armies and was made possible by the extension of railways, the taking up of the prairie lands through the operation of the Homestead Law of 1862, the marketing of the railway land grants, and the increased use of agricultural machinery in those years. Between 1860 and 1870 the population of the North Central group of states (engaged chiefly in grain raising) increased over 42%, and in the next decade by 34%, a total addition to the population in those two decades of 8,000,000. Between 1870 and 1880 about 200,000 sq. m. were added to the farm lands of the United States, an area almost equal in extent to that of France. In the same decade the North Central states increased their improved farms from near 78,500,000 acres to over 136,800,000 acres. The product of Indian corn about doubled between 1860 and 1880, and that of wheat and oats more than doubled. The addition came chiefly from the Middle West. In 1860 the North Central states raised 95,000,000 bushels of wheat; in 1870 nearly 195,000,000; in 1880 329,000,000. In 1870 the same states produced 439,000,000 bushels of corn; in 1880 they produced over 1,285,000,000.

Railway Abuses.

319. The pressing need of increased transportation facilities had led, as we have seen, to lavish land grants and to subsidies by nation, states and municipalities to the railways. The railways themselves, tempted by these opportunities, had extended their lines in some cases beyond the immediate needs of the regions entered in advance of settlement. Extravagances in construction and operation, aggravated by "construction rings" of railway officials, who secured the contracts for themselves and their friends, and by rolling stock companies who received extravagant prices by favouritism, as well as the watering of stock in the creation of systems by absorption and consolidation of railway corporations, brought about a condition where the roads were no longer able to meet the demands of their stockholders for returns on the investment without imposing rates that the Western farmer deemed extortionate. In the competitive development of these roads and in the struggle of business corporations and localities with each other, the roads also discriminated between persons and places. This condition chiefly accounted for the political unrest which manifested itself in the West in the so-called "Granger" movements of the 'seventies.

320. The farmers felt the pressure of the unsettled currency, taxes were very heavy, the protective tariff seemed to them to bear unduly upon the producers of crops which exceeded the home consumption and had to seek the foreign markets. The price of Indian corn, wheat and cotton in the early 'seventies tended to fall as production rose, so that the gold value of the total crop was not greatly increased during the decade after the war, in spite of the extraordinary extension of agricultural settlement and the increase of production. Dissatisfaction with his share in the prosperity of the country, and especially with the charges of middlemen and transportation companies, discontent with the backwardness of rural social conditions, and a desire for larger political influence, all aided in fostering the growth of

organizations designed to promote the farmers' interests. The most influential of these organizations was the Patrons of Husbandry, which was founded in 1867 and spread chiefly after 1872 by local clubs or "granges," especially in the West and South.

The "Granger" Movement.

321. The height of the movement was reached in the autumn of 1874. It threatened the disruption of the old political parties in most of the Middle Western states. By holding the balance of power the Grangers secured legislation in many of these states, fixed maximum railway rates, and provided for regulation through commissions to prevent discriminations. In the reaction after the panic of 1873 (when nearly a fifth of the railway mileage of the United States had passed into the hands of receivers) many of the "Granger laws" were repealed, the regulation was rendered nominal and the railways more than regained their political power in the states; yet the agitation had established the important principle, sanctioned by decisions of the Supreme Court, that the railways were common carriers subject fully to public regulation so far as it was not confiscatory. The movement for regulation of interstate commerce by congressional legislation was begun at this time under the leadership of congressmen from the Granger states. Later efforts were more wisely considered and more effective; but the rural democracy showed its opposition to the increasing political influence of capital, to special privileges and to the attempts of corporations to avoid public control periodically thereafter (see FARMERS' MOVEMENT). The attempt to eliminate the middlemen by co-operative stores and grain elevators was another feature of the time which gained a brief strength but soon declined.

The Tweed Ring.

322. The presidential election of 1872 took place in the midst of this Western upheaval. At the same time in the South the reform Republicans and Democrats were uniting under the name of "Conservatives" against the carpet-bag rule, and control was passing into their hands. A reform movement was active against the evident corruption in national and municipal administrations, for Grant's trust in his appointees was grossly violated. The Tweed Ring was systematically looting New York City, and prior to Tweed's indictment in 1871 (See NEW YORK (City); TAMMANY HALL; TILDEN, S. J.) it was acquiring large power in state legislation. Jay Gould, the railway operator, was one of the signers of Tweed's million dollar bail bond. Civil service reformers, men of moderate views with respect to Reconstruction, such as Carl Schurz, many War Democrats who had adhered to the Union party, and tariff reformers began to break away.

Liberal Republican Movement.

323. The Liberal-Republican movement started in Missouri, and a national convention was called to meet at Cincinnati on the 1st of May 1872. Their platform announced irreconcilable differences on the tariff and left it to the Congressional districts, attacked the corruption of civil service by the administration, supported the results of the war as embodied in the last three amendments and demanded amnesty and local civil government for the South. It opposed further land grants to railways, but denounced repudiation and demanded specie payments in terms which excluded from its support the advocates of inflation of the currency. This effort to combine the opponents of Grant's administration was wrecked by the nomination of Horace Greeley, a strong protectionist, who did not command the confidence of the masses of the disaffected. Although endorsed by the Democrats, Greeley was defeated by Grant, who ran on the record of the Republican party, which now dropped the word Union from its name. Greeley died before the electoral count; the Democrats won only the states of Maryland, Kentucky, Missouri, Tennessee, Georgia and Texas, the votes of Louisiana and Arkansas being thrown out.

Grant Re-elected.

Panic of 1873.

324. The enormous cost of the war, the excessive railway building, over-trading, and inflated credit and fluctuating currency, the sinking of capital in opening new farming lands and in readjusting manufactures to new conditions brought their results in the panic of 1873, precipitated by the failure (Sept. 18) of Jay Cooke, the financier of the Northern Pacific railway. For over five years the nation underwent a drastic purgation; railway building almost ceased, and so late as 1877 over 18% of the railway mileage of the nation was in the hands of receivers. The iron industry was prostrated, and mercantile failures for four years amounted to $775,000,000. At the close of the period there was a replacement of partnerships and individual businesses by corporations, but in the interval political unrest was in the foreground.

The Crédit Mobilier; the Salary Grab.

325. The charges that congressmen had been bribed by stock in the Crédit Mobilier (*q.v.*), a construction company controlled by Union Pacific stockholders, led to a congressional investigation which damaged the reputations of prominent Republicans, including Vice-president Schuyler Colfax; but the same Congress which investigated this scandal voted itself retroactive increases of salary, and this "back-pay grab" created popular indignation. Evidences of fraud and corruption in revenue collection under the "moiety system," and the general demoralization of the civil service continued. The demand for relief from the stringency of the crisis of 1873 expressed itself in the so-called Inflation Bill (passed April 1874), providing a maximum of four hundred million dollars for greenback issues. This was vetoed by Grant, but he later signed a bill accepting as a maximum the existing greenback circulation of $382,000,000. This compromise was satisfactory neither to contractionists nor greenbackers. The latter especially resented the provisions regarding the national banks and their circulation.

Republicans lose Control of Congress.

326. The "tidal wave" in the Congressional elections of 1874 was the result of these conditions. It marked a political revolution. The House of Representatives, which exhibited a two-thirds Republican majority in 1872, showed an opposition majority of about seventy, and the Senate was soon to be close. Such Republican strongholds as Pennsylvania, Ohio and Massachusetts went over to the Democrats in the state elections, while in the grain-raising states of the Middle West the Grangers were holding the balance of power, and in the South the Republican radicals remained in force in few states and only by the use of Federal troops. President Grant in his message of December 1874 acknowledged that public opinion was opposed to this use of force, but declared that without it negro suffrage would be worse than a mockery. Thus by the year 1874 the era of triumphant Republicanism and Reconstruction was closing. The leaders perceiving power about to pass from them rapidly enacted a series of party measures before the meeting of the newly elected Congress. Under the leadership of Senator John Sherman an act was passed (Jan. 14, 1875) providing for resumption of specie payments on the 1st of January 1879, gradually contracting greenbacks to three hundred million dollars and compensating this by expanding the circulation of the national banks. Sherman's personal preference was to make the greenbacks exchangeable for 4% bonds and thus to make the general public instead of the banking houses the purchasers of these securities, but he was unable to convince his colleagues. In the field of the tariff a similar policy was followed. The act of 1870 had somewhat reduced duties on tea, coffee, sugar and iron; but under Western pressure in 1872 the Republican Congress had consented to a 10% reduction on most classes of goods in order to save the general system of protection. On the eve of their relinquishment of full power the Republicans (March 3, 1875) repealed the Tariff Act of 1872, increased the duties on molasses and sugar and increased the revenue tax on tobacco and spirits. Thus the tariff was restored to the war basis, before the incoming Democratic House could block the advance. Similarly on the 1st of March Congress passed a Civil Rights Act, milder than the measure for which Sumner had fought so long, guaranteeing equal rights to the negroes in hotels, public conveyances, and places of amusement and forbidding the exclusion of them from juries. But an effort to pass a new force bill levelled against the intimidation of negro voters failed. By these measures the Republicans placed the

The Tariff.

Civil Rights Act.

important features of their policy where they could be overturned only by a Democratic capture of presidency and Senate.

Supreme Court Decisions.

327. In the midst of these changes the Supreme Court handed down decisions undoing important portions of the Reconstruction system by restraining the tendency of the nation to encroach on the sphere of the state; and restricting the scope of the recent constitutional amendments. On the 14th of April 1873, in the Slaughter House cases, the courts held that the amendments were primarily restrictions upon the states for the protection of the freedom of the coloured man, rather than extensions of the power of the Federal government under the definition of United States citizenship, and that general fundamental civil rights remained under state protection. In the case of the *United States* v. *Reese*, decided on the 27th of March 1876, the court declared parts of the act of 1870 (which provided for the use of Federal force to protect the negro in his right to vote) unconstitutional, on the ground that they did not specify that the denial of suffrage must be on the sole ground of race or colour. A reasonable prerequisite, such as a poll tax, for voting was permissible. The South later took advantage of this decision to restrain negro suffrage indirectly. In *United States* v. *Cruikshank* (1876) the court held that the amendments to the Constitution left it still the duty of the state, rather than of the United States, to protect its citizens, even when whites had mobbed the negroes. The right of the nation in the case was held to be limited to taking care that the state governments and laws offered equal protection to whites and blacks. The affirmation of the power of the states over common carriers in the *Granger cases* (1877) has been mentioned. In 1883 the court declared the conspiracy clause of the Ku-Klux Act unconstitutional and restricted the application of the law to acts of a state through its officers and not to private citizens. In the same year it declared the Civil Rights Act of 1875 invalid.

328. In 1875 President Grant refused the appeal of the "carpet-bagger" Governor Adelbert Ames of Mississippi to be supported by troops, whereupon Ames resigned his office into the hands of the Conservatives. The Mississippi plan of general intimidation of negroes to keep them from the polls was followed in Louisiana, South Carolina and Florida which alone remained Republican. Thus steadily the radical Reconstruction policy and Republican control of the South were being reversed. It was made clear that negro suffrage could be enforced upon the South only by military rule which could no longer command Northern sympathy or the sanction of the Federal court. Northern interest increasingly turned to other issues, and especially to discontent over administrative corruption.

The Whisky Ring.

329. The spoils system had triumphed over the advocates of civil service reform to such an extent that Grant abandoned the competitive system in 1875 on the ground that Congress did not support him in the policy. Enormous frauds in the collection of the internal revenue by the Whisky Ring with the connivance of Federal officials were revealed in 1875, and about the same time, Secretary of War William W. Belknap resigned to avoid impeachment for corruption in the conduct of Indian affairs. The enforced resignation in 1876 of Secretary of the Treasury Benjamin H. Bristow (*q.v.*) after he had successfully exposed the Whisky Ring, and of Postmaster-General Marshall Jewell, who had resisted the spoils system in his department, tended to discredit the administration. Blaine, the leader of the Republicans in the House of Representatives, fell under suspicion on account of his earlier relations with the Little Rock & Fort Smith and Northern Pacific railways (see BLAINE, J. G.), which left it doubtful, in spite of his aggressive defence, whether he had not used his influence as speaker in previous Congresses to secure pecuniary advantages from land grant railways. This clouded Blaine's prospects for a presidential nomination, and the House of Representatives voted a resolution against the third term which Grant seemed not unwilling to accept.

Party Platforms of 1876.

330. Thus the campaign of 1876 approached, with the Republicans divided into (1) steadfast supporters of the Grant administration, (2) a discontented reform wing (which favoured ex-Secretary Bristow), and (3) an intermediate group which followed Blaine. This statesman made a bold stroke to shift the fighting which the Democrats planned to make against the scandals of the administration, to the old time war issues. By proposing to exclude Jefferson Davis from amnesty, he goaded southern congressmen into indiscreet utterances which fanned anew the fires of sectional animosity. The Republican platform, while deprecating sectionalism, placed the war record of the party in the foreground and denounced the Democracy, because it counted upon the united South as its chief hope of success. A compromise candidate was selected in the person of Governor Rutherford B. Hayes, of Ohio, who had vigorously opposed the greenback movement in his state, and whose life and character, though little known to the general public, made him acceptable to the reform leaders of the party. The Democrats, demanding reform, economy, a revenue tariff and the repeal of the resumption clause of the act of 1875, chose the reform governor of New York, Samuel J. Tilden, as their candidate. The Independent National, or Greenback, party, which was to develop rapidly in the next two years, nominated Peter Cooper, a New York philanthropist, and demanded the repeal of the Resumption Act, and the enactment of a law providing a paper currency issued directly by the government, and convertible on demand into United States obligations bearing a rate of interest not exceeding one cent a day for each one hundred dollars and exchangeable for United States notes at par. It also proposed the suppression of bank paper, and was in general antagonistic to the bond-holding and banking interests.

Hayes-Tilden Contest; the Electoral Commission.

331. The election proved to be a very close contest. Tilden, according to the count of both parties, had a plurality of over a quarter of a million votes, and at first the leading Republican journals conceded his election. He had carried New York, Indiana, New Jersey and Connecticut and, by the Democratic count, the solid South. But the Republican headquarters claimed the election of Hayes by one electoral vote, based on the belief that the states of South Carolina, Florida and Louisiana,[1] had gone Republican. Since these states were in the midst of the transition from negro to white government, and elections were notorious for fraudulent practices, a serious question was raised, first as to the proper authority to count the electoral vote, and second, how far it was permissible to go behind the returns of the state authorities to ascertain the validity of the canvass of the votes in the state. The political capacity and moderation of the nation were severely tested; but in the end a characteristic American solution was found by the creation of an Electoral Commission (*q.v.*) in which five associate justices of the Supreme Court were joined with an equal number of representatives from each of the two houses of Congress. The result was that this commission refused to "go behind the returns," and Hayes was declared elected by one vote.

Hayes Elected.

To prevent the threatened danger of a filibuster by Democrats of the House of Representatives against the completion of the count until after legal date for the inauguration of the president, Hayes's friends agreed with leading Democrats that he would withdraw the Federal troops from Louisiana. Thus a new era began under a moderate and reforming Republican president, a close Republican Senate and a Democratic House of Representatives. The Southern question was not settled, but other issues of an economic and social nature increasingly forced themselves to the front. They were concealed in a measure by the fact that the following of each of the leading political parties was divided on financial policies, which resulted in attempts to compromise and evade the issue by the party managers. During the dozen years that followed Hayes's inauguration neither party held complete possession of both the executive and the two houses of Congress. His own moderate character, the conditions of his election and the check imposed during the first two years by a Democratic House of Representatives (and during the second two years by an opposition in both houses) made the period of Hayes's administration a transition from the era of Reconstruction to the era of dominant economic and reform agitation.

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[1] There was a conflict with regard to the electoral vote of Oregon also. (See OREGON: *History*.)

332. When he withdrew the troops which sustained the Republican governments in Louisiana and South Carolina, those states returned to the rule of the white Democrats. In the Congress elected in 1878 the former slave states chose 101 Democrats to the House of Representatives and only four Republicans. Leading Republicans like Blaine protested vigorously against the policy, declaring that the men who saved the Union should govern it; and on the other hand the Democrats in Congress added "riders" to appropriation bills designed to starve the administration into complete cessation of the use of troops and Federal deputy marshals at Southern elections. Extra sessions had to be summoned in 1877 and 1879 to provide supplies for the government, due to this policy. Hayes assisted his party by vetoing these coercive attempts of the Democrats and it was not until later that Federal attempts to supervise Southern elections entirely ceased.

Civil Service Reform.

333. As his early policy toward the South had dissatisfied many of the leaders of his party, his opposition to the spoils system alienated others. In 1877 a Civil Service Reform Association was formed in New York, and under the leadership of reformers like George William Curtis, Carl Schurz, John Jay and Dorman B. Eaton, it extended to other states. In June 1877 President Hayes issued an executive order against the participation of Federal officers in political management, and he furnished evidence of his sincerity by removing Alonzo B. Cornell, the naval officer of New York, who was also chairman of both state and national Republican committees, and Chester A. Arthur, collector of the port of New York. As both men were friends of Senator Roscoe Conkling of that state, the leader of the Grant men, this was a bold challenge. The "Stalwarts" answered it by soon afterward securing the nomination of Cornell as governor of New York and Arthur as vice-president of the United States.

Coinage Act of 1873.

334. The monetary question rose to primary importance at this time. Hayes himself had campaigned in Ohio successfully against the Greenback movement, and he chose as his secretary of the treasury, John Sherman, former senator from that state, whose long service as chairman of the finance committee had made him familiar with conditions and influential with moderate men of all factions. The *per capita* circulation of the nation had fallen from $20·57 in 1865 to $15·58 in 1877 and was still declining. The remarkable increase in the production of silver, as the new mining regions were opened, was accompanied by a fall in its ratio to gold from 15 to 1 in 1860 to 17 to 1 in 1877. Congress had, in 1873, passed an act dropping the standard silver dollar from the list of coins; the significance of this omission of a coin not widely circulated, although it came at a time when European nations were adopting the gold standard, passed almost unnoticed at the moment; but the demonetization of silver was afterward stigmatized as a conspiracy, "the crime of 1873." As the date (January 1, 1879) for the redemption of the greenbacks in specie approached, demands were renewed for the replacement of national bank notes by greenbacks, for the postponement, or abandonment of resumption, for the free coinage of silver, and for the use of silver as well as gold in the payment of bonds redeemable in "coin." Sectional grouping of the debtor against the creditor regions, rather than party alignment, showed itself in the votes, for each party had its "soft money" as well as its "hard money" followers. Many who could not support the Greenback party in its theory that currency derived value from purchasing power based on the government's credit and authority rather than on convertibility, would, nevertheless, make larger use of paper money; while men who did not assent to the free coinage reasoning opposed the single gold standard as too narrow and too much under the influence of the speculative and banking interests, and would adopt some system of bi-metallism.

The Bland-Allison Act.

335. A Monetary Commission, appointed in 1876, reported in 1877, but without agreement or real influence upon the country. The president took strong ground against free coinage (though he would resume coinage of silver in limited quantities) and against the payment of bonds in silver; but the House of Representatives passed the measure, known as the Bland Bill, for the free coinage of silver, by a vote of 163 to 34. In the Senate this was amended, and as it finally passed both houses it was known as the Bland-Allison Act after the two leaders, the Democratic representative from Missouri and the Republican senator from Iowa. This compromise was carried over the veto of President Hayes and became a law on the 28th of February 1878. In the vote of the 15th of February, all but one of the senators from New England, New York and New Jersey opposed it, while the states west of the Alleghanies furnished only four opposing votes. The law restored the legal tender character of the silver dollar and authorized the secretary of the treasury to buy silver bullion at the market price, to an amount of not less than $2,000,000 nor more than $4,000,000 per month, and to coin the bullion into silver dollars. Silver certificates of denominations not less than ten dollars were to be issued upon deposit of silver dollars. As neither the silver nor the certificates circulated freely the denominations of the certificates were reduced in 1886, when they filled the deficiency in the contracting bank-note circulation.

336. Hardly had the Bland-Allison compromise been effected on the silver issue when an act was passed (May 31, 1878) forbidding the further retirement of greenbacks, which remained at $346,681,000. Substantially the same sectional alignment was followed in the vote on this bill as in the silver votes. Not satisfied with this legislation, nearly a million voters cast their ballots for Greenback party candidates at the Congressional elections in the autumn of 1878. The preparations of Secretary Sherman had been so carefully made, and the turning tide of trade brought coin so freely to the United States, that before the date of resumption of specie payments a gold reserve had been accumulated to the amount of $133,000,000 in excess of matured liabilities and the greenbacks rose to par before the date of redemption.

Party Platforms of 1880.

337. In the campaign of 1880, Hayes and Tilden both declined to stand for renomination. Thus the issue of the "fraud of 1876," which the Democratic platform called the paramount issue, was subordinated. Nor was it possible for the Republicans to force the tariff question into a commanding position, for although the Democratic platform declared for a tariff for revenue only, a considerable wing of that party led by Samuel J. Randall, of Pennsylvania, favoured protection. General Winfield S. Hancock, a distinguished soldier in the Civil War, whose nomination for the presidency by the Democrats was designed to allay Northern distrust, refused to make the tariff a national issue. The recent adjustment of the monetary question and the return of prosperity relegated the discussion of the currency also to a subordinate place, so that the Greenback party was able to poll only a little over 300,000 votes instead of the million which it commanded two years before. It favoured unlimited coinage of silver as well as the replacement of bank-notes by greenbacks.

Garfield Elected President.

338. The Republicans, after a heated convention in which the followers of Grant (who had recently returned from a several years' trip round the world), Blaine and Sherman, fought each other to a deadlock, selected General James A. Garfield (*q.v.*) of Ohio, who was political manager for Sherman in the convention. This was a blow to the Grant, or "Stalwart" wing, which was partly placated by the nomination of Arthur for the vice-presidency. Garfield's popular plurality was only a little over seven thousand out of a total vote of over nine millions; but his electoral vote was 214 to Hancock's 155. The area of the former slave

states marked the boundaries between the Republican and the Democratic states, except that Hancock also carried New Jersey, Nevada and California. The Republicans won the elections for the House of Representatives which would meet in 1881, and the Senate was at first nearly evenly divided, two independents holding the balance. In the ensuing four years party lines were badly broken, factions made bitter war upon each other, and the independent reformers or "Mugwumps" (*q.v.*) grew in numbers. The selection of Blaine as secretary of state committed Garfield to the anti-Grant wing, and the breach was widened by his appointment of the collector of the port of New York against the protests of Roscoe Conkling and Thomas C. Platt, the "Stalwart" senators from New York. They resigned, then sought re-election in order to vindicate the right of senatorial recommendation; but were defeated.

Assassination of Garfield; Arthur becomes President.

Pendleton Act.

Anti-Polygamy Act; Chinese Exclusion.

339. In the midst of this excitement the president was assassinated by a disappointed office-seeker of unsound mind. Vice-President Arthur, who succeeded Garfield in September 1881, by his tact and moderation won the admiration of former opponents; but the bad crops in 1881 and the dissatisfaction with boss rule among independent voters caused a Democratic victory in the Congressional campaign of 1882. Garfield's assassination had given new impetus to the movement against the spoils system, a National Civil Service Reform League had been organized in 1881, President Arthur presented the question in his message of December of that year, and in 1882 George H. Pendleton, a Democratic senator from Ohio, urged the subject upon the attention of Congress. Stimulated by the elections of 1882 Congress passed an act (January 16, 1883) authorizing the president to appoint a commission to classify certain of the Federal employees, and providing for appointment and promotion within this classified list by competitive examination, the employees being distributed among the states and territories according to population, with preference for soldiers and sailors of the Civil War. Congressional recommendations for these offices were not to be received, and political assessments for campaign purposes were forbidden. This was an effective beginning in the purification of the civil service; but the evil of assessment of employees was succeeded by the evil of soliciting campaign contributions from corporations interested in legislation. The extension of the competitive list proceeded gradually through succeeding administrations. The Edmunds Anti-Polygamy Act (1882) was levelled at the Mormons (*q.v.*), and the Chinese Exclusion Act was passed at the demand of labour, after a long agitation in 1882, the way having been prepared by the Treaty of Peking in 1880. Bills to this effect had been vetoed by Hayes and Arthur as violative of international agreement, but the desire of the politicians to win the California vote, and the compromise by which the exclusion was limited to ten years finally carried the measure, and the Supreme Court (1889) held it constitutional. Later acts modified and extended the exclusion.

340. From 1879 to 1890 the treasury showed a surplus of revenue over expenditure. This furnishes the explanation of much of the legislation of that period. It led to extravagant appropriations, such as the Arrears of Pensions Act of 1879, and the River and Harbor Act of 1882 providing for the expenditure of more than $18,000,000, which was passed over the veto of Arthur. Appropriation bills were merely constructed in various committees of Congress under a system of bargaining between interests and sections with primary reference to the political fortunes of the congressmen.

341. The surplus also strengthened the demand for a reduction of the tariff. A tariff commission, composed of men friendly to protection, appointed in 1882, proposed an average reduction of 20 to 25%. Nevertheless in the act as passed in 1883 duties were increased in general on those protected articles which continued to be imported in large volume, especially on certain woollen goods and about two-thirds of the imported cotton goods, and on iron ore and some steel products, while they were lowered on finer grades of wool and cheaper grades of woollen and cotton fabrics, &c. It was unsatisfactory to large portions of both parties and did not materially lower the revenue; but the act of 1883 made extensive reductions in internal taxes. As the Senate had just fallen into the hands of the Republicans, and the House would not become Democratic until the new Congress met, this protective law gave the former the advantage of position. Moreover the Democrats were themselves divided, nineteen Representatives (one-third from Pennsylvania) voting with the Republicans on the act of 1883. In the next Congress (1884), when the leaders made an attempt to rally the Democrats to show their position by passing a bill for a horizontal reduction of 20% in general, forty-one Democrats voted against the bill and prevented its passage through the House.

Party Platforms of 1884.

342. Thus the campaign of 1884 found both parties still lacking unity of policy although it seemed possible that the tariff might become the touchstone of the contest. The Republicans challenged the independents by nominating Blaine, whose record was objectionable to many reformers, and who had been chiefly identified with the Reconstruction politics. The Democrats, taking advantage of the situation, nominated Grover Cleveland (*q.v.*) of New York. He had won approval by his reform administration as mayor of Buffalo and as governor of New York during the past two years, when he had shown an independence of party "bosses" and had convinced the public of his sincerity and strength of character. He represented conceptions and interests which had grown up since the war, and which appealed to a new generation of voters. The platform emphasized the idea that "new issues are born of time and progress," and made the leading question that of reform and change in administration, lest the continued rule of one party should corrupt the government. On the question of tariff the Democrats took a conservative attitude, emphasizing their desire to promote healthy growth, rather than to injure any domestic industries, and recognizing that capital had been invested and manufactures developed in reliance upon the protective system. Subject to these limitations, they demanded correction of the abuses of the tariff and adjustment of it to the needs of the government economically administered. The Greenbackers nominated General Benjamin F. Butler of Massachusetts, recently chosen governor of that state on the Democratic ticket, but he polled only 175,000 votes, while John P. St John, the candidate of those who would prohibit the liquor traffic, secured 150,000 votes, an unprecedented gain. The Prohibitionist platform included a demand that all money, coin and paper, should be made, issued and regulated by the government and be a legal tender for all debts, public and private.

Cleveland Elected President.

343. The campaign abounded in bitter personalities, and the popular vote was close, Cleveland's plurality being only twenty-three thousand. The great state of New York, with electoral votes enough to have turned the scale, was carried by the Democrats by only a few more than one thousand votes out of a total of over a million. Cleveland's electoral majority was 37. The election was nevertheless recognized as making an epoch. For the first time since victory came to Lincoln and the Republicans on the eve of the Civil War, nearly a quarter of a century earlier, the country had entrusted power to the Democrats, although over two-thirds of their electoral vote came from the former slave states. New York, Connecticut, New Jersey and Indiana constituted their Northern territory. Perhaps the most significant thing about the result was the evidence that in the North political and sectional habits and prejudices were giving way among a sufficient number of independent voters, responsive to strong personal leadership on reform issues, to turn the political scale. The transition from war issues which began in 1872, and became marked in 1876, was completed by the election of Cleveland in 1884.

Civil Service.

During the first half of his term President Cleveland had the opposition of a strongly Republican Senate. In the second half the Senate remained Republican by a majority of two, and the House continued Democratic. His civil service policy naturally met severe criticism not only from his party foes, but also from the spoilsmen among his Democratic followers, who desired a clean sweep of Republican office-holders, and from those of his independent supporters who looked to him to establish the service on a strictly non-partisan basis. The outcome of the first two years of his administration was that, of the entire body of Federal office-holders, two-thirds were changed and the obnoxious Tenure of Office Act was repealed, thus leaving the president the right of removal without presenting his reasons. Nevertheless there was a gain, for Cleveland somewhat checked the political activity of office-holders, the criticism by the Republicans placed them on record against the former spoils system, and before leaving the presidency (but after the election of 1888 showed that power was to pass to the Republicans), he transferred the railway mail service to the classified list requiring competitive examination.

344. The transition of executive power for the time to the Democratic party, however much it impressed the imaginations of the public as the end of an era, was not so significant as the national growth and expansion in the decade between 1880 and 1890 whereby forces were set loose which determined the characteristics of the succeeding period. Between these years the nation grew from about fifty millions to over sixty-two millions. The Middle West, or North Central group of states, gained nearly five millions and the Western division over a million and a quarter. West of the Alleghanies altogether more than eight million souls had been added, while the old Eastern states gained but four millions. In 1890 the North Central division alone had achieved a population nearly five millions greater than that of the North Atlantic, while the trans-Alleghany region surpassed the whole East by about ten millions, and the numbers of its representatives in House and Senate placed the political destiny of the nation in its hands.

Development of the West.

345. One of the most important reasons for the wholesale taking up of Western resources in these and the following years was the burst of railway building subsequent to the interruption of the panic of 1873. The eager pioneers pushed into western Kansas and Nebraska as they had into the northern Ohio Valley a half-century before. Nebraska grew from a population of one hundred and twenty-three thousand in 1870 to nearly half a million in 1880 and to over a million in 1890. From about a third of a million in 1870, Kansas rose to almost a million in 1880, and to nearly a million and a half in 1890. The railway had "boomed" the Golden West and a cycle of abundant rains seemed to justify the belief that the "Great American Desert" was a myth. Thus settlers borrowed money to secure farms beyond the region of safe annual rainfall under the agricultural methods of traditional pioneering. Swift disappointment overtook them after 1886, when droughts and grasshoppers ruined the crops and turned back the tide of Middle Western colonists until the western parts of these states were almost depopulated, Kansas alone losing one-seventh of its population; nor did prosperity return for a decade.

346. As the column of settlement along the Ohio Valley had extended its flanks into the old North-West between the Ohio and the Great Lakes, and into the old South-West of the lower Mississippi after the War of 1812, so the later pioneers by railway trains began to take possession of the remoter and vaster North-West and South-West. The "granger roads," centring in Chicago, thrust their lines out to develop wheat farms in interior Iowa, Minnesota and the Dakotas, where the virgin soil of the prairie farms brought returns that transferred the wheat belt to this new land of promise, and by competition forced the older wheat areas to develop varied agriculture. The introduction of the recently invented steel roller system of making flour into the Minneapolis mills not only built up a great flour industry there but created a demand for the hard wheat suited to the North-western prairies. The pine forests of Michigan, Wisconsin and Minnesota were exploited in the same era.

347. A more impressive movement was in progress as additional transcontinental railways were extended from the frontier to the Pacific. In 1870 for a thousand miles west of Duluth, at the head of Lake Superior, along the line of the projected Northern Pacific railway there were no cities or little towns. Relying upon its land grant and upon the undeveloped resources of the vast tributary region, the railway, after halting for a few years subsequent to the panic of 1873 at Bismarck on the Missouri rushed its construction to Seattle and was opened in 1883. The Great Northern, a product of the vision and sound judgment of James J. Hill, started from St Paul without a land grant and reached Puget Sound in 1893, constructing lateral feeders as it built. Thus a new industrial zone had been brought into existence. Colorado had become a state in 1876; in 1889 North Dakota, South Dakota, Washington and Montana were admitted as states and the next year Idaho and Wyoming were added. The Western political forces, especially the friends of silver, were thus given the balance of power in the Senate and additional weight in the electoral college.

The South-West.

348. As a new North-West was opened by the completion of the Canadian Pacific (1883), the Northern Pacific (1883) and the Great Northern (1893), so the new South-West was entered by the completion of the Southern Pacific from New Orleans across Texas, New Mexico, Arizona and southern California to San Francisco by 1883. In 1883 also the lines which became the Atchison, Topeka & Santa Fé, extending from the lower Missouri valley, with St Louis and Kansas City as important terminals, through south-eastern Colorado, northern Arizona and New Mexico, reached the same goal. The Denver & Rio Grande in the same period opened new mining areas between Denver and Ogden. Not only additional mines were reached by these lines, but a great cattle country, recently the habitat of the bison and the Indian, was opened. All the large cities commanding the approaches to this country developed packing industries, but Chicago especially profited. Although her main supply was still the Middle Western farms, this domestic supply was supplemented by vast quantities of range cattle. South-eastern Texas was the original home of these cattle ranches, but the driving of herds to supply the miners of the Rocky Mountains revealed the fact that the whole bison country was capable of supporting range cattle, and the practice grew of driving the stock to the feeding ground of the north and returning. The height of the movement along the cattle trail, which in its largest extent ran through the public lands of the great plains from Texas to the Dakotas and Montana, was reached in 1884. In that period cattlemen fought over the possession of the range, controlled vast tracts by seizing the approaches to the water supplies under perversion of the land laws, fenced in the public domain, either defiantly or by leases from land grant roads, and called out proclamations of presidents from Hayes to Cleveland. The steady advance of the farmer, and protective measures against the spread of the cattle diseases known as Texas fever, gradually prevented the continuance of the trail, and ultimately broke down the system of great ranches. The grade of cattle was improved and great packing interests organized the industry on the basis of concentrated large scale production. About 1870 shipment of livestock from Chicago had become significant, and within a decade the refrigerator car revolutionized the packing industry by making possible the shipment of dressed beef not only to the markets of the Eastern United States but even to Europe. The value of slaughtering and packing industries in the United States increased from less than thirty million dollars in 1870, to over three hundred millions in 1880, and to five hundred and sixty-four millions in 1890.

349. Another important revolution in American economic life was effected by the opening of new iron-mines, the growth of the steel and coal industry and the rise of an extraordinary internal commerce along the whole length of the Great Lakes. By 1890 the output of pig-iron in the United States surpassed

Mining and Commerce.

that of Great Britain, having doubled since 1880. The full meaning of the revolution is seen in the fact that by 1907 the United States produced more pig-iron and steel than Great Britain, Germany and France combined. As a result of the growth of the wheat, lumber and iron-ore production of the North-West, the traffic along the thousand miles of the Great Lakes grew (chiefly after 1890) by leaps, and changed from wooden sailing vessels to steel ships driven by steam. The traffic through the Sault Ste Marie Canal came greatly to exceed that through the Suez Canal.

The South.

350. The South shared in these industrial transformations. Not only did white labour produce an increasing proportion of the cotton crop, which was now extended into the cut-over pine lands, but cheap white labour came from the uplands to cotton mills situated at the water-powers. This, with the abundant supply of raw material, enabled the South to develop cotton manufacture between 1880 and 1890 on a scale that threatened New England's dominance. The southern Appalachians began to yield their treasures of coal and iron; northern Alabama became one of the great centres of the iron industry and the South produced nearly 400,000 tons of pig iron in 1880 and two and a half millions twenty years later. By 1890 the production of coal, iron-ore and pig-iron in this section was as great as that of the United States in 1870. The value of the products of manufacture in the South rose from $338,000,000 in 1880 to $1,184,000,000 in 1900. The exploitation of the long leaf pine forests also attracted Northern capital. Fruit and truck gardening grew rapidly, and the South began to exhibit traits of industrial development familiar in the North and West. Protective tariffs and the interests of capital found recruits in the old-time planting states; but the negro problem continued to hold the South as a whole to the Democratic party.

Industrial and Financial Changes.

351. The opportunities opened to capital by these forces of growth in the West and South, as well as the general influence of an age of machine production, led to transformations in the East which brought new difficulties for political solution. The East began to exhibit characteristics of other long-settled countries where increasing density of population and highly developed industry are accompanied by labour troubles, and where problems of democratic society and government take the form of forcible action or political revolt, in the absence of ample outlets into adjacent areas of cheap lands and new opportunities. To capital the opening resources of the West, and the general national prosperity after 1879, offered such inducements that large scale production by corporations and vast designs became the order of the day. The forces which had exhibited themselves in increased manufacture and railway development between the Civil War and the panic of 1873 now found expression in a general concentration of industries into fewer plants with vastly greater capital and output, in the combination of partnerships into corporations, and of corporations into agreements, pools and trusts to avoid competition and to secure the needed capital and economies for dealing with the new problems of industrial magnitude. Western farming competition led to the actual abandonment of much inferior land in New England and to agricultural disadvantages in the Middle states. As agriculture became less attractive and as industrial demands grew, the urban population of the East increased at the expense of the rural. The numbers of cities of the United States with more than 8000 people nearly doubled between 1880 and 1890; by 1900 the urban population constituted a third of the total, and this phenomenon was especially marked in the North Atlantic division, where by 1900 over half the population was in cities of more than eight thousand inhabitants.

352. In similar fashion concentration of industry in large establishments was in progress. In 1880 nearly two thousand mills were engaged in the woollen industry; in 1890 not many more than thirteen hundred. Even more marked was the change in iron and steel, where large-scale production and concentration of mills began to revolutionize this fundamental industry, and other lines of production showed the same tendency. The anthracite mines of Pennsylvania, the great resource for the nation, fell into the possession of seven coal-carrying railways which became closely allied in interest. In most of the important industries the tendency of large organizations to subject or drive out the small undertakings became significant. Already the railways to avoid "cut-throat competition" had begun to consolidate their systems by absorption of component lines, to form rate agreements and to "pool" their earnings in given districts. Western agitation had led to reports and bills by committees headed by Western congressmen, such as the report of William Windom, of Minnesota, in 1874, where the construction of Federal lines to regulate rates by competition, was suggested; the report of George W. McCrary of Iowa, whose bill for regulation was passed by the House in 1874 under the stimulus of the Granger movement, but failed in the Senate; that of John H. Reagan, of Texas (1878), whose bill forbidding pooling and compelling publicity of rates by the machinery of the Federal courts, was discussed for several years, but failed to become law; and that of Shelby M. Cullom, of Illinois, in 1886.

The Interstate Commerce Act.

353. The decision of the Supreme Court in the *Wabash case*, made in that year, reversed the doctrine followed in the case of *Munn* v. *Illinois*, and held that the regulative power of the state (even in the absence of Federal legislation) was limited to traffic wholly within the state and not passing from one state to another. The Cullom bill as enacted into the Interstate Commerce Law of the 4th of February 1887, was framed to prevent unjust discriminations by the railroads between persons, places and commodities, the tendency of which was, as the report declared, to foster monopoly. The law forbade discriminations and pooling, made a higher charge for a short haul than for a long haul over the same road illegal (unless permitted after investigation by the commission), required publicity of rates, and provided for a commission to investigate and fine offenders. But the decisions of the commission were reviewable by the Federal courts and the offender could be coerced, if he refused to obey the commission, only by judicial proceedings. The commission was empowered to provide uniform accounting and to exact annual reports from the roads. The principle settled by the law was an important one, and marked the growing reliance of the former individualistic nation upon Federal regulation to check the progress of economic consolidation and monopoly. But the difficulties by no means disappeared; the Federal judiciary refusing to accept the findings of the commission on questions of fact, retried the cases; and the Supreme Court overruled the commission on fundamental questions, and narrowed the scope of the act by interpretation.

Labour Combinations; Industrial and Social Unrest.

354. Labour exhibited the tendency to combination shown by capital. The Knights of Labor, founded in 1869, on the basis of "the individual masses" instead of the trades unions, and professing the principle that "the injury of one is the concern of all," grew from a membership of about one hundred thousand in 1885 to seven hundred and thirty thousand in 1886. The number of strikes in 1886 was over twice as many as in any previous year. In one of the strikes on the Gould railway system six thousand miles of railway were held up. In New York, Henry George, author of books proposing the single tax on land as a remedy for social ills, ran for mayor of the city and received 68,000 out of 219,000 votes. At the same time socialistic doctrines spread, even among Western farmers. But sympathetic strikes, anarchistic outbreaks, and drastic plans for social change did not appeal to the people as a whole. The Knights of Labor began to split, and the unions, organized as the American Federation of Labor, began to take their place with a less radical membership. President Cleveland broke with precedents in 1886 by sending in the first message on labour, in which he advocated, without success, a labour commission to settle controversies. A national bureau of labour to collect statistics had been established in 1884; state legislation increasingly provided for arbitration of labour disputes, and regulation of factories and child

Immigration. **Cleveland's Vetoes.** **Tariff Message.** **The Mills Bill.**

labour. Early in 1885 a law had been enacted forbidding the importation of labour under contract, and in 1888 the Chinese Exclusion Act was continued. Immigration was exceptionally large in the decade from 1880 to 1890, amounting to about five and a quarter millions as compared with two million eight hundred thousand for the previous decade. But a large number of these new-comers settled on the newly opened lands of the Middle West. By 1890 the persons of German parentage in the Middle West numbered over four millions—more than half the total of persons of German parentage in the nation. Minnesota held 373,000 persons of Scandinavian parentage, and of the whole of this element the Middle West had all but about 300,000. The Irish constituted the largest element among the English-speaking immigrants. The population of foreign parentage amounted to one-third of the whole population of the United States in 1890. In the midst of this national development and turmoil President Cleveland struggled to unite his party on a definite issue. The silver question continued to divide each party, the continued fall of silver leading to renewed agitation for free coinage. In 1886 a bill for this purpose was defeated by a majority of 37 in the House, 98 Democrats favouring it, and 70 opposing, as against 26 Republicans for it and 93 against. The surplus led to extravagant appropriation bills, such as special pension bills, which Cleveland vetoed by the wholesale, thereby incurring criticism by veterans of the Civil War, and river and harbour improvement measures, particularly the act of 1886, to which the president gave reluctant assent and the bill of 1887 to which he gave a "pocket veto" by refusing his signature. But the retention of the surplus in the treasury would create a monetary stringency, its deposit in banks aroused opposition, and its use to buy bonds was unpopular with the Democrats. Cleveland boldly met the issue and gave purpose to his party by his annual message of December 1887, which he entirely devoted to an exposition of the situation arising from the surplus, and to a demand for a revision of the tariff in order to reduce revenue. He did not profess free trade doctrines: "It is a condition which confronts us, not a theory," he declared. The election of 1886 had reduced the Democratic majority in the House, but the president was able to induce his party to pass the Mills Bill (1888) through that body as a concrete presentation of policy. The bill put many important raw materials (including wool and unmanufactured lumber) on the free list, substituted *ad valorem* for specific duties to a large extent, and generally reduced the protective duties. It was believed that the measure would remit over fifty and a-half million dollars of duties, nearly twenty millions of which would result from additions to the free list. The Republican Senate also found party unity on the tariff issue and its committee on finance, under the leadership of Senator Nelson W. Aldrich of Rhode Island, drafted a counter proposal. They would reduce revenue by repealing the taxes on tobacco, and the taxes on spirits used in the arts and for mechanical purposes, and by revising the tariff so as to check imports of articles produced at home.

Benjamin Harrison elected President.

355. On the tariff issue the two parties contested the election of 1888, the Republicans denouncing the Mills Bill and the Democrats supporting it. Blaine having withdrawn from the contest, and John Sherman having secured but little more than half the votes necessary to nominate, the Republicans picked from a multitude of candidates General Benjamin Harrison of Indiana, grandson of President William Henry Harrison, to run against Mr Cleveland. The popular vote was exceedingly close, but Harrison had an electoral majority of 65, having carried all of the states except the solid South, Connecticut and New Jersey. The increasing use of money to influence the election, and particularly the association of great business interests with such political "bosses" as Matthew S. Quay of Pennsylvania and Thomas C. Platt of New York, were features of the campaign. The Congressional elections ensured to the Republicans the undisputed control of all branches of the government when the Fifty-first Congress should convene, and it was generally agreed that the party had a mandate to sustain the protective tariff.

Speaker Thomas B. Reed.

356. Lacking a large majority in either house the Republicans were not only exposed to the danger of free silver defections in the Senate, but to "filibustering" by the Democratic minority in the House as a means of blocking the victorious party's programme. These obstructive tactics were made possible chiefly by the use of privileged motions and roll calls to delay business, and the refusal to respond on the roll call for a vote, thus preventing a quorum. Speaker Thomas B. Reed of Maine, a virile and keen-witted leader, greatly strengthened the power of the speaker, as well as expediting the business of the House, by ruling that the Constitution required a present, not a voting, quorum; and in spite of disorderly protests he "counted a quorum" of those actually present. By securing rules sanctioning this action and empowering the speaker to refuse to entertain dilatory motions, that officer became the effective agent for carrying on the business of the party majority. As his power through the committee on rules, which he appointed, grew, he came, in the course of time, also to dominate the action of the House, refusing to recognize members except for motions which he approved, and through his lieutenants on important committees selecting such measures for consideration as seemed most desirable. This efficiency of action was secured at a loss to the house as a representative and debating body, responsive to minority proposals.

The Sherman Anti-Trust Act.

357. But the discipline of party caucus and House rules enabled the Republican leaders to put through with rapidity a number of important laws. One of these was the measure known as the Sherman Anti-Trust Act of the 2nd of July 1890, which declared combinations affecting commerce between the several states, or with foreign nations, illegal and punishable by fine or imprisonment or both. This act, the full power of which was not exhibited until later, was a response to the growing unrest of the nation as other corporations emulated the success of the Standard Oil Trust (formed in 1882). The members of a trust combined in an organization managed by boards of trustees whose certificates the former owners accepted instead of their shares of stock in the component companies. Competition was thus eliminated within the combination and the greatly increased capital and economies enabled it not only to deal with the increasing magnitude of business operation, but also to master the smaller concerns which opposed it. State legislation had proved unable to check the process, partly because the trust was an interstate affair. By putting into operation its power under the Constitution to regulate interstate commerce, Congress responded to the popular demand for Federal restraint of these great combinations which threatened the old American ideals of individualism and freedom of competition. The trusts, although embarrassed, soon showed their ability to find other devices to maintain their unified control. Nor was the act used, in this period, to prevent the railways from agreements and combinations which in large measure neutralized the anti-pooling clause of the Interstate Commerce Act of 1887.

Sherman Silver Purchase Act.

358. Another important law was the so-called Sherman Silver Purchase Act of the 14th of July 1890. By 1889 the ratio of silver to gold had fallen to 1 to 22. In the twelve years of the Bland-Allison Act of 1878 over 378,000,000 silver dollars had been coined from bullion purchased at the market price. This bullion value was falling: it was $·89 in 1877 and $·72 in 1889. The production of gold in the United States in 1878 was about two and one-half million fine ounces, and of silver about thirty-five millions; in 1890 the gold production was 1,588,000 and the silver 54,500,000. The Silver Purchase Act authorized the secretary of the treasury to purchase each month 4,500,000 oz. of silver at its market price and to pay for it in treasury notes redeemable at his discretion, in silver or gold. This law, passed to placate the demands of the free silver men by increasing the use of silver, was insufficient to prevent the Senate from passing a free coinage bill by a combination of Democrats and the

silver Republicans, chiefly from the newer states of the Far West; but this free coinage bill was lost in the House by a small majority. The explanation of this sudden re-opening of the question was that of party apprehension. In some of the Republican states of the Middle West, long relied upon as safe, the Farmers' Alliance had been spreading, and fomenting a demand for unlimited coinage of silver. A silver convention held at St Louis in the fall of 1889 had been attended by many delegates from this region as well as from the new silver-mining states whose increased power in the Senate was soon to be effective. It was feared, therefore, that a veto of a free coinage measure might array the West and South-West against the East and break up the party.

The McKinley Tariff.

359. The customs duties upon which the fighting of the campaign of 1888 had turned was promptly taken up, and in the McKinley Tariff Act of the 1st of October 1890 the Republicans embodied their conceptions of protection to American industry. Some of the main features of this law were: the addition of agricultural products to the protected articles; the extension of the free list, particularly the inclusion therein of raw sugar, which had been bringing in a revenue of $50,000,000 annually; the granting of compensating bounties to sugar planters to an amount of about $10,000,000 a year; and the raising of duties to the prohibitory point on many articles of general consumption which could be produced at home. Mr Blaine, then secretary of state, had just been active in promoting closer relations with South America wherein he hoped for an extension of American trade and he severely criticized the bill as it passed the House, because the free list opened wide the doors of American trade, particularly to sugar producing countries, without first exacting compensating advantages for our products in those markets. To meet this criticism a provision was finally added authorizing the president to impose discriminating duties where it was necessary to obtain the advantages of reciprocity.

360. This tariff, which passed on the eve of the Congressional elections of 1890, was immediately followed by such increases in prices and the cost of living that it was potent in bringing about the political revolution, or "land slide," which swept the Republicans from power in the House of Representatives. The Republicans returned but 88 members as compared with nearly twice that number in the Congress which passed the McKinley Bill. The South sent but four Republicans; New England a majority of Democrats; and such strongholds of Republicanism as the Middle Western states of Illinois, Michigan, Wisconsin, Iowa and Kansas, hitherto responsive to the traditions of the Civil War, sent Democratic or independent delegations. Looked at broadly, the movement was a rural uprising, strongest in the South and Middle West, the old Granger areas, against forces which seemed to them to threaten their ideals of American democracy. But the movement was recruited by the silver-mining states and discontented labour interests.

Western Discontent.

361. Farm products had not proportionally shared the general increase in prosperity. This convinced large portions of the agricultural West that the currency system had too narrow a basis in gold, which was appreciating in value. Much of the Middle Western agricultural development had been made on borrowed Eastern capital, and it seemed to the farmer that the principal of his mortgage was in effect increasing with the rise in the price of gold, at the same time that his crops brought a smaller net profit. He did not give due attention to the effect of greatly increased production, as the new wheat lands were opened on such a grand scale; but he was keenly sensitive to increased freight rates and discriminations, to the influence of Eastern capitalists, banks, bondholders, trusts and railways upon Federal and state legislatures and judiciary, and to the large amount of railway lands, unproductively held by the companies, while the land hunger of the nation was exhibited in the rush to newly opened Indian lands, such as Oklahoma (1889) and parts of the Sioux reservation (1890). After the evidence of the power of this tide of Western discontent in the elections of 1890, those portions of it which were ripest for revolt combined in 1892 as the People's party or Populists, soon to prove an important political factor.

Pensions.

362. The Republicans meanwhile had been actively reducing the surplus. In 1892 the excess of revenue over expenditures was ten million dollars; by 1893 only two millions. This was effected not only by the Tariff Act but by such measures as the Dependent Pension Act of 1890 (resulting in a list of pensioners of the Civil War which cost the nation $68,000,000 by 1893, over half of these pensioners having been added during Harrison's administration); the rapid construction of the new navy, raising the United States from twelfth to fifth in the list of naval powers; the repayment of the direct war tax to the states (1891) to the amount of fifty-one millions; and other appropriations such as those provided by river and harbour bills. The Democrats stigmatized this Congress as a "billion dollar Congress" from its expenditures, to which Speaker Reed replied that the United States was a billion dollar nation. In fact the Democrats when they regained power were not able greatly to diminish the cost of government.

Homestead Strike.

363. The Democratic House in the Fifty-second Congress repressed obstructive Republican tactics by methods like those adopted by Speaker Reed, and contented itself with passing a series of bills through that body proposing reductions of the tariff in special schedules, including free wool and a reduction of the duty on woollens, free raw material for the cotton planters of the South, free binding twine for the farmers of the North and a reduced duty on tin plate for the fruit raisers. The new industries of the southern Appalachians prevented action on coal and iron. Of course these bills failed in the Republican Senate. A bloody strike on the eve of the election of 1892 in the great steel works at Homestead, Pennsylvania, where armed guards engaged by the company fired upon the mob which sought higher wages, was not without its adverse effect upon public sentiment in regard to the Republican tariff for the protection of labour.

364. During the campaign of 1892 the Democrats rejected a conservative tariff plank, denounced the McKinley tariff in violent language, and denied the constitutional power to impose tariff duties except for the purpose of revenue only. But Cleveland, who was renominated in spite of vigorous opposition from leading politicians of his own state, toned down the platform utterances on the tariff in his letter of acceptance. In their declarations upon the currency the Democrats furnished a common standing ground for the different factions by attacking the Silver Purchase Act of 1890 as a cowardly makeshift.

The People's Party.

365. The People's party, in its national convention at Omaha (July 1892), drew a gloomy picture of government corrupted in all of its branches, business prostrated, farms covered with mortgages, labour oppressed, lands concentrating in the hands of capitalists. Demanding the restoration of government to the "plain people," they proposed an expansion of its powers, to afford an adequate volume of currency and to check the tendency to "breed tramps and millionaires." Among their positive proposals were: the free and unlimited coinage of silver at the legal ratio of sixteen to one; the expansion of a national currency issued directly to the people; the establishment of postal savings banks; government ownership of the railways, telegraph and telephone; restoration to the government of the lands held by railways and other corporations in excess of their needs; and a graduated income tax. In supplementary resolutions the Australian ballot system, which had spread rapidly in the past few years, was commended, as also were the initiative and referendum in law-making. Combining with the Democratic party in various states beyond the Mississippi, and with Republicans in some of the Southern states, they won large masses of voters in the West, and exerted an influence upon public opinion in that section beyond what was indicated in the returns, although General James B. Weaver of Iowa, their candidate for the presidency, received over 1,000,000 popular votes and 22 votes in the electoral college. The Republicans renominated President Harrison, though he lacked an enthusiastic personal following. They

supported the McKinley Tariff Act in spite of the wave of opposition shown in the elections of 1890. But, fearing party divisions, they, like the Democrats, made an ambiguous declaration on the currency. The result of the election of 1892 was to return the Democrats under Cleveland to power by a plurality of over 380,000 and an electoral plurality of 132. Congress in both branches was to be Democratic in 1893, and the way was open for the first time in a generation for that party to carry out a policy unchecked by any legislative or executive branch of government.

Cleveland re-elected President.

366. But before Cleveland was fairly started in his second administration the disastrous panic of 1893 swept the nation, nor did prosperity return during the four years that followed. The panic is not, directly at least, to be traced to the silver purchases, but was the result of various causes, including the agricultural depression, farm mortgages, reckless railway financiering and unsound banking in the United States, as well as to Argentine and European financial troubles. The panic began in the spring with the failure of the Reading railway (which had undertaken the acquisition of coal land and an extension of activity beyond its resources) and the collapse of the National Cordage Company, one of the numerous examples of reckless trust financiering into which large banks had also been drawn. Clearing-house certificates were resorted to by the New York banks in June, followed in August by partial suspension of specie payments. Currency remained at a premium for a month; deposits in national banks shrank enormously; national bank loans contracted more than 14·7%; failures were common; 22,000 m. of railways were under receiverships, and construction almost ceased. The interruption to business is indicated by the decline of iron production by one-fourth.

Panic of 1893.

367. The panic of 1893 was in many ways a turning-point in American history. It focused attention upon monetary questions, prostrated the silver-mining states, embittered the already discontented farming regions of the West, produced an industrial chaos out of which the stronger economic interests emerged with increased power by the absorption of embarrassed companies, and was accompanied by renewed labour troubles. Most noteworthy of these was the Pullman Car Company strike near Chicago in 1894, which led to sympathetic strikes by the American Railway Union, extending over twenty-seven states and Territories from Cincinnati to San Francisco. Mobs of the worst classes of Chicago burned and looted cars. The refusal of Governor John P. Altgeld of Illinois to call out the militia, and the interference with the United States mails, led President Cleveland to order Federal troops to the scene, on the constitutional ground that they were necessary to prevent interference with interstate commerce and the postal service and to enforce the processes of the Federal courts. The latter issued a sweeping injunction requiring that the members of the American Railway Union or other persons desist from interference with the business of the railways concerned. The president of the striking organization, Eugene V. Debs, was imprisoned for contempt of court and conspiracy.

Railway Strike.

368. The most immediate political effect of the panic was upon the silver issue. Soon after the outbreak of the financial crisis, the gold reserve, which protected the greenbacks and the treasury notes issued under the Silver Purchase Act, shrank ominously, while foreigners returned their American securities instead of sending gold. To sell bonds in order to replenish the gold reserve, and to repeal the Silver Purchase Act without substituting free coinage, would aggravate western discontent and turn away the promise of recruits to the Democratic party from the Populists of the prairie and silver-mining states; to carry out the Democratic platform by a tariff for revenue only while mills were shutting down would be hazardous in the East. The fruits of victory were turning to ashes; but Cleveland summoned a special session of Congress for August, while the panic was acute, and asked his party to repeal the Silver Purchase Act without accompanying the repeal with provisions for silver. Not until the last of October 1893 was repeal carried, by a vote in which the friends of repeal in the House were about equally divided between Democrats and Republicans, and nearly two-thirds of its opponents Democrats.

Repeal of Silver Purchase Act.

369. By this time the surplus had disappeared and the gold reserve was drawn upon for ordinary expenses. Early in 1894 the administration, failing to secure legislation from Congress to authorize the sale of gold bonds on favourable terms to protect the reserve, sold under the Resumption Act of 1875 $50,000,000 5% bonds, redeemable in ten years. Part of this very gold, however, was withdrawn from the reserve by the presentation of legal tender notes for redemption, and the "endless chain" continued this operation to the verge of extinguishing the reserve, so that another loan of $50,000,000 in 1894 was followed in 1895 by a dramatic meeting between Cleveland and some of his cabinet with the important Wall Street banker, J. Pierpont Morgan, who agreed on behalf of his syndicate to sell the government $65,166,000 of gold for $62,315,000 of bonds, equivalent to 4% bonds for thirty years at a price of 104. In return the syndicate agreed to use its influence to protect the withdrawals of gold from the treasury. These securities were over-subscribed when offered to the public at 112¼. President Cleveland had protected the treasury and sustained the parity of gold and silver, but at the cost of disrupting his party, which steadfastly refused to authorize gold bonds. Again, in the beginning of 1896, the treasury was forced to sell bonds, but this time it dealt directly with the public and easily placed $100,000,000 in bonds at about 111, affording a rate of interest about equal to 3·4%.

370. Before the political harvest of the monetary issue was reaped, the Democrats had also found party ties too weak to bear the strain of an effective redemption of the party pledges on the tariff. The Wilson Bill prepared as the administrative measure was reported late in 1893, while the panic was still exerting a baneful influence. Its leading features were the substitution of *ad valorem* for specific duties in general, the extension of the free list to include such materials of manufacture as iron ore, wool, coal, sugar and lumber, and the reduction of many prohibitory rates. The loss in revenue was partly provided for by an income tax, significant of the new forces affecting American society, and an increase in the duty on distilled liquors. Although the bill passed the House by an overwhelming majority, it met the opposition in the Senate of the representatives, Democratic as well as Republican, of those states whose interests were adversely affected, especially the iron ore and coal producing states of the Southern Appalachians, the sugar producers of Louisiana, the wool growers and manufacturers of Ohio, and the regions of accumulated property in the East, where an income tax was especially obnoxious. Led by Senators Arthur P. Gorman, of Maryland; Calvin S. Brice, of Ohio; and David B. Hill, of New York, the bill was transformed by an alliance between Democratic and Republican senators, on the plea that it would otherwise result in a deficit of $100,000,000. Coal, iron ore and sugar were withdrawn from the free raw materials and specific duties replaced *ad valorem* in many cases, while many other individual schedules were amended in the direction of protection. The House, given the alternative of allowing the McKinley Act to remain or to accept the Senate's bill, yielded, and the Wilson-Gorman Tariff Act became a law without the president's signature, on the 27th of August 1894. He called upon his followers still to fight for free raw materials, and wrote bitterly of "the trusts and combinations, the communism of pelf, whose machinations have prevented us from reaching the success we deserved." Even the income tax was soon (1895) held by the Supreme Court to be unconstitutional.

The Wilson Bill.

371. Toward the close of his administration Cleveland's brusque message on the Venezuelan boundary question (see later) aroused such excitement and so rallied the general public (though not the more conservative) that the war spirit, shown soon afterwards against Spain, might have been a potent factor

in the election of 1896 had not England exhibited exceptional moderation and self-restraint in her attitude. The silver question, therefore, became the important issue. The Republicans nominated McKinley and declared for the gold standard in opposition to free coinage, losing thereby an influential following in the silver-mining and prairie states, but gaining the support of multitudes of business men among the Democrats in the East and Middle West, who saw in the free-silver programme a violation of good faith and a menace to returning prosperity. The Democratic convention marked a revolution in the party. The old school leaders were deposed by decisive majorities, and a radical platform was constructed which made "the free and unlimited coinage of both silver and gold at the present legal ratio of sixteen to one, without waiting for the aid or consent of any other nation," the paramount issue. Objecting also to the decision against the income tax, and to "government by injunction as a new and highly dangerous form of oppression," they incurred the charge of hostility to the Federal judiciary. William J. Bryan made a brilliant speech in behalf of free coinage, and so voiced the passion and thought of the captivated convention that he was nominated by it for the presidency over the veteran free-silver leader, Richard P. Bland of Missouri. The Cleveland men, or "gold Democrats," broke with their party after it became committed to free silver, and holding a convention of their own, nominated General John McA. Palmer of Illinois for the presidency on a platform which extolled Cleveland, attacked free coinage, and favoured the gold standard. Its main influence was to permit many Cleveland men to vote against Bryan without renouncing the name of Democrats. On the other hand the Populist convention also nominated Bryan on a platform more radical than that of the Democrats, since it included government ownership of the railways, the initiative and referendum, and a currency issued without the intervention of banks.

Free Silver Issue; William J. Bryan.

Gold Democrats.

372. The contest was marked by great excitement as Bryan travelled across the country addressing great audiences. The endangered business interests found an efficient manager in Marcus A. Hanna of Ohio, McKinley's adviser, and expended large sums in a campaign of education. In the event, the older states of the Middle West, holding the balance between the manufacturing and capitalistic East and the populistic prairie and mining states of the West, gave their decision against free silver. But class appeals and class voting were a marked feature of the campaign, the regions of agricultural depression and farm mortgages favouring Bryan, and those of urban life favouring McKinley. Labour was not convinced that its interests lay in expanding the currency, and Mr Hanna had conducted McKinley's campaign successfully on the plea that he was the advance agent of prosperity under the gold standard and a restoration of confidence. McKinley carried all the Northern states east of the Missouri, and North Dakota, Oregon and California of the Farther West, as well as Maryland, Delaware, West Virginia and Kentucky along the borders of the South. His plurality over Bryan in the popular vote was more than 600,000, and his electoral majority 95. All the departments of government were transferred by the election to the Republicans.

William McKinley elected President.

373. Having secured power, the administration called a special session of Congress, and enacted the Dingley protective tariff (July 24, 1897), under which the deficit in the treasury was turned into a surplus. The act raised duties to their highest point, and as the protective schedules included some important articles produced by trusts which had a practical monopoly, such as sugar and petroleum, this was seized upon by the Democrats to stigmatize the tariff as the "mother of trusts." Many articles which had been placed on the free list in the Tariff Act of 1894, including lumber, wool and the raw material for cotton baling, were made dutiable. The high rates were defended, in part, by the provision authorizing the president to negotiate reciprocity treaties under which they might be lowered. Several such treaties were signed, but the Senate refused to ratify them.

Dingley Tariff.

374. The Republicans also wrote their triumph into the Gold Standard Act of the 4th of March 1900, which ensured the maintenance of this standard by reserving $150,000,000 of gold coin and bullion to redeem the United States notes and the treasury notes of 1890, and by authorizing the sale of bonds when necessary to maintain the reserve. National banks were authorized in the smaller towns (three thousand or less) with a capital of $25,000, half of that formerly required, and increased circulation was further provided for by permitting the national banks to issue United States bonds up to their par value.

Gold Standard Act.

375. The economic policy of the Republicans was facilitated by the prosperity which set in about 1898. The downfall of silver-mining turned the prospectors to seek new gold fields, and they found them, especially in Alaska, about this time; and contemporaneously the chemists discovered cheaper and more efficient methods of extracting the gold from low-grade ores. Within five years after the crisis of 1893 the gold production of the United States nearly doubled. The United States coined $437,500,000 in gold in the five-year period 1897–1902, while the average for five-year periods since 1873 had been only $224,000,000. Thus gold instead of silver began to inundate the market, and to diminish the demand for expansion of the currency. Agriculture, prostrated in the years immediately preceding and following the panic of 1893, turned to the scientific study of its problems, developed dry farming, rotation and variety of crops, introduced forage crops like alfalfa, fed its Indian corn to cattle and hogs, and thus converted it into a profitable and condensed form for shipment. Range cattle were brought to the corn belt and fattened, while packing industries moved closer to these western centres of supply. Dairy-farming replaced the unprofitable attempts of older sections of the Middle West and the East to compete with the wheat-fields of the Farther West. Truck and fruit farming increased in the South, and the canning industry added utility to the fruits and vegetables of the West. Following the trend of combination the farmers formed growers' associations and studied the demand of the market to guide their sales. The mortgaged farms were gradually freed from debt. The wheat crop increased from less than 400,000,000 bushels valued at $213,000,000 in 1893 to 675,000,000 bushels valued at $392,000,000 in 1898. Prosperity and contentment replaced agitation in the populistic West for the time, and the Republican party gained the advantage of these changed conditions. Land values and the price of farm products rose. The farmers soon found it profitable to sell all or part of their land and re-invest in the cheaper virgin soils of the farther North-West and South-West, and thus began a new movement of colonization into the new West, while the landowners who remained gained an increasingly higher status, though farm labour failed to share proportionally in this advance.

Economic and Industrial Changes.

376. In the South also there was greater contentment as the new industries of iron, textiles and forestry grew, and as the cotton crops increased. Unrest was diminished by the new state constitutions, which after 1890 disqualified negro voters by educational and tax requirements so contrived as not to disfranchise the poor whites.

The South.

377. In the decade which followed the crisis of 1893 a new industrial structure was made out of the chaos of the panic. "High financiering" was undertaken on a scale hitherto unknown. Combinations absorbed their weaker rivals; Standard Oil especially gained large interests in New York banks and in the iron mines and transportation lines about the Great Lakes, while it extended its power over new fields of oil in the South-West. In general, a small group of powerful financial interests acquired holdings in other lines of business, and by absorptions and "community of interest" exerted great influence upon the whole business world. The group of financiers, headed by J. Pierpont

"High Financiering."

Morgan, came to dominate various Southern transportation lines and the anthracite coal roads and mines, and extended their influence to the Northern Pacific railway, while a new genius in railway financiering, Edward H. Harriman, began an avowed plan of controlling the entire railway system of the nation. Backed by an important banking syndicate he rescued the Union Pacific from bankruptcy, and with its profits as a working basis he started in to acquire connecting and competing lines. Labour also shared in the general prosperity after 1898. Relative real wages increased, even allowing for the higher cost of living, and the length of the working day in general decreased except in special industries.

378. By 1900 the continental United States had a population of 76,000,000; an aggregate real and personal wealth of $88,500,000,000; a per capita public debt of $14·52, and per capita money circulation of $26·94 against $21·41 in 1896. In 1901 bank clearings amounted to nearly $115,000,000,000 against $45,000,000,000 in 1894. Imports of merchandise had fallen in this period, while exports rose from about $847,000,000 in 1893 to $1,394,000,000 in 1900. Of these exports food stuffs and food animals, crude and partly manufactured, aggregated nearly 40% of the total. The production of pig-iron, which was about 7,000,000 long tons in 1893, was nearly twice that in 1900. This economic prosperity and these far-reaching processes of social change by which the remaining natural resources of the nation were rapidly appropriated, went on contemporaneously with the extension of the activity of the nation overseas. The first rough conquest of the wilderness accomplished, the long period of internal colonization drawing to a close, the United States turned to consider its position as a world power.

General Prosperity.

379. To understand this position it is necessary to return to an earlier period and briefly survey the foreign relations since the close of the Reconstruction era. The most significant and persistent influence came from the growing interest of the United States in the Pacific, as its population and economic power extended to that ocean. The problem of an overflow of Chinese migration to the Pacific coast, and the jeopardizing of the American standard of labour by this flood, had been settled by various treaties and laws since 1880. The question of the relation of the United States to an interoceanic canal was not so easily settled. In 1878 Colombia granted a concession to a French company, promoted by Ferdinand de Lesseps, the engineer of the Suez Canal, to dig a tide-level canal through the Isthmus of Panama. President Hayes voiced the antagonism of the United States to this project of European capital in his message of 1880 in which he declared that such a canal should be under the control of this nation, and that it would be "virtually a part of the coast-line of the United States." Although an American company was organized to construct a canal under a concession from Nicaragua in 1884, no real progress was made, and the French company, defeated by engineering and sanitary difficulties, failed at the close of 1888.

Isthmian Canal.

380. Meantime, for a few months, Blaine, as secretary of state under President Garfield, began a vigorous foreign policy with especial reference to the Pacific. He attempted to get the consent of England to abrogate the Clayton-Bulwer Treaty of 1850, which contemplated the construction of an isthmian canal by private enterprise under joint control and neutralization of the United States and Great Britain, together with such other powers as should join them. In South America he actively pressed the influence of the United States to settle the war between Chile and Peru. Again, in the years from 1889 to 1892, Blaine held the portfolio of state, and attempted to increase the influence of his country in Spanish America by the Pan-American Congress of 1890, which proposed a great international railway system and bank, commercial reciprocity and arbitration, without immediate results. (See PAN-AMERICAN CONFERENCES.) Indeed, the bad feeling aroused by his earlier policy toward Chile found expression in 1891 in a mob at Valparaiso, when some of the men from the United States ship "Baltimore" on shore leave were killed and wounded. An apology averted the war which President Harrison threatened. Blaine also asserted, against Canada particularly, the right of the United States to the seals of the Bering Sea; but in 1893 arbitrators decided against the claim.

Pan-American Congress.

Chile.

Bering Sea.

381. As the navy grew and American policy increasingly turned to the Pacific, the need of coaling stations and positions advantageous to its sea power was appreciated. By a tripartite treaty in 1889 the Samoan islands were placed under the joint control of the United States, England and Germany, and, a decade later, they were divided among these powers, Tutuila and the harbour of Pago-Pago falling to the United States. The Hawaiian islands, which had been brought under the influence of civilization by American missionaries, were connected by commercial ties with the United States. Upon the attempt of the ruler to overturn the constitution, the American party, aided by the moral support of the United States, which landed marines, revolted, set up a republic, and asked annexation to the Union. A treaty, negotiated under President Harrison to this end, was withdrawn by President Cleveland, after investigation, on the ground that the part of the United States in the revolution was improper. He attempted without success to restore the original state of affairs, and on the 7th of July 1898 the islands were annexed.

Samoan Islands.

Hawaiian Islands.

382. President Cleveland's conservatism in this and other matters of foreign policy had not prepared the people for the sudden exhibition of firmness in foreign policy with which he startled the nation in his message of December 1895 upon the question of the boundary of Venezuela. That nation and England had a long-standing dispute over the line which separated British Guiana from Venezuela. Great Britain declined to arbitrate, at the suggestion of the United States, and gave an interpretation to the Monroe Doctrine which the administration declined to accept. President Cleveland thereupon brusquely announced to Congress his belief that Great Britain's attitude was in effect an attempt to control Venezuela, and proposed that a commission on the part of the United States should report upon the disputed boundary, and support Venezuela in the possession of what should be ascertained to be her rightful territory. Secretary-of-State Richard Olney declared: "To-day the United States is practically sovereign on this continent, and its fiat is law upon the subjects to which it confines its interposition." Great Britain tactfully accepted arbitration, however, and in the end (1899) was awarded most of the territory regarding which she had been unwilling to arbitrate.

Venezuelan Boundary.

The growing activity of the United States in foreign relations next manifested itself against Spain. Cuba in its commanding position with reference to the Gulf of Mexico and the approaches to the proposed isthmian canal, as well as in its commercial relations, and its menace as a breeding spot for yellow fever, had long been regarded by the United States as an important factor in her foreign policy. Successive administrations from the time of Jefferson had declared that it must not fall to another European nation, if Spain relinquished it, and that it was against the policy of the United States to join other nations in guaranteeing it to Spain. Between 1868 and 1878 a harsh war had been in progress between the island and the mother country, and American intervention was imminent. But Spain promised reforms and peace followed; again in 1895 revolt broke out, accompanied by severe repressive measures, involving grave commercial injury to the United States. (See SPANISH-AMERICAN WAR.)

Cuba; Spanish-American War.

383. By the Treaty of Paris, signed on the 10th of December 1898, Spain lost the remaining fragments of her ancient American Empire. She relinquished Cuba, which the United States continued temporarily to occupy without holding the sovereignty pending the orderly establishment of an independent government for the island. Porto

Treaty of Paris, 1898.

Rico, Guam and the Philippines were ceded outright to the United States, which agreed to pay $20,000,000 to Spain, and to satisfy the claims of its citizens against that power. By the treaty Congress was to determine the civil rights and political status of the native inhabitants of the ceded territory.

Results of the War.

384. As a result of the Spanish-American War, the United States found itself in a position of increased importance and prestige among the nations of the world. Especially in the Pacific, it was immediately involved in the diplomatic situation created by the efforts of European states to divide China into spheres of influence or of actual possession. The interests of the United States in the trade with China, as well as her new position in the Philippines, inclined her to oppose this policy, and Secretary-of-State John Hay showed himself one of the great American diplomats in his treatment of this difficult problem. In order to preserve Chinese entity and the "open door" for trade, he drew replies from the nations concerned, the result of which was to compel them to avow and moderate their intentions. When the Boxer insurrection broke out in China in 1900, and the legations were besieged at Peking, it was largely through the United States that a less rigorous treatment was secured for that disordered nation.

385. The acquisition of Porto Rico and the acceptance of responsibilities in Cuba gave new importance to the isthmian canal and increased the relative weight of the United States in regard to its control. The popular excitement with which the voyage of the "Oregon" was followed, as it took its way 14,000 m. around South America to participate in the destruction of the Spanish fleet in the battle of Santiago, brought home to the American people the need of such communication between the Atlantic and Pacific coasts.

The Philippines.

386. But the immediate political issues were concerned with problems of the relation of the newly won lands to the United States government. Bryan had persuaded his party to join in ratifying the treaty of Paris, expecting to determine the status of the islands later. But attention soon turned to the insurrection which broke out (Feb. 4, 1899) in the Philippines (*q.v.*) under Aguinaldo, after it became probable that the administration intended to retain these islands, not under a weak protectorate, but as a possession to be ruled and "assimilated." It was not until the spring of 1902 that this insurrection was completely put down, and in the interval the question of the destiny of the islands and the harshness of the measures of repression aroused political debate. The Democrats and many Republicans charged the administration with a policy of imperialism.

Porto Rico and Cuba.

387. The same issue was involved, in its constitutional and economic aspects, in the treatment of Porto Rico and Cuba. While the insurrection continued in the Philippines the government there was legally a military one, although exercised in part through civil officers and commissions. But in the case of Porto Rico the question was whether the "Constitution follows the flag," that is, whether it extended of its own force without an act of Congress to acquired territory, and covered the inhabitants with all the rights of citizens of the United States, as an integral part of the American people. Not only was it a question whether the native inhabitants of these new acquisitions could be wisely entrusted with this degree of political liberty, but the problem of the tariff was involved. The beet sugar producers of the United States feared the effect of the competition of Porto Rican sugar unless a protective tariff excluded this commodity. But if Porto Rico were an integral part of the United States the Dingley tariff could not be applied against its products, since this act imposed duties only on articles from "foreign countries." To meet this difficulty the Foraker Act of 1900 imposed a special tariff for two years upon Porto Rico, the proceeds to go to that island's own treasury. The act further asserted the principle that the inhabitants of the new possessions were not incorporated into the United States or entitled to all the privileges of citizens of the United States under the Constitution, by declaring that statutory acts of the United States locally inapplicable should not be in force in Porto Rico. The Supreme Court sustained this act in 1901, holding that Porto Rico was not so strictly a part of the United States that separate customs tariffs could not be imposed upon the territory. The close division of the court and the variety of opinions by which the decision was sustained left it somewhat uncertain whether and how far the Constitution extended of its own force to these annexations. The Foraker Act also provided a government for the island (see PORTO RICO). In Cuba the United States remained in authority until the 20th of May 1902, and details of the work of the government there, and the subsequent arrangements whereby the United States secured the substantial advantages of a protectorate without destroying the independence of Cuba, will be found in the article on CUBA.

"Imperialism."

388. Meantime, in the election of 1900, the Democrats renominated Bryan on a platform which opposed the Republican administration's acts in relation to the newly acquired territory and declared that "imperialism" was the paramount issue. The platform reaffirmed its silver doctrine of the previous campaign and denounced the tariff as a breeder of trusts. The Republicans renominated McKinley and endorsed his administration. While the Democrats declared for publicity in the affairs of interstate corporations and favoured enlargement of the interstate commerce law to prevent discriminations in railway rates, the Republicans were less hostile in their attitude toward the combinations, admitting the necessity of honest co-operation of capital to meet new business conditions. The Populists divided, the "anti-fusionists" supporting a separate ticket, with free silver, government ownership of railways, and anti-imperialism prominent in their demands; the other wing supported Bryan.

Re-election and Assassination of McKinley.

Marcus A. Hanna, the Republican campaign manager, who was increasingly influential with the great business interests of the country, appealed to labour to support the administration and thereby retain "a full dinner pail." McKinley received an electoral majority of 137 and a popular plurality of 849,790. Before his second term was fairly begun he was shot by an anarchist while attending the Pan-American Exposition at Buffalo, and died on the 14th of September 1901. His wisdom in choosing able cabinet officers, his sympathetic tact in dealing with men and with sections, as well as the victories of the Spanish-American War, had brought him popularity even among his political opponents. But McKinley, like Cleveland, lacked the imagination to perceive and the desire to voice the aspirations and demands that had been gathering force for many years for legislation and executive action that should deal with the problem of effective regulation of the economic forces that were transforming American society. This gave his opportunity to Theodore Roosevelt (*q.v.*), who as vice-president now succeeded to office.

Roosevelt.

It was in foreign relations, which Secretary Hay continued to conduct, that continuity with McKinley's administration was most evident. But even here a bolder spirit, a readiness to break new paths and to take short cuts was shown by the new president. Venezuela had long delayed the payment of claims of citizens of various nations. In 1901, the president, having been informed by Germany of its intention to collect the claims of its citizens by force, but without acquisition of territory, announced that the United States would not guarantee any state against punishment if it misconducted itself, provided that the punishment did not take the form of acquisition of territory. As a result, a blockade of Venezuela was undertaken by the joint action of Germany, England and Italy at the close of 1902. The diplomatic intervention of the United States early the next year resulted in Venezuela's agreement to pay the claims in part and to set aside a portion of her customs receipts to this end. But since the blockading powers demanded preferential treatment, the United States secured a reference of the question to the Hague court, which decided that this demand was justified. San

San Domingo.

Domingo offered a similar problem, having a debt incurred by revolutionary governments, beyond its power to pay, and being threatened with forcible intervention by European states. President Roosevelt, in 1904, declared that in case of wrongdoing or impotency requiring intervention in the western hemisphere the United States might be forced "to the exercise of an international police power." In 1905 San Domingo and the United States signed a protocol under which the latter was empowered to take possession of the custom-house, conduct the finances and settle the domestic and foreign debts of San Domingo. In spite of the refusal of the Senate to assent to this protocol, President Roosevelt put the arrangement unofficially into effect, until, in 1907, the Senate consented to a treaty authorizing it with some modifications.

Policy in the Far East; the Portsmouth Treaty.

389. In the Far East the Boxer insurrection in China had been followed by the combined military expedition of the powers to the relief of Peking (in which the United States shared), and the exaction of a huge indemnity, of which the United States relinquished nearly half of its share, as in excess of the actual losses. The United States protested against Russian demands upon China, and actively participated in the negotiations which resulted in Russia's agreement to evacuate Manchuria. The delays of that power and her policy toward China having led Japan to declare war, Secretary Hay's diplomacy was influential in limiting the zone of hostilities; and the good offices of President Roosevelt brought about the conference between the two powers at Portsmouth, New Hampshire, which terminated hostilities in 1905. In this, and in his efforts to promote peace by extending the power of the various international peace congresses and by making the Hague tribunal an effective instrument for settling disputes, Roosevelt won the approval of Europe as well as of America. The dispute over the boundary between Alaska and Canada was narrowed by diplomatic discussion, and the remaining questions, involving the control of important ports at the head of the great inlets which offered access to the goldfields, were settled by arbitration in 1903 favourably to the American contentions.

390. The Isthmian Canal also received a settlement in this administration by a process which was thoroughly characteristic of the resolution of President Roosevelt. The Clayton-Bulwer treaty was superseded by the Hay-Pauncefote treaty of 1901, by which Great Britain withdrew her objections to a canal constructed by the United States, and under the sole guarantee of neutralization by the latter power. The treaty also omitted a clause previously insisted on, forbidding the fortification of the canal. Having thus cleared the way, the United States next debated the advantages of the Nicaragua and the Panama routes. Influenced by the cost of acquiring the rights and property of the French company, an American commission reported in 1901 in favour of the Nicaraguan route; but upon receiving information that a smaller sum would be accepted, the Spooner Law was enacted (June 28, 1902) authorizing the president to purchase the rights and property of the Panama Company for $40,000,000, to acquire upon reasonable terms the title and jurisdiction to a canal strip at least 6 m. wide from Colombia, and through the Isthmian Canal Commission to construct the canal. But if the president was unable to secure a valid title from the French company and the control from Colombia within "a reasonable time and upon reasonable terms" the Nicaraguan route was to be made the line of the canal. With this means of pressure the president acquired the French rights; but Colombia declined to ratify the treaty negotiated for the purpose of giving the United States the specified control, on the terms offered. In this emergency an insurrection broke out in Panama on the 3rd of November 1903. The naval force of the United States, acting under the theory that it was obliged to keep open the transit across the isthmus by its treaty obligations, excluded armed forces from the canal strip, and the Republic of Panama, having declared its independence of Colombia, was promptly recognized on the 6th of November. Twelve days later a treaty was negotiated with this republic, by which the United States paid Panama $10,000,000, together with an annuity of $250,000 to begin ten years later, and guaranteed the independence of the republic, receiving in exchange the substantial sovereignty and ownership of a ten-mile strip for the canal. This treaty was ratified by the Senate on the 23rd of February 1904, and excavation was begun in 1907. (See PANAMA CANAL.)

The Panama Canal.

The Philippines.

391. In the Philippines early in 1901 municipal and provincial governments were provided for, and the president had been for a brief time granted full power to govern the archipelago. He appointed Judge Taft civil governor, and limited the power of the military governor to regions where insurrection continued. On the 1st of July 1902 Congressional authority was substituted for that of the president, but Taft remained governor. The provisions of the Constitution guaranteeing life, liberty and property were in general extended specifically to the dependency, and a legislative assembly was promised, the lower house elective, and the upper house to consist of the Philippine Commission. By negotiations with Rome Governor Taft secured for the Philippines the "friars' lands" which had been a source of friction. On the 16th of October 1907 the first Philippine assembly was convened in the presence of Taft, then secretary of war.

392. The tariff question complicated American relations with both the Philippines and Cuba. Beet sugar and tobacco interests feared the competition of these products, and opposed freedom of trade between the United States and the new territories. The Philippine tariff of 1902 made a reduction of only 25% from the Dingley tariff in the case of the products of those islands, instead of the 75% urged by Taft; but the duties were to go to the Philippines. In the case of Cuba a more heated controversy arose over the tariff—Roosevelt strongly urged a substantial reduction in justice to Cuba at several regular and special sessions of Congress; but not until the close of 1903 was a treaty in operation which, under the principle of reciprocity, admitted some products of the United States to Cuba at reduced rates, and allowed Cuban products a reduction of 20% from the Dingley tariff, stipulating at the same time that so long as this arrangement continued no sugar should be admitted at reduced rates from any other country. This sacrifice of the means of reciprocity with sugar countries for the advantage of the beet sugar raisers of the West was quickly followed by the acquisition of preponderant interest in the beet sugar refineries by the Sugar Trust, which was thus able to control the domestic market; but for the time being it was evident that the forces friendly to the protective tariff had increased their following in important agricultural regions.

393. The dominant historical tendencies of the beginning of the 20th century in the United States, however, were characterized by huge combinations of capital and labour, the rapid passing of natural resources into private possession, and the exploitation of these resources on the principle of individualism by aggregations of capital which prevented effective competition by ordinary individuals. Pioneer conceptions of individual industrial achievement free from governmental restraint were adopted by huge monopolies, and the result was a demand for social control of these dangerous forces.

Combinations of Capital.

394. After the Sherman Anti-Trust Act of 1890 the combinations found in the favourable laws of states like New Jersey opportunity to incorporate under the device of the "holding company," which was supposed to be within the law. A "promotion mania" set in in 1901. The steel industry, after a threatened war between the Standard Oil and Carnegie groups, was united by Pierpont Morgan into the United States Steel Corporation with stocks and bonds aggregating $1,400,000,000. This was only one of the many combinations embracing public utilities of all kinds. Where open consolidation was not effected, secret agreements, as in the case of the meat packers, effectively regulated the market. In the field of railway transportation, Harriman used the bonds of the

Union Pacific to acquire the Southern Pacific with the Central Pacific, and by 1906 he was dictator of one-third of the total mileage of the United States. Meanwhile the Great Northern and the Northern Pacific had been brought into friendly working arrangements under James J. Hill, and tried to secure the Burlington railway. A fierce contest followed between the Hill, Morgan and Harriman forces, resulting in a compromise by which the Northern Securities Company, a holding company for the joint interests of the contestants, was created. It was admitted by the counsel for this company that the machinery provided in this organization would permit the consolidation of all the railways of the country in the hands of three or four individuals. By using notes of one railway company, based on its treasury securities, it was possible to acquire a controlling interest in others; and by watering the capital stock to recover the cost of the undertaking, while the public paid the added rates to supply dividends on the watered stock.

The Northern Securities Company.

395. Following a similar tendency the great Wall Street banking houses were dominated by the large financial groups in the interest of speculative undertakings, the directors of banks loaning to themselves, as directors of industrial combinations, the funds which flowed into New York from all the banks of the interior. By a similar process the great insurance and trust companies of New York became feeders to the same operations. Thus a community of control over the fundamental economic interests of the nation was lodged in a few hands. Rebates and discriminations by the railways gave advantage to the powerful shippers, and worked in the same direction.

396. Such was the situation in domestic affairs which confronted Roosevelt when he became president. In his first message he foreshadowed his determination to grapple with these problems. In 1903 he instructed the attorney-general to bring suit to dissolve the Northern Securities Company as a combination in restraint of trade, and in 1904 the Supreme Court held the merger illegal. But the effect was to increase the tendency to change from incomplete combination of financial interests to consolidated corporations owning the property, and to lead the government, on the other hand, to seek to regulate these vast business interests by legislation. The Elkins Law, passed in 1903, increased the power of the interstate commerce commission to prosecute offenders, especially those who violated the anti-rebating clauses. In the same year the creation of the Federal Bureau of Corporations provided for increased publicity in the affairs of these organizations.

The Elkins Law: the Bureau of Corporations.

397. Labour was combining in its turn. Not only did local unions in most of the trades increase in number and power, but workers in separate industries over large areas were combined for collective bargaining and the national organization, the American Federation of Labor, had a membership by 1905 of approximately 2,000,000. Labour legislation by the states increased under these influences, and political leaders became increasingly aware of the power of the labour vote, while employers began to form counter organizations to check the growth of the movement. In 1902 Pennsylvania members of the United Mine Workers of America, led by John Mitchell, struck. Inasmuch as their employers were the owners of the anthracite coal monopoly under the control of an allied group of coal-carrying railways, the contest was one of far-reaching importance, and soon brought about a coal famine felt throughout the nation. So threatening was the situation that President Roosevelt called a conference of the contestants, and succeeded in inducing them to submit their difficulties to an arbitration commission which, by its report, in the spring of 1903, awarded to the miners shorter hours and an increase of wages.

Combinations of Labour.

398. Steadily the United States enlarged its economic functions. In 1903 Congress created a Department of Commerce and Labor and made the secretary a member of the cabinet. The reports of this department gave publicity to investigations of the perplexing industrial conditions. The Department of Agriculture enlarged its staff and its activity, investigating diseases of plants and animals, ascertaining means of checking insect pests, advising upon the suitability of soils to crops, seeking new and better seeds, and circulating general information. The contemporaneous development of agricultural education in the various Western and Southern states whose agricultural colleges had been subsidized by land grants and appropriations by the Federal government, and the experimental farms conducted by railways, all worked to the same end. Congress passed acts to limit the substitution of oleomargarine for butter (1902) and provided for the limitation of the spread of live-stock diseases (1903). The nation began also to awake to the need of protecting its remaining forests, which were rapidly falling into the hands of corporations by perversion of homestead and other land laws. President Cleveland had withdrawn large forest tracts, and in 1898 Gifford Pinchot was made head of a division of forestry in the Department of Agriculture. In 1901 the work was organized under a separate bureau, and four years later the National Forests were placed under his management.

Economic Measures of the Federal Government

399. The increasing demand for lands for agriculture led also, under Roosevelt, to the real beginning of national irrigation actively in the vast arid area of the Far West. The Reclamation Service was created by the act of the 17th of June 1902, which set aside the proceeds of the sale of public lands in thirteen states and three Territories as a fund for irrigation works. The government itself reserved timber and coal tracts, water powers and other requisites for construction, and sold the irrigated lands to actual settlers in small farms, while retaining title to the reservoirs and the works. The income from the reclamation fund between 1901 and 1910 aggregated over $60,000,000. By the use of suitable crops and dry farming agricultural occupation was extended into formerly desert lands.

The Reclamation Service.

When corruption was discovered in the Land Office and Post Office, Roosevelt, instead of yielding to the effort to conceal the scandal, compelled effective investigation. Two United States senators were convicted of land frauds. The application to all kinds of lands, whether coal lands, timber tracts, water rights or other natural resources, of the general principle of homesteads governing the acquisition of agricultural lands, had invited fraudulent entries. The Homestead Act of 1862, the Timber Culture Act of 1873, the Desert Land Act of 1877, the Stone and Timber Act of 1878 had all been used by corporations to secure great tracts of valuable land through employing men to homestead them, and the laws themselves were loosely enforced. In successive messages, and by reports of public land commissions, the administration urged the importance of readjusting the land laws for the protection of the public.

400. In the election of 1904 the popularity of President Roosevelt, after his strenuous activity in challenging some of the strongest tendencies in American life, was put to the test. His political management exhibited the fact that he was trained in the school of the New York politician as well as in the reformer's camp, and he was easily nominated by the Republicans on a platform which endorsed his administration, and made no promise of tariff changes. The Democrats turned to the conservative wing, omitted any reference to silver or the income tax, and nominated Judge Alton B. Parker, of New York. The radicals, who favoured William R. Hearst, the well-known newspaper proprietor, who was influential with the masses of large cities, were largely represented in the convention, but unable to poll a third of its vote. Parker accepted the nomination after telegraphing that he regarded the gold standard as irrevocably established. The issue of imperialism had been largely eliminated by the current of events and the anti-trust issue was professed by both parties. In the outcome Roosevelt won by the unprecedented popular plurality of over 2,500,000, and an electoral majority of 196.

Elections of 1904.

401. The state elections of the same period showed that a

wave of reform and of revolt against former political forces was rising. In five states which Roosevelt carried by his popularity the machine Republican candidates for governor were defeated by reforming Democratic candidates, and in cities like Chicago and Philadelphia the issues of reform and radicalism won unexpected though temporary success. Roosevelt had "stolen the thunder" of the parties of social unrest, including the old populistic areas of the Middle West and the labour element of the cities at the same time that he retained control of the Republican party machinery.

The President's Radicalism.

402. In his second administration President Roosevelt pressed his policies so hard and with such increasing radicalism that he lost control of the regular organization in Congress before the end of his term. In the House Speaker Joseph G. Cannon, of Illinois, exhibited the full power of his office in concentrating party policies in the hands of the few regular leaders, while in the Senate a directing group of New England men who had served for a long time, chiefly senators Nelson W. Aldrich and Eugene Hale, showed a similar mastery. Against this control a significant revolt, illustrative of revived discontent in the Middle West, was made by the Republican senator Robert M. La Follette, of Wisconsin, who had won his fight in that state against the faction friendly to the railways, and had secured primary elections, railway rate regulation on the basis of expert valuation of the physical property of the railways, and a system of taxation which rested more heavily upon public utilities. In pressing similar policies upon Congress he became isolated from the party leaders, but forced them to go on record by roll calls.

New York Insurance Investigation.

403. In New York a legislative investigation of the insurance companies disclosed such connexions with the high financiering of Wall Street as to create widespread distrust and to lead to reform legislation. The attorney who conducted the investigation, Charles Evans Hughes (b. 1862), had shown such ability that he was chosen governor of New York in 1906.[1] His administration was marked by independence of the party machine and a progressive policy. Foreign relations were conducted during the second administration of Roosevelt by Secretary Elihu Root from 1905. He fostered friendly relations with the other American nations, allaying their concern lest ambitious designs of their larger neighbour might endanger their independence. In Cuba a signal illustration of the good faith of the United States was exhibited when an insurrection in the summer of 1906 left the republic substantially without a government.

Cuba.

Mr Taft, then secretary of war, was sent, under the treaty provisions for intervention, to organize a provisional government. During his few days' service as governor-general he set in motion the machinery for restoring order. But President Roosevelt had plainly stated that if the insurrectionary habit became confirmed in Cuba she could not expect to retain continued independence.

Japanese Immigration.

404. Attention was again fixed upon the Pacific coast, not only by the earthquake and conflagration which in 1906 destroyed the business parts and much of the residence section of San Francisco, but also by municipal regulations there against the presence of Japanese in the public schools. The incident seemed to threaten grave consequences, which were averted by the popularity of Roosevelt both in California and in Japan. In the Immigration Act of the 20th of February 1907 the problem of exclusion of Japanese labour, which underlay the difficulty, was partly solved by preventing the entrance to the continental United States by way of neighbouring countries of persons holding passports issued by a foreign government for going to other countries or dependencies of the United States. Since Japan discouraged its citizens from migrating directly to the United States this satisfied California.

405. As a demonstration of the naval power of the United States in Pacific waters, the President sent the American fleet on a cruise around the world, in the course of which they were received in a friendly spirit by Japan. The navy was increased to keep pace with the growth of that of other nations, both in numbers and size of vessels, in this period, but not to the extent demanded by the administration. Already a more efficient organization of both army and navy had been effected. While the nation prepared for war, it also engaged prominently in the successive international peace congresses between 1899 and 1907, aiming consistently to increase the use of arbitration.

Railway Rate Regulation Act.

406. The tendencies of the government to deal with social improvement were exemplified by the laws of 1906 providing for pure food and meat inspection. The Railway Rate Regulation Act of 1906 strengthened previous inter-state acts by including pipe lines (except for gas and water) under the jurisdiction of the Interstate Commerce Commission, and extending the meaning of "common carrier" to include express and sleeping-car companies. Published rate schedules were required, not to be changed without thirty days' notice, and more stringent provisions were made to prevent rebating. The act provided for review by the Federal courts, and did not permit the commission to investigate an increase of rates until the rates went into operation, nor did it provide for a valuation of the railways as a basis of rate-making which the commission had desired. Later acts partly met the demands of railway employés by increasing the liability of common carriers and by providing for shorter hours.

Financial Panic of 1907.

407. Although Roosevelt had made concessions to the railways in the formation of the act of 1906, his utterances showed a tendency alarming to the large business interests and the holders of corporation securities generally. The unsettled business conditions were reflected in the stock market, and began to produce a reaction against the activity of government in this direction. The panic of 1907 started with the downfall of an attempted combination of a chain of banks, copper interests and other enterprises of F. Augustus Heinze and Charles W. Morse, two daring operators in Wall Street, and was followed by the collapse of the Knickerbocker Trust Company (October 21, 1907). Already, in 1903, liquidation had begun in some of the stocks so actively issued in the preceding years. The leading New York banks failed to check speculation, however, and were even contributors to the movement up to the time of the panic. The country was generally prosperous, though much of the banking funds was tied up in New York City at this juncture. Clearing-house certificates were resorted to; by the 1st of November partial suspension was general throughout the nation; and banking facilities were more completely interrupted than at any time since the Civil War. The government greatly increased its deposits, and offered Panama 2% bonds to the amount of $50,000,000, and 3% certificates for $100,000,000, with the object of providing the national banks a basis for additional note issues. But these were taken only to a small amount, as they proved useful for their moral effect chiefly. An enormous addition to the money supply was made in the course of the panic, both by governmental activity, gold imports and national bank-notes. The crisis was brought to a close before the end of 1907 by the vigour of the government and the activity of the large financial interests under the lead of J. P. Morgan, who finally entered the field to stop the decline, at the same time that his associates in the Steel Trust acquired possession of their last remaining rival of importance, the Tennessee Coal & Iron Company.

Conservation.

408. The reaction after the panic, and the loss of influence resulting from his announcement that he would not permit his renomination for the campaign of 1908, left Roosevelt unable to exercise the compelling power which he had displayed in previous years. Congress under the control of the conservatives refused him legislation which he asked, but before he left the presidency he raised a new issue to national importance in his calling of a congress of state governors and experts to consider the need

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[1] In 1910 Hughes was appointed a justice of the United States Supreme Court.

of the conservation of natural resources (see IRRIGATION: *United States*; and the article ROOSEVELT). This congress met in May 1908 and endorsed the proposal for vigorous attention by state and nation to the question.

409. In the campaign of 1908 he succeeded, against the opposition of both the extreme conservative and the radical wings, in procuring the nomination of Secretary Taft by the Republicans on a platform endorsing the Roosevelt policies, promising a revision of the tariff at a special session, on the basis of such protection as would equal the difference between the cost of production at home and abroad, together with a reasonable profit to American industries, and providing for maximum and minimum rates to be used in furthering American commerce and preventing discriminations by other nations. A postal bank was promised, a more effective regulation of the railways, and a modification of the Sherman Anti-Trust Act. Labour failed to secure a thoroughgoing pledge to prevent the use of the writ of injunction in labour disputes, but the convention promised legislation to limit its use. The Democrats again selected William J. Bryan as their candidate; demanded the enforcement of criminal law against "trust magnates" and such additional legislation as would prevent private monopoly; opposed the use of injunctions in cases where they would issue if no industrial dispute was involved; impugned the Republicans' good faith in tariff revision, promising for themselves a substantial reduction of duties; favoured an income tax and a guarantee fund by national banks to pay depositors of insolvent banks, or a postal savings bank, if the guaranteed bank could not be secured; demanded election of United States senators by direct vote of the people, legislation to prevent contributions by corporations to campaign funds, and a more efficient regulation of railways. The party also declared against centralization, favouring the use of both Federal and state control of interstate commerce and private monopoly.

William H. Taft, President.

410. The Republicans won a sweeping victory, Taft's popular plurality reaching about 1,270,000 and his electoral majority 159. But it had been won by some ambiguity of utterance with respect to tariff and railway regulation. The result was made manifest early in the new administration, when party contentions over the direction of revision of the tariff, the thoroughness of the regulation of railways and corporations, and the question of where the postal bank fund should be placed, resulted in a movement of "insurgency" among the Republicans of the Middle West. The insurgents termed themselves "Progressive Republicans," and did not hesitate to join forces with the Democrats in order to shape legislation to their wishes. Progressives and Democrats united in overturning the control of Speaker J. G. Cannon in the House of Representatives by modifying the rules, and a group of senators, chiefly from the Middle Western states, destroyed the control of the regular leaders in the Upper House. President Taft's influence over the revolting wing was further weakened by the charges made against his secretary of the interior, Richard A. Ballinger, on behalf of Gifford Pinchot, the chief forester, who accused the administration of obstructing Mr Roosevelt's "conservation" policy.

Roosevelt's "New Nationalism."

411. Mr Pinchot was indeed removed from office, but the "conservation" issue was raised to primary importance by the return of Mr Roosevelt from his African trip. His influence was revealed even while he was enjoying the hospitality of European countries on his return. There was a widely extended desire to know his judgment of the administration's policy; but he maintained silence until the close of the summer of 1910, when in a series of public utterances in the West he ranged himself, on the whole, with the progressive wing and announced a "new nationalism" which should enlarge the power of the Federal government and drive the "special interests" out of politics. The "insurgents" achieved remarkable victories in the Middle West, California, New Hampshire and New York in the fall conventions and primary elections, retiring various leaders of the regular wing of the Republicans. Senators Aldrich and Hale, former regular leaders in the Senate, had already announced their purpose to resign. President Taft's utterances indicated his intention to discontinue the use of patronage against the leaders of the progressive wing and to secure additional tariff revision by separate schedules. The result of the autumn elections was a pronounced victory for the Democratic party.

412. At the close of the first decade of the 20th century the United States was actively engaged in settling its social economic questions, with a tendency toward radicalism in its dealings with the great industrial forces of the nation. The "sweat shops" and slums of the great cities were filled with new material for American society to assimilate. To the sisterhood of states had been added Oklahoma (1907), and in 1910 Congress empowered New Mexico and Arizona to form constitutions preparatory to statehood, thus extinguishing the last Territories, except the insular dependencies and Alaska. Already the food supply showed signs of not keeping pace with the growth of population, while the supply of gold flowed in with undiminished volume. High prices became a factor in the political situation. Between 1890 and 1900, in the continental United States, farms were added in area equal to that of France and Italy combined. Even the addition of improved farm land in that decade surpassed the whole area of France or of the German Empire in Europe. But intensive cultivation and agricultural returns hardly kept pace with the growth in population or the extension of farms.

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UNITED STATES NAVAL ACADEMY, an institution for the education of officers of the United States Navy, at Annapolis, Maryland, occupying about 200 acres on the banks of the Severn. Its principal buildings are the marine engineering building, the academic building (containing the library), the chapel, the gymnasium, the physics and chemistry building, the auditorium, the armoury, the power-house, the administration building, Bancroft Hall (the midshipmen's quarters), officers' mess and club, and Sampson Row, Upshur Row and Rodgers Row, the officers' quarters.[1] By an Act of Congress passed in 1903 two midshipmen (as the students have been called since 1902; "naval cadets" was the term formerly used) were allowed for each senator, representative, and delegate in Congress, two for the District of Columbia, and five each year at large; but after 1913 only one midshipman is to be appointed for each senator, representative and delegate in Congress. Candidates are nominated by their senator, representative, or delegate in Congress, and those from the District of Columbia and those appointed at large are chosen by the President; but to be admitted they must be between sixteen and twenty years of age and must pass an entrance examination. Each midshipman is paid $600 a year, beginning with the date of his admission; and he must bind himself to serve in the United States Navy for eight years (including the years spent in the academy) unless he is discharged sooner. The course of instruction is for four years—"final graduation" comes only after six years, the additional years being spent at sea—and is in eleven departments: discipline, seamanship, ordnance and gunnery, navigation, marine engineering and naval construction, mathematics and mechanics, physics and chemistry, electrical engineering, English, modern languages, naval hygiene and physiology. Vessels for practice work of midshipmen in the first, second, and third year classes are attached to the academy during the academic year, and from early in June to September of each year the midshipmen are engaged in practice cruises. The academy is governed by the Bureau of Navigation of the United States Navy Department, and is under the immediate supervision of a superintendent appointed by the secretary of the navy, with whom are associated the Commandant of Midshipmen, a disciplinary officer, and the Academic Board, which is composed of the superintendent and the head of each of the eleven departments. The institution was founded as the Naval School in 1845 by the secretary of the navy, George Bancroft, and was opened in October of that year. Originally a course of study for five years was prescribed, but only the first and last were spent at the school, the other three being passed at sea. The present name was adopted when the school was reorganized in 1850, being placed under the supervision of the chief of the Bureau of Ordnance and Hydrography, and under the immediate charge of the superintendent, and the course of study was extended to seven years; the first two and the last two to be spent at the school, the intervening three years to be passed at sea. The four years of study were made consecutive in 1851, and the practice cruises were substituted for the three consecutive years at sea. At the outbreak of the Civil War the three upper classes were detached and were ordered to sea, and the academy was removed to Fort Adams, Newport, Rhode Island (May 1861), but it was brought back to Annapolis in the summer of 1865. The supervision of the academy was transferred from the Bureau of Ordnance and Hydrography to the Bureau of Navigation when that bureau was established in 1862; and, although it was placed under the direct care of the Navy Department in 1867, it has been (except in 1869–1889) under the Bureau of Navigation for administrative routine and financial management. The Spanish-American War greatly emphasized its importance, and the academy was almost wholly rebuilt and much enlarged in 1809–1906.

See J. R. Soley, *Historical Sketch of the United States Naval Academy* (Washington, 1876); Park Benjamin, *The United States Naval Academy* (New York, 1900); Randall Blackshaw, "The New Naval Academy," in the *Century Magazine* for October 1905.

UNITS, DIMENSIONS OF. Measurable entities of different kinds cannot be compared directly. Each one must be specified in terms of a unit of its own kind; a single number attached to this unit forms its measure. Thus if the unit of length be taken to be L centimetres, a line whose length is *l* centimetres will be represented in relation to this unit by the number l/L; while if the unit is increased [L] times, that is, if a new unit is adopted equal to [L] times the former one, the numerical measure of each length must in consequence be divided by [L]. Measurable entities are either fundamental or derived. For example, velocity is of the latter kind, being based upon a combination of the fundamental entities length and time; a velocity may be defined, in the usual form of language expressive of a limiting value, as the rate at which the distance from some related mark is changing per unit time. The element of length is thus involved directly, and the element of time inversely in the derived idea of velocity; the meaning of this statement being that when the unit of length is increased [L] times and the unit of time is increased [T] times, the numerical value of any given velocity, considered as specified in terms of the units of length and time, is diminished $[L]/[T]$ times. In other words, these changes in the units of length and time involve change in the unit of velocity determined by them, such that it is increased [V] times where $[V]=[L][T]^{-1}$. This relation is conveniently expressed by the statement that velocity is of + 1 dimension in length and of − 1 dimension in time. Again, acceleration of motion is defined as rate of increase of velocity per unit time; hence the change of the units of length and time will increase the corresponding or derived unit of acceleration $[V]/[T]$ times, that is $[L][T]^{-2}$ times: this expression thus represents the dimensions (1 in length and −2 in time) of the derived entity acceleration in terms of its fundamental elements length and time. In the science of dynamics all entities are derived from the three fundamental ones, length, time and mass; for example, the dimensions of force (P) are those of mass and acceleration jointly, so that in algebraic form $(P)=[M][L][T]^{-2}$. This restriction of the fundamental units to three must therefore be applicable to all departments of physical science that are reducible to pure dynamics.

The mode of transformation of a derived entity, as regards its numerical value, from one set of fundamental units of reference to another set, is exhibited in the simple illustrations above given. The procedure is as follows. When the numerical values of the new units, expressed in terms of the former ones, are substituted for the symbols, in the expression for the dimensions of the entity under consideration, the number which results is the numerical value of the new unit of that entity in terms of the former unit: thus all numerical values of entities of this kind must be divided by this number, in order to transfer them from the former to the latter system of fundamental units.

As above stated, physical science aims at reducing the phenomena of which it treats to the common denomination of the positions and movements of masses. Before the time of Gauss it was customary to use a statical measure of force, alongside the kinetic measure depending on the acceleration of motion that the force can produce in a given mass. Such a statical measure could be conveniently applied by the extension of a spring, which, however, has to be corrected for temperature, or by weighing against standard weights, which has to be corrected for locality. On the other hand, the kinetic measure is independent of local conditions, if only we have absolute scales of length and time at our disposal. It has been found to be indispensable, for simplicity and precision in physical science, to express the measure of force in only one way; and statical forces are therefore now generally referred in theoretical discussions to the kinetic unit of measurement. In mechanical engineering the static unit has largely survived; but the increasing importance of electrical applications is introducing uniformity there also. In the science of electricity two different systems of units, the electrostatic and the electrodynamic, still to a large extent persist. The electrostatic system arose because in the development of the subject statics came before kinetics; but in the complete synthesis it is usually found convenient to express the various quantities in terms of the electrokinetic system alone.

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[1] The old quarters of the superintendent, a colonial house, once the official residence of the governors of Maryland, was destroyed in 1900. In 1909 old Fort Severn, a small circular structure with thick walls, built in 1809, was torn down.

The system of measurement now adopted as fundamental in physics takes the centimetre as unit of length, the gramme as unit of mass, and the second as unit of time. The choice of these units was in the first instance arbitrary and dictated by convenience; for some purposes subsidiary systems based on multiples of these units by certain powers of ten are found convenient. There are certain absolute entities in nature, such as the constant of gravitation, the velocity of light in free space, and the constants occurring in the expression giving the constitution of the radiation in an enclosure that corresponds to each temperature, which are the same for all kinds of matter; these might be utilized, if known with sufficient accuracy, to establish a system of units of an absolute or cosmical kind. The wave-length of a given spectral line might be utilized in the same manner, but that depends on recovering the kind of matter which produces the line.

In physical science the uniformities in the course of phenomena are elucidated by the discovery of permanent or intrinsic relations between the measurable properties of material systems. Each such relation is expressible as an equation connecting the numerical values of entities belonging to the system. Such an equation, representing as it does a relation between actual things, must remain true when the measurements are referred to a new set of fundamental units. Thus, for example, the kinematical equation $v^2 = nf^2l$, if n is purely numerical, contradicts the necessary relations involved in the definitions of the entities velocity, acceleration, and length which occur in it. For on changing to a new set of units as above the equation should still hold; it, however, then becomes $v^2/[\mathrm{V}]^2 = n \cdot f^2/[\mathrm{F}]^2 \cdot l/[\mathrm{L}]$. Hence on division there remains a dimensional relation $[\mathrm{V}]^2 = [\mathrm{F}]^2[\mathrm{L}]$, which is in disagreement with the dimensions above determined of the derived units that are involved in it. The inference follows, either that an equation such as that from which we started is a formal impossibility, or else that the factor n which it contains is not a mere number, but represents n times the unit of some derived quantity which ought to be specified in order to render the equation a complete statement of a physical relation. On the latter hypothesis the dimensions [N] of this quantity are determined by the dimensional equation $[\mathrm{V}]^2 = [\mathrm{N}][\mathrm{F}]^2[\mathrm{L}]$ where, in terms of the fundamental units of length and time, $[\mathrm{V}] = [\mathrm{L}][\mathrm{T}]^{-1}$, $[\mathrm{F}] = [\mathrm{L}][\mathrm{T}]^{-2}$; whence by substitution it appears that $[\mathrm{N}] = [\mathrm{L}]^{-1}[\mathrm{T}]^2$. Thus, instead of being merely numerical, n must represent in the above formula the measure of some physical entity, which may be classified by the statement that it has the conjoint dimensions of time directly and of velocity inversely.

It often happens that a simple comparison of the dimensions of the quantities which determine a physical system will lead to important knowledge as to the necessary relations that subsist between them. Thus in the case of a simple pendulum the period of oscillation τ can depend only on the angular amplitude a of the swing, the mass m of the bob considered as a point, and the length l of the suspending fibre considered as without mass, and on the value of g the acceleration due to gravity, which is the active force; that is, $\tau = f(a, m, l, g)$. The dimensions must be the same on both sides of this formula, for, when they are expressed in terms of the three independent dynamical quantities mass, length, and time, there must be complete identity between its two sides. Now, the dimensions of g are $[\mathrm{L}][\mathrm{T}]^{-2}$; and when the unit of length is altered the numerical value of the period is unaltered, hence its expression must be restricted to the form $f(a, m, l/g)$. Moreover, as the period does not depend on the unit of mass, the form is further reduced to $f(a, l/g)$; and as it is of the dimensions $+1$ in time, it must be a multiple of $(l/g)^{\frac{1}{2}}$, and therefore of the form $\phi(a)\sqrt{(l/g)}$. Thus the period of oscillation has been determined by these considerations except as regards the manner in which it depends on the amplitude a of the swing. When a process of this kind leads to a definite result, it will be one which makes the unknown quantity jointly proportional to various powers of the other quantities involved; it will therefore shorten the process if we assume such an expression for it in advance, and find whether it is possible to determine the exponents definitely and uniquely so as to obtain the correct dimensions. In the present example, assuming in this way the relation $\tau = \mathrm{A}a^pm^ql^rg^s$, where A is a pure numeric, we are led to the dimensional equation $[\mathrm{T}] = [a]^p[\mathrm{M}]^q[\mathrm{L}]^r[\mathrm{LT}^{-2}]^s$, showing that the law assumed would not persist when the fundamental units of length, mass, and time are altered, unless $q=0$, $s=-\frac{1}{2}$, $r=\frac{1}{2}$; as an angle has no dimensions, being determined by its numerical ratio to the *invariable* angle forming four right angles, p remains undetermined. This leads to the same result, $\tau = \phi(a)l^{+\frac{1}{2}}g^{-\frac{1}{2}}$, as before.

As illustrating the power and also the limitations of this method of dimensions, we may apply it (after Lord Rayleigh, *Roy. Soc. Proc.*, March 1900) to the laws of viscosity in gases. The dimensions of viscosity (μ) are (force/area) ÷ (velocity/length), giving $[\mathrm{ML}^{-1}\mathrm{T}^{-1}]$ in terms of the fundamental units. Now, on the dynamical theory of gases viscosity must be a function of the mass m of a molecule, the number n of molecules per unit volume, their velocity of mean square $\bar{v}$, and their effective radius a; it can depend on nothing else. The equation of dimensions cannot supply more than *three* relations connecting these four possibilities of variation, and so cannot here lead to a definite result without further knowledge of the physical circumstances. And we remark conversely, in passing, that wherever in a problem of physical dynamics we know that the quantity sought can depend on only three other quantities whose dynamical dimensions are known, it must vary as a simple power of each. The additional knowledge required, in order to enable us to proceed in a case like the present, must be of the form of such an equation of simple variation. In the present case it is involved in the new fact that in an actual gas the mean free path is very great compared with the effective molecular radius. On this account the mean free path is inversely as the number of molecules per unit volume; and therefore the coefficient of viscosity, being proportional to these two quantities jointly, is independent of either, so long as the other quantities defining the system remain unchanged. If the molecules are taken to be spheres which exert mutual action only during collision, we therefore assume

$$\mu \propto m^x\bar{v}^ya^z,$$

which requires that the equation of dimensions

$$[\mathrm{ML}^{-1}\mathrm{T}^{-1}] = [\mathrm{M}]^x[\mathrm{LT}^{-1}]^y[\mathrm{L}]^z$$

must be satisfied. This gives $x=1$, $y=1$, $z=-2$. As the temperature is proportional to $m\bar{v}^2$, it follows that the viscosity is proportional to the square root of the mass of the molecule and the square root of the absolute temperature, and inversely proportional to the square of the effective molecular radius, being, as already seen, uninfluenced by change of density.

If the atoms are taken to be Boscovichian points exerting mutual attractions, the effective diameter a is not definite; but we can still proceed in cases where the law of mutual attraction is expressed by a simple formula of variation—that is, *provided* it is of type km^2r^s, where r is the distance between the two molecules. Then, noting that, as this is a force, the dimensions of k must be $[\mathrm{M}^{-1}\mathrm{L}^{s+1}\mathrm{T}^{-2}]$, we can assume

$$\mu \propto m^x\bar{v}^yk^w,$$

provided $$[\mathrm{ML}^{-1}\mathrm{T}^{-1}] = [\mathrm{M}]^x[\mathrm{LT}^{-1}]^y[\mathrm{M}^{-1}\mathrm{L}^{s+1}\mathrm{T}^{-2}]^w,$$
which demands and is satisfied by

$$x-w=1,\ y+2w=1,\ y+(s+1)w=-1,$$

so that $$w=-\frac{2}{s-1},\ y=\frac{s+3}{s-1},\ x=\frac{s-3}{s-1}.$$

Thus, on this supposition,

$$\mu \propto m^{\frac{s-9}{2s-2}}k^{-\frac{2}{s-1}}\theta^{\frac{s+3}{2s-2}}$$

where θ represents absolute temperature. (See DIFFUSION.)

When the quantity sought depends on more than three others, the method may often be equally useful, though it cannot give a complete result. Cf. Sir G. G. Stokes, *Math. and Phys. Papers*, v. (1881) p. 106, and Lord Rayleigh, *Phil. Mag.* (1905), (1) p. 494, for examples dealing with the determination of viscosity from observations of the retarded swings of a vane, and with the formulation of the most general type of characteristic equation for gases respectively. As another example we may consider what is involved in Bashforth's experimental conclusion that the air-resistances to shot of the same shape are proportional to the squares of their linear dimensions. *A priori*, the resistance is a force which is determined by the density of the air ρ, the linear dimensions l of the shot, the viscosity of the air μ, the velocity of the shot v, and the velocity of sound in air c, there being no other physical quantity sensibly involved. Five elements are thus concerned, and we can combine them in two ways so as to obtain quantities of no dimensions; for example, we may choose $\rho vl/\mu$ and v/c. The resistance to the shot must therefore be of the form $\mu^x\rho^y v^z\phi(\rho vl/\mu)f(v/c)$, this form being of sufficient generality, as it involves an undetermined function for each element beyond three. On equating dimensions we find $x=2$, $y=-1$, $z=0$. Now, Bashforth's result shows that $\phi(\chi)=\chi^2$. Therefore the resistance is $\rho v^2l^2f(v/c)$, and is thus to our degree of approximation independent of the viscosity. Moreover, we might have assumed this practical independence straight off, on known hydrodynamic grounds; and then the argument from dimensions could have predicted Bashforth's law, if the present application of the doctrine of dimensions to a case involving turbulent fluid motion not mathematically specifiable is valid. One of the important results drawn by Osborne Reynolds from his experiments on the *régime* of flow in pipes was a confirmation of its validity: we now see that the ballistic result furnishes another confirmation.

In electrical science two essentially distinct systems of measurement were arrived at according as the development began with the phenomena of electrostatics or those of electrokinetics. An electric charge appears as an entity having different dimensions in terms of the fundamental dynamical units in the two cases: the ratio of these dimensions proves to be the dimensions of a velocity. It was found, first by W. Weber, by measuring the same charge by its static and its kinetic effects, that the ratio of the two units is a velocity sensibly identical with the velocity of light, so far as regards experiments conducted in space devoid of dense matter. The emergence of a definite absolute velocity such as this, out of a comparison of two different ways of approaching the same quantity, entitles us to assert that the two ways can be consolidated into a single dynamical theory only by some development in which this velocity comes to play an actual part. Thus the hypothesis of the mere existence of some complete dynamical theory was enough to show, in the stage which electrical science had reached under Gauss and Weber, that there is a definite physical velocity involved in and underlying electric phenomena, which it would have been hardly possible to imagine as other than a velocity of propagation of electrical effects of some kind. The time was thus ripe for the reconstruction of electric theory by Faraday and Maxwell.

The power of the method of dimensions in thus revealing general relations has its source in the hypothesis that, however complicated in appearance, the phenomena are really restricted within the narrow range of dependence on the three fundamental entities. The proposition is also therein involved, that if a changing physical system be compared with another system in which the scale is altered in different ratios as regards corresponding lengths, masses, and times, then if all quantities affecting the second system are altered from the corresponding quantities affecting the first in the ratios determined by their physical dimensions, the stage of progress of the second system will always correspond to that of the first; under this form the application of the principle, to determine the correlations of the dynamics of similar systems, originated with Newton (*Principia*, lib. ii. prop. 32). For example, in comparing the behaviour of an animal with that of another animal of the same build but on a smaller scale, we may take the mass per unit volume and the muscular force per unit sectional area to be the same for both; thus [L], [M], . . . being now ratios of corresponding quantities, we have $[ML^{-3}]=1$ and $[ML^{-1}T^{-2}]=1$, giving $[L]=[T]$; thus the larger animal effects movements of his limbs more slowly in simple proportion to his linear dimensions, while the velocity of movement is the same for both at corresponding stages.

But this is only on the hypothesis that the extraneous force of gravity does not intervene, for that force does not vary in the same manner as the muscular forces. The result has thus application only to a case like that of fishes in which gravity is equilibrated by the buoyancy of the water. The effect of the inertia of the water, considered as a perfect fluid, is included in this comparison; but the forces arising from viscosity do not correspond in the two systems, so that neither system may be so small that viscosity is an important agent in its motion. The limbs of a land animal have mainly to support his weight, which varies as the cube of his linear dimensions, while the sectional areas of his muscles and bones vary only as the square thereof. Thus the diameters of his limbs should increase in a greater ratio than that of his body—theoretically in the latter ratio raised to the power $\frac{3}{2}$, if other things were the same. An application of this principle, which has become indispensable in modern naval architecture, permits the prediction of the behaviour of a large ship from that of a small-scale model. The principle is also of very wide utility in unravelling the fundamental relations in definite physical problems of such complexity that complete treatment is beyond the present powers of mathematical analysis; it has been applied, for example, to the motions of systems involving viscous fluids, in elucidation of wind and waves, by Helmholtz (*Akad. Berlin*, 1873 and 1889), and in the electrodynamics of material atomic systems in motion by Lorentz and by Larmor.

As already stated, the essentials of the doctrine of dimensions in its most fundamental aspect, that relating to the comparison of the properties of correlated systems, originated with Newton. The explicit formulation of the idea of the *dimensions*, or the *exponents of dimension*, of physical quantities was first made by Fourier, *Théorie de la chaleur*, 1822, ch. ii. sec. 9; the homogeneity in dimensions of all the terms of an equation is insisted on by him, much as explained above; and the use of this principle as a test of accuracy and precision is illustrated. (J. L.*)

UNITS, PHYSICAL. In order that our acquaintance with any part of nature may become exact we must have not merely a qualitative but a quantitative knowledge of facts. Hence the moment that any branch of science begins to develop to any extent, attempts are made to measure and evaluate the quantities and effects found to exist. To do this we have to select for each measurable magnitude a *unit* or standard of reference (Latin, *unitas*, unity), by comparison with which amounts of other like quantities may be numerically defined. There is nothing to prevent us from selecting these fundamental quantities, in terms of which other like quantities are to be expressed, in a perfectly arbitrary and independent manner, and as a matter of fact this is what is generally done in the early stages of every science. We may, for instance, choose a certain length, a certain volume, a certain mass, a certain force or power as our units of length, volume, mass, force or power, which have no simple or direct relation to each other. Similarly we may select for more special measurements any arbitrary electric current, electromotive force, or resistance, and call them our units. The progress of knowledge, however, is greatly assisted if all the measurable quantities are brought into relation with each other by so selecting the units that they are related in the most simple manner, each to the other and to one common set of measurable magnitudes called the *fundamental quantities*.

The progress of this co-ordination of units has been greatly aided by the discovery that forms of physical energy can be converted into one another, and that the conversion is by definite rule and amount (see ENERGY). Thus the mechanical energy associated with moving masses can be converted into heat, hence heat can be measured in mechanical energy units. The amount of heat required to raise one gramme of water through 1° C. in the neighbourhood of 10° C. is equal to forty-two million *ergs*, the *erg* being the kinetic energy or energy of motion associated with a mass of 2 grammes when moving uniformly, without rotation, with a velocity of 1 cm. per second. This number is commonly called the "mechanical equivalent of heat," but would be more exactly described as the "mechanical equivalent of the specific heat of water at 10° C." Again, the fact that the maintenance of an electric current requires energy, and that when produced its energy can be wholly utilized in heating a mass of water, enables us to make a similar statement about the energy required to maintain a current of one ampere through a resistance of one ohm for one second, and to define it by its equivalent in the energy of a moving mass. Physical units have therefore been selected with the object of establishing simple relations between each of them and the fundamental mechanical units. Measurements based on such relations are called *absolute measurements.* The science of dynamics, as far as that part of it is concerned which deals with the motion and energy of material substances, starts from certain primary definitions concerning the measurable quantities involved. In constructing a system of physical units, the first thing to consider is the manner in which we shall connect the various items. What, for instance, shall be the unit of force, and how shall it be determined by simple reference to the units of mass, length and time?

The modern absolute system of physical measurement is founded upon dynamical notions, and originated with C. F. Gauss. We are for the most part concerned in studying motions in nature; and even when we find bodies at rest in equilibrium it is because the causes of motion are balanced rather than absent. Moreover, the postulate which lies at the base of all present-day study of physics is that in the ultimate issue we must seek for a mechanical explanation of the facts of nature if we are to reach any explanation intelligible to the human mind. Accordingly the root of all science is the knowledge of the laws of motion, and the enunciation of these laws by Newton laid the foundation of a more exact knowledge of nature than had been possible before. Our fundamental scientific notions are those of *length*, *time*, and *mass.* No metaphysical discussion has been able to resolve these ideas into anything simpler or to derive them from each other. Hence in selecting units for physical measurements we have first to choose units for the above three quantities.

Fundamental Units.—Two systems of fundamental units are in common use: the British system, having the yard and pound as the standard units of length and mass, frequently termed the "foot-pound-second" (F.P.S.) system; and the "centimetre-gramme-second" system (C.G.S.), having the centimetre and gramme as standard units of length and mass, termed the "metric" system. The fundamental unit of time is the same in both systems, namely, the "mean solar second," 86,400 of which make 1 solar day (see TIME). Since these systems and the corresponding standards, together with their factors of conversion, are treated in detail in the article WEIGHTS AND MEASURES, we need only deal here with such units as receive special scientific use, *i.e.* other than in ordinary commercial practice. The choice of a unit in which to express any quantity is determined by the magnitude and proportional error of the measurement. In astronomy, where immense distances have to be very frequently expressed, a common unit is the mean radius of the earth's orbit, the "astronomical unit" of length, *i.e.* 92,900,000 miles. But while this unit serves well for the region of our solar system, its use involves unwieldy numerical coefficients when stellar distances are to be expressed. Astronomers have therefore adopted a unit of length termed the "light year," which is the distance traversed by light in a year; this unit is 63,000 times the mean radius of the earth's orbit. The relative merits of these units as terms in which astronomical distances may be expressed is exhibited by the values of the distance of the star α Centauri from our earth, namely, 25,000,000,000,000 miles = 275,000 astronomical units = 4·35 light years.

As another example of a physical unit chosen as a matter of convenience, we may refer to the magnitudes of the wave-lengths of light. These quantities are extremely small, and admit of correct determination to about one part in ten-thousand, and range, in the visible spectrum, from about 6 to 4 ten-millionths of a metre. Since their values are determined to four significant figures, it is desirable to choose a unit which represents the value as an integer number; the unit is therefore a ten-thousand-millionth of a metre, termed a "tenth metre," since it is 10^{-10} metres. Sometimes the thousand-millionth of a metre, the "micromillimetre," denoted by $\mu\mu$, serves as a unit for wave lengths. Another relatively minute unit is the "micron," denoted by μ, and equal to one-millionth of a metre; it is especially used by bacteriologists.

Units in Mechanics.—The quantities to be measured in mechanics (*q.v.*) are velocity and acceleration, dependent on the units of length and time only, momentum, force, energy or work and power, dependent on the three fundamental units. The unit of velocity in the British system is 1 foot, 1 yard, or 1 mile per second; or the time to which the distance is referred may be expressed in hours, days, &c., the choice depending upon the actual magnitude of the velocity or on custom. Thus the muzzle velocity of a rifle or cannon shot is expressed in feet per second, whereas the speed of a train is usually expressed in miles per hour. Similarly, the unit on the metric system is 1 metre, or any decimal multiple thereof, per second, per hour, &c. Since acceleration is the rate of increase of velocity per unit time, it is obvious that the unit of acceleration depends solely upon the units chosen to express unit velocity; thus if the unit of velocity be one foot per second, the unit of acceleration is one foot per second per second, if one metre per second the unit is one metre per second per second, and similarly for other units of velocity. Momentum is defined as the product of mass into velocity; unit momentum is therefore the momentum of unit mass into unit velocity; in the British system the unit of mass may be the pound, ton, &c., and the unit of velocity any of those mentioned above; and in the metric system, the gramme, kilogramme, &c., may be the unit of mass, while the metre per second, or any other metric unit of velocity, is the remaining term of the product.

Force, being measured by the change of momentum in unit time, is expressed in terms of the same units in which unit momentum is defined. The common British unit is the "poundal," the force which in one second retards or accelerates the velocity of a mass of one pound by one foot per second. The metric (and scientific) unit, named the "dyne," is derived from the centimetre, gramme, and second. The poundal and dyne are related as follows:—1 poundal = 13,825·5 dynes.

A common unit of force, especially among engineers, is the "weight of one pound," by which is meant the force equivalent to the gravitational attraction of the earth on a mass of one pound. This unit obviously depends on gravity; and since this varies with the latitude and height of the place of observation (see EARTH, FIGURE OF), the "force of one pound" of the engineer is not constant. Roughly, it equals 32·17 poundals or 980 dynes. The most frequent uses of this engineer's unit are to be found in the expressions for pressure, especially in the boilers and cylinders of steam engines, and in structures, such as bridges, foundations of buildings, &c. The expression takes the form: pounds per square foot or inch, meaning a force equivalent to so many pounds' weight distributed over a square foot or inch, as the case may be. Other units of pressure (and therefore special units of force) are the "atmosphere" (abbreviated "atmo"), the force exerted on unit area by the column of air vertically above it; the "millimetre or centimetre of mercury," the usual scientific units, the force exerted on unit area by a column of mercury one millimetre or centimetre high; and the "foot of water," the column being one foot of water. All these units admit of ready conversion:—1 atmo = 760 mm. mercury = 32 feet of water = 1,013,600 dynes.

Energy of work is measured by force acting over a distance. The scientific unit is the "erg," which is the energy expended when a force of one dyne acts over one centimetre. This unit is too small for measuring the quantity of energy associated, for instance, with engines; for such purposes a unit ten-million times as great, termed the "joule," is used. The British absolute unit is the "poundal-foot." As we noticed in the case of units of force, common-life experience has led to the introduction of units dependent on gravitation, and therefore not invariable: the common British practical unit of this class is the "foot-pound"; in the metric system its congener is the "kilogramme-metre."

Power is the rate at which force does work; it is therefore expressed by "units of energy per second." The metric unit in use is the "watt," being the rate equal to one joule per second. Larger units in practical use are: "kilowatt," equal to 1000 watts; the corresponding energy unit being the kilowatt-second, and 3600 kilowatt-seconds or 1 kilowatt-hour called a "Board of Trade unit" or a "kelvin." This last is a unit of energy, not power. In British engineering practice the common unit of power is the "horse-power" (HP), which equals 550 foot-pounds performed per second, or 33,000 foot-pounds per minute; its equivalent in the metric system is about 746 watts, the ratio varying, however, with gravity.

Units of Heat.—In studying the phenomena of heat, two measurable quantities immediately present themselves:—(1) temperature or thermal potential, and (2) quantity of heat. Three arbitrary scales are in use for measuring temperature (see THERMOMETRY), and each of these scales affords units suitable for the expression of temperature. On the Centigrade scale the unit, termed a "Centigrade degree," is one-hundredth of the interval between the temperature of water boiling under normal barometric pressure (760 mm. of mercury) and that of melting ice; the "Fahrenheit degree" is one-hundred-and-eightieth, and the "Réaumur degree" is one-eightieth of the same difference. In addition to these scales there is the "thermo-dynamic scale," which, being based on dynamical reasoning, admits of correlation with the fundamental units. This subject is discussed in the articles THERMODYNAMICS and THERMOMETRY.

Empirical units of "quantity of heat" readily suggest themselves as the amount of heat necessary to heat a unit mass of any substance through unit temperature. In the metric system the unit, termed a "calorie," is the quantity of heat required to raise a gramme of water through one degree Centigrade. This quantity, however, is not constant, since the specific heat of water varies with temperature (see CALORIMETRY). In defining the calorie, therefore, the particular temperatures must be specified; consequently there are several calories particularized by special designations:—(1) conventional or common gramme-calorie, the heat required to raise 1 gramme of water between 15° C. and 17° C. through 1° C.; (2) "mean or average gramme calorie," one-hundredth of the total heat required to raise the temperature of 1 gramme of water from 0° C. to 100° C.; (3) "zero gramme calorie," the heat required to raise 1 gramme of water from 0° C. to 1° C. These units are thus related:—1 common calorie = 1·987 mean calories = 0·992 zero calories. A unit in common use in thermo-chemistry is the *major calorie*, which refers to one kilogramme of water and 1° C. In the British system the common unit, termed the "British Thermal Unit" (B.Th.U.), is the amount of heat required to raise one pound of water through one degree Fahrenheit.

A correlation of these units of quantity of heat with the fundamental units of mass, length and time attended the recognition of the fact that heat was a form of energy; and their quantitative relationships followed from the experimental determinations of the so-called "mechanical equivalent of heat," *i.e.* the amount of mechanical energy, expressed in ergs, joules, or foot-pounds, equivalent to a certain quantity of heat (cf. CALORIMETRY). These results show that a gram-calorie is equivalent to about 4·2 joules, and a British thermal unit to 780 foot-pounds.

Electrical Units.—The next most important units are the electrical units. We are principally concerned in electrical work with three quantities called respectively, electric current, electromotive force, and resistance. These are related to one another by Ohm's law, which states that the electric current in a circuit is directly as the electromotive force and inversely as the resistance, when the current is unvarying and the temperature of the circuit constant. Hence if we choose units for two of these quantities, the above law defines the unit for the third. Much discussion has taken place over this question. The choice is decided by the nature of the quantities themselves. Since resistance is a permanent quality of a substance, it is possible to select a certain piece of wire or tube full of mercury, and declare that its resistance shall be the unit of resistance, and if the substance is permanent we shall possess an unalterable standard or unit of resistance. For these reasons the practical unit of resistance, now called the international ohm, has been selected as one of the above three electrical units.

It has now been decided that the second unit shall be the unit of electric current. As an electric current is not a thing, but a process, the unit current can only be reproduced when desired. There are two available methods for creating a standard or unit electric current. If an unvarying current is passed through a neutral solution of silver nitrate it decomposes or electrolyses it and deposits silver upon the negative pole or cathode of the electrolytic cell. According to Faraday's law and all subsequent experience, the same current deposits in the same time the same mass of silver. Hence we may define the unit current by the mass of silver it can liberate per second. Again, an electric current in one circuit exerts mechanical force upon a magnetic pole or a current in another circuit suitably placed, and we may measure the force and define by it a unit electric current. Both these methods have been used. Thirdly, the unit of electromotive force may be defined as equal to the difference of potential between the ends of the unit of resistance when the unit of current flows in it.

Absolute electrical units.

Apart, however, from the relation of these electrical units to each other, it has been found to be of great importance to establish a simple relation between the latter and the absolute mechanical units. Thus an electric current which is passed through a conductor dissipates its energy as heat, and hence creates a certain quantity of heat per unit of time. Having chosen our units of energy and related unit of quantity of heat, we must so choose the unit of current that when passed through the unit of resistance it shall dissipate 1 unit of energy in 1 unit of time.

British Association units.

A further consideration has weight in selecting the size of the units, namely, that they must be of convenient magnitude for the ordinary measurements. The founders of the modern system of practical electrical units were a committee appointed by the British Association in 1861, at the suggestion of Lord Kelvin, which made its first report in 1862 at Cambridge (see *B. A. Report*). The five subsequent reports containing the results of the committee's work, together with a large amount of most valuable matter on the subject of electric units, were collected in a volume edited by Prof. Fleeming Jenkin in 1873, entitled *Reports of the Committee on Electrical Standards*. This committee has continued to sit and report annually to the British Association since that date. In their second report in 1863 (see *B.A. Report*, Newcastle-on-Tyne) the committee recommended the adoption of the absolute system of electric and magnetic units on the basis originally proposed by Gauss and Weber, namely, that these units should be derived from the fundamental dynamical units, but assuming the units of length, mass and time to be the metre, gramme and second instead of the millimetre, milligramme and second as proposed by Weber. Considerable differences of opinion existed as to the choice of the fundamental units, but ultimately a suggestion of Lord Kelvin's was adopted to select the centimetre, gramme, and second, and to construct a system of electrical units (called the C.G.S. system) derived from the above fundamental units. On this system the unit of force is the *dyne* and the unit of work the *erg*. The dyne is the uniform force which when acting on a mass of 1 gramme for 1 second gives it a velocity of 1 centimetre per second. The erg is the work done by 1 dyne when acting through a distance of 1 centimetre in its own direction. The electric and magnetic units were then derived, as previously suggested by Weber, in the following manner: If we consider two very small spheres placed with centres 1 centimetre apart in air and charged with equal quantities of electricity, then if the force between these bodies is 1 dyne each sphere is said to be charged with 1 unit of electric quantity on the electrostatic system. Again, if we consider two isolated magnetic poles of equal strength and consider them placed 1 centimetre apart in air, then if the force between them is 1 dyne these poles are said to have a strength of 1 unit on the electromagnetic system. Unfortunately the committee did not take into account the fact that in the first case the force between the electric charges depends upon and varies inversely as the dielectric constant of the medium in which the experiment is made, and in the second case it depends upon the magnetic permeability of the medium in which the magnetic poles exist. To put it in other words, they assume that the dielectric constant of the circumambient medium was unity in the first case, and that the permeability was also unity in the second case.

The result of this choice was that two systems of measurement were created, one depending upon the unit of electric quantity so chosen, called the *electrostatic system*, and the other depending upon the unit magnetic pole defined as above, called the *electromagnetic system* of C.G.S. units. Moreover, it was found that in neither of these systems were the units of very convenient magnitude. Hence, finally, the committee adopted a third system of units called the practical system, in which convenient decimal multiples or fractions of the electromagnetic units were selected and named for use. This system, moreover, is not only consistent with itself, but may be considered to be derived from a system of dynamical units in which the unit of length is the earth quadrant or 10 million metres, the unit of mass is 10^{-11} of a gramme and the unit of time is 1 second. The units on this system have received names derived from those of eminent discoverers. Moreover, there is a certain relation between the size of the units for the same quantity on the electrostatic (E.S.) system and that on the electromagnetic (E.M.) system, which depends upon the velocity of light in the medium in which the measurements are supposed to be made. Thus on the E.S. system the unit of electric quantity is a point charge which at a distance of 1 cm. acts on another equal charge with a force of 1 dyne. The E.S. unit of electric current is a current such that 1 E.S. unit of quantity flows per second across each section of the circuit. On the E.M. system we start with the definition that the unit magnetic pole is one which acts on another equal pole at a distance of 1 cm. with a force of 1 dyne. The unit of current on the E.M. system is a current such that if flowing in circular circuit of 1 cm. radius each unit of length of it will act on a unit magnetic pole at the centre with a force of 1 dyne. This E.M. unit of current is much larger than the E.S. unit defined as above. It is v times greater, where $v=3\times10^{10}$ is the velocity of light in air expressed in cms. per second. The reason for this can only be understood by considering the *dimensions* of the quantities with which we are concerned. If L, M, T denote length, mass, time, and we adopt certain sized units of each, then we may measure any derived quantity, such as velocity, acceleration, or force in terms of the derived dynamical units as already explained. Suppose, however, we alter the size of our selected units of L, M or T, we have to consider how this alters the corresponding units of velocity, acceleration, force, &c. To do this we have to consider their dimensions. If the unit of velocity is the unit of length passed over per unit of time, then it is obvious that it varies directly as the unit of length, and inversely as the unit of time. Hence we may say that the dimensions of velocity are L/T or LT^{-1}; similarly the dimensions of acceleration are L/T^2 or LT^{-2}, and the dimensions of a force are MLT^{-2}.

For a fuller explanation see above (UNITS, DIMENSIONS OF), or Everett's *Illustrations of the C.G.S. System of Units*.

Electrostatic and electromagnetic units.

Accordingly on the electrostatic system the unit of electric quantity is such that $f=q^2/Kd^2$, where q is the quantity of the two equal charges, d their distance, f the mechanical force or stress between them, and K the dielectric constant of the dielectric in which they are immersed. Hence since f is of the dimensions MLT^{-2}, q^2 must be of the dimensions of KML^3T^{-2}, and q of the dimensions $M^{\frac{1}{2}}L^{\frac{3}{2}}T^{-1}K^{\frac{1}{2}}$. The dimensions of K, the dielectric constant, are unknown. Hence, in accordance with the suggestion of Sir A. Rücker (*Phil. Mag.*, February 1889), we must treat it as a fundamental quantity. The dimensions of an electric current on the electrostatic system are therefore those of an electric quantity divided by a time, since by current we mean the quantity of electricity conveyed per second. Accordingly current on the E.S. system has the dimensions $M^{\frac{1}{2}}L^{\frac{3}{2}}T^{-2}K^{\frac{1}{2}}$.

We may obtain the dimensions of an electric current on the magnetic system by observing that if two circuits traversed by the same or equal currents are placed at a distance from each other, the mechanical force or stress between two elements of the circuit, in accordance with Ampère's law (see ELECTRO-KINETICS), varies as the square of the current C, the product of the elements of length ds, ds' of the circuits, inversely as the square of their distance d, and directly as the permeability μ of the medium in which they are immersed. Hence $C^2 ds\, ds'\mu/d^2$ must be of the dimensions of a force or of the dimensions MLT^{-2}. Now, ds and ds' are lengths, and d is a length, hence the dimensions of electric current on the E.M. system must be $M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-1}\mu^{-\frac{1}{2}}$. Accordingly the dimensions of current on the E.S. system are $M^{\frac{1}{2}}L^{\frac{3}{2}}T^{-2}K^{\frac{1}{2}}$, and on the E.M. system they are $M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-1}\mu^{-\frac{1}{2}}$, where μ and K, the permeability and dielectric constant of the medium, are of unknown dimensions, and therefore treated as fundamental quantities.

The ratio of the dimensions of an electric current on the two systems (E.S. and E.M.) is therefore $LT^{-1}K^{\frac{1}{2}}\mu^{\frac{1}{2}}$. This ratio must be a mere numeric of no dimensions, and therefore the dimensions of $\sqrt{K\mu}$ must be those of the reciprocal of a velocity. We do not know what the dimensions of μ and K are separately, but we do know, therefore, that their product has the dimensions of the reciprocal of the square of a velocity.

Again, we may arrive at two dimensional expressions for electromotive force or difference of potential. Electrostatic difference of potential between two places is measured by the mechanical work required to move a small conductor charged with a unit electric charge from one place to the other against the electric force. Hence if V stands for the difference of potential between the two places, and Q for the charge on the small conductor, the product QV must be of the dimensions of the *work* or *energy*, or of the force×length, or of ML^2T^{-2}. But Q on the electrostatic system of measurement is of the dimensions $M^{\frac{1}{2}}L^{\frac{3}{2}}T^{-1}K^{\frac{1}{2}}$; the potential difference V must be, therefore, of the dimensions $M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-1}K^{-\frac{1}{2}}$. Again, since by Ohm's law and Joule's law electromotive force multiplied by a current is equal to the power expended on a circuit, the dimensions of electromotive force, or, what is the same thing, of potential difference, in the electromagnetic system of measurement must be those of power divided by a current. Since mechanical power means *rate of doing work*, the dimensions of power must be ML^2T^{-3}. We have already seen that on the electromagnetic system the dimensions of a current are $M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-1}\mu^{-\frac{1}{2}}$; therefore the dimensions of electromotive force or potential on the electromagnetic system must be $M^{\frac{1}{2}}L^{\frac{3}{2}}T^{-2}\mu^{\frac{1}{2}}$. Here again we find that the ratio of the dimensions on the electrostatic system to the dimensions on the electromagnetic system is $L^{-1}TK^{-\frac{1}{2}}\mu^{-\frac{1}{2}}$.

In the same manner we may recover from fundamental facts and relations the dimensions of every electric and magnetic quantity on the two systems, starting in one case from electrostatic phenomena and in the other case from electromagnetic or magnetic. The electrostatic dimensional expression will always involve K, and the electromagnetic dimensional expression will always involve μ, and in every case the dimensions in terms of K are to those in terms of μ for the same quantity in the ratio of a power of $LT^{-1}K^{\frac{1}{2}}\mu^{\frac{1}{2}}$. This therefore confirms the view that whatever may be the true dimensions in terms of fundamental units of μ and K, their product is the inverse square of a velocity.

Table I. gives the dimensions of all the principal electric and magnetic quantities on the electrostatic and electromagnetic systems.

It will be seen that in every case the ratio of the dimensions on the two systems is a power of $LT^{-1}K^{\frac{1}{2}}\mu^{\frac{1}{2}}$, or of a velocity multiplied by the square root of the product K and μ; in other words, it is the product of a velocity multiplied by the geometric mean of K and μ. This quantity $1/\sqrt{K\mu}$ must therefore be of the dimensions of a velocity, and the questions arise, What is the absolute value of this velocity? and, How is it to be determined? The answer is, that the value of the velocity in concrete numbers may be obtained by measuring the magnitude of any electric quantity in two ways, one making use only of electrostatic phenomena, and the other only of electromagnetic. To take one instance:—It is easy to show that the electrostatic capacity of a sphere suspended in air or in vacuo at a great distance from other conductors is given by a number equal to its radius in centimetres. Suppose such a sphere to be charged and discharged rapidly with electricity from any source, such as a battery. It would take electricity from the source at a certain rate, and would in fact act like a resistance in permitting the passage through it or by it of a certain quantity of electricity per unit of time. If K is the capacity and n is the number of discharges per second, then nK is a quantity of the dimensions of an electric conductivity, or of the reciprocal of a resistance. If a conductor, of which the electrostatic capacity can be calculated, and which has associated with it a commutator that charges and

TABLE I.—DIMENSIONS OF ELECTRIC QUANTITIES

Quantity.	Symbol.	Dimensions on the Electrostatic System E.S.	Dimensions on the Electromagnetic System E.M.	Ratio of E.S to E.M.
Magnetic permeability	(μ)	$L^{-2}T^{2}K^{-1}$	μ	$L^{-2}T^{2}K^{-1}\mu^{-1}$
Magnetic force or field	(H)	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-2}K^{\frac{1}{2}}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}\mu^{-\frac{1}{2}}$	$L\ T^{-1}K^{\frac{1}{2}}\mu^{\frac{1}{2}}$
Magnetic flux density or induction	(B)	$L^{\frac{3}{2}}M^{\frac{1}{2}}K^{-\frac{1}{2}}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}\mu^{\frac{1}{2}}$	$L^{-1}T\ K^{-\frac{1}{2}}\mu^{-\frac{1}{2}}$
Total magnetic flux	(Z)	$L^{\frac{1}{2}}M^{\frac{1}{2}}K^{-\frac{1}{2}}$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}\mu^{\frac{1}{2}}$	$L^{-1}T\ K^{-\frac{1}{2}}\mu^{-\frac{1}{2}}$
Magnetization	(I)	$L^{-\frac{3}{2}}M^{\frac{1}{2}}K^{-\frac{1}{2}}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}\mu^{\frac{1}{2}}$	$L^{-1}T\ K^{-\frac{1}{2}}\mu^{\frac{1}{2}}$
Magnetic pole strength	(m)	$L^{\frac{1}{2}}M^{\frac{1}{2}}K^{-\frac{1}{2}}$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}\mu^{\frac{1}{2}}$	$L^{-1}T\ K^{-\frac{1}{2}}\mu^{-\frac{1}{2}}$
Magnetic moment	(M)	$L^{\frac{3}{2}}M^{\frac{1}{2}}K^{-\frac{1}{2}}$	$L^{\frac{5}{2}}M^{\frac{1}{2}}T^{-1}\mu^{\frac{1}{2}}$	$L^{-1}T\ K^{-\frac{1}{2}}\mu^{-\frac{1}{2}}$
Magnetic potential or magnetomotive force	(M.M.F.)	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-2}K^{\frac{1}{2}}$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}\mu^{-\frac{1}{2}}$	$L\ T^{-1}K^{\frac{1}{2}}\mu^{\frac{1}{2}}$
Specific inductive capacity	(K)	K	$L^{-2}T^{2}\mu^{-1}$	$L^{2}T^{-2}K\mu$
Electric force	(e)	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}K^{-\frac{1}{2}}$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-2}\mu^{\frac{1}{2}}$	$L^{-1}T\ K^{-\frac{1}{2}}\mu^{-\frac{1}{2}}$
Electric displacement	(D)	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}K^{\frac{1}{2}}$	$L^{-\frac{3}{2}}M^{\frac{1}{2}}\mu^{-\frac{1}{2}}$	$L\ T^{-1}K^{\frac{1}{2}}\mu^{\frac{1}{2}}$
Electric quantity	(Q)	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}K^{\frac{1}{2}}$	$L^{\frac{1}{2}}M^{\frac{1}{2}}\mu^{-\frac{1}{2}}$	$L\ T^{-1}K^{\frac{1}{2}}\mu^{\frac{1}{2}}$
Electric current	(A)	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-2}K^{\frac{1}{2}}$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}\mu^{-\frac{1}{2}}$	$L\ T^{-1}K^{\frac{1}{2}}\mu^{\frac{1}{2}}$
Electric potential Electromotive force	(V) (E.M.F.)	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}K^{-\frac{1}{2}}$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-2}\mu^{\frac{1}{2}}$	$L^{-1}T\ K^{-\frac{1}{2}}\mu^{-\frac{1}{2}}$
Electric resistance	(R)	$L^{-1}T\ K^{-1}$	$L\ T^{-1}\mu$	$L^{-2}T^{2}K^{-1}\mu^{-1}$
Electric capacity	(C)	$L\ K$	$L^{-1}T^{2}\mu^{-1}$	$L^{2}T^{-2}K\mu$
Self-inductance Mutual inductance	(L) (M)	$L^{-1}T^{2}K^{-1}$	$L\ \mu$	$L^{-2}T^{2}K^{-1}\mu^{-1}$

discharges it *n* times per second, is arranged in one branch of a Wheatstone's Bridge, it can be treated and measured as if it were a resistance, and its equivalent resistance calculated in terms of the resistance of all the other branches of the bridge (see *Phil. Mag.*, 1885, 20, 258).

Accordingly, we have two methods of measuring the capacity of a conductor. One, the electrostatic method, depends only on the measurement of a length, which in the case of a sphere in free space is its radius; the other, the electromagnetic method, determines the capacity in terms of the quotient of a time by a resistance. The ratio of the electrostatic to the electromagnetic value of the same capacity is therefore of the dimensions of a velocity multiplied by a resistance in electromagnetic value, or of the dimensions of a velocity squared. This particular experimental measurement has been carried out carefully by many observers, and the result has been always to show that the velocity *v* which expresses the ratio is very nearly equal to 30 thousand million centimetres per second; v=nearly 3×10^{10}. The value of this important constant can be determined by experiments made to measure electric quantity, potential, resistance or capacity, both in electrostatic and in electromagnetic measure. For details of the various methods employed, the reader must be referred to standard treatises on Electricity and Magnetism, where full particulars will be found (see Maxwell, *Treatise on Electricity and Magnetism*, vol. ii. ch. xix. and ed.; also Mascart and Joubert, *Treatise on Electricity and Magnetism*, vol. ii. ch. viii., Eng. trans. by Atkinson).

Table II. gives a list of some of these determinations of *v*, with references to the original papers.

It will be seen that all the most recent values, especially those in which a comparison of capacity has been made, approximate to 3×10^{10} centimetres per second, a value which is closely in accord with the latest and best determinations of the velocity of light.

Practical units.

We have in the next place to consider the question of practical electric units and the determination and construction of concrete standards. The committee of the British Association charged with the duty of arranging a system of absolute and magnetic units settled also on a system of practical units of convenient magnitude, and gave names to them as follows:—

10^{9} absolute electromagnetic units of resistance = 1 ohm
10^{8} " " units of electromotive force = 1 volt
$\frac{1}{10}$th of an " " unit of current = 1 ampere
$\frac{1}{10}$th of an " " unit of quantity = 1 coulomb
10^{-9} " " units of capacity = 1 farad
10^{-15} " " units of capacity = 1 microfarad

Since the date when the preceding terms were adopted, other multiples of absolute C.G.S. units have received practical names, thus:—

10^{7} ergs or absolute C.G.S. units of energy = 1 joule
10^{7} ergs per second or C.G.S. units of power = 1 watt
10^{9} absolute units of inductance = 1 henry
10^{8} absolute units of magnetic flux = 1 weber[1]
1 absolute unit of magnetomotive force = 1 gauss[1]

An Electrical Congress was held in Chicago, U.S.A., in August 1893, to consider the subject of international practical electrical units, and the result of a conference between scientific representatives of Great Britain, the United States, France, Germany, Italy, Mexico, Austria, Switzerland, Sweden and British North America, after deliberation for six days, was a unanimous agreement to recommend the following resolutions as the definition of practical international units. These resolutions and definitions were confirmed at other conferences, and at the last one held in London in October 1908 were finally adopted. It was agreed to take:—

"As a unit of resistance, the *International Ohm*, which is based upon the ohm equal to 10^{9} units of resistance of the C.G.S. system of electromagnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice 14·4521 grammes in mass, of a constant cross-sectional area and of the length of 106·3 cm.

"As a unit of current, the *International Ampere*, which is one-tenth of the unit of current of the C.G.S. system of electromagnetic units, and which is represented sufficiently well for practical use by the unvarying current which, when passed through a solution of nitrate of silver in water, deposits silver at the rate of 0·00111800 of a gramme per second.

"As a unit of electromotive force, the *International Volt*, which is the electromotive force that, steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere. It is represented sufficiently well for practical purposes by $\frac{1000}{1018\cdot3}$ of the E.M.F. of a normal or saturated cadmium Weston cell at 20° C., prepared in the manner described in a certain specification.

"As a unit of quantity, the *International Coulomb*, which is the quantity of electricity transferred by a current of one international ampere in one second.

"As the unit of capacity, the *International Farad*, which is the capacity of a condenser charged to a potential of one international volt by one international coulomb of electricity.

"As a unit of work, the *Joule*, which is equal to 10^{7} units of work in the C.G.S. System, and which is represented sufficiently well for practical use by the energy expended in one second by an international ampere in an international ohm.

"As a unit of power, the *Watt*, which is equal to 10^{7} units of power in the C.G.S. System, and which is represented sufficiently well for practical use by the work done at the rate of one joule per second.

"As the unit of inductance, the *Henry*, which is the induction in a circuit when an electromotive force induced in this circuit is one international volt, while the inducing current varies at the rate of one ampere per second."

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[1] Neither the weber nor the gauss has received very general adoption, although recommended by the Committee of the British Association on Electrical Units. Many different suggestions have been made as to the meaning to be applied to the word "gauss." The practical electrical engineer, up to the present, prefers to use *one ampere-turn* as his unit of magnetomotive force, and *one line of force* as the unit of magnetic flux, equal respectively to $10/4\pi$ times and 1 times the C.G.S. absolute units. Very frequently the "kiloline," equal to 1000 lines of force, is now used as a unit of magnetic flux.

TABLE II.—OBSERVED VALUES OF *v* IN CENTIMETRES PER SECOND

Date.	Name.	Reference.	Electric Quantity Measured.	*v* in Centimetres per Second.
1856	W. Weber and R. Kohlrausch	*Electrodynamische Massbestimmungen* and *Pogg. Ann.* xcix., August 10, 1856	Quantity	$3·107\times10^{10}$
1867 1868	Lord Kelvin and W. F. King	*Report of British Assoc.*, 1869, p. 434; and *Reports on Electrical Standards*, F. Jenkin, p. 186	Potential	$2·81\times10^{10}$
1868	J. Clerk Maxwell	*Phil. Trans. Roy. Soc.*, 1868, p. 643	„	$2·84\times10^{10}$
1872	Lord Kelvin and Dugald M'Kichan	*Phil. Trans. Roy. Soc.*, 1873, p. 409	„	$2·89\times10^{10}$
1878	W. E. Ayrton and J Perry	*Journ. Soc. Tel. Eng.* vol. viii. p. 126	Capacity	$2·94\times10^{10}$
1880	Lord Kelvin and Shida	*Phil. Mag.*, 1880, vol. x. p. 431	Potential	$2·955\times10^{10}$
1881	A. G. Stoletow .	*Soc. Franc. de Phys.*, 1881	Capacity	$2·99\times10^{10}$
1882	F Exner . .	*Wien. Ber.*, 1882	Potential	$2·92\times10^{10}$
1883	Sir J. J. Thomson	*Phil. Trans. Roy. Soc.*, 1883, p. 707	Capacity	$2·963\times10^{10}$
1884	I. Klemencic . .	*Journ. Soc. Tel. Eng.*, 1887, p. 162	„	$3·019\times10^{10}$
1888	F. Himstedt . .	*Electrician*, March 23, 1888, vol. xx. p. 530	„	$3·007\times10^{10}$
1888	Lord Kelvin, Ayrton and Perry	*British Association*, Bath; and *Electrician*, Sept. 28, 1888	Potential	$2·93\times10^{10}$
1888	H. Fison . .	*Electrician*, vol. xxi. p. 215; and, *Proc. Phys. Soc. Lond.*, June 9, 1888	Capacity	$2·965\times10^{10}$
1889	Lord Kelvin . .	*Proc. Roy. Inst.*, 1889	Potential	$3·004\times10^{10}$
1889	H. A. Rowland .	*Phil. Mag.*, 1889	Quantity	$2·981\times10^{10}$
1889	E. B. Rosa . .	*Phil. Mag.*, 1889	Capacity	$3·000\times10^{10}$
1890	Sir J. J Thomson and G F C. Searle	*Phil. Trans.*, 1890	„	$2·995\times10^{10}$
1897	M. E. Maltby. .	*Wied. Ann.* 1897	Alternating currents	$3·015\times10^{10}$

In connexion with the numerical values in the above definitions much work has been done. The electrochemical equivalent of silver or the weight in grammes deposited per second by 1 C.G.S. electromagnetic unit of current has been the subject of much research. The following determinations of it have been given by various observers:—

Name.	Value.	Reference.
E. E. N. Mascart . .	0·011156	*Journ. de physique*, 1884, (2), 3, 283.
F. and W Kohlrausch .	0·011183	*Wied. Ann.*, 1886, 27, 1.
Lord Rayleigh and Mrs Sedgwick	0·011179	*Phil. Trans. Roy. Soc.*, 1884, 2, 411.
J. S. H. Pellat and A. Potier	0·011192	*Journ. de Phys.*, 1890, (2), 9, 381.
Karl Kahle . . .	0·011183	*Wied. Ann.*, 1899, 67, 1
G. W. Patterson and K. E. Guthe	0·011192	*Physical Review*, 1898, 7, 251.
J. S. H. Pellat and S. A. Leduc	0·011195	*Comptes rendus*, 1903, 136, 1649.

Although some observers have urged that the 0·01119 is nearer to the true value than 0·01118, the preponderance of the evidence seems in favour of this latter number and hence the value per ampere-second is taken as 0·0011800 gramme. The exact value of the electromotive force of a Clark cell has also been the subject of much research. Two forms of cell are in use, the simple tubular form and the H-form introduced by Lord Rayleigh. The Berlin Reichsanstalt has issued a specification for a particular H-form of Clark cell, and its E.M.F at 15° C. is taken as 1·4328 international volts. The E.M.F. of the cell set up in accordance with the British Board of Trade specification is taken as 1·434 international volts at 15° C. The detailed specifications are given in Fleming's *Handbook for the Electrical Laboratory and Testing Room* (1901), vol. i. chap. 1; in the same book will be found copious references to the scientific literature of the Clark cell. One objection to the Clark cell as a concrete standard of electromotive force is its variation with temperature and with slight impurities in the mercurous sulphate used in its construction. The Clark cell is a voltaic cell made with mercury, mercurous sulphate, zinc sulphate, and zinc as elements, and its E.M.F. decreases 0·08% per degree Centigrade with rise of temperature. In 1891 Mr Weston proposed to employ cadmium and cadmium sulphate in place of zinc and zinc sulphate and found that the temperature coefficient for the cadmium cell might be made as low as 0·004 % per degree Centigrade. Its E.M.F. is, however, 1·0184 international volts at 20° C. For details of construction and the literature of the subject see Fleming's *Handbook for the Electrical Laboratory*, vol. i. chap. 1.

In the British Board of Trade laboratory the ampere and the volt are not recovered by immediate reference to the electrochemical equivalent of silver or the Clark cell, but by means of instruments called a standard ampere balance and a standard 100-volt electrostatic voltmeter. In the standard ampere balance the current is determined by weighing the attraction between two coils traversed by the current, and the ampere is defined to be the current which causes a certain attraction between the coils of this standard form of ampere balance. The form of ampere balance in use at the British Board of Trade electrical standards office is described in Fleming's *Handbook for the Electrical Laboratory*, vol. i., and that constructed for the British National Physical Laboratory in the report of the Committee on Electrical Standards (*Brit. Assoc. Rep.*, 1905). This latter instrument will recover the ampere within one-thousandth part. For a further description of it and for full discussion of the present position of knowledge respecting the values of the international practical units the reader is referred to a paper by Dr F. A. Wolff read before the International Electrical Congress at St Louis Exhibition, U.S.A., in 1904, and the subsequent discussion (see *Journ. Inst. Elec. Eng. Lond.*, 1904–5, 34, 190, and 35, 3).

The construction of the international ohm or practical unit of resistance involves a knowledge of the specific resistance of mercury. Numerous determinations of this constant have been made. The results are expressed either in terms of the length in cm. of the column of pure mercury of 1 sq. mm. in section which at 0° C. has a resistance of 10^9 C.G.S. electromagnetic units, or else in terms of the weight of mercury in grammes for a column of constant cross-sectional area and length of 100·3 cm. The latter method was adopted at the British Association Meeting at Edinburgh in 1892, but there is some uncertainty as to the value of the density of mercury at 0° C. which was then adopted. Hence it was proposed by Professor J. Viriamu Jones that the redetermination of the ohm should be made when required by means of the Lorentz method (see J. V. Jones, "The Absolute Measurement of Electrical Resistance," *Proc. Roy. Inst.* vol. 14, part iii. p. 601). For the length of the mercury column defining the ohm as above, Lord Rayleigh in 1882 found the value 106·27 cm., and R. T. Glazebrook in the same year the value 106·28 cm. by a different method, while another determination by Lord Rayleigh and Mrs Sedgwick in 1883 gave 106·22 cm. Viriamu Jones in 1891 gave the value 106·30 cm., and one by W. E. Ayrton in 1897 by the same method obtained the value 106·27 to 106·28 cm. Hence the specific resistance of mercury cannot be said to be known to 1 part in 10,000, and the absolute value of the ohm in centimetres per second is uncertain to at least that amount. (See also J. Viriamu Jones, "On a Determination of the International Ohm in Absolute Measure," *Brit. Assoc. Report*, 1894.)

Rational system of electrical units.

Giorgi's system of electrical units.

The above-described practical system based on the C.G.S. double system of theoretical units labours under several very great disadvantages. The practical system is derived from and connected with an abnormally large unit of length (the earth quadrant) and an absurdly small unit of mass. Also in consequence of the manner in which the unit electric quantity and magnetic pole strength are defined, a coefficient, 4π, makes its appearance in many practical equations. For example, on the present system the magnetic force H in the interior of a long spiral wire of N turns per centimetre of length when a current of A amperes circulates in the wire is $4\pi AN/10$. Again, the electric displacement or induction D through a unit of area is connected with the electric force E and the dielectric constant K by the equation $D = KE/4\pi$. In numerous electric and magnetic equations the constant 4π makes its appearance where it is apparently meaningless. A system of units in which this constant is put into its right place by appropriate definitions is called a rational system of electric units. Several physicists have proposed such systems. Amongst others that of Professor G. Giorgi especially deserves mention. We have seen that in expressing the dimensions of electric and magnetic qualities we cannot do so simply by reference to the units of length, mass and time, but must introduce a fourth fundamental quantity. This we may take to be the dielectric constant of the ether or its magnetic permeability, and thus we obtain two systems of measurement. Professor Giorgi proposes that the four fundamental quantities shall be the units of length, mass, time and electrical resistance, and takes as the concrete units or standards the metre, kilogramme, second and ohm. Now this proposal not only has the advantage that the theoretical units are identical with the actual practical concrete units, but it is also a rational system. Moreover, the present practical units are unaltered; the ampere, volt, coulomb, weber, joule and watt remain the actual as well as theoretical units of current, electromotive force, quantity, magnetic flux, work and power. But the unit of magnetic force becomes the ampere-turn per metre, and the unit of electric force the volt per metre; thus the magnetic units are measured in terms of electric units. The numerical value of the permeability of ether or air becomes $4\pi \times 10^{-7}$ and the dielectric constant of the ether or air becomes $1/4\pi \times 9 \times 10^9$; their product is therefore $1/(3 \times 10^8)^2$, which is the reciprocal of the square of the velocity of light in metres per second.

For a discussion of the Giorgi proposals, see a paper by Professor M. Ascoli, read before the International Electrical Congress at St Louis, 1904 (*Journ. Inst. Elect. Eng. Lond.*, 1904, 34, 176).

It can hardly be said that the present system of electrical units is entirely satisfactory in all respects. Great difficulty would of course be experienced in again altering the accepted practical concrete units, but if at any future time a reformation should be possible, it would be desirable to bear in mind the recommendations made by Oliver Heaviside with regard to their rationalization. The British Association Committee defined the strength of a magnetic pole by reference to the mechanical stress between it and another equal pole: hence the British Association unit magnetic pole is a pole which at a distance of one centimetre attracts or repels another equal pole with a force of one dyne. This, we have seen, is an imperfect definition, because it omits all reference to the permeability of the medium in which the experiment takes place; but it is also unsatisfactory as a starting-point for a system of units for another reason. The important quantity in connexion with polar magnets is not a mechanical stress between the free poles of different magnets, but the magnetic flux emanating from, or associating with, them. From a technical point of view this latter quality is far more important than the mechanical stress between the magnetic poles, because we mostly employ magnets to create induced electromotive force, and the quantity we are then mostly concerned with is the magnetic flux proceeding from the poles. Hence the most natural definition of a unit magnet pole is that pole from which proceeds a total magnetic flux of one unit. The definition of one unit of magnetic flux must then be that flux which, when inserted into or withdrawn from a conducting circuit of one turn having unit area and unit conductivity, creates in it a flow or circulation of one unit of electric quantity. The definition of a unit magnetic pole ought, therefore, to have been approached from the definition of a unit of electric quantity.

On the C.G.S. or British Association system, if a magnetic filament has a pole strength m—that is to say, if it has a magnetization I, and a section s, such that Is equals m—then it can be shown that the total flux emanating from the pole is $4\pi m$. The factor 4π, in consequence of this definition, makes its appearance in many practically important expressions. For instance, in the well-known magnetic equation connecting the vector values of magnetization I, magnetic force H and magnetic flux density B, where we have the equation

$$B = H + 4\pi I,$$

the appearance of the quantity 4π disguises the real physical meaning of the equation.

The true remedy for this difficulty has been suggested by Heaviside to be the substitution of *rational* for *irrational* formulae and definitions.

Heaviside's rational system.

He proposes to restate the definition of a unit magnetic pole in such a manner as to remove this constant 4π from the most frequently employed equations. His starting-point is a new definition according to which a unit magnetic pole is said to have a strength of m units if it attracts or repels another equal pole placed at a distance of d centimetres with a force of $m^2/4\pi d^2$ dynes. It follows from this definition that a rational unit magnetic pole is weaker or smaller than the irrational or British Association unit pole in the ratio of $1/\sqrt{4\pi}$ to 1, or ·28205 to 1. The magnetic force due to a rational pole of strength m at a distance of d centimetres being $m/4\pi d^2$ units, if we suppose a magnetic filament having a pole of strength m in rational units to have a smaller sphere of radius r described round its pole, the magnetic force on the surface of this sphere is $m/4\pi r^2$ units, and this is therefore also the numerical value of the flux density. Hence the total magnetic flux through the surface of the sphere is

$$4\pi r^2 \times m/4\pi r^2 \text{ units} = m \text{ units};$$

and therefore the number which denotes the total magnetic flux coming out of the pole of strength m in rational units is also m.

The Heaviside system thus gives us an obvious and natural definition of a unit magnetic pole, namely, that it is a pole through which proceeds the unit of magnetic flux. It follows, therefore, that if the intensity of magnetization of the magnetic filament is I and the section is s, the total flux traversing the centre of the magnet is Is units; and that if the filament is an endless or poleless iron filament magnetized uniformly by a resultant external magnetic force H, the flux density will be expressed in rational units by the equation $B = I + H$. The physical meaning of this equation is that the flux per square centimetre in the iron is simply obtained by adding together the flux per square centimetre, if the iron is supposed to be removed, and the magnetization of the iron at that place. On the rational system, since the unit pole strength has been decreased in the ratio of I to $1/\sqrt{4\pi}$, or of 3·5441 to 1, when compared with the magnitude of the present irrational unit pole, and since the unit of magnetic flux is the total flux proceeding from a magnetic pole, it follows that Heaviside's unit of magnetic flux is larger than the C.G.S. unit of magnetic flux in the ratio of 3·5441 to 1.

It will be seen, therefore, that the Heaviside rational units are all incommeasurable with the practical units. This is a great barrier to their adoption in practice, because it is impossible to discard all the existing resistance coils, ammeters, voltmeters, &c., and equally impossible to recalibrate or readjust them to read in Heaviside units. A suggestion has been made, in modification of the Heaviside system, which would provide a system of rational practical units not impossible of adoption. It has been pointed out by J. A. Fleming that if in place of the ampere, ohm, watt, joule, farad and coulomb, we employ the dekampere, dekohm, the dekawatt, the dekajoule, the dekafarad and the dekacoulomb, we have a system of practical units such that measurements made in these units are equal to measurements made in Heaviside rational units when multiplied by some power of 4π. Moreover, he has shown that this power of 4π, in the case of most units, varies inversely as the power under which μ appears in the complete dimensional expression for the quantity in electromagnetic measurement. Thus a current measured in Heaviside rational units is numerically equal to $(4\pi)^{\frac{1}{2}}$ times the same current measured in dekamperes, and in the electromagnetic dimensional expression for current, namely, $L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}\mu^{-\frac{1}{2}}$, μ appears as $\mu^{-\frac{1}{2}}$. If, then, we consider the permeability of the ether to be numerically 4π instead of unity, the measurement of a current in dekamperes will be a number which is the same as that given by reckoning in Heaviside rational units. In this way a system of *Rational Practical Units* (R.P. Units) might be constructed as follows:—

The R.P.	Unit of	Magnetic Force	= 4π ×	the C.G.S.	Unit.
,,	,,	Magnetic Polarity	= $1/4\pi$ ×	,,	,,
,,	,,	Magnetic Flux	=	1	,,
,,	,,	Magnetomotive Force	=	1	,,
,,	,,	Electric Current	=	1	,,
,,	,,	Electric Quantity	=	1	,,
,,	,,	Electromotive Force	=	10^9	,,
,,	,,	Resistance	=	10^8	,,
,,	,,	Inductance	=	10^8	,,
,,	,,	Power	=	10^8	,,
,,	,,	Work	=	10^8	,,
,,	,,	Capacity	=	10^{-8}	,,

All except the unit of magnetic force and magnetic polarity are commensurable with the corresponding C.G.S. units, and in multiples which form a convenient practical system.

Even the rational systems already mentioned do not entirely fulfil the ideal of a system of physical units. There are certain constants of nature which are fundamental, invariable, and, as far as we know, of the same magnitude in all parts of the universe. One of these is the *mass* of the atom, say of hydrogen. Another is the *length* of a wave of light of particular refrangibility emitted by some atom, say one of the two yellow lines in the spectrum of sodium or one of the hydrogen lines. Also a *time* is fixed by the velocity of light in space which is according to the best measurement very close to 3×10^{10} cms. per sec. Another natural unit is the so-called *constant of gravitation*, or the force in dynes due to the attraction of two spherical masses each of 1 gramme with centres at a distance of 1 cm. Very approximately this is equal to 648×10^{-10} dynes. Another natural electrical unit of great importance is the electric charge represented by 1 electron (see ELECTRICITY). This according to the latest determination is nearly $3·4 \times 10^{-10}$ electrostatic units of quantity on the C.G.S. system. Hence, 2930 million electrons are equal to 1 E.S. unit of quantity on the C.G.S. system, and the quantity called 1 coulomb is equal to 879×10^{16} electrons. In round numbers 9×10^{18} electrons make 1 coulomb. The electron is nature's unit of electricity and is the charge carried by 1 hydrogen ion in electrolysis (see CONDUCTION, ELECTRIC, § *Liquids*). Accordingly a truly natural system of physical units would be one which was based upon the electron, or a multiple of it, as a unit of electric quantity, the velocity of light or fraction of it as a unit of velocity, and the mass of an atom of hydrogen or multiple of it as a unit of mass. An approximation to such a natural system of electric units will be found discussed in chap. 17 of a book on *The Electron Theory*, by E.E. Fournier d'Albe (London, 1906), to which the reader is referred.

See J. Clerk Maxwell, *Treatise on Electricity and Magnetism*, vol. ii. chap. x. (3rd ed., Oxford, 1892); E. E. N. Mascart and J. Joubert, *Treatise on Electricity and Magnetism*, translation by E. Atkinson, vol. i. chap. xi. (London, 1883); J. D. Everett, *Illustrations of the C.G.S. System of Units* (London, 1891); Magnus Maclean, *Physical Units* (London, 1896); Fleeming Jenkin, *Reports on Electrical Standards* (London, 1873); *Reports* of the British Association Committee on Electrical Units from 1862 to present date; J. A. Fleming, *A Handbook for the Electrical Laboratory and Testing-Room* (2 vols., London, 1901); Lord Rayleigh, *Collected Scientific Papers*, vol. ii. (1881–87); A. Grey, *Absolute Measurements in Electricity and Magnetism*, vol. ii. part ii. chap. ix. p. 150 (London, 1893); Oliver Heaviside, *Electromagnetic Theory*, i. 116 (London, 1893); Sir A. W. Rücker, "On the Suppressed Dimensions of Physical Quantities," *Proc. Phys. Soc. Lond.* (1888), 10, 37; W. Williams, "On the Relation of the Dimensions of Physical Quantities to Directions in Space," *Proc. Phys. Soc. Lond.* (1892), 11, 257; R. A. Fessenden, "On the Nature of the Electric and Magnetic Quantities," *Physical Review* (January 1900).

(J. A. F.)

UNIVERSALIST CHURCH, a religious body organized in the United States, and represented chiefly by parishes and churches in that country and in Canada. While the distribution of the denomination extends to every state in the Union, the greater number of organizations and members are found in New England and New York.

A distinction should be noted between Universalism and the Universalist denomination. Universalism is found very early in the history of the Christian Church—apparently from the beginning. It was certainly held and taught by several of the greatest of the Apostolic and Church fathers: as Clement of Alexandria, Gregory of Nyssa, Origen and probably by Chrysostom and Jerome. It was taught in a majority of the Christian Schools of the second and third centuries; at Alexandria, at Antioch, at Edessa and at Nisibis.[1] But the Universalist denomination is of modern origin and confined mostly to the American continent. It dates from the arrival in Good Luck, N.J., of the Rev. John Murray (1714–1815),[2] of London, in September 1770; although there were some preachers of the doctrine in the country before Mr Murray came. He preached in various places in New Jersey, New York, Pennsylvania and Massachusetts, and societies sprang up as the result of his ministry in all these states. His first regular settlement was in Gloucester, Mass., in 1774, whence in 1793 he removed to Boston, which from that time forth became the headquarters of the denomination. A contemporary of Murray in his later years was Hosea Ballou (*q.v.*), also of Boston, who soon became the recognized leader of the movement, and for half a century was its most honoured and influential name. During his ministry the sect developed from twenty or thirty churches to five hundred, with a distribution over the Eastern and Middle states. In the period of Mr Ballou's domination little attention was paid to organization. It was the period of the propagation of the doctrine and of the controversies to which that gave rise. But about 1860 began an agitation for a more coherent organization, and a polity better suited to unity and progress than the spontaneous congregationalism that had developed during the earlier period. The result of that agitation was the adoption, at the Centennial Convention in 1870, of a somewhat elaborate plan of organization, and a manual of administration under which the denomination has since been conducted.

The plan of organization of the Universalist body follows, with necessary modifications, the scheme of the civil organization of the national government. While the local parish is the unit, the states are organized as independent federations, and combined into a national congress or convention. The parishes within the territory of a state are organized into a state convention; representatives, duly elected by the several state conventions, constitute the General Convention, which is the supreme legislative authority of the denomination. The state conventions meet annually; the General Convention once in two years. In the interval of sessions a Board of Trustees, consisting of eleven members, of whom the secretary, the chief administrative officer of the Convention, is one, administer the affairs of the denomination, except those concerns "reserved to the states and the people."

Doctrine.—The historic symbol of the denomination remains the Winchester Profession, adopted at the meeting of the General Convention—then a spontaneous yearly gathering of Universalists, without ecclesiastical authority—in Winchester, N.H., in Sept. 1803. It consists of three brief articles, as follows:—

Article I.—We believe that the Holy Scriptures of the Old and New Testaments contain a revelation of the character of God and of the duty, interest and final destination of mankind.

Article II.—We believe that there is one God, whose nature is Love, revealed in one Lord Jesus Christ, by one Holy Spirit of Grace, who will finally restore the whole family of mankind to holiness and happiness.

Article III.—We believe that holiness and true happiness are inseparably connected, and that believers ought to be careful to maintain order and practise good works; for these things are good and profitable unto men.[3]

At the session of the General Convention in Boston in October 1900, a still briefer "Statement of Essential Principles" was adopted and made the condition of fellowship, in the following terms:—

1. The Universal Fatherhood of God; 2. the Spiritual authority and leadership of His Son, Jesus Christ; 3. the trustworthiness of the Bible as containing a revelation from God; 4. the certainty of just retribution for sin; 5. the final harmony of all souls with God.

Universalism, shortly described, is the belief that what ought to be will be. In a sane and beneficent universe the primacy belongs to Truth, Right, Love. These are the supreme powers. The logic of this conception of the natural and moral order is imperious. It compels the conclusion that, although we see not yet all things put under the sway of the Prince of Peace, we see the Divine plan set forth in Him, and cannot doubt the consummation which He embodies and predicts. Universalists are those members of the Christian family in whom this thought has become predominant. The idea that there is a Divine order, and that it contemplates the final triumph of Good over Evil, in human society as a whole and in the history of each individual, has taken possession of them. Hence they are Universalists.

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[1] See Dr Edward Beecher's *History of Opinions on the Scriptural Doctrine of Retribution* (New York, 1878), and Hosea Ballou 2nd's *Ancient History of Universalism* (Boston, 1829).

[2] A Wesleyan, then a follower of Whitefield, Murray became a Universalist after reading the tract on *Union* (1759) written by James Relly (1720–1778), minister of a Universalist congregation in London. Murray was a chaplain in a Rhode Island brigade during the War of American Independence, and a friend of General Nathanael Greene. His Universalism was Calvinistic in its tone, arguing from a universal election to a universal redemption—Ballou first openly broke with Calvinism. Murray's parish in Gloucester through him brought successful suit for the recovery of property appropriated for the use of the original (Congregational) parish, and thus gained the first legal recognition granted in New England to a Universalist society. See the *Autobiography* (Boston, 1816) edited by his wife, Judith Sargent Murray (1751–1820).

[3] Certain Universalists objected to the last clause of Article II. as implying a universal fall in Adam's sin; and others objected to the material and utilitarian construction which might be put on the last clause of Article III.

The Universalist Church embraces but a fraction of those who hold the Universalist belief. The literature of religion, the testimony of common knowledge, the drift of theological thinking, equally with the results of expert investigation, confirm this conclusion. But the denomination holds aloft the banner, conducts the campaign of education and organization, and represents in the religious world the principle, that the best possible outcome is to be expected to the human experiment.

Work.—Some idea of the work carried on by the denomination may be derived from the extent and variety of its organized forces. There were in 1907 about 1000 parishes on its roll; and these, with large numbers of families not included in parishes, were organized into 41 state and provincial conventions; into a National Young People's Christian Union of over 600 local societies, with a membership of 10,000; into one National Women's Missionary Association and several state societies; and into one General Convention, with its Board of Trustees, Secretary, Superintendent, and Committees on Missions, Education, Investments, Ways and Means and Fellowship.

a. The Home Missionary work devolves in the first instance on the several State Conventions, which have a Board and local secretaries and superintendents charged with this particular business in their several territories. In the next place, the Home Missionary work in new fields and where the local organization is weak, is in charge of the Board of Trustees of the General Convention. They employ a Southern Missionary and a General Superintendent, and appoint and aid in maintaining superintendents and missionaries in the newer states and Territories—as the North-Western Superintendent, the California Superintendent, &c.

b. Foreign Missions. In 1907 the Universalist denomination had for about fifteen years maintained a mission in Japan, where five American and five native missionaries were regularly employed, with teachers and helpers of varying numbers. The parent church of this mission is established in Tokyo, and plantings have been made at eight or nine other points throughout the empire. A Girls' Home is maintained in Tokyo, and a considerable work in teaching and training is conducted under the auspices of the Mission in universities and other schools elsewhere. A mission under the auspices of the Universalist General Convention is also maintained at Columbia, Province of Camagüey, Cuba.

c. The educational interests and activities of the denomination are expressed in four colleges, established by the Universalists—Tufts College (1852), at Medford, Massachusetts; Lombard College (1855; opened in 1852 as Illinois Liberal Institute), at Galesburg, Illinois; St Lawrence University (1856), at Canton, New York; and Buchtel College (1872), at Akron, Ohio; three theological schools, connected with the first three colleges just named and founded respectively in 1869, 1881 and 1858; and three academies, Dean Academy, Franklin, Massachusetts, Goddard Seminary, Barre, Vermont, and Westbrook Seminary, Portland, Maine; and a publishing house in Boston with a branch in Chicago is one of the denomination's chief agencies for the spread of the knowledge of what it holds to be the truth.

d. The Chapin Home in New York, the Church of the Messiah Home in Philadelphia, the Washburne Home in Minneapolis and the Bethany Home in Boston are examples of the benevolent and charitable work in which the Universalist body is interested and enlisted.

As stated above, the Universalist denomination embraces about 1000 churches, with congregations numbering about 200,000 persons; a membership of communicants reported in 1906 as 55,831; a membership in Sunday schools of 52,538; and church property valued at $10,598,100·39.

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UNIVERSAL LANGUAGES. The inconveniences resulting from the diversity of languages have been felt since the dawn of civilization. Even the most gifted linguist cannot master more than a comparatively small number of languages, and has to rely more or less on interpreters in his intercourse with speakers of foreign languages.

Advancing civilization brought with it a partial remedy at different periods and in different parts of the world by the spread of such languages as Assyrian, Greek, Latin, Arabic, English over a wide area as the accompaniment of political supremacy, or as a vehicle of culture. Even when Latin split up into the Romance languages, and ceased to be a living language itself, it still survived as the common learned language of Europe both in speech and writing (see LATIN LANGUAGE and CLASSICS), till the rapid development of modern science and modern thought and the rapidly increasing complexity of modern life outstripped the limited range of a language never suited for international use.

Meanwhile the growth of the spirit of nationality has largely increased the number of literary languages. Russian men of science are no longer content to record their discoveries in French or German. The English student of science or philosophy has to leave unread many important works written in the more remote European languages, or make their acquaintance through an often inaccurate translation—perhaps in a language of which he is only imperfectly master.

The question of the adoption of a common language becomes, therefore, more and more pressing.

The most obvious solution of the problem would be the adoption of some one existing language as a means of international communication. But which? To revive the international use of Latin is out of the question. If it is to be a dead language, post-classical Greek would afford a more flexible —and perhaps an easier—means of expression. If we dismiss dead languages as impracticable, the choice of a living language raises new difficulties. To exalt English, or French, or Spanish to the rank of a world-language would give its native speakers such an advantage over the other nationalities that it has been seriously proposed to disarm international jealously by selecting such a language as Norwegian, which is spoken by a small community and is at the same time comparatively simple in structure.

But even if agreement were possible, we are still met by the difficulty that to the average human being it is practically impossible to acquire anything like an easy, thorough command of any foreign language. No natural language is really easy. In fact, we may go further and say that all languages are equally difficult (see H. Sweet, *Practical Study of Languages*, p. 66); although some are made more difficult than they need be by the way in which they are written—by the crabbedness of their alphabet, or by their unphonetic spelling—by the want of handbooks or their unpractical character, by the artificiality of their literature, and other purely external causes. Norwegian is easy to a Swede because it is practically a mere dialect of his own language: he knows two-thirds of it already. But that does not prove that Norwegian is easy in itself—that it would be easy, for instance, to an Oriental. The dialects of Chinese are mutually unintelligible, but it takes a Chinaman only about six months to learn another dialect, which would occupy even a gifted European at least three years to learn to speak; and yet Chinese is, from a European point of view, far simpler in structure than Norwegian, or even English.

Natural languages are difficult because they are imperfect expressions of thought: because language is only partly rational. The greatest difficulty of a language is the vocabulary; and the foundation of the vocabulary of all languages is practically arbitrary: there is no connexion between sound and meaning except in a few isolated words. And even that part of a language which can be brought more or less under general rules is full of irregularities and exceptions, ambiguities and redundancies of expression, and superfluous or irrational distinctions such as those of grammatical gender, so that when we have learnt one sentence we can never be sure that it will serve as a pattern for another.

These considerations suggest a further step towards the attainment of a common language: to rationalize and make regular some existing language. Even if we agreed to adopt an existing language unaltered in itself, we should certainly get rid of its external difficulties: neither English nor French could become world-languages till they had got rid of their unphonetic spelling. But from this it would be a natural step to eliminate such grammatical difficulties as those of *shall* and *will* in English. If this were once agreed on, why not go a step further and get rid of all grammatical irregularities, making, for instance, *better men* into *gooder mans*, *saw*, *seen* into *seed*, and so on? The vocabulary would offer little obstacle to a parallel simplification. The self-evident method would be to select certain words as the foundation: to use them as root-words from which all the other words could be formed by derivation and composition. The inconvenient length of many of the words so formed would then suggest reducing the root-words to a monosyllabic form, with such modifications as would be required to prevent confusions of form or meaning, or to make their pronunciation easier.

It is on these principles that the well-known Volapük (*q.v.*) is constructed (1880)—the first artificial language that achieved a certain measure of success. But its roots are so disguised by arbitrary alterations that the English basis is not generally easy to recognize.

Volapük is mainly an adapted (borrowed) or a-posteriori language, as opposed to an original or a-priori one, although it belongs partly to the latter class as well. Its vocabulary is adapted, but its grammar is, to a great extent, original.

On the ruins of Volapük there rose Esperanto (*q.v.*), which by 1907 had become the most widely known and used of its numerous competitors. In its grammar Esperanto is partly original, partly borrowed. Its vocabulary is not based exclusively on that of any one language, but is selected from the chief European languages—including Latin and Greek—the words being generally unaltered except in spelling. The extensive use made of word-composition and of derivative prefixes and suffixes enables the author to reduce the number of his root-words to between two and three thousand. This does not include international literary, scientific and technical words such as *professor*, *telegraph*, which are not translated into Esperanto compounds or derivatives, but are simply incorporated into the language with the minimum of change.

The most formidable rival of Esperanto is unquestionably Idiom Neutral (1902). It is the collective work of the *Akademi internasional de lingu universal*, its real author being the director of the *Akademi*, M. Rosenberger, of St Petersburg. This academy was originally instituted by the two international Volapük congresses in 1887 and 1889: it now numbers among its members not only many former adherents of the defunct Volapük, but also many ex-Esperantists. The most marked feature of Idiom Neutral is that its vocabulary is definitely and consistently based on the principle of the maximum of internationality for the roots. A systematic examination of the vocabularies of the seven chief European languages—English, French, German, Spanish, Italian, Russian, Latin—showed that the number of international roots and words was much greater than had been supposed. There are many, such as *apetit* and *tri*, "three," which occur in all seven; and it is only occasionally that it has been found necessary to adopt a word or root which occurs in less than four of them. The result is that instead of the unpleasant mixture of Romance elements with words taken arbitrarily from English and German which makes a great part of the vocabulary of Esperanto unintelligible to learners who know only one language, Idiom Neutral offers a vocabulary which is practically Romance-Latin. Thus the Idiom Neutral *ornit*, "bird," and *diurn*, "day," are almost self-interpreting even apart from any context, while the Esperanto *bird* and *tag* are unintelligible except to those who know English and German; and as the former is pronounced in Esperanto approximately as English *beard*, it is only intelligible to English speakers when written, not when spoken. In its grammar Idiom Neutral is almost entirely a-posteriori on a Romance basis, generally following French, sometimes in a somewhat slavish and unintelligent fashion, as in the use of *eske* as an interrogative particle, and of *leplu* as the mark of the superlative, although there is no definite article in Idiom Neutral. On the whole, there can be no doubt that Idiom Neutral is the simplest language that has yet been devised, and the most easily understood by any educated European; those who take several days to learn to read Esperanto find that they can read Idiom Neutral in as many minutes. Compare the following extract from a letter written by a Norwegian doctor to a colleague in Russia with the specimens given under the headings VOLAPÜK and ESPERANTO:—

> Idiom Neutral es usabl no sole pro skribasion, ma et pro perlasion; sikause in kongres sekuant internasional de medisinisti mi av intension usar ist idiom pro mie raport di maladitet "lupus," e mi esper esar komprended per omni medisinisti present.

But the construction of such languages is by no means so easy as would at first sight appear. All a-posteriori systems are liable to various defects, the inevitable result of the conflict between their old and new elements, and the difficulties and embarrassments of an arbitrary selection. Thus Idiom Neutral, which ought to be the most perfect of these attempts, admits homonyms (*kar*="carriage" and "dear," adj.), alternative forms such as *sientik* and *sientifik*, and ambiguities such as *filosofi*, which is both an abstract noun and the plural of *filosof*, "philosopher." Esperanto is better constructed in this respect; but it often only avoids confusion by arbitrary alteration of its words.

Another difficulty is that of national associations. No one likes to have his own language travestied. Thus Esperanto, which looks like bad Italian, is on that account less popular among the speakers of Romance languages (except in France) than elsewhere. It is a significant fact that none of the inventors of these languages base them on their native speech.

And then, these languages are not international after all. A really international language ought to be as acceptable to speakers of Arabic, Chinese or Japanese as to a European. Even from a European point of view they are not wholly international.

And they are not independent languages: they are only parasites—sickly parasites—on other languages. Their vocabularies are liable to incessant change and addition; and the meanings of their words are liable to be misunderstood in different ways by speakers of different languages. It is no answer to say that they are only auxiliary languages, which are not intended to supplant the national languages; for every artificial language must, at first at least, content itself with this rôle.

It is evident that the a-priori is the only basis which is really international, neutral and independent. And it is a significant fact that the earlier attempts were all a-priori. But all these attempts—beginning with Dalgarno's *Ars signorum* (1661) and Wilkins' well-known *Real Character* (1668)—have been failures. They were failures because the ground was not sufficiently prepared. A great part of Wilkins' folio is taken up with attempts to lay the necessary foundations. He saw—what none of his successors has yet seen—the necessity of a knowledge of the formation of sounds and the principles of their representation; and his sketch of phonetics is still valuable. His classification of the ideas expressed by language is an attempt to do what was afterwards done by Linnaeus and his successors and by Roget in the *Thesaurus of English Words and Phrases*.

Wilkins was only a dilettante, because the greater part of science was then only in the dilettante stage. We have a right now to demand that our universal language shall be the work, not of dilettantes, but of experts: that is, of trained philologists.

Now that the ground has been prepared—now that the principles of linguistic science are the common property of the educated world, and the chief languages of the earth have been made accessible, and whole families of languages have been included in comparative grammars and dictionaries—we have a right to ask that no one shall henceforth come before the public as the inventor of a new language till he has made himself acquainted with those branches of the science of language which form the natural foundation for such a work.

The first step in constructing an artificial language is to settle what sounds it is to contain. The answer, of course, is: the easiest. To the man in the street the only easy sounds are those of his own language. The question, which sounds are easiest in themselves, can only be settled by means of general practical phonetics, which often leads to conclusions directly contradicting popular prejudices. Then comes the question, how these sounds are to be written. It would be an easy matter to re-write Esperanto in the alphabet, say, of the International Phonetic Association, instead of its present antiquated and unpractical orthography; but the mere fact that the author of Esperanto did not take the trouble to make himself acquainted with the principles of phonetics and sound-representation before attacking so stupendous a problem makes us sceptical of his competence for the rest of his task.

The grammar of the new language must not be a mere imitation of that of Latin or an ordinary modern European language: it must be based on first principles. The inventor, after carefully considering the grammatical structure of languages of different types, must not only pick out what is best in each, but must consider whether he cannot do still better.

As regards the vocabulary, we are told that the inventor of Esperanto in his first attempts to construct a new language began with forming his roots by arbitrary combinations of letters, but failed to arrive at any satisfactory result in this way. It is, in fact, impossible to construct words arbitrarily: the attempt to do so inevitably results in distorted reminiscences of words already familiar to the experimenter. There are only two ways in which it is possible to construct an a-priori vocabulary: the *schematic* and the *symbolic*. The systems of Dalgarno and Wilkins belong to the former class. Wilkins's vocabulary is founded on a classification of all ideas under 40 categories, each expressed by the combination of a consonant and a vowel in a certain arbitrary (partly alphabetic) order. Thus *de* signifies "element," from which is formed the first subdivision *deb*, "fire," from which, again, is formed the further subdivision *deba*, "flame." The objections to this method are that there is no direct connexion between the words and their meanings, and that it involves not only knowing by heart the endless categories, and subdivisions of these, on which it is founded, but also their order and number—a task beyond any human memory. Even if it were not, no one would care to learn a classification which the advance of knowledge might render obsolete in a few years—together with the language itself.

The symbolic method, on the other hand, aims at establishing a direct association between the word and the idea it expresses, as is already the case, to some extent, in existing languages. Thus we have imitative words such as *cuckoo*, interjectional words, such as *hush*, and specially symbolic or gesture-words, such as *thou*, *me*, *mother*.

The difficulty in carrying out the symbolic principle is that the associations are few and often vague. But the material is sufficient, if handled in a practical spirit. However far removed from theoretical perfection the result might be, it would have at least two advantages:—(1) There would be none of that waste of material which is common to all natural languages and those artificial ones which are founded on them. (2) This would result in a brevity far exceeding that of the opposite type of language.

A well constructed a-priori language would, indeed, have many uses far transcending those of a rough-and-ready language of the Esperanto type. It would be more than a mere auxiliary language. It would be useful not only as a means of international communication, but as a means of expression superior in most respects to the native language: as an aid, not a hindrance, to accurate thought and scientific exactitude. It would repel by its unfamiliarity. It would have to be learnt; and it would not be learnt without effort, for its use would imply accurate thought and emancipation from the associations of the native language. But the difficulties would be impartially distributed: the new language would not necessarily be more difficult for the speakers of one language than for those of another.

The obstacles to the construction and adoption of an a-priori language are many; and meanwhile the need is pressing. So it is possible that the problem may be partially solved in the near future by the provisional adoption of an adapted language. Although such a language would not be very acceptable to non-European nations, it would still be easier to them than any European language. But whatever language may be adopted, it must be imposed by a competent tribunal, which, as in all analogous cases, will refuse to consider any scheme which has not been worked out by experts—that is, by scientific linguists. (H. Sw.)

UNIVERSITIES.[1] The medieval Latin term *universitas* (from which the English word "university" is derived) was originally employed to denote any community or corporation regarded under its collective aspect. When used in its modern sense, as denoting a body devoted to learning and education, it required the addition of other words in order to complete the definition—the most frequent form of expression being "universitas magistrorum et scholarium" (or "discipulorum"). In the course of time, probably towards the latter part of the 14th century, the term began to be used by itself, with the exclusive meaning of a community of teachers and scholars whose corporate existence had been recognized and sanctioned by civil or ecclesiastical authority or by both. But the more ancient and customary designation of such communities in medieval times (regarded as places of instruction) was "studium" (and subsequently "studium generale"), a term implying a centre of instruction for all.[2] The expressions "universitas studii" and "universitatis collegium" are also occasionally to be met with in official documents.

It is necessary, however, to bear in mind, on the one hand, that a university often had a vigorous virtual existence long before it obtained that legal recognition which entitled it, technically, to take rank as a "studium generale," and, on the other hand, that hostels, halls and colleges, together with complete courses in all the recognized branches of learning, were by no means necessarily involved in the earliest conception of a university. The university, in its earliest stage of development, appears to have been simply a scholastic gild—a spontaneous combination, that is to say, of teachers or scholars, or of both combined, and formed probably on the analogy of the trades gilds, and the gilds of aliens in foreign cities, which, in the course of the 13th and 14th centuries, are to be found springing up in most of the great European centres. The design of these organizations, in the first instance, was little more than that of securing mutual protection—for the craftsman, in the pursuit of his special calling; for the alien, as lacking the rights and privileges inherited by the citizen. And so the university, composed as it was to a great extent of students from foreign countries, was a combination formed for the protection of its members from the extortion of the townsmen and the other annoyances incident in medieval times to residence in a foreign state. It was a first stage of development in connexion with these primary organizations, when the chancellor of the cathedral, or some other authority, began, as we shall shortly see, to accord to other masters permission to open other schools than the cathedral school in the neighbourhood of his church; a further stage was reached when a licence to teach—granted only after a formal examination—empowered a master to carry on his vocation at any similar centre that either already existed or might afterwards be formed throughout Europe—"facultas ubique docendi." It was a still further development when it began to be recognized that, without a licence from either pope, emperor or king, no "studium generale" could be formed possessing this right of conferring degrees, which originally meant nothing more than licences to teach.

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[1] It is the design of the present article to exhibit the universities in their general historical development; more detailed information respecting the *present condition* of each will be found in the separate articles under topographical headings.

[2] Denifle, *Die Universitäten des Mittelalters*, i. 1–29.

Meaning of "studium generale."

Origin of the term "university."

In the north of Europe such licences were granted by the Chancellor Scholasticus, or some other officer of a cathedral church; in the south it is probable that the gilds of masters (when these came to be formed) were at first free to grant their own licences, without any ecclesiastical or other supervision. But in all cases such permissions were of a purely local character. Gradually, however, towards the end of the 12th century, a few great schools claimed from the excellence of their teaching to be of more than merely local importance. Practically a doctor of Paris or Bologna would be allowed to teach anywhere; while those great schools began to be known as *studia generalia*, *i.e.* places resorted to by scholars from all parts. Eventually the term came to have a more definite and technical signification. The emperor Frederick II. set the example of attempting to confer by an authoritative bull upon his new school at Naples the prestige which the earlier *studia* had acquired by reputation and general consent. In 1229 Gregory IX. did the same for Toulouse, and in 1233 added to its original privileges a bull by which any one who had been admitted to the doctorate or mastership in that university should have the right to teach anywhere without further examination. Other *studia generalia* were subsequently founded by papal or imperial bulls; and in 1292 even the oldest universities, Paris and Bologna, found it desirable to obtain similar bulls from Nicolas IV. From this time the notion began to prevail among the jurists that the essence of the *studium generale* was the privilege of conferring the *jus ubicunque docendi*, and that no new *studium* could acquire that position without a papal or imperial bull. By this time, however, there were a few *studia generalia* (*e.g.* Oxford) whose position was too well established to be seriously questioned, although they had never obtained such a bull; these were held to be *studia generalia ex consuetudine*. A few Spanish universities founded by royal charter were held to be *studia generalia respectu regni*. The word *universitas* was originally applied only to the scholastic gild (or gilds) within the *studium*, and was at first not used absolutely; the phrase was always *universitas magistrorum*, or *scholarium* or *magistrorum et scholarium*. By the close of the medieval period, however, the distinction between the terms *studium generale* and *universitas* was more or less lost sight of, and in Germany especially the term *universitas* began to be used alone.[1]

History of learning before the university era.

In order, however, clearly to understand the conditions under which the earliest universities came into existence, it is necessary to take account, not only of their organization, but also of their studies, and to recognize the main influences which, from the 6th to the 12th century, served to modify both the theory and the practice of education. In the former century, the schools of the Roman empire, which had down to that time kept alive the traditions of pagan education, had been almost entirely swept away by the barbaric invasions. The latter century marks the period when the institutions which supplied their place—the episcopal schools attached to the cathedrals and the monastic schools—attained to their highest degree of influence and reputation. Between these and the schools of the empire there existed an essential difference, in that the theory of education by which they were pervaded was in complete contrast to the simply secular theory of the schools of paganism. The cathedral school taught only what was supposed to be necessary for the education of the priest; the monastic school taught only what was supposed to be in harmony with the aims of the monk. But between the pagan system and the Christian system by which it had been superseded there yet existed something that was common to both: the latter, even in the narrow and meagre instruction which it imparted, could not altogether dispense with the ancient text-books, simply because there were no others in existence. Certain treatises of Aristotle, of Porphyry, of Martianus Capella and of Boetius continued consequently to be used and studied; and in the slender outlines of pagan learning thus still kept in view, and in the exposition which they necessitated, we recognize the main cause which prevented the thought and literature of classic antiquity from falling altogether into oblivion.

Revival in time of Charlemagne.

Under the rule of the Merovingian dynasty even these scanty traditions of learning declined throughout the Frankish dominions; but in England the designs of Gregory the Great, as carried out by Theodorus, Bede and Alcuin, resulted in a great revival of education and letters. The influence of this revival extended in the 8th and 9th centuries to Frankland, where Charlemagne, advised and aided by Alcuin, effected a memorable reformation, which included both the monastic and the cathedral schools; while the school attached to the imperial court, known as the Palace School, also became a famous centre of learned intercourse and instruction.

General causes of formation of first universities.

But the activity thus generated, and the interest in learning which it served for a time to diffuse, well-nigh died out amid the anarchy which characterizes the 10th century in Latin Christendom, and it is at least questionable whether any real connexion can be shown to have existed between this earlier revival and that remarkable movement in which the university of Paris had its origin. On the whole, however, a clearly traced, although imperfectly continuous, succession of distinguished teachers has inclined the majority of those who have studied this obscure period to conclude that a certain tradition of learning, handed down from the famous school over which Alcuin presided at the great abbey of St Martin at Tours, continued to survive, and became the nucleus of the teaching in which the university took its rise. But, in order adequately to explain the remarkable development and novel character which that teaching assumed in the course of the 12th and 13th centuries, it is necessary to take account of the operation of certain more general causes to which the origin of the great majority of the earlier universities may in common unhesitatingly be referred. These causes are—(1) the introduction of new subjects of study, as embodied in a new or revived literature; (2) the adoption of new methods of teaching which were rendered necessary by the new studies; (3) the growing tendency to organization which accompanied the development and consolidation of the European nationalities.

Rise of university of Salerno.

That the earlier universities took their rise to a great extent in endeavours to obtain and provide instruction of a kind beyond the range of the monastic and cathedral schools appears to be very generally admitted, but with respect to the origin of the first European university—that of Salerno in Italy, which became known as a school of medicine as early as the 9th century—the circumstances are pronounced by a recent investigator to be "veiled in impenetrable obscurity."[2] One writer[3] derives its origin from an independent tradition of classical learning which continued to exist in Italy down to the 10th century. Another writer[4] maintains that it had its beginning in the teaching at the famous Benedictine monastery of Monte Cassino, where the study of medicine was undoubtedly pursued. But the most authoritative researches point to the conclusion that the medical system of Salerno was originally an outcome of the Graeco-Roman tradition of the old Roman world, and the Arabic medicine was not introduced till the highest fame of the Civitas Hippocratica was passing away. It *may* have been influenced by the late survival of the Greek language in southern Italy, though this cannot be proved. In the first half of the 9th century the emperor at Constantinople sent to the Caliph

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[1] Denifle i. 34–39.

[2] Rashdall, *Universities of Europe in the Middle Ages*, i. 76.

[3] De Renzi, *Storia Documentata della Scuola Medica di Salerno* (ed. 1857), p. 145.

[4] Puccinotti, *Storia della Medicina*, i. 317–26.

Mamoun at Bagdad a considerable collection of Greek manuscripts, which seems to have given the earliest impulse to the study of the Hellenic pagan literature by the Saracens. The original texts were translated into Arabic by Syrian Christians, and these versions were, in turn, rendered into Latin for the use of teachers in the West. Of the existence of such versions we have evidence, according to Jourdain,[1] long prior to the time when Constantine the African (d. 1087) began to deliver his lectures on the science at Salerno, although these early versions have since altogether disappeared. Under his teaching the fame of Salerno as a medical school became diffused all over Europe; it was distinguished also by its catholic spirit, and, at a time when Jews were the object of religious persecution throughout Europe, members of this nationality were to be found both as teachers and learners at Salerno. Ordericus Vitalis, who wrote in the first half of the 12th century, speaks of it as then long famous. In 1231 it was constituted by the emperor Frederick II. the only school of medicine in the kingdom of Naples.

Bologna.

Decretum of Gratian and the canon law.

Foreign students at Bologna

The great revival of legal studies which took place at Bologna about the year 1000 had also been preceded by a corresponding activity elsewhere—at Pavia by a famous school of Lombard law, and at Ravenna by a yet more important school of Roman law. And in Bologna itself we have evidence that the Digest was known and studied before the time of Irnerius (1100–30), a certain Pepo being named as lecturing on the text about the year 1076. The traditional story about the "discovery" of the Pandects at Amalfi in 1135 was disproved even before the time of Savigny. Schulte has shown that the publication of the *Decretum* of Gratian must be placed earlier than the traditional date, *i.e.* not later than 1142. This instruction again was of a kind which the monastic and cathedral schools could not supply, and it also contributed to meet a new and pressing demand. The neighbouring states of Lombardy were at this time increasing rapidly in population and in wealth; and the greater complexity of their political relations, their growing manufactures and commerce, demanded a more definite application of the principles embodied in the codes that had been handed down by Theodosius and Justinian. But the distinctly secular character of this new study, and its close connexion with the claims and prerogatives of the Western emperor, aroused at first the susceptibilities of the Roman see, and for a time Bologna and its civilians were regarded by the church with distrust and even with alarm. These sentiments were not, however, of long duration. In the year 1151 the appearance of the *Decretum* of Gratian, largely compiled from spurious documents, invested the studies of the canonist with fresh importance; and numerous decrees of past and almost forgotten pontiffs now claimed to take their stand side by side with the enactments contained in the *Corpus Juris Civilis*. They constituted, in fact, the main basis of those new pretensions asserted with so much success by the popedom in the course of the 12th and 13th centuries. It was necessary, accordingly, that the *Decretum* should be known and studied beyond the walls of the monastery or the episcopal palace, and that its pages should receive authoritative exposition at some common centre of instruction. Such a centre was to be found in Bologna. The needs of the secular student and of the ecclesiastical student were thus brought for a time into accord, and from the days of Irnerius down to the close of the 13th century we have satisfactory evidence that Bologna was generally recognized as the chief school both of the civil and the canon law.[2] It has, indeed, been asserted that university degrees were instituted there as early as the pontificate of Eugenius III. (1145–53), but the statement rests on no good authority, and is in every way improbable. There is, however, another tradition which is in better harmony with the known facts. When Barbarossa marched his forces into Italy on his memorable expedition of 1155, and reasserted those imperial claims which had so long lain dormant, the professors of the civil law and their scholars, but more especially the foreign students, gathered round the Western representative of the Roman Caesars, and besought his intervention in their favour in their relations with the citizens of Bologna. A large proportion of the students were probably from Germany; and it did not escape Frederick's penetration that the civilian might prove an invaluable ally in the assertion of his imperial pretensions. He received the suppliants graciously, and, finding that their grievances were real, especially against the landlords in whose houses they were domiciled, he granted the foreign students substantial protection, by conferring on them certain special immunities and privileges (November 1158).[3] These privileges were embodied in the celebrated *Authentica, Habita*, in the *Corpus Juris Civilis* of the empire (bk. iv. tit. 13), and were eventually extended so as to include all the other universities of Italy. In them we may discern the precedent for that state protection of the university which, however essential at one time for the security and freedom of the teacher and the taught, has been far from proving an unmixed benefit—the influence which the civil power has thus been able to exert being too often wielded for the suppression of that very liberty of thought and inquiry from which the earlier universities derived in no small measure their importance and their fame.

The "universities" at Bologna.

But, though there was a flourishing school of study, it is to be observed that Bologna did not possess a university so early as 1158. Its first university was not constituted until the close of the 12th century. The "universities" at Bologna were, as Denifle has shown, really student gilds, formed under influences quite distinct from the protecting clauses of the *Authentica*, and suggested, as already noted, by the precedent of those foreign gilds which, in the course of the 12th century, began to rise throughout western Europe. These were originally only two in number, the *Ultramontani* and the *Citramontani*, and arose out of the absolute necessity, under which residents in a foreign city found themselves, of obtaining by combination that protection and those rights which they could not claim as citizens. These societies were modelled, Denifle considers, not on the trade gilds which rose in Bologna in the 13th century, but on the Teutonic gilds which arose nearly a century earlier in north-western Europe, being essentially "spontaneous confederations of aliens on a foreign soil." Originally, they did not include the native student element and were composed exclusively of students in law.

Their democratic character.

Other similar communities in Italy.

The power resulting from this principle of combination, when superadded to the privileges conferred by Barbarossa, gave to the students of Bologna a superiority of which they were not slow to avail themselves. Under the leadership of their rector, they extorted from the citizens concessions which raised them from the condition of an oppressed to that of a specially privileged class. The same principle, when put in force against the professors, reduced the latter to a position of humble deference to the very body whom they were called upon to instruct, and imparted to the entire university that essentially democratic character by which it was afterwards distinguished. It is not surprising that such advantages should have led to an imitation and extension of the principle by which they were obtained. Denifle considers that the "universities" at Bologna were at one time certainly more than four in number, and we know that the Italian students alone were subdivided into two—the Tuscans and the Lombards. In the centres formed by secession from the parent body a like subdivision took place. At Vercelli there were four *universitates*, composed respectively of Italians, English, Provençals and Germans; at Padua there were similar divisions into Italians,

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[1] *Sur l'âge et l'origine des traductions latines*, &c., p. 225.

[2] Denifle, *Die Universitäten*, &c., i. 48.

[3] See Savigny, *Gesch. d. röm. Rechts*, iii. 152, 491–92. See also Giesebrecht, *Gesch. d. Kaiserzeit* (ed. 1880), v. 51–52. The story is preserved in a recently discovered metrical composition descriptive of the history of Frederick I.; see *Sitzungsberichte d. Bairisch. Akad. d. Wissenschaft, Phil.-Hist. Klasse* (1879), ii. 285. Its authenticity is called in question by Denifle, but it would seem to be quite in harmony with the known facts.

French (*i.e. Francigenae*, comprising both English and Normans), Provençals (including Spaniards and Catalans). When, accordingly, we learn from Odofred that in the time of the eminent jurist Azo, who lectured at Bologna about 1200, the number of the students there amounted to some ten thousand, of whom the majority were foreigners, it seems reasonable to conclude that the number of these confederations of students (*societates scholarium*) at Bologna was yet greater. It is certain that they were not formed simultaneously, but, similarly to the free gilds, one after the other—the last in order being that of the Tuscans, which was composed of students from Tuscany, the Campagna and Rome. Nor are we, again, to look upon them as in any way the outcome of those democratic principles which found favour in Bologna, but rather as originating in the traditional home associations of the foreign students, fostered, however, by the peculiar conditions of their university life. As the Tuscan division (the one least in sympathy, in most respects, with Teutonic institutions) was the last formed, so, Denifle conjectures, the German "university" may have introduced the conception which was successively adopted by the other nationalities.

The rector.

In marked resemblance to the gilds, these confederations were presided over by a common head, the "rector scholarium," an obvious imitation of the "rector societatum" or "artium" of the gild, but to be carefully distinguished from the "rector scholarum" or director of the studies, with whose function the former officer had, at this time, nothing in common. Like the gilds, again, the different nations were represented by their "consiliarii," a deliberative assembly with whom the rector habitually took counsel.

Mature age of the students.

While recognizing the essentially democratic character of the constitution of these communities, it is to be remembered that the students, unlike the majority at Paris and later universities, were mostly at this time of mature years. As the civil law and the canon law were at first the only branches of study, the class whom they attracted were often men already filling office in some department of the church or state—archdeacons, the heads of schools, canons of cathedrals, and like functionaries forming a considerable element in the aggregate. It has been observed, indeed, that the permission accorded them by Frederick I. of choosing, in all cases of dispute, their own tribunal, thus constituting them, to a great extent, *sui juris*, seems to presuppose a certain maturity of judgment among those on whom this discretionary power was bestowed.

Innocent IV., in according his sanction to the new statutes of the university in 1253, refers to them as drawn up by the "rectores et universitas scholarium Bononiensium."

Formation of the universitates.

Faculties instituted.

About the year 1200 were formed the two faculties of medicine and philosophy (or "the arts"[1]), the former being somewhat the earlier. It was developed, as that of the civil law had been developed, by a succession of able teachers, among whom Thaddeus Alderottus was especially eminent. The faculty of arts, down to the 14th century, scarcely attained to equal eminence. The teaching of theology remained for a long time exclusively in the hands of the Dominicans; and it was not until the year 1360 that Innocent VI. recognized Bologna as a "studium generale" in this branch—in other words, as a place of theological education for all students, with the power of conferring degrees of universal validity.

Account of the university by Anglicus.

In the year 1371 the cardinal legate, Anglicus, compiled, as chief director of ecclesiastical affairs in the city, an account of the university, which he presented to Urban V. The information it supplies is, however, defective, owing to the fact that only the professors who were in receipt of salaries from the municipality are mentioned. Of these there were twelve of civil law and six of canon law; three of medicine, three of practical medicine and one of surgery; two of logic, and one each of astrology, rhetoric and notarial practice. The professors of theology, who, as members of the religious orders, received no state remuneration, are unmentioned. The significance of the term "college," as first employed at Bologna, differed, like that of "university," from that which it subsequently acquired. The *collegia* of the doctors no more connoted the idea of a place of residence than did the *universitates* of the students. There were the College of Doctors of Civil Law, the College of Doctors of Canon Law, the College of Doctors in Medicine and Arts and (from 1352) the College of Doctors in Theology. Though the professors were largely dependent upon the students, they had separate organizations of their own; the college alone was concerned in the conferment of degrees. Each faculty was therefore at Bologna entirely independent of every other (except for the union of medicine and arts): the only connecting link between them was the necessity of obtaining their degrees (after 1219) from the same chancellor, the archdeacon of Bologna. The decline in the reputation of the *studium* from about 1250 was largely due to the successful efforts of the doctors to exclude all but Bolognese citizens from membership of the doctoral colleges (which alone possessed the valuable "right of promotion"), and from the more valuable salaried chairs. They even attempted and partially succeeded in restricting these privileges to members of their own families.

The universities at Bologna.

The earliest colleges.

Colleges as places of residence for students existed, however, at Bologna at a very early date, but it is not until the 14th century that we find them possessing any organization; and the humble *domus*, as it was termed, was at first designed solely for necessitous students, not being natives of Bologna. A separate house, with a certain fund for the maintenance of a specified number of scholars, was all that was originally contemplated. Such was the character of that founded by Zoen, bishop of Avignon, in February 1256 (O.S.), the same month and year, it is to be noted, in which the Sorbonne was founded in Paris. It was designed for the maintenance of eight scholars from the province of Avignon, under the supervision of three canons of the church, maintaining themselves in the university. Each scholar was to receive 24 Bolognese lire annually for five years. The college of Brescia was founded in 1326 by William of Brescia, archdeacon of Bologna, for poor foreign students without distinction as to nationality. The Spanish college, founded in 1364, for twenty-four Spanish scholars and two chaplains, is noted by Denifle as the one college founded in medieval times which still exists on the Continent.

Origin of university of Paris.

Study of logic.

Of the general fact that the early universities rose in response to new wants the commencement of the university of Paris supplies us with a further illustration. The study of logic, which, prior to the 12th century, was founded exclusively on one or two meagre compends, received about the year 1100, on two occasions, a powerful stimulus—in the first instance, from the memorable controversy between Lanfranc and Berengar; in the second, from the no less famous controversy between Anselm and Roscellinus. A belief sprang up that an intelligent apprehension of spiritual truth depended on a correct use of prescribed methods of argumentation. Dialectic was looked upon as "the science of sciences"; and when, somewhere in the first decade of the 12th century, William of Champeaux opened in Paris a school for the more advanced study of dialectic as an art, his teaching was attended with marked success. Among his pupils was Abelard, in whose hands the study made a yet more notable advance; so that, by the middle of the century, we find John of Salisbury, on returning from the French capital to England, relating with astonishment, not unmingled with contempt, how all learned Paris had gone well-nigh mad in its pursuit and practice of the new dialectic.

Teaching of Abelard.

Abelard taught in the first instance at the cathedral school at Notre Dame, and subsequently at the schools on the Montagne Ste Geneviève, of which he was the founder, and where he imparted to logic its new development. But in 1147 the secular canons of Ste Geneviève

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[1] The arts course of study was that represented by the ancient *trivium* (*i.e.* grammar, logic and rhetoric) and the *quadrivium* (*i.e.* arithmetic, geometry, music and astronomy) as handed down from the schools of the Roman empire. See J. B. Mullinger's *History of the University of Cambridge*, i. 24–27.

Study of theology.

Lombard's "Sentences."

gave place to canons regular from St Victor; and henceforth the school on the former foundation was merely a school for the teaching of theology, and was attended only by the members of the house.[1] The schools out of which the university arose were those attached to the cathedral on the Île de la Cité, and presided over by the chancellor—a dignitary who must be carefully distinguished from the later chancellor of the university. For a long time the teachers lived in separate houses on the island, and it was only by degrees that they combined themselves into a society, and that special buildings were constructed for their class-work. But the flame which Abelard's teaching had kindled was not destined to expire. Among his pupils was Peter Lombard, who was bishop of Paris in 1159, and widely known to posterity as the compiler of the famous volume of the *Sentences*. The design of this work was to place before the student, in as strictly logical a form as practicable, the views (*sententiae*) of the fathers and all the great doctors of the church upon the chief and most difficult points in the Christian belief. Conceived with the purpose of allaying and preventing, it really stimulated, controversy. The logicians seized upon it as a great storehouse of indisputable major premises, on which they argued with renewed energy and with endless ingenuity of dialectical refinement; and upon this new compendium of theological doctrine, which became the text-book of the middle ages, the schoolmen, in their successive treatises *Super sententias*, expended a considerable share of that subtlety and labour which still excite the astonishment of the student of metaphysical literature.

Rise of other early universities.

It is in these prominent features in the history of these early universities—the development of new methods of instruction concurrently with the appearance of new material for their application—that we find the most probable solution of the question as to how the university, as distinguished from the older cathedral or monastic schools, was first formed. In a similar manner, it seems probable, the majority of the earlier universities of Italy—Reggio, Modena, Vicenza, Padua and Vercelli—arose, for they had their origin independently alike of the civil and the papal authority. Instances, it is true, occur, which cannot be referred to this spontaneous mode of growth. The university of Naples, for example, was founded solely by the fiat of the emperor Frederick II. in the year 1224; and, if we may rely upon the documents cited by Denifle, Innocent IV. about the year 1245 founded in connexion with the curia a "studium generale,"[2] which was attached to the papal court, and followed it when removed from Rome, very much as the Palace School of Charles the Great accompanied that monarch on his progresses.

Early organization of university of Paris.

As the university of Paris became the model, not only for the universities of France north of the Loire, but also for the great majority of those of central Europe as well as for Oxford and Cambridge, some account of its early organization will here be indispensable. Such an account is rendered still further necessary by the fact that the recent and almost exhaustive researches of Denifle, the Dominican father, have led him to conclusions which on some important points run altogether counter to those sanctioned by the high authority of Savigny.

Inception.

The bachelor of arts.

The original university, as already stated, took its rise entirely out of the movement carried on by teachers on the island, who taught by virtue of the licence conferred by the chancellor of the cathedral. In the second decade of the 13th century, it is true, we find masters withdrawing themselves from his authority by repairing to the left bank of the Seine and placing themselves under the jurisdiction of the abbot of the monastery of Ste Geneviève; and in 1255 this dignitary is to be found appointing a chancellor whose duty it should be to confer *licentia docendi* on those candidates who were desirous of opening schools in that district. But it was around the bestowal of this licence by the chancellor of Notre Dame, on the Île de la Cité, that the university of Paris grew up. It is in this licence that the whole significance of the master of arts degree is contained; for what is technically known as admission to that degree was really nothing more nor less than receiving the chancellor's permission to "incept," and by "inception" was implied the master's formal entrance upon, and commencement of, the functions of a duly licensed teacher, and his recognition as such by his brothers in the profession. The previous stage of his academic career, that of bachelordom, had been one of apprenticeship for the mastership; and his emancipation from this state was symbolized by placing the magisterial cap (*biretta*) upon his head, a ceremony which, in imitation of the old Roman ceremony of manumission, was performed by his former instructor, "under whom" he was said to incept. He then gave a formal inaugural lecture, and, after this proof of magisterial capacity, was welcomed into the society of his professional brethren with set speeches, and took his seat in his master's chair.

The university formed.

This community of teachers of recognized fitness did not in itself suffice to constitute a university, but some time between the years 1150 and 1170, the period when the *Sentences* of Peter Lombard were given to the world, the university of Paris came formally into being. Its first written statutes were not, however, compiled until about the year 1208, and it was not until long after that date that it possessed a "rector." Its earliest recognition as a legal corporation belongs to about the year 1211, when a brief of Innocent III. empowered it to elect a proctor to be its representative at the papal court. By this permission it obtained the right to sue or to be sued in a court of justice as a corporate body.

Difficulties of first development.

This papal recognition was, however, very far from implying the episcopal recognition, and the earlier history of the new community exhibits it as in continual conflict alike with the chancellor, the bishop and the cathedral chapter of Paris, by all of whom it was regarded as a centre of insubordination and doctrinal licence. Had it not been, indeed, for the papal aid, the university would probably not have survived the contest; but with that powerful assistance it came to be regarded as the great Transalpine centre of orthodox theological teaching. Successive pontiffs, down to the great schism of 1378, made it one of the foremost points of their policy to cultivate friendly and confidential relations with the authorities of the university of Paris, and systematically to discourage the formation of theological faculties at other centres. In 1231 Gregory IX., in the bull *Parens Scientiarum*, gave full recognition to the right of the several faculties to regulate and modify the constitution of the entire university—a formal sanction which, in Denifle's opinion, rendered the bull in question the Magna Charta of the university.

The "nations."

In comparing the relative antiquity of the universities of Paris and Bologna, it is difficult to give an unqualified decision. The university of masters at the former was probably slightly anterior to the university of students at the latter; but there is good reason for believing that Paris, in reducing its traditional customs to statutory form, largely availed itself of the precedents afforded by the already existing code of the Transalpine centre. The fully developed university was divided into four faculties—three "superior," viz. those of theology, canon law and medicine, and one "inferior," that of arts, which was divided into four "nations." These nations, which included both professors and scholars, were—(1) the French nation, composed, in addition to the native element, of Spaniards, Italians and Greeks; (2) the Picard nation, representing the students from the north-east and from the Netherlands; (3) the Norman nation; (4) the English nation, comprising, besides students from the provinces under English rule, those from England, Ireland, Scotland and

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[1] The view of Thurot (*De l'organisation de l'enseignement dans l'université de Paris*, pp. 4–7) that the university arose out of a combination of these several schools is rejected by Denifle (see *Die Universitäten*, &c., i. 653–94).

[2] Where the words *studium generale* are placed within marks of quotation they occur in the original charter of foundation of the university referred to.

Germany. The head of each faculty was the dean; the head of each nation was the proctor. The rector, who in the first instance was head of the faculty of arts, by whom he was elected, was eventually head of the whole university. In congregations of the university matters were decided by a majority of faculties; the vote of the faculty of arts was determined by a majority of nations. The chancellor of Notre Dame, whose functions were now limited to the conferment of the licence, stood as such outside the university or gild altogether, though as a doctor of theology he was always a member of that faculty. Only "regents," that is, masters actually engaged in teaching, had any right to be present or to vote in congregations. Neither the entire university nor the separate faculties had thus, it will be seen, originally a common head, and it was not until the middle of the 14th century that the rector became the head of the collective university, by the incorporation under him, first, of the students of the canon law and of medicine (which took place about the end of the 13th century), and, secondly, of the theologians, which took place about half a century later.

The Sorbonne.

In the course of the 16th and 17th centuries this democratic constitution of the middle ages was largely superseded by the growth of a small oligarchy of officials. The tribunal of the university—the rector, deans and proctors—came to occupy a somewhat similar position to the old "Hebdomadal Board" of heads of colleges at Oxford and the *Caput* at Cambridge. Moreover, the teaching functions of the university, or rather of the faculty of arts, owing chiefly to the absence of any endowment for the regents or teaching graduates, practically passed to the colleges. Almost as much as the English universities, Paris came to be virtually reduced to a federation of colleges, though the colleges were at Paris less independent of university authority, while the smaller colleges sent their members to receive instruction in the larger ones (*collèges de plein exercise*), which received large numbers of non-foundation members. This state of things lasted till the French Revolution swept away the whole university system of the middle ages. It may be remarked that the famous Sorbonne was really the most celebrated college of Paris—founded by Robert de Sorbonne *circa* 1257—but as this college and the college of Navarre were the only college foundations which provided for students in theology, the close connexion of the former with the faculty and the use of its hall for the disputations of that body led to the word Sorbonne becoming a popular term for the theological faculty of Paris.

Paris and Bologna contrasted.

Papal policy.

Apart from the broad differences in their organization, the very conception of learning, it will be observed, was different at Bologna from what it was at Paris. In the former it was entirely professional—designed, that is to say, to prepare the student for a definite and practical career in after life; in the latter it was sought to provide a general mental training, and to attract the learner to studies which were speculative rather than practical. In the sequel, the less mercenary spirit in which Paris cultivated knowledge added immensely to her influence and reputation, which about the middle of the 14th century may be said to have reached their apogee. It had forty colleges, governed either by secular or religious communities, and numbered among its students representatives of every country in Europe (Jourdain, *Excursions historiques*, c. xiv.). The university became known as the great school where theology was studied in its most scientific spirit; and the decisions of its great doctors upon those abstruse questions which absorbed so much of the highest intellectual activity of the middle ages were regarded as almost final. The popes themselves, although averse from theological controversies, deemed it expedient to cultivate friendly relations with a centre of such importance for the purpose of securing their influence in a yet wider field. Down therefore to the time of the great schism (1378), they at once conciliated the university of Paris and consulted what they deemed to be the interests of the Roman see, by discouraging the creation of faculties of theology elsewhere. The apparent exceptions to this policy are easily explained: the four faculties of theology which they sanctioned in Italy—Pisa (1343), Florence (1349), Bologna (1362) and Padua (1363)—were designed to benefit the Italian monasteries, by saving the monks the expense and dangers of a long journey beyond the Alps; while that at Toulouse (1229) took its rise under circumstances entirely exceptional, being designed as a bulwark against the heresy of the Albigenses. The popes, on the other hand, favoured the creation of new faculties of law, and especially of the canon law, as the latter represented the source from which Rome derived her most warmly contested powers and prerogatives. The effects of this twofold policy were sufficiently intelligible: the withholding of each charter which it was sought to obtain for a new school of theology only served to augment the numbers that flocked to Paris; the bestowal of each new charter for a faculty of law served in like manner to divert a certain proportionate number from Bologna. These facts enable us to understand how it is that, in the 13th and 14th centuries, we find, even in France, a larger number of universities created after the model of Bologna than after that of Paris.

Reggio and Modena.

Vicenza.

Padua.

In their earliest stage, however, the importance of these new institutions was but imperfectly discerned alike by the civil and the ecclesiastical power, and the first four universities of Italy, after Bologna, rose into existence, like Bologna itself, without a charter from either pope or emperor. Of these the first were those of Reggio nell' Emilia and Modena, both of which are to be found mentioned as schools of civil law before the close of the 12th century. The latter, throughout the 13th century, appears to have been resorted to by teachers of sufficient eminence to form a flourishing school, composed of students not only from the city itself, but also from a considerable distance. Both of them would seem to have been formed independently of Bologna, but the university of Vicenza was probably the outcome of a migration of the students from the former city, which took place in the year 1204. During the next fifty years Vicenza attained to considerable prosperity, and appears to have been recognized by Innocent III.; its students were divided into four nations, each with its own rector; and in 1264 it included in its professoriate teachers, not only of the civil law, but also of medicine, grammar and dialectic. The university of Padua was unquestionably the direct result of the migration in 1222 of a considerable number of students from Bologna. Some writers, indeed, have inferred that the "studium" in the latter city was transferred in its entirety, but the continued residence of a certain proportion in Bologna is proved by the fact that two years later we find them appealing to Honorius III. in a dispute with the civic authorities. In the year 1228 the students of Padua were compelled by circumstances to transfer their residence to Vercelli, and the latter city guaranteed them, besides other privileges, the right to rent no less than five hundred lodging-houses at a fixed rental for a period of eight years. At first Padua was a school only of the civil and canon law; and during the oppressive tyranny of Ezzelin (1237–60) the university maintained its existence with some difficulty. But in the latter part of the century it incorporated the faculties of grammar, rhetoric and medicine, and became known as one of the most flourishing schools of Italy, and a great centre of the Dominicans, at that time among the most active promoters of learning.

Naples.

The university of Naples was founded by the emperor Frederick II. in the year 1225, as a school of theology, jurisprudence, the arts and medicine—his design being that his subjects in the kingdom of Naples should find in the capital adequate instruction in every branch of learning, and "not be compelled in the pursuit of knowledge to have recourse to foreign nations or to beg in other lands." In the year 1231, however, he decreed that the faculty of medicine should cease to exist, and that the study should be pursued nowhere in the kingdom but at Salerno. The university never attained to much eminence, and after the death of Frederick came for a time altogether to an end, but was restored in 1258 by King Manfred. In 1266 its faculty of medicine was reconstituted, and from 1272–74 Thomas Aquinas was one of its teachers of theology. *Vercelli.* The commencement of the university of Vercelli belongs to about the year 1228; it probably included, like Naples, all the faculties, but would seem to have been regarded with little favour by the Roman See, and by the year 1372 had ceased to exist, although mention of colleges of law and medicine is to be found after that date. *Piacenza.* The two universities of Piacenza and Pavia stand in close connexion with each other. The former is noted by Denifle as the earliest in Italy which was founded by virtue of a papal charter (6th February 1248), although the scheme remained for a long time inoperative. At length, in the year 1398, the university was reconstituted by Giovanni Galeazzo Visconti, duke of Milan, who in the same year caused the university of Pavia to be transferred thither. Piacenza now became the scene of a sudden but short-lived academic prosperity. We are told of no less than twenty-seven professors of the civil law—among them the celebrated Baldus; of twenty-two professors of medicine; of professors of philosophy, astrology, grammar and rhetoric; and of lecturers on Seneca and Dante. The faculty of theology would appear, however, never to have been duly constituted, and but one lecturer in this faculty is mentioned. With the death of Galeazzo in 1402, this precarious activity came suddenly to an end; and in 1404 the university had ceased to exist. Its history is, indeed, unintelligible, unless taken in conjunction with that of Pavia. *Pavia.* Even before Irnerius taught at Bologna, Pavia had been widely known as a seat of legal studies, and more especially of the Lombard law, although the evidence is wanting which would serve to establish a direct connexion between this early school and the university which was founded there in 1361, by virtue of the charter granted by the emperor Charles IV. The new "studium" included faculties of jurisprudence, philosophy, medicine and the arts, and its students were formally taken under the imperial protection, and endowed with privileges identical with those which had been granted to Paris, Bologna, Oxford, Orleans and Montpellier; but its existence in Pavia was suddenly suspended by the removal, above noted, of its students to Piacenza. It shared again in the decline which overtook the university of Piacenza after the death of Giovanni Galeazzo, and during the period from 1404 to 1412 it altogether ceased to exist. But in October 1412 the lectures were recommenced, and the university entered upon the most brilliant period of its existence. Its professors throughout the 15th century were men of distinguished ability, attracted by munificent salaries such as but few other universities could offer, while in the number of students who resorted thither from other countries, and more especially for the study of the civil law, Pavia had no rival in Italy but Padua. *Arezzo.* Arezzo appears to have been known as a centre of the same study so early as 1215, and its earliest statutes are assigned to the year 1255. By that time it had become a school of arts and medicine also; but for a considerable period after it was almost entirely deserted, and is almost unmentioned until the year 1338, when it acquired new importance by the accession of several eminent jurists from Bologna. In May 1355 it received its charter as a *studium generale* from Charles IV. After the year 1373 the school gradually dwindled, although it did not become altogether extinct until about the year 1470. *Rome.* The university of Rome (which is to be carefully distinguished from the school attached to the Curia) owed its foundation (1303) to Boniface VIII., and was especially designed by that pontiff for the benefit of the poor foreign students sojourning in the capital. It originally included all the faculties; but in 1318 John XXII. decreed that it should possess the power of conferring degrees only in the canon and civil law. The university maintained its existence throughout the period of the residence of the popes of Avignon, and under the patronage of Leo X. could boast in 1514 of no less than eighty professors. This imposing array would seem, however, to be but a fallacious test of the prosperity of the academic community, for it is stated that many of the professors, owing to the imperfect manner in which they were protected in their privileges, were in the receipt of such insufficient fees that they were compelled to combine other employments with that of lecturing in order to support themselves. An appeal addressed to Leo X. in the year 1513 represents the number of students as so small as to be sometimes exceeded by that of the lecturers ("ut quandoque plures sint qui legant quam qui audiant"). *Perugia.* Scarcely any of the universities in Italy in the 14th century attracted a larger concourse than that of Perugia, where the study chiefly cultivated was that of the civil law. The university received its charter as a *studium generale* from Clement V. in the year 1308, but had already in 1306 been formally recognized by the civic authorities, by whom it was commended to the special care and protection of the podestà. In common with the rest of the Italian universities, it suffered severely from the great plague of 1348–49; but in 1355 it received new privileges from the emperor, and in 1362 its first college, dedicated to Gregory the Great, was founded by the bishop of Perugia. *Treviso.* The university of Treviso, which received its charter from Frederick the Fair in 1318, was of little celebrity and but short duration. *Florence.* The circumstances of the rise of the university of Florence are unknown, but the earliest evidence of academic instruction belongs to the year 1320. The dispersion of the university of Bologna, in the March and April of the following year, afforded a favourable opportunity for the creation of a *studium generale,* but the necessary measures were taken somewhat tardily, and in the meantime the greater number of the Bolognese students had betaken themselves to Siena, where for the space of three years twenty-two professors gathered round them a body of enthusiastic students. Eventually the majority returned to Bologna, and when in 1338 that city was placed under an interdict by Benedict XII. another exodus of students repaired to Pisa, which in 1343 received from Clement VI. its charter as a *studium generale.* Closed in 1406, Pisa, aided by the powerful intervention of Lorenzo de' Medici, reopened in 1473, to undergo, however, a long series of vicissitudes which at last found a termination in 1850, when its fortunes were placed on a more stable basis, and it gradually acquired the reputation of ranking among the foremost universities of a reunited Italy. The charter of foundation for Florence, on the other hand, was not granted until May 31, 1349, when Clement VI. decreed that there should be instituted a *studium generale* in theology, jurisprudence, medicine and every other recognized faculty of learning, the teachers to be professors who had obtained the degree of doctor or master either at Bologna or Paris, or "some other *studium generale* of celebrity." On the 2nd of January 1364 the university also obtained the grant of imperial privileges from Charles IV. On 14th February 1388 it adopted a body of statutes which are still extant, and afford an interesting study in connexion with the university history of the period. The university now entered upon that brilliant period in its history which was destined to so summary an extinction. "It is almost touching," says Denifle, "to note how untiringly Florence exerted herself at this period to attract as teachers to her schools the great masters of the sciences and learning." In the year 1472, however, it was decided that Florence was not a convenient seat for a university, and its students joined the throngs which repaired to the reopened halls of Pisa. *Siena.* A special interest attaches to the rise of the university of Siena, as that of one which had made good its position prior to becoming recognized either by emperor or pope. Its beginning dates from about the year 1241, but its charter was first granted by the emperor Charles IV., at the petition of the citizens, in the year 1357. It was founded as a *studium generale* in jurisprudence, the arts and medicine. The imperial charter was confirmed by Gregory XII. in 1408, and the various bulls relating to the university which he subsequently issued afford a good illustration of the conditions of academic life in these times. Residence on the part of the students appears to have been sometimes dispensed with. The bishop of Siena was nominated chancellor of the university, just as, says the bull, he had been appointed to that office by the imperial authority. The graduates were to be admitted to the same privileges as those of Bologna or Paris; and a faculty of theology was added to the curriculum of studies. **Ferrara.** The university of Ferrara owes its foundation to the house of Este—Alberto, marquess of Este, having obtained from Boniface IX. in 1391 a charter couched in terms precisely similar to those of the charter for Pisa. In the first half of the 15th century the university was adorned by the presence of several distinguished humanists, but its fortunes were singularly chequered, and it would appear for a certain period to have been altogether extinct. It was, however, restored, and became in the latter part of the century one of the most celebrated of the universities of Italy. In the year 1474 its circle of studies comprised all the existing faculties, and it numbered no less than fifty-one professors or lecturers. In later times Ferrara has been noted chiefly as a school of medicine.

Of the universities modelled on that of Paris, Oxford would appear to have been the earliest, and the manner of its development was probably similar. **Oxford.** Certain schools, opened within the precincts of the dissolved nunnery of St Frideswyde and of Oseney abbey, are supposed to have been the nucleus round which the university grew up. In the year 1133 one Robert Pullen, a theologian of considerable eminence (but whether an Englishman or a Breton is uncertain), arrived from Paris and delivered lectures on the Bible. It has been maintained, on the authority of Gervase of Canterbury, that Vacarius, a native of Lombardy, who, in the latter half of the 12th century, incurred the displeasure of King Stephen by lecturing in England on the civil law, delivered lectures at Oxford. H. S. Denifle, however (*Die Entstehung der Universitäten*, p. 241), maintains that the naming of Oxford is a gratuitous assumption on the part of Gervase, and that we have, at best, only presumptive evidence of a *studium generale* there in the 12th century. Of this, Mr Rashdall inclines to find the beginning in a migration of English students from Paris about 1167 or 1168. In the first-mentioned year we are told by John of Salisbury that "France, the mildest and most civil of nations," has "expelled her foreign scholars" (*Materials for the History of Thomas Becket*, ed. Robertson, vi. pp. 235–36). At about the same time we hear of an edict of Henry II., during the quarrel with Becket, recalling all clerks holding benefices in England (as they loved their benefices), and forbidding all clerks in England to cross the Channel (ibid. i. pp. 53–54). The archbishop himself remarks that "The king wills that all scholars shall be compelled to return to their country or be deprived of their benefices" (ibid. vii. p. 146). Paris was at this time the great place of higher education for English students. No English school was a recognized *studium generale*. Immediately after 1168 allusions to Oxford as a *studium* and a *studium generale* begin to multiply. The natural inference is that the breaking off of relations between England and Paris in 1167 or 1168 led to the growth of a *studium generale* in Oxford, formed no doubt in the first instance of seceders from Paris. In the 13th century mention first occurs of university "chests," especially the Frideswyde chest, which were benefactions designed as funds for the assistance of poor students. Halls, or places of licensed residence for students, also began to be established. In the year 1257, when the bishop of Lincoln, as diocesan, had trenched too closely on the liberties of the community, the deputies from Oxford, when preferring their appeal to the king at St Albans, could venture to speak of the university as "schola secunda ecclesiae," or second only to Paris. Its numbers about this time were probably some three thousand; but it was essentially a fluctuating body, and whenever plague or tumult led to a temporary dispersion a serious diminution in its numerical strength generally ensued for some time after. Against such vicissitudes the foundation of colleges proved the most effectual remedy. Of these the three earliest were University College, founded in 1249 by William of Durham; Balliol College, founded about 1263 by John Balliol, the father of the king of Scotland of the same name; and Merton College, founded in 1264. The last-named is especially notable as associated with a new conception of university education, namely, that of collegiate discipline for the secular clergy, instead of for any one of the religious orders, for whose sole benefit all similar foundations had hitherto been designed. The statutes given to the society by Walter de Merton are not less noteworthy, as characterized not only by breadth of conception, but also by a careful and discriminating attention to detail, which led to their adoption as the model for later colleges, not only at Oxford but at Cambridge. Of the service rendered by these foundations to the university at large we have significant proof in the fact that, although representing only a small numerical minority in the academic community at large, their members soon obtained a considerable preponderance in the administration of affairs.

The university of Cambridge, although it rose into existence somewhat later than Oxford, may reasonably be held to have had its origin in the same century. **Cambridge.** There was probably a certain amount of educational work carried on by the canons of the church of St Giles, which gradually developed into the instruction belonging to a regular *studium*. In the year 1112 the canons crossed the river and took up their residence in the new priory in Barnwell, and their work of instruction acquired additional importance. In 1209 a body of students migrated thither from Oxford. Then, as early as the year 1224, the Franciscans established themselves in the town, and, somewhat less than half a century later, were followed by the Dominicans. At both the English universities, as at Paris, the Mendicants and other religious orders were admitted to degrees, a privilege which, until the year 1337, was extended to them at no other university. Their interest in and influence at these three centres was consequently proportionably great. In the years 1231 and 1233 certain royal and papal letters afford satisfactory proof that by that time the university of Cambridge was already an organized body with a chancellor at its head—a dignitary appointed by the bishop of Ely for the express purpose of granting degrees and governing the *studium*. In 1229 and 1231 the numbers were largely augmented by migrations from Paris and from Oxford. Cambridge, however, in its turn suffered from emigration; while in the year 1261, and again in 1381, the records of the university were wantonly burnt by the townsmen. Throughout the 13th century, indeed, the university was still only a very slightly and imperfectly organized community. Its endowments were of the most slender kind; it had no systematic code for the government of its members; the supervision of the students was very imperfectly provided for. Although both Oxford and Cambridge were modelled on Paris, their higher faculties never developed the same distinct organization; and while the two proctors at Cambridge originally represented "north" and "south," the "nations" are scarcely to be discerned. An important step in the direction of discipline was, however, made in the year 1276, when an ordinance was passed requiring that every one who claimed to be recognized as a scholar should have a fixed master within fifteen days after his entry into the university. The traditional constitution of the English universities was in its origin an imitation of the Parisian chancellor, modified by the absence of the cathedral chancellor. As Oxford was not in the 12th century a bishop's see, the bishop (in 1214, if not earlier) appointed a chancellor for the express purpose of granting degrees and governing the *studium*. But he was from the first elected by the masters, and early obtained recognition as the head of the university as well as the representative of the bishop. The *procuratores* (originally also *rectores*) remained representatives of the faculty of arts and (there being at Oxford no deans) of the whole university. But the feature which most served to give permanence and cohesion to the entire community was, as at Oxford, the institution of colleges. The earliest of these was Peterhouse, first founded as a separate institution by Hugh Balsham, bishop of Ely, in the year 1284, its earliest extant code being that given in 1344 by Simon de Montacute, which was little more than a transcript of that drawn up by Walter de Merton for his scholars at Oxford. In 1323 was founded Michaelhouse, and two years later, in 1326, Edward II. instituted his foundation of "king's scholars," afterwards forming the community of King's Hall. Both these societies in the 16th century were merged in Trinity College. To these succeeded Pembroke Hall (1347) and Gonville Hall (1348). All these colleges, although by no means conceived in a spirit of hostility to either the monastic or the mendicant orders, were expressly designed for the benefit of the secular clergy. The foundation of Trinity Hall (*Aula*)[1] in 1350 by Bishop Bateman, on the other hand, as a school of civil and canon law, was probably designed to further ultramontane interests. That of Corpus Christi (1352), the outcome of the liberality of a gild of Cambridge townsmen, was conceived with the combined object of providing a house of education for the clergy, and at the same time securing the regular performance of masses for the benefit of the souls of departed members of the gild. But both Trinity Hall and Corpus Christi College, as well as Clare Hall, founded in 1359, were to a great extent indebted for their origin to the ravages caused among the clergy by the great plague of 1349. In the latter half of the same century, the coming change of feeling is shown by the fact that the chancellor was under the necessity of issuing a decree (1374) in order to protect the house of the Carmelites from molestation on the part of the students.

Returning to France, or rather to the territory included within the boundaries of modern France, we find **Montpellier.** Montpellier a recognized school of medical science as early as the 12th century. William VIII., lord of Montpellier, in the year 1181 proclaimed it a school of free resort, where any teacher of medical science, from whatever country, might give instruction. Before the end of the century it possessed also a faculty of jurisprudence, a branch of learning for which it afterwards became famed. The university of medicine and that of law continued, however, to be totally distinct bodies with different constitutions. Petrarch was sent by his father to Montpellier to study the civil law. On 26th October 1289 Montpellier was raised by Nicholas IV. to the rank of a "studium generale," a mark of favour which, in a region where papal influence was so potent, resulted in a considerable accession of prosperity. The university also now included a faculty of arts; and there is satisfactory evidence of the existence of a faculty of theology before the close of the 14th century, although not formally recognized by the pope before the year 1421. In the course of the same century several colleges for poor students were also founded. **Toulouse.** The university of Toulouse is to be noted as the first founded in any country by virtue of a papal charter. It took its rise in the efforts of Rome for the suppression of the Albigensian heresy, and its foundation formed one of the articles of the conditions of peace imposed by Louis IX. on Count Raymond of Toulouse. In the year 1233 it first acquired its full privileges as a "studium generale" by virtue of a charter given by Gregory IX. This pontiff watched over the university with especial solicitude, and through his exertions it soon became noted as a centre of that Dominican teaching which involved the extermination of the Catharists. As a school of arts, jurisprudence and medicine, although faculties of each existed, it never attained to any reputation. **Orleans.** The university of Orleans had a virtual existence as a studium generale as early as the first half of the 13th century, but in the year 1305 Clement V. endowed it with new privileges, and gave its teachers permission to form themselves into a corporation. The schools of the city had an existence long prior—as early, it is said, as the 6th century—and subsequently supplied the nucleus for the foundation of a university at Blois; but of this university no records are extant.[2] Orleans, in its organization, was modelled mainly on Paris, but its studies were complementary rather than in rivalry to the older university. The absorbing character of the study of the civil law, and the mercenary spirit in which it was pursued, had led the authorities at Paris to refuse to recognize it as a faculty. The study found a home at Orleans, where it was cultivated with an energy which attracted numerous students. In January 1235 we find the bishop of Orleans soliciting the advice of Gregory IX. as to the expediency of countenancing a study which was prohibited in Paris. Gregory decided that the lectures might be continued; but he ordered that no beneficed ecclesiastic should be allowed to devote himself to so eminently secular a branch of learning. Orleans subsequently incorporated a faculty of arts, but its reputation from this period was always that of a school of legal studies, and in the 14th century its reputation in this respect was surpassed by no other university in Europe. Prior to the 13th century it had been famed for its classical learning; and **Angers.** Angers, which received its charter at the same time, also once enjoyed a like reputation, which, in a similar manner, it exchanged for that of a school for civilians and canonists. The roll of the university forwarded in 1378 to Clement VII. contains the names of 8 professors *utriusque juris*, 2 of civil and 2 of canon law, 72 licentiates, 284 bachelors of both the legal faculties, and 190 scholars. **Avignon.** The university of Avignon was first recognized as a "studium generale" by Boniface VIII. in the year 1303, with power to grant degrees in jurisprudence, arts and medicine. Its numbers declined somewhat during the residence of the popes, owing to the counter-attractions of the "studium" attached to the Curia; but after the return of the papal court to Rome it became one of the most frequented universities in France, and possessed at one time no less than seven colleges. **Cahors.** The university of Cahors enjoyed the advantage of being regarded with especial favour by John XXII. In June 1332 he conferred upon it privileges identical with those already granted to the university of Toulouse. In the following October, again following the precedent established at Toulouse, he appointed the *scholasticus* of the cathedral chancellor of the university. In November of the same year a bull, couched in terms almost identical with those of the Magna Charta of Paris, assimilated the constitution of Cahors to that of the oldest university. The two schools in France which, down to the close of the 14th century, most closely resembled Paris were Orleans and Cahors. The civil immunities and privileges of the latter university were not, however, acquired until the year 1367, when Edward III. of England, in his capacity as duke of Aquitaine, not only exempted the scholars from the payment of all taxes and imposts, but bestowed upon them the peculiar privilege known as *privilegium fori*. Cahors also received a licence for faculties of theology and medicine, but, like Orleans, it was chiefly known as a school of jurisprudence. **Grenoble.** It was as a "studium generale" in the same three faculties that Grenoble, in the year 1339, received its charter from Benedict XII. The university never attained to much importance, and its annals are for the most part involved in obscurity. At the commencement of the 16th century it had ceased altogether to exist, was reorganized by Francis of Bourbon in 1542, and in 1565 was united to the university of Valence. **Perpignan. Orange.** The university of Perpignan, founded, according to Denifle, in 1379 by Clement VII. (although tradition had previously ascribed its origin to Pedro IV. of Aragon), and that of Orange, founded in 1365 by Charles IV., were universities only by name and constitution, their names rarely appearing in contemporary chronicles, while their very existence becomes at times a matter for reasonable doubt.

Palencia, Huesca, Lerida. To some of the earlier Spanish universities—such as Palencia, founded about the year 1214 by Alphonso VIII.; Huesca, founded in 1354 by Pedro IV.; and Lerida, founded in 1300 by James II.—the same description is applicable; and their insignificance is probably indicated by the fact that they entirely failed to attract foreign students.

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[1] *Aula* denoting the building which the "college" of scholars was to inhabit; the society continued to retain this designation in order to distinguish it from Trinity *College*, founded in 1546.

[2] See Ch. Desmaze, *L'Université de Paris* (1200–1875).

Valladolid. **Alcalà.** **Seville and Salamanca.**

Valladolid, which received its charter from Pope Clement VI. in 1346, attained, however, to great celebrity; and the foreign teachers and students frequenting the university became so numerous that in 1373 King Enriquez II. caused an enactment to be passed for securing to them the same privileges as those already accorded to the native element. But the total number of the students in 1403 was only 116, and grammar and logic, along with jurisprudence (which was the principal study), constituted the sole curriculum. In 1418, however, at the council of Constance, Martin V. not only decreed that Valladolid should take rank as a *studium generale*, but also as a "universitas theologiae," and that the new faculty should possess the same privileges as those of the same faculty in Paris. From this time accordingly the advance of the university in numbers was steady and continuous throughout the 15th century, and, along with Salamanca, it served as the model for Alcalà in 1499. The university which rose on the banks of the Henares and became famous under the direction of the eminent Ximenes, was removed in 1623 to Madrid; and for the next century and a half the foremost place among the universities of Spain must be assigned to Salamanca, to which Seville, in the south, stood in the relation of a kind of subsidiary school, having been founded in 1254 by Alphonso the Wise, simply for the study of Latin and of the Semitic languages, especially Arabic. Salamanca had been founded in 1243 by Ferdinand III. of Castile as a studium generale in the three faculties of jurisprudence, the arts and medicine. The king also extended his special protection to the students, granting them numerous privileges and immunities. Under his son Alphonso (above named) the university acquired a further development, and eventually included all the faculties save that of theology. But the main stress of its activity, as was the case with all the earlier Spanish universities until the beginning of the 15th century, was laid on the civil and the canon law. The provision for the payment of its professors was, however, at first so inadequate and precarious that in 1298 they by common consent suspended their lectures, in consequence of their scanty remuneration. A permanent remedy for this difficulty was thereupon provided, by the appropriation of a certain portion of the ecclesiastical revenues of the diocese for the purpose of augmenting the professors' salaries, and the efforts of Martin V. established a school of theology which was afterwards regarded almost as an oracle by Catholic Europe. About the year 1600 the students are shown by the matriculation books to have numbered over 5000. According to Cervantes they were noted for their lawlessness. The earliest of the numerous colleges founded at Salamanca was that of St Bartholomew, long noted for its ancient library and valuable collection of manuscripts, which now form part of the royal library in Madrid.

Coimbra.

The one university possessed by Portugal had its seat in medieval times alternately in Lisbon and in Coimbra, until, in the year 1537, it was permanently attached to the latter city. Its formal foundation took place in 1309, when it received from King Diniz a charter, the provisions of which were mainly taken from those of the charter given to Salamanca. In 1772 the university was entirely reconstituted.

Prague.

Of the universities included in the present Austrian empire, Prague, which existed as a "studium" in the 13th century, was the earliest. It was at first frequented mainly by students from Styria and Austria, countries at that time ruled by the emperor Charles IV., who was also king of Bohemia, and at whose request Pope Clement VI., on the 26th of January 1347, promulgated a bull authorizing the foundation of a "studium generale" in all the faculties. In the following year Charles himself issued a charter for the foundation. This document, which, if original in character, would have been of much interest, has but few distinctive features of its own, its provisions being throughout adapted from those contained in the charters given by Frederick II. for the university of Naples and by Conrad for Salerno—almost the only important feature of difference being that Charles bestows on the students of Prague all the civil privileges and immunities which were enjoyed by the teachers of Paris and Bologna. Charles had himself been a student in Paris, and the organization of his new foundation was modelled on that university, a like division into four "nations" (although with different names) constituting one of the most marked features of imitation. The numerous students—and none of the medieval universities attracted in their earlier history a larger concourse—were drawn from a gradually widening area, which at length included, not only all parts of Germany, but also England, France, Lombardy, Hungary and Poland. Contemporary writers, with the exaggeration characteristic of medieval credulity, even speak of thirty thousand students as present in the university at one time—a statement for which Denifle proposes to substitute two thousand as a more probable estimate. It is certain, however, that Prague, prior to the foundation of Leipzig, was one of the most frequented centres of learning in Europe, and Paris suffered a considerable diminution in her numbers owing to the counter-attractions of the great *studium* of Slavonia.

Cracow.

The university of Cracow in Poland was founded in May 1364, by virtue of a charter given by King Casimir the Great, who bestowed on it the same privileges as those possessed by the universities of Bologna and Padua. In the following September Urban V., in consideration of the remoteness of the city from other centres of education, constituted it a "studium generale" in all the faculties save that of theology. It is, however, doubtful whether these designs were carried into actual realization, for it is certain that, for a long time after the death of Casimir, there was no university whatever. Its real commencement must accordingly be considered to belong to the year 1400, when it was reconstituted, and the papal sanction was given for the incorporation of a faculty of theology. From this time its growth and prosperity were continuous; and with the year 1416 it had so far acquired a European reputation as to venture upon forwarding an expression of its views in connexion with the deliberations of the council of Constance. Towards the close of the 15th century the university is said to have been in high repute as a school of both astronomical and humanistic studies.

Vienna.

The Avignonese popes appear to have regarded the establishment of new faculties of theology with especial jealousy; and when, in 1364, Duke Rudolph IV. founded the university of Vienna, with the design of constituting it a "studium generale" in all the faculties, Urban V. refused his asssent to the foundation of a theological school. Owing to the sudden death of Duke Rudolph, the university languished for the next twenty years, but after the accession of Duke Albert III., who may be regarded as its real founder, it acquired additional privileges, and its prosperity became marked and continuous. Like Prague, Vienna was for a long time distinguished by the comparatively little attention bestowed by its teachers on the study of the civil law.

Fünfkirchen.

No country in the 14th century was looked upon with greater disfavour at Rome than Hungary. It was stigmatized as the land of heresy and schism. When, accordingly, in 1367 King Louis applied to Urban V. for his sanction of the scheme of founding a university at Fünfkirchen, Urban would not consent to the foundation of a faculty of theology, although theological learning was in special need of encouragement in those regions; the pontiff even made it a condition of his sanction for a studium generale that King Louis should first undertake to provide for the payment of the professors. We hear but little concerning the university after its foundation, and it is doubtful whether it survived for any length of time the close of the century. "The extreme east of civilized continental Europe in medieval times," observes Denifle, "can be compared, so far as university education is concerned, only with the extreme west and the extreme south. In Hungary, as in Portugal and in Naples, there was constant fluctuation, but the west and the south, although troubled by yet greater commotions than Hungary, bore better fruit. Among all the countries possessed of universities in medieval times, Hungary occupies the lowest place—a state of affairs of which, however, the proximity of the Turk must be looked upon as a main cause."

Heidelberg.

The university of Heidelberg (the oldest of those of the German realm) received its charter (October 23, 1385) from Urban VI. as a "studium generale" in all the recognized faculties save that of the civil law—the form and substance of the document being almost identical with those of the charter granted to Vienna. It was granted at the request of the elector palatine, Rupert I., who conferred on the teachers and students, at the same time, the same civil privileges as those which belonged to the university of Paris. In this case the functionary invested with the power of bestowing degrees was non-resident, the licences being conferred by the provost of the cathedral at Worms. But the real founder, as he was also the organizer and teacher, of the university was Marsilius of Inghen, to whose ability and energy Heidelberg was indebted for no little of its early reputation and success. The omission of the civil law from the studies licensed in the original charter would seem to show that the pontiff's compliance with the elector's request was merely formal, and Heidelberg, like Cologne, included the civil law among its faculties almost from its first creation. No medieval university achieved a more rapid and permanent success. Regarded with favour alike by the civil and ecclesiastical potentates, its early annals were singularly free from crises like those which characterize the history of many of the medieval universities. The number of those admitted to degrees from the commencement of the first session (19th October 1386 to 16th December 1387) amounted to 579.[1]

Cologne.

Owing to the labours of the Dominicans, Cologne had gained a reputation as a seat of learning long before the founding of its university; and it was through the advocacy of some leading members of the Mendicant orders that, at the desire of the city council, its charter as a "studium generale" (21st May 1388) was obtained from Urban VI. It was organized on the model of the university of Paris, as a school of theology and canon law, and "any other recognized faculty"—the civil law being incorporated as a faculty soon after the promulgation of the charter. In common with the other early universities of Germany—Prague, Vienna and Heidelberg—Cologne owed nothing to imperial patronage, while it would appear to have been, from the first, the object of special favour with Rome. This circumstance serves to account for its distinctly ultramontane sympathies in medieval times and even far into the 16th century. In a report transmitted to Gregory XIII. in 1577, the university expressly derives both its first origin and its privileges from the Holy See, and professes to owe no allegiance save to the Roman pontiff.

Erfurt.

Erfurt, no less noted as a centre of Franciscan than was Cologne of Dominican influence, received its charter (16th September 1379) from the anti-pope Clement VII. as a "studium generale" in all the faculties. Ten years later (4th May 1389) it was founded afresh by Urban VI., without any recognition of the act of his pretended predecessor. In the 15th century the number of its students was larger than that at any other German university—a fact attributable partly to the reputation it had acquired as a school of jurisprudence, and partly to the ardour with which the nominalist and realist controversies of the time were debated in its midst; its readiness in according a hearing to novel theories causing it to be known as *novorum omnium portus.*

The collegiate system is to be noted as a feature common to all these early German universities; and, in nearly all, the professors were partly remunerated by the appropriation of certain prebends, appertaining to some neighbouring church, to their maintenance.

Relations of the popes to the universities.

Würzburg.

During the first half of the 15th century the relations of the Roman pontiffs to the universities continued much the same, although the independent attitude assumed by the deputies of those bodies at the great councils of Constance and Basel, and especially by those from Paris, could not fail to give rise to apprehensions. The papal bulls for each new foundation begin to indicate a certain jealousy with respect to the appropriation of prebends by the founders. Where such appropriations are recognized, and more particularly in France, a formal sanction of the transfer generally finds a place in the bull authorizing the foundation; but sometimes the founder or founders are themselves enjoined to provide the endowments requisite for the establishment and support of the university. In this manner the control of the pontiff over each newly created seat of learning assumed a more real character, from the fact that his assent was accompanied by conditions which rendered it no longer a mere formality. The imperial intervention, on the other hand, was rarely invoked in Germany—Greifswald, Freiburg and Tübingen being the only instances in which the emperor's confirmation of the foundation was solicited.[2] The inadequacy of the traditional studies to meet the growing wants of civilization, and the consequent lack of sympathy on the part of each civic population in which a new studium was founded, now become frequently apparent. Of such conditions the fortunes of the studium at Würzburg in Bavaria—founded in 1402 by a bishop, with a charter bestowed by Boniface IX.—illustrate the dangers. The students belonged chiefly to the faculties of law and theology, and the frequency of their conflicts with the citizens made it necessary before ten years had elapsed to close the university, which was not reopened until 1582. Under the patronage of the prince Bishop Julius Echter von Mespelbrunn, however, it soon became largely frequented by Catholic students. At the present time, under the patronage of the house of Wittelsbach, it is widely famed as a school of medicine.

Catania.

Barcelona.

In Turin the university founded in 1412 by the counts of Savoy had to be refounded in 1431. The efforts of Parma in the 14th century to raise itself by papal aid to the dignity of a university proved altogether abortive, and it was not until 1422 that, under the protection of the dukes of Milan, its object was attained. In Sicily, Catania, the earliest of its high schools, was created a university by Alphonso of Aragon in 1445. Five years later Barcelona received from Pope Nicholas V. the same privileges as Toulouse had obtained from Gregory IX. Among the Spanish universities, however, none has had a more chequered history, although now taking rank with foremost.

Budapest.

In Hungary, Mathias Corvinus obtained from Paul II. in 1465 permission to found a general studium where he thought best within his realms—a latitude of choice conceded probably in consequence of the dangers which menaced the kingdom alike from Bohemia and from the Turks; while the fact that the university at Ofen (Hungarian *Buda*) was not actually founded until some ten years later, may have been owing to the resolute stand made by the youthful monarch against the claims to nominate bishops put forward not only by Pope Paul but by his successor Sixtus IV. (1471–84). After a series of eventful experiences, the university of Budapest remains, at the present time, almost exclusively Magyar. It has a school of law at Pressburg, which is all that remains of the university there founded by Mathias Corvinus in 1465.

Foundation of Louvain.

In northern Germany and in the Netherlands, on the other hand, the growing wealth and prosperity of the different states especially favoured the formation of new centres of learning. In the flourishing duchy of Brabant the university of Louvain (1426) was to a great extent controlled by the municipality; and their patronage, although ultimately attended with detrimental results, long enabled Louvain to outbid all the other universities of Europe in the munificence with which she rewarded her professors. In the course of the next century the "Belgian Athens," as she is styled by Lipsius, ranked second only to Paris in numbers and reputation. In its numerous separate foundations and general organization—it possessed no less than twenty-eight colleges—it closely resembled the English universities; while its active press afforded facilities to the author and the controversialist of which both Cambridge and Oxford were at that time almost destitute. It embraced all the faculties, and no degrees in Europe stood so high as guarantees of general acquirements. Erasmus records it as a common saying, that "no one could graduate at Louvain without knowledge, manners and age." Sir William Hamilton speaks of the examination at Louvain for a degree in arts as "the best example upon record of the true mode of such examination, and, until recent times, in fact, the only example in the history of universities worthy of consideration at all." He has translated from Vernulaeus the order and method of this examination.[1] In 1788 the faculties of jurisprudence, medicine and philosophy were removed to Brussels, and in 1797 the French suspended the university altogether.

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[1] The statistics of Hautz (*Gesch. d. Univ. Heidelberg*, i. 177–178) are corrected by Denifle (*Die Entstehung der Universitäten*, p. 385).

[2] Meiners, *Gesch. d. hohen Schulen*, i. 370.

Leipzig.

In Germany the conditions under which the new centres were created reflect and illustrate the history of the country in a remarkable manner. Those connected with the rise of the university of Leipzig are especially noteworthy, it having been the result of the migration of almost the entire German element from the university of Prague. This element comprised (1) Bavarians, (2) Saxons, (3) Poles (this last-named division being drawn from a wide area, which included Meissen, Lusatia, Silesia and Prussia), and, being represented by three votes in the assemblies of the university, while the Bohemians possessed but one, had acquired a preponderance in the direction of affairs which the latter could no longer submit to. Religious differences, again, evoked mainly by the preaching of John Huss, further intensified the existing disagreements; and eventually, in the year 1409, King Wenceslaus, at the prayer of his Bohemian subjects, issued a decree which exactly reversed the previous distribution of votes,—three votes being assigned to the Bohemian nation and only one to all the rest. The Germans took deep umbrage, and seceded to Leipzig, where, a bull having been obtained from Alexander V. (September 9, 1409), a new "studium generale" was founded by the landgrave of Thuringia and the margraves of Meissen. The members were divided into four nations—composed of natives of Meissen, Saxony, Bavaria and Poland. Two colleges were founded, a greater and a smaller, but designed, not for poor students, but for masters of arts—twelve being admitted on the former and eight on the latter foundation.

Rostock.

At Rostock, in the north, the dukes John and Albert of Mecklenburg conceived the design of founding a university from which the faculty of theology should be excluded. Pope Martin V., to whom they applied for his sanction, was scarcely in a position to refuse it, absorbed as he was with the pacification of Italy, the consolidation of his own temporal power, and the restoration of his almost ruinous capital. The university was accordingly founded as proposed in 1419; but in 1431 Eugenius IV. instituted a faculty of theology, and two colleges were founded with the same design and on the same scale as at Leipzig. Six years later the whole academic community having incurred the papal ban was fain to migrate to Greifswald, returning, however, to Rostock in 1443, but with one important exception, that of a master of arts named Henry Rubenow, who remained to become burgomaster of the former city, and succeeded in persuading Duke Wratislaw of Pommern to make it the seat of a university. Calixtus III. granted a bull in 1456, but it was stipulated that the rector should be a bishop, and the professorial chairs were also made partially dependent for endowment on canonries. Greifswald thus became exposed to the full brunt of the struggle which had ensued when the endeavour to nationalize the German church was terminated by the Concordat of Vienna (1448). Of its original statutes only those of the arts faculty are extant.

Greifswald.

Freiburg.

The universities of Freiburg in Baden and Tübingen in Württemberg, on the other hand, reflect the sympathies of the Catholic party under the Austrian rule. They alike owed their foundation to the countess Matilda, by whose persuasion her husband, the archduke of Austria, known as Albrecht VI., was induced to found Freiburg in 1455, and Count Eberhard (her son by a former marriage) to found Tübingen in 1477. The first session at Freiburg opened auspiciously in 1460 under the supervision of its rector, Matthew Hummel of Villingen, an accomplished and learned man, and its numbers were soon largely augmented by migrations of students from Vienna and from Heidelberg, while its resources, which originally were chiefly an annual grant from the city council, were increased by the bestowal of canonries and prebends in the neighbouring parishes. Erasmus had made Freiburg his residence from 1529 to 1535, during which time he may have originated a tradition of liberal learning, but in 1620, under the rule of the archduke Maximilian, the control of the Humanistic studies and of the entire faculty of philosophy was handed over to the Jesuits, who also gained possession of two of the chairs of theology. Although Strassburg since 1872 has been able to offer considerable counter-attractions, Freiburg has held her own, and numbers over 1600 students. The university of Tübingen was founded in 1477 with four faculties—those of theology, law, medicine and the arts—and numbered scholars such as John Reuchlin and Melanchthon among its teachers; while in the last century it was famous both for its school of medicine and that of theology (see TÜBINGEN). Its general condition in the year 1541–1542, and the sources whence its revenues were derived, have been illustrated by Hoffmann in a short paper which shows the fluctuating nature of the resources of a university in the 16th century—liable to be affected as they were both by the seasons and the markets.[2]

Tübingen.

Aix in Provence.

Poitiers.

The earliest 15th-century university in France was that of Aix in Provence. It had originally been nothing more than a school of theology and law, but in 1409 it was re-organized under the direction of the local count as a studium generale on the model of Paris. The sphere of its activity is indicated by the fact that the students were divided into Burgundians, Provençals and Catalans. The next foundation, that of Poitiers, had a wider significance as illustrating the struggle that was going on between the French crown and the Roman see. It was instituted by Charles VII. in 1431, almost immediately after his accession, with the special design of creating a centre of learning less favourable to English interests than Paris had at that time shown herself to be. Eugenius IV. could not refuse his sanction to the scheme, but he endeavoured partially to defeat Charles's design by conferring on the new "studium generale" simply the same privileges as those possessed by Toulouse, and thus placing it at a disadvantage in comparison with Paris. Charles rejoined by an extraordinary exercise of his own prerogative, conferring on Poitiers all the privileges collectively possessed by Paris, Toulouse, Montpellier, Angers and Orleans, and at the same time placing the university under special royal protection. The foundation of the university of Caen, in the diocese of Bayeux, was attended by conditions almost exactly the reverse of those which belonged to the foundation of that at Poitiers. It was founded under English auspices during the short period of the supremacy of the English arms in Normandy in the 15th century. Its charter (May 1437) was given by Eugenius IV., and the bishop of Bayeux was appointed its chancellor. The university of Paris had by this time completely forfeited the favour of Eugenius by its attitude at the council of Basel, and Eugenius inserted in the charter for Caen a clause of an entirely novel character, requiring all those admitted to degrees to take an oath of fidelity to the see of Rome, and to bind themselves to attempt nothing prejudicial to her interests. To this proviso the famous Pragmatic Sanction of Bourges was Charles's rejoinder in the following year. On the 18th of May 1442 we find King Henry VI. writing to Eugenius, and dwelling with satisfaction on the rapid progress of the new university, to which, he says, students had flocked from all quarters, and were still daily

Caen.

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[1] *Dissertations and Discussions*, Append. iii

[2] *Ökonomischer Zustand der Universität Tübingen gegen die Mitte des 16ten Jahrhunderts* (1845).

arriving.[1] Ten years later, when the English had been expelled, its charter was given afresh by Charles in terms which left the original charter unrecognized; both teachers and learners were subject to the civil authorities of the city, and all privileges made previously conferred in cases of legal disputes were abolished. From this time the university of Caen was distinguished by its loyal spirit and firm resistance to ultramontane pretensions; and, although swept away at the French Revolution, it was afterwards restored, owing to the sense of the services it had thus once rendered to the national cause.[2] **Bordeaux, Valence, Nantes.** No especially notable circumstances characterize the foundation of the university of Bordeaux (1441) or that of Valence (1452), but that of Nantes, which received its charter from Pius II. in 1463, is distinguished by the fact that it did not receive the ratification of the king of France, and the conditions under which its earlier traditions were formed thus closely resemble those of Poitiers. It seems also to have been regarded with particular favour by Pius II., a pontiff who was at once a ripe scholar and a writer upon education. He gave to Nantes a notable body of privileges, which not only represent an embodiment of all the various privileges granted to universities prior to that date, but afterwards became, with their copious and somewhat tautological phraseology, the accepted model for the great majority of university charters, whether issued by the pope or by the emperor, or by the civil authority. The bishop of Nantes was appointed head of the university, and was charged with the special protection of its privileges against all interference from whatever quarter.[3] **Bourges.** The bull for the foundation of the university of Bourges was given in 1465 by Paul II. at the request of Louis XI. and his brother. It confers on the community the same privileges as those enjoyed by the other universities of France. The royal sanction was given at the petition of the citizens; but, from reasons which do not appear, they deemed it necessary further to petition that their charter might also be registered and enrolled by the parlement of Paris.

Basel. Founded about the same time, and probably in a spirit of direct rivalry to Freiburg, the university of Basel was opened in 1460 under the auspices of its own citizens. The cathedral school in that ancient city, together with others attached to the monasteries, afforded a sufficient nucleus for a studium, and Pius II., who, as Aeneas Sylvius, had been a resident in the city, was easily prevailed upon to grant the charter (November 12, 1459). During the first seventy years of its existence the university prospered, and its chairs were held by eminent professors, among them historical scholars, such as Sebastian Brant and Jacob Wimpheling. But with the Reformation, Basel became the arena of contests which menaced the very existence of the university itself, the professors being, for the most part, opposed to the new movement with which the burghers warmly sympathized. Eventually, the statutes were revised, and in the latter half of the 16th century the university may be said to have attained its apogee. **Ingolstadt.** Before he had signed the bull for the foundation of the university of Basel, Pope Pius, at the request of Duke William of Bavaria, had issued another bull for the foundation of a university at Ingolstadt (7th April 1459). But it was not until 1472 that the work of teaching was actually commenced there. Some long-existing prebends, founded by former dukes of Bavaria, were appropriated to the endowment, and the chairs in the different faculties were distributed as follows: theology 2, jurisprudence 3, medicine 1, arts 6—arts in conjunction with theology thus obtaining the preponderance. As at Caen, twenty-two years before, an oath of fidelity to the Roman pontiff was imposed on every student admitted to a degree.[4] That this proviso was not subsequently abolished, as at Caen, is a feature in the history of the university of Ingolstadt which was attended by important results. Nowhere did the Reformation meet with more stubborn resistance, and it was at Ingolstadt that the Counter-Reformation was commenced. In 1556 the Jesuits made their first settlement in the university.

The next two universities took their rise in the archiepiscopal seats of Treves and Mainz. **Treves.** That at Treves received its charter as early as 1450; but the first academical session did not commence until 1473. Here the ecclesiastical influences appear to have been unfavourable to the project. The archbishop demanded 2000 florins as the price of his sanction. The cathedral chapter threw difficulties in the way of the appropriation of certain livings and canonries to the university endowment; and so obstinate was their resistance that in 1655 they succeeded in altogether rescinding the gift on payment of a very inadequate sum. It was not until 1722 that the assembly of deputies, by a formal grant, relieved the university from the difficulties in which it had become involved. **Mainz.** The university of Mainz, on the other hand, was almost entirely indebted to the archbishop Diether for its foundation. It was at his petition that Sixtus IV. granted the charter, 23rd November 1476; and Diether, being himself an enthusiastic humanist, thereupon circulated a letter, couched in elegant Latinity, addressed to students throughout his diocese, inviting them to repair to the new centre, and dilating on the advantages of academic studies and of learning. The rise of these two universities, however, neither of which attained to much distinction, represents little more than the incorporation of certain already existing institutions into a homogeneous whole, the power of conferring degrees being superadded.

Upsala and Copenhagen. Nearly contemporaneous with these foundations were those of Upsala (1477) and Copenhagen (1479), which, although lying without the political boundaries of Germany, reflected her influence. The charter for Copenhagen was given by Sixtus IV. as early as 1475. The students attracted to this new centre were mainly from within the radius of the university of Cologne, and its statutes were little more than a transcript of those of the latter foundation.

Wittenberg. The electorates of Wittenberg and Brandenburg were now the only two considerable German territories which did not possess a "studium generale," and the university founded at Wittenberg by Maximilian I. (6th July 1502) is notable as the first established in Germany by virtue of an imperial as distinguished from a papal decree. Its charter is, however, drawn up with the traditional phraseology of the pontifical bulls, and is evidently not conceived in any spirit of antagonism to Rome. Wittenberg is constituted a "studium generale" in all the four faculties—the right to confer degrees in theology and canon law having been sanctioned by the papal legate some months before, on the 2nd of February 1502. The endowment of the university with church revenues duly received the papal sanction—a bull of Alexander VI. authorizing the appropriation of twelve canonries attached to the castle church, as well as of eleven prebends in outlying districts—*ut sic per omnem modum unum corpus ex studio et collegio praedictis fiat et constituatur*. No university in Germany attracted to itself a larger share of the attention of Europe at its commencement. And it was its distinguishing merit that it was the first academic centre north of the Alps where the antiquated methods and barbarous Latinity of the scholastic era were overthrown. **Frankfort-on-the-Oder.** The last university founded in Germany prior to the Reformation was that of Frankfort-on-the-Oder. The design, first conceived by the elector John of Brandenburg, was carried into execution by his son Joachim, at whose request Pope Julius II. issued a bull for the foundation, 15th March 1506. An imperial charter, identical in its contents with the papal bull, followed on the 26th of October. The university received an endowment of canonries and livings similar to that of Wittenberg, and some houses in the city were assigned for its use by the elector.

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[1] Bekynton's *Correspondence*, i. 123.

[2] De la Rue, *Essais hist. sur la ville de Caen*, ii. 137–140.

[3] Meiners i. 368.

[4] Paulsen, in speaking of this proviso as one "die weder vorher noch nachher sonst vorkommt," would consequently seem to be not quite accurate. See *Die Gründung der deutschen Universitäten*, p. 277.

St Andrews.

The first university in Scotland was that of St Andrews, founded in 1411 by Henry Wardlaw, bishop of that see, and modelled chiefly on the constitution of the university of Paris. It acquired all its three colleges—St Salvator's, St Leonard's and St Mary's—before the Reformation—the first having been founded in 1456 by Bishop James Kennedy; the second in 1512 by the youthful Archbishop Alexander Stuart (natural son of James IV.), and John Hepburn, the prior of the monastery of St Andrews; and the third, also in 1512, by the Beatons, who in the year 1537 procured a bull from Pope Paul III. dedicating the college to the Blessed Virgin Mary of the Assumption, and adding further endowments. The most ancient of the universities of Scotland, with its three colleges, was thus reared in an atmosphere of medieval theology, and undoubtedly designed as a bulwark against heresy and schism. But "by a strange irony of fate," it has been observed, "two of these colleges became, almost from the first, the foremost agents in working the overthrow of that church which they were founded to defend." St Leonard's more especially, like St John's or Queens' at Cambridge, became a noted centre of intellectual life and Reformation principles. That he "had drunk at St Leonard's well" became a current expression for implying that a theologian had imbibed the doctrines of Protestantism.

Glasgow.

The university of Glasgow was founded as a "studium generale" in 1453, and possessed two colleges. Prior to the Reformation it acquired but little celebrity; its discipline was lax, and the number of the students but small, while the instruction was not only inefficient but irregularly given; no funds were provided for the maintenance of regular lectures in the higher faculties; and there was no adequate executive power for the maintenance of discipline.

Aberdeen.

The university of Aberdeen, which was founded in 1494, at first possessed only one college, namely, King's, which was coextensive with the university and conferred degrees. Marischal College, founded in 1593 by George Keith, fifth Earl Marischal, was constituted by its founder independent of the university in Old Aberdeen, being itself also a college and a university, with the power of conferring degrees. Bishop Elphinstone, the founder both of the university and of King's College (1505), had been educated at Glasgow, and had subsequently both studied and taught at Paris and at Orleans. To the wider experience which he had thus gained we may probably attribute the fact that the constitution of the university of Aberdeen was free from the glaring defects which then characterized that of the university of Glasgow.[1] But in all the medieval universities of Germany, England and Scotland, modelled as they were on a common type, the absence of adequate discipline was, in a greater or less degree, a common defect. In connexion with this feature we may note the comparatively small percentage of matriculated students proceeding to the degree of B.A. and M.A. when compared with later times.

Degrees taken at Leipzig.

Of this disparity the table on next column, exhibiting the relative numbers in the university of Leipzig for every ten years from the year 1427 to 1552, probably affords a fair average illustration—the remarkable fluctuations probably depending quite as much upon the comparative healthiness of the period (in respect of freedom from epidemic) and the abundance of the harvests as upon any other cause.

General aspects of German medieval universities.

The German universities in these times seem to have admitted for the most part their inferiority in learning to older and more favoured centres; and their consciousness of the fact is shown by the efforts which they made to attract instructors from Italy, and by the frequent resort of the more ambitious students to schools like Paris, Bologna, Padua and Pavia. That they took their rise in any spirit of systematic opposition to the Roman see (as Meiners and others have contended), or that their organization was something external to and independent of the church, is an assertion somewhat qualified by the foregoing evidence. Generally speaking, they were eminently conservative bodies, and the new learning of the humanists and the new methods of instruction that now began to demand attention were alike for a long period unable to gain admission within academic circles. Reformers such as Hegius, John Wessel and Rudolphus Agricola carried on their work at places like Deventer remote from university influences. That there was a considerable amount of mental activity going on in the universities themselves is not to be denied; but it was mostly of that unprofitable kind which, while giving rise to endless controversy, turned upon questions in connexion with which the implied postulates and the terminology employed rendered all scientific investigation hopeless. At almost every university—Leipzig, Greifswald and Prague (after 1409) being the principal exceptions—the so-called Realists and Nominalists represented two great parties occupied with an internecine struggle. At Paris, owing to the overwhelming strength of the theologians, the Nominalists were indeed under a kind of ban; but at Heidelberg they had altogether expelled their antagonists. It was much the same at Vienna and at Erfurt—the latter, from the ready reception which it gave to new speculation, being styled by its enemies "novorum omnium portus." At Basel, under the leadership of the eminent Johannes a Lapide, the Realists with difficulty maintained their ground. Freiburg, Tübingen and Ingolstadt, in the hope of diminishing controversy, arrived at a kind of compromise, each party having its own professor, and representing a distinct "nation." At Mainz the authorities adopted a manual of logic which was essentially an embodiment of Nominalistic principles.

Years.	Matriculations.	Years.	B.A.	M.A.	Percentage of	
					B.A's.	M.A's.
1427–1430	737	1429–1432	151	28	20·4	3·8
1437–1440	715	1439–1442	199	50	27·8	6·9
1447–1450	808	1449–1452	274	(50)	33·9	..
1457–1460	1,447	1459–1462	559	81	38·6	5·6
1467–1470	1,137	1469–1472	410	61	36·0	5·4
1477–1480	1,163	1479–1482	458	49	39·4	4·2
1487–1490	1,858	1489–1492	714	62	38·4	3·4
1497–1500	1,288	1499–1502	497	59	38·5	4·6
1507–1510	1,948	1509–1512	510	65	26·1	3·4
1517–1520	1,445	1519–1522	247	35	17·0	2·4
1527–1530	419	1529–1532	77	33	18·4	7·9
1537–1540	686	1539–1542	122	27	17·8	3·9
1547–1550	1,318	1549–1552	200	72	15·2	5·5
	14.969		4418	672	29·5	4·5

In Italy, almost without exception, it was decided that these controversies were endless and that their effects were pernicious.

Abandonment of logical studies in Italy.

It was resolved, accordingly, to expel logic, and allow its place to be filled by rhetoric. It was by virtue of this decision, which was of a tacit rather than a formal character, that the expounders of the new learning in the 15th century—men like Emmanuel Chrysoloras, Guarino, Leonardo Bruni, Bessarion, Argyropulos and Valla—carried into effect that important revolution in academic studies which constitutes a new era in university learning, and largely helped to pave the way for the Reformation.[2] This discouragement of the controversial spirit, continued as it was in relation to theological questions after the Reformation, obtained for the Italian universities a fortunate immunity from dissensions like those which, as we shall shortly see, distracted the centres of learning in Germany.

High reputation of Italian professors.

The professorial body also attained to an almost unrivalled reputation. It was exceptionally select, only those who were in receipt of salaries being permitted, as a rule, to lecture; it was also famed for its ability, the institution of concurrent chairs proving an excellent stimulus. These chairs were of two kinds—"ordinary" and "extraordinary"—the former being the more liberally endowed and fewer in number. For each subject of importance there were thus always two and sometimes three rival chairs, and a powerful and continuous emulation was thus maintained among the teachers. "From the integrity of their patrons, and the lofty standard by which they were judged," says Sir W. Hamilton, "the call to a Paduan or Pisan chair was deemed the highest of all literary honours. The status of professor was in Italy elevated to a dignity which in other countries it has never reached; and not a few of the most illustrious teachers in the Italian seminaries were of the proudest nobility of the land. While the universities of other countries had fallen from Christian and cosmopolite to sectarian and local schools, it is the peculiar glory of the Italian that, under the enlightened liberality of their patrons, they still continued to assert their European universality. Creed and country were in them no bar—the latter not even a reason of preference. Foreigners of every nation are to be found among their professors; and the most learned man in Scotland, Thomas Dempster, sought in a Pisan chair that theatre for his abilities which he could not find at home."[1]

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[1] *Fasti Aberdonenses*, Pref. p. xvi.

[2] For an excellent account of this movement, see Georg Voigt, *Die Wiederbelebung des classischen Alterthums* (2nd ed., 2 vols., 1880).

Valencia. **Seville.** **Granada.** **Oviedo.**

To such catholicity of sentiment the Spanish universities during the same period offer a complete contrast, their history being so strongly modified by political and religious movements that some reference to these becomes indispensable. Valencia, founded in 1501 as a school not only of theology and of civil and canon law, but also of the arts and of medicine, and sanctioned at the petition of its council by Alexander VI. (see Denifle, i. 645–46), and Seville, sanctioned by Julius II. in 1505, appear both to have been regarded without mistrust at Rome. But although the latter pontiff had approved the foundation of the university of Santiago as early as 1504, the bull for its creation was not granted by Clement VII. until 1526. While, again, the design of establishing a university at Granada had been approved by Charles V. in the same year, it was not until 1531 that Clement gave his consent, and even then the work of preparation was deferred for another six years. Little indeed is to be learnt respecting the new society until the foundation of the liberally endowed College de Sacro Monte by the archbishop of the province in 1605. These delays are partly to be accounted for by the well-known political jealousies that existed between the monarch and the pontiff; but it is also to be noted that at precisely the same period a movement of no slight importance, whereby it was sought to gain the recognition by the church of the writings and teaching of Erasmus, had been going on in the universities of Spain, and had ultimately died out. It died out at the uncreating voice of the Dominican Melchior Cano, who revived the ancient scholasticism and the teaching of Aquinas. Then followed the Jesuits, whom Cano himself had once denounced as "precursors of Antichrist," and under their direction the scholastic philosophy, together with a certain attention to Greek and Hebrew, became the dominant study. And when the council of Trent had done its work, and doctrinal controversy seemed to have been finally laid to rest, Gregory XIII. in 1574 authorized the foundation of the university of Oviedo; but this was not opened until 1608, and then only with a faculty of law. After this time the universities in Spain shared in the general decline of the country; and even after the expulsion of the Jesuits in 1769 no marked improvement is discernible in their schools. On the contrary, the departure of a body of very able instructors, who, whatever objections might be taken to their doctrinal teaching, were mostly good scholars and men in close touch with the outer world, distinctly favoured that tendency to lifeless routine and unreasoning tradition which characterizes the Spanish universities until the second half of the 19th century.

Italian universities. **Macerata.** **Camerino.** **Urbino.** **Modena.** **Sicily. Palermo.** **Sassari. Cagliari.**

The comparative unimportance of the universities founded during the same period in Italy is partially explained by the number of those which previously existed. In the papal states Macerata and Camerino were founded at a wide interval; the former, according to tradition, by a bull of Nicholas IV. as early as the 13th century, the latter not until the year 1727 by a bull of Benedict XIII. Macerata, however, ceased to exist as a university in the last century, retaining only a faculty of law, but contributing to the maintenance of the medical faculty at Camerino, which was constituted one of the newly created "free universities" (along with Urbino, Ferrara and Perugia) in 1890, but continued to exist only with the aid of contributions levied on the local parishes. Urbino, originally opened as a studium under papal patronage in 1671, was also constituted a free university, its chief study being that of law. At Modena there had long existed a faculty of the same study which enjoyed a high repute, but it was not until 1683 that it received its charter from Duke Francis II. of Este as the university of his capital. Like Camerino, Modena had to rely chiefly on funds collected in the commune, but was able nevertheless to acquire some reputation as a school of law and medicine, declining, when the Jesuits were installed by the Austrian authorities, to revive again in the general recovery which took place among the seats of learning after the unification of Italy. In Sicily, Palermo (1779) originated in an earlier institution composed mainly of subjects of Ferdinand IV., who had followed him on his expulsion from the throne of the Two Sicilies at Naples towards the end of the 18th century. It was closed in 1805, but reopened in 1850 to become a school of considerable importance in all the faculties with over 1000 students. The two universities of Sardinia—Sassari (1634) and Cagliari (1596)—were founded under the Spanish rule, and both died out when that rule was exchanged for that of Austria. Under the auspices of the house of Savoy they were re-established, but neither can be said to have since achieved any marked success.

For the most part, however, the Reformation represents the great boundary line in the history of the medieval universities, and long after Luther and Calvin had passed away was still the main influence in the history of those new foundations which arose in Protestant countries. Even in Catholic countries its secondary effects were scarcely less perceptible, as they found expression in connexion with the Counter-Reformation. In Germany the Thirty Years' War was attended by consequences which were felt long after the 17th century. In France the Revolution of 1789 resulted in the actual uprooting of the university system.

Pernicious influences of sectarianism.

The influence of the Humanists, and the special character which it assumed as it made its way in Germany in connexion with the labours of scholars like Erasmus, John Reuchlin and Melanchthon, augured well for the future. It was free from the frivolities, the pedantry, the immoralities and the scepticism which characterized so large a proportion of the corresponding culture in Italy. It gave promise of resulting at once in a critical and enlightened study of the masterpieces of classical antiquity, and in a reverent and yet rational interpretation of the Scriptures and the Fathers. The fierce bigotry and the ceaseless controversies evoked by the promulgation of Lutheran or Calvinistic doctrine dispelled, however, this hopeful prospect, and converted what might otherwise have become the tranquil abodes of the Muses into gloomy fortresses of sectarianism. Of the manner in which it affected the highest culture, the observation of Henke in his *Life of Calixtus* (i. 8), that for a century after the Reformation the history of Lutheran theology becomes almost identified with that of the German universities, may serve as an illustration.

Marburg.

The first Protestant university was that of Marburg, founded by Philip the Magnanimous, landgrave of Hesse, 30th May 1527. Expressly designed as a bulwark of Lutheranism, it was mainly built up out of the confiscation of the property of the religious orders in the Hessian capital. The house of the Dominicans, who had fled on the first rumour of spoliation, was converted into lecture-rooms for the faculty of jurisprudence. The church and convent of the order known as the "Kugelherrn" was appropriated to the theological faculty. The friary of the Barefooted Friars was shared between the faculties of medicine and philosophy. The university, which was the object of the landgrave's peculiar care, rapidly rose to celebrity; it was resorted to by students from remote countries, even from Greece, and its professors were of distinguished ability. How much, however, of this popularity depended on its theological associations is to be seen in the fact that after the year 1605, when, by the decree of Count Maurice, its formulary of faith was changed from Lutheran to Calvinistic, its numbers greatly declined. This dictation of the temporal power now becomes one of the most notable features in academic history in Protestant Germany. The universities, having repudiated the papal authority, while that of the episcopal order was at an end, now began to pay especial court to the temporal ruler, and sought in every way to conciliate his goodwill, representing with peculiar distinctness the theory—*cujus regio, ejus religio*. This tendency was further strengthened by the fact that their colleges, bursaries and other similar foundations were no longer derived from or supported by ecclesiastical institutions, but were mainly dependent on the civil power.

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[1] Hamilton, *Discussions*, 2nd ed. p. 373.

Königsberg.

The Lutheran university of Königsberg was founded 17th August 1544 by Albert III., margrave of Brandenburg, and the first duke of Prussia, and his wife Dorothea, a Danish princess. In this instance, the religious character of the foundation not having been determined at the commencement, the papal and the imperial sanction were both applied for, although not accorded. King Sigismund of Poland, however, which kingdom exercised at that time a protectorate over the Prussian duchy, ultimately gave the necessary charter (29th September 1561), at the same time ordaining that all students who graduated as masters in the faculty of philosophy should rank as nobles of the Polish kingdom. When Prussia was raised to the rank of a kingdom (1701) the university was made a royal foundation, and the "collegium Fridericianum," which was then erected, received corresponding privileges. In 1862 the university buildings were rebuilt, and the number of the students soon after rose to nearly a thousand.

Jena.

The Lutheran university of Jena had its origin in a gymnasium founded by John Frederick the Magnanimous, elector of Saxony, during his imprisonment, for the express purpose of promoting Evangelical doctrines and repairing the loss of Wittenberg, where the Philippists had gained the ascendancy. Its charter, which the emperor Charles V. had refused to grant, and which was obtained with some difficulty from his brother, Ferdinand I., enabled the authorities to open the university on the 2nd of February 1558. Distinguished for its vehement assertion of Lutheran doctrine, its hostility to the teaching of Wittenberg was hardly less pronounced than that with which both centres regard Roman Catholicism. For a long time it was chiefly noted as a school of medicine, and in the 17th and 18th centuries was in bad repute for the lawlessness of its students, among whom duelling prevailed to a scandalous extent. The beauty of its situation and the eminence of its professoriate have, however, generally attracted a considerable proportion of students from other countries. Its numbers in 1906 were 1281.

Helmstedt.

The Lutheran university of Helmstedt, founded by Duke Julius (of the house of Brunswick-Wolfenbüttel), and designated after him in its official records as "Academia Julia," received its charter, 8th May 1575, from the emperor Maximilian II. No university in the 16th century commenced under more favourable auspices. It was munificently endowed by the founder and by his son; and its "Convictorium," or college for poor students, expended in the course of thirty years no less than 100,000 thalers, an extraordinary expenditure for an institution of such a character in those days. Beautifully and conveniently situated in what had now become the well-peopled region between the Weser and the lower Elbe, and distinguished by its comparatively temperate maintenance of the Lutheran tenets, it attracted a considerable concourse of students, especially from the upper classes, not a few being of princely rank. Throughout its history, until suppressed in 1809, Helmstedt enjoyed the special and powerful patronage of the dukes of Saxony.

Altdorf.

The "Gymnasium Aegidianum" of Nuremberg, founded in 1526, and removed in 1575 to Altdorf, represents the origin of the university of Altdorf. A charter was granted in 1578 by the emperor Rudolph II., and the university was formally opened in 1580. It was at first, however, empowered only to grant degrees in arts; but in 1623 the emperor Ferdinand II. added the permission to create doctors of law and medicine, and also to confer crowns on poets; and in 1697 its faculties were completed by the permission given by the emperor Leopold I. to create doctors of theology. Like Louvain, Altdorf was nominally ruled by the municipality, but in the latter university this power of control remained practically inoperative, and the consequent freedom enjoyed by the community from evils like those which brought about the decline of Louvain is thus described by Hamilton: "The decline of that great and wealthy seminary (Louvain) was mainly determined by its vicious patronage, both as vested in the university and in the town. Altdorf, on the other hand, was about the poorest university in Germany, and long one of the most eminent. Its whole endowment never rose above £800 a year; and, till the period of its declension, the professors of Altdorf make at least as distinguished a figure in the history of philosophy as those of all the eight universities of the British empire together. On looking closely into its constitution the anomaly is at once solved. The patrician senate of Nuremberg were too intelligent and patriotic to attempt the exercise of such a function. The nomination of professors, though formally ratified by the senate, was virtually made by a board of four curators; and what is worthy of remark, as long as curatorial patronage was a singularity in Germany, Altdorf maintained its relative pre-eminence, losing it only when a similar mean was adopted in the more favoured universities of the empire."[1]

Giessen.

Rinteln.

Strassburg.

The conversion of Marburg into a school of Calvinistic doctrine gave occasion to the foundation of the universities of Giessen and of Rinteln. Of these the former, founded by the margrave of Hesse-Darmstadt, Louis V., as a kind of refuge for the Lutheran professors from Marburg, received its charter from the emperor Rudolph II. (19th May 1607). When, however, the margraves of Darmstadt acquired possession of Marburg in 1625, the university was transferred thither; in 1650 it was moved back again to Giessen. The number of matriculated students, which at the beginning of last century was about 250, had risen before its close to over 800. In common with the other universities of Germany, but with a facility which obtained for it a specially unenviable reputation, Giessen was for a long time wont to confer the degree of doctor *in absentia* in the different faculties without requiring adequate credentials. This practice drew forth an emphatic protest from the eminent historian Mommsen, and was abandoned long before his death. The university of Rinteln was founded 17th July 1621 by the emperor Ferdinand II. Almost immediately after its foundation it became the prey of contending parties in the Thirty Years' War, and its early development was thus materially hindered. It never, however, attained to much distinction, and in 1819 it was suppressed. The university of Strassburg was founded in 1621 on the basis of an already existing academy, to which the celebrated John Sturm stood, during the latter part of his life, in the relation of "rector perpetuus"; and of which we are told that in 1578 it included more than a thousand scholars, among whom were 200 of the nobility, 24 counts and barons and three princes. It also attracted students from all parts of Europe, and especially from Portugal, Poland, Denmark, France and England. The method of Sturm's teaching became the basis of that of the Jesuits, and through them of the public school instruction in England. In 1621 Ferdinand II. conferred on this academy full privileges as a university; in the language of the charter, "in omnibus facultatibus, doctores, licentiatos, magistros, et baccalaureos, atque insuper *poetas laureatos* creandi et promovendi."[2] In 1681

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[1] *Discussions*, &c., 2nd ed., pp. 388–89.

[2] *Promulg. Acad. Privil.*, &c. (Strassburg, 1628).

Strassburg became French, and remained so until 1872, when it was refounded by the Emperor William I., and before the close of the century numbered over 1100 students.

Moscow.

Wilna.

Dorpat.

Charkow.

Kasan.

St Petersburg.

Helsingfors.

Kiev.

Odessa.

Tomsk.

At the beginning of last century Russia possessed but three universities—that of Moscow (1755), founded by the Empress Elizabeth; of Wilna (1578), which was Polish and chiefly in the hands of the Jesuits; and of Dorpat [Yuriev] in Livonia, which was virtually German. Under the enlightened policy of Alexander I. was founded the university of Charkow (1804) for New Russia, that of Kazan (1804) for the countries about the Volga, but designed also for the populations of Finland and Siberia, and that of St Petersburg (1819). Each of the foregoing six universities had a definite district assigned to it, from whence it was entitled to recruit students, and, as a further incentive to the pursuit of academic studies, a *ukas* promulgated in 1809 proclaimed that in all appointments to official posts throughout the empire the holders of a university degree would receive the first consideration in the competition for vacancies. In 1826 the university at Åbo in Finland was removed to Helsingfors, and still preserves the charter whereby, in its original home, it had been constituted a university by Queen Christina and her chancellor Oxenstiern in the year 1640. In 1832 the foundation of the St Wladimir University of Kiev absorbed both that at Wilna and the lyceum of Kremenetz. Odessa, founded in 1865, was designed to represent the university of New Russia. Although at St Petersburg considerable attention was regularly given to the teaching of languages, especially those of Armenia, Georgia, and Tatary, the general status of the Russian universities continued throughout the greater part of last century exceptionally low; and in 1884 they were all reconstituted by the promulgation of a "universal code"; with this the statutes of the universities at Dorpat (1632) and Warsaw (1886) are essentially in agreement. The former, originally founded at the suggestion of the governor-general, with the design of bringing "martial Livonia into the path of virtue and morality," was at first almost exclusively taught by German professors, of whom, however, very few had retained their chairs at the conclusion of last century. The study of the Slavonic languages, on the other hand, received a considerable stimulus; and when, by a decree in May 1887, the use of the Russian language was made obligatory in all places of instruction throughout the Baltic provinces, Russian began to displace German as the language of the lecture-room, the only faculties in which the use of German continued to be permissible being those of theology and medicine. The university of Tomsk in western Siberia, founded in 1888, recruited its numbers chiefly from students in the same faculties. It was, however, without endowment, and depended chiefly on a grant from the state aided by private liberality.

Influence of Dorpat.

Prague.

During the ensuing twenty years the general influence of Dorpat rapidly spread far beyond the Baltic provinces, while the number of students, which in 1879 was 1106, rose to nearly 2000.[1] In 1889, however, the appointment of the university officials was taken from the Senatus Academicus and entrusted to the state minister, a change which went far to deprive the university of its claim to be considered German. A like contest between contending nationalities met with a final solution at Prague, where a Czech university having been established on an independent basis, the German university began its separate career in the winter session of 1882–83. The German foundation retains certain revenues accruing from special endowments, but the state subvention is divided between the two.

Bamberg.

Innsbruck.

Breslau.

The repudiation on the part of the Protestant universities of both papal and episcopal authority evoked a counter-demonstration among those centres which still adhered to Catholicism, while their theological intolerance gave rise to a great reaction, under the influence of which the medieval Catholic universities were reinvigorated and reorganized (although strictly on the traditional lines), while new and important centres were created. It was on the tide of this reaction, aided by their own skilful teaching and practical sagacity, that the Jesuits were borne to that commanding position which made them for a time the arbiters of education in Europe. The earliest university whose charter represented this reaction was that of Bamberg, founded by the prince-bishop Melchior Otto, after whom it was named "Academia Ottoniana." It was opened 1st September 1648, and received both from the emperor Frederick III. and Pope Innocent X. all the civil and ecclesiastical privileges of a medieval foundation. At first, however, it comprised only the faculties of arts and of theology; to these was added in 1729 that of jurisprudence, and in 1764 that of medicine. In this latter faculty Dr Ignatius Döllinger (the father of the historian) was for a long time a distinguished professor. The university library is of especial interest, as including that of an earlier Jesuit foundation and also valuable collections by private donors. Its collection of manuscripts in like manner includes those contained in some thirty suppressed monasteries, convents, and religious institutions at the time of the "secularization." The university of Innsbruck was founded in 1672 by the emperor Leopold I., from whom it received its name of "Academia Leopoldina." In the following century, under the patronage of the empress Maria Theresa, it made considerable progress, and received from her its ancient library and bookshelves in 1745. In 1782 the university underwent a somewhat singular change, being reduced by the emperor Joseph II. from the status of a university to that of a lyceum, although retaining in the theological faculty the right of conferring degrees. In 1791 it was restored to its privileges by the emperor Leopold II., and since that time the faculties of philosophy, law and medicine have been represented in nearly equal proportions. The foundation of the university of Breslau was contemplated as early as the year 1505, when Ladislaus, king of Hungary, gave his sanction to the project; but Pope Julius II., in the assumed interests of Cracow, withheld his assent.

The Jesuits in the university.

Condition of the University of Paris.

Nearly two centuries later, in 1702, under singularly altered conditions, the Jesuits prevailed upon the emperor Leopold I. to found a university without soliciting the papal sanction. When Frederick the Great conquered Silesia in 1741, he took both the university and the Jesuits in Breslau under his protection, and when in 1774 the order was suppressed by Clement XIV. he established them as priests in the Royal Scholastic Institute, at the same time giving new statutes to the university. In 1811 the university was considerably augmented by the incorporation of that at Frankfort-on-the-Oder, and was ultimately reconstituted on lines similar to those of the newly founded university of Berlin. In no country was the influence of the Jesuits on the universities more marked than in France. The civil wars in that country during the thirty years which preceded the close of the 16th century told with disastrous effects upon the condition of the university of Paris, and with the commencement of the 17th century its collegiate life seemed at an end, and its forty colleges stood absolutely deserted. To this state of affairs the obstinate conservatism of the academic authorities not a little contributed. The statutes by which the university was still governed were those which had been given by the cardinal D'Estouteville, the papal legate, in 1452, and remained entirely unmodified by the influences of the Renaissance. In 1579 the edict of Blois promulgated a scheme of organization for all the universities of the realm (at that time twenty-one in number)—a measure which, though productive of unity of teaching, did nothing towards the advancement of the studies themselves. The theological instruction became largely absorbed by the episcopal colleges, and acquired, in the schools of the different orders, a narrower and more dogmatic character. The eminent lawyers of France, unable to find chairs in Paris, distributed themselves among the chief towns of the provinces. The Jesuits did not fail to profit by this immobility and excessive conservatism on the part of the university, and during the second half of the 16th century and the whole of the 17th they had contrived to gain almost a complete monopoly of both the higher and the lower education of provincial France. Their schools rose at Toulouse and Bordeaux, at Auch, Agen, Rhodez, Périgueux, Limoges, Le Puy, Aubenas, Béziers, Tournon, in the colleges of Flanders and Lorraine, Douai and Pont-à-Mousson—places beyond the jurisdiction of the parlement of Paris or even of the crown of France. Their banishment from Paris itself had been by the decree of the parlement alone, and had never been confirmed by the crown. "Lyons," says Pattison, "loudly demanded a Jesuit college, and even the Huguenot Lesdiguières, almost king in Dauphiné, was preparing to erect one at Grenoble. Amiens, Rheims, Rouen, Dijon, and Bourges were only waiting a favourable opportunity to introduce the Jesuits within their walls."[1] The university was rescued from the fate which seemed to threaten it only by the excellent statutes given by Richer in 1598, and by the discerning protection extended to it by Henry IV., while its higher culture was in some measure provided for by the establishment by Richelieu in 1635 of the Académie française.

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[1] See *Die deutsche Universität Dorpat im Lichte der Geschichte*, 1882.

Colleges of the Jesuits in France.

Edinburgh.

The "college of Edinburgh" was founded by charter of James VI., dated 14th April 1582. This document contains no reference to a *studium generale*, nor is there ground for supposing that the foundation of a university was at that time contemplated. In marked contrast to the three older centres in Scotland, the college rose comparatively untrammelled by the traditions of medievalism, and its creation was not effected without some jealousy and opposition on the part of its predecessors. Its first course of instruction was commenced in the Kirk of Field, under the direction of Robert Rollock, who had been educated at St Andrews under Andrew Melville, the eminent Covenanter. "He began to teach," says Craufurd, "in the lower hall of the great lodging, there being a great concourse of students allured with the great worth of the man; but diverse of them being not ripe enough in the Latin tongue, were in November next put under the charge of Mr Duncan Narne, . . . who, upon Mr Rollock's recommendation, was chosen second master of the college."[2] In 1585 both Rollock and Nairne subscribed the National Covenant, and a like subscription was from that time required from all who were admitted to degrees in the college.

Results of the Thirty Years' War.

Halle.

Influence of Thomasius and Francke.

Göttingen.

Disastrous as were the effects of the Thirty Years' War upon the external condition of the German universities, resulting in not a few instances in the total dispersion of the students and the burning of the buildings and libraries, they were less detrimental and less permanent than those which were discernible in the tone and temper of these communities. A formal pedantry and unintelligent method of study, combined with a passionate dogmatism in matters of religious belief and a rude contempt for the amenities of social intercourse, became the leading characteristics, and lasted throughout the 17th century. But in the year 1693 the foundation of the university of Halle opened up a career to two very eminent men, whose influence, widely different as was its character, may be compared for its effects with that of Luther and Melanchthon, and served to modify the whole current of German philosophy and German theology. Halle has indeed been described as "the first real modern university." It was really indebted for its origin to a spirit of rivalry between the conservatism of Saxony and the progressive tendencies of the house of Brandenburg, but the occasion of its rise was the removal of the ducal court from Halle to Magdeburg. The archbishopric of the latter city having passed into the possession of Brandenburg in 1680 was changed into a dukedom, and the city itself was selected as the ducal residence. This change left unoccupied some commodious buildings in Halle, which it was decided to utilize for purposes of education. A "Ritterschule" for the sons of the nobility was opened, and in the course of a few years it was decided to found a university. Saxony endeavoured to thwart the scheme, urging the proximity of Leipzig; but her opposition was overruled by the emperor Leopold I., who granted (19th October 1693) the requisite charter, and in the following year the work of the university commenced. Frankfort-on-the-Oder had by this time become a centre of the Reformed party, and the primary object in founding a university in Halle was to create a centre for the Lutheran party; but its character, under the influence of its two most notable teachers, Christian Thomasius and A. H. Francke, soon expanded beyond the limits of this conception to assume a highly original form. Thomasius and Francke had both been driven from Leipzig owing to the disfavour with which their liberal and progressive tendencies were there regarded by the academic authorities, and on many points the two teachers were in agreement. They both regarded with contempt alike the scholastic philosophy and the scholastic theology; they both desired to see the rule of the civil power superseding that of the ecclesiastical power in the seats of learning; they were both opposed to the ascendancy of classical studies as expounded by the humanists—Francke regarding the Greek and Roman pagan writers with the old traditional dislike, as immoral, while Thomasius looked upon them with contempt, as antiquated and representing only a standpoint which had been long left behind; both again agreed as to the desirability of including the elements of modern culture in the education of the young. But here their agreement ceased. It was the aim of Thomasius, as far as possible, to secularize education, and to introduce among his countrymen French habits and French modes of thought; his own attire was gay and fashionable, and he was in the habit of taking his seat in the professorial chair adorned with gold chain and rings, and with his dagger by his side. Francke, who became the leader of the Pietists, regarded all this with even greater aversion than he did the lifeless orthodoxy traditional in the universities, and was shocked at the worldly tone and disregard for sacred things which characterized his brother professor. Both, however, commanded a considerable following among the students. Thomasius was professor in the faculty of jurisprudence, Francke in that of theology. And it was a common prediction in those days with respect to a student who proposed to pursue his academic career at Halle, that he would infallibly become either an atheist or a Pietist. But the services rendered by Thomasius to learning were genuine and lasting. He was the first to set the example, soon after followed by all the universities of Germany, of lecturing in the vernacular instead of in the customary Latin; and the discourse in which he first departed from the traditional method was devoted to the consideration of how far the German nation might with advantage imitate the French in matters of social life and intercourse. His more general views, as a disciple of the Cartesian philosophy and founder of the modern Rationalismus, exposed him to incessant attacks; but by the establishment of a monthly journal (at that time an original idea) he obtained a channel for expounding his views and refuting his antagonists which gave him a great advantage. On the influence of Francke, as the founder of that Pietistic school with which the reputation of Halle afterwards became especially identified, it is unnecessary here to dilate.[1] Christian Wolf, who followed Thomasius as an assertor of the new culture, was driven from Halle by the accusations of the Pietists, who declared that his teaching was fraught with atheistical principles. In 1740, however, he was recalled by Frederick II., and reinstated in high office with every mark of consideration and respect. Throughout the whole of the 18th century Halle was the leader of academic thought and advanced theology in Protestant Germany, although sharing that leadership, after the middle of the century, with Göttingen. The university of Göttingen (named after its founder "Georgia Augusta") was endowed with the amplest privileges as a university by George II. of England, elector of Hanover, 7th December

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[1] *Life of Casaubon*, p. 181.

[2] Craufurd, *Hist. of the Univ. of Edinburgh*, pp. 19–28.

[1] See Paulsen, *Gesch. des gelehrten Unterrichts*, &c., pp. 348–58.

Erlangen.

1736. The imperial sanction of the scheme had been given three years before (13th January 1733), and the university was formally opened 17th September 1737. The king himself assumed the office of "rector magnificentissimus," and the liberality of the royal endowments (doubling those of Halle), and the not less liberal character of the spirit that pervaded its organization, soon raised it to a foremost place among the schools of Germany. Halle had just expelled Wolf; and Göttingen, modelled on the same lines as Halle, but rejecting its Pietism and disclaiming its intolerance, appealed with remarkable success to the most enlightened feeling of the time. It included all the faculties, and two of its first professors—Mosheim, the eminent theologian, from Helmstedt, and G. L. Böhmer, the no less distinguished jurist from Halle—together with Gesner, the man of letters, at once established its reputation. Much of its early success was also due to the supervision of its chief curator (there were two)—Baron Münchhausen, himself a man of considerable attainments, who by his sagacious superintendence did much to promote the general efficiency of the whole professoriate. Not least among its attractions was also its splendid library, located in an ancient monastery, and now containing over 200,000 volumes and 5000 MSS. In addition to its general influence as a distinguished seat of learning, Göttingen may claim to have been mainly instrumental in diffusing a more adequate conception of the importance of the study of history. Before the latter half of the 18th century the mode of treatment adopted by university lecturers was singularly wanting in breadth of view. Profane history was held of but little account, excepting so far as it served to illustrate ecclesiastical and sacred history; while this, again, was invariably treated in the narrow spirit of the polemic, intent mainly on the defence of his own confession, according as he represented the Lutheran or the Reformed Church. The labours of the professors at Göttingen, especially Putter, Gatterer, Schlözer and Spittler, combined with those of Mascov at Leipzig, did much towards promoting both a more catholic treatment and a wider scope. Not less beneficial was the example set at Göttingen of securing the appointment of its professors by a less prejudiced and partial body than a university board is only too likely to become. "'The Great Münchhausen,' says an illustrious professor of that seminary, 'allowed our university the right of presentation, of designation, or of recommendation, as little as the right of free election; for he was taught by experience that, although the faculties of universities may know the individuals best qualified to supply their vacant chairs, *they are seldom or never disposed to propose for appointment the worthiest within their knowledge*.'"[1] The system of patronage adopted at Göttingen was, in fact, identical with that which had already been instituted in the universities of the Netherlands by Douza. The university of Erlangen, a Lutheran centre, was founded by Frederick, margrave of Baireuth. Its charter was granted by the emperor Charles VII., 21st February 1743, and the university was formally constituted, 4th November. From its special guardian, Alexander, the last margrave of Ansbach, it was styled "Academia Alexandrina." In 1791, Ansbach and Baireuth having passed into the possession of Prussia, Erlangen also became subject to the Prussian government, and, as the 19th century advanced, her theological faculty became distinguished by the fervour and ability with which it championed the tenets of Lutheranism.

The English and German universities compared.

On comparison with the great English universities, the universities of Germany must be pronounced inferior both in point of discipline and of moral control over the students. The superiority of the former in these respects is partly to be attributed to the more systematic care which they took, from a very early date, for the supervision of each student, by requiring that within a certain specified time after his entry into the university he should be registered as a pupil of some master of arts, who was responsible for his conduct, and represented him generally in his relations to the academic authorities. Marburg in its earliest statutes (those of 1529) endeavoured to establish a similar rule, but without success.[2] The development of the collegiate system at Oxford and Cambridge materially assisted the carrying out of this discipline. Although again, as in the German universities, feuds were not unfrequent, especially those between "north" and "south" (the natives of the northern and southern counties), the fact that in elections to fellowships and scholarships only a certain proportion were allowed to be taken from either of these divisions acted as a considerable check upon the possibility of any one college representing either element exclusively. In the German universities, on the other hand, the ancient division into nations, which died out with the 15th century, was revived under another form by the institution of national colleges, which largely served to foster the spirit of rivalry and contention. The demoralization induced by the Thirty Years' War and the increase of duelling intensified these tendencies, which, together with the tyranny of the older over the younger students, known as "Pennalismus," were evils against which the authorities contended, but ineffectually, by various ordinances. The institution of "Burschentum," having for its design the encouragement of good fellowship and social feeling irrespective of nationality, served only as a partial check upon these excesses, which again received fresh stimulus by the rival institution of "Landsmannschaften," or societies of the same nationality. The latter proved singularly provocative of duelling, while the arrogant and even tyrannical demeanour of their members towards the unassociated students gave rise to a general combination of the latter for the purposes of self-defence and organized resistance.

Extinction of German universities during 1798–1815.

Munich.

Münster.

The political storms which marked the close of the 18th and the beginning of the 19th century gave the death-blow to not a few of the ancient universities of Germany. Mainz and Cologne ceased to exist in 1798; Bamberg, Dillingen and Duisburg in 1804; Rinteln and Helmstedt in 1809; Salzburg in 1810; Erfurt in 1816. Altdorf was united to Erlangen in 1807, Frankfort-on-the-Oder to Breslau in 1809, and Wittenberg to Halle in 1815. The university of Ingolstadt was first moved in 1802 to Landshut, and from thence in 1826 to Munich, where it was united to the academy of sciences which was founded in the Bavarian capital in 1759. Münster in Prussia was for the first time constituted a university in four faculties by Maximilian Frederick (elector and archbishop) in 1771. Its charter was confirmed by Clement XIV. in 1773, and again by the Emperor Joseph II. The university was abolished in the year 1818; but two faculties, those of theology and philosophy, continued to exist, and in 1843 it received the full privileges of a Prussian university together with the designation of a royal foundation. Of those of the above centres which altogether ceased to exist, but few were much missed or regretted—that at Mainz, which had numbered some six hundred students, being the one notable exception. The others had for the most part fallen into a perfunctory and lifeless mode of teaching, and, with wasted or diminished revenues and declining numbers, had long ceased worthily to represent the functions of a university, while the more studious in each centre were harassed by the frequency with which it was made an arena for political demonstrations. Whatever loss may have attended their suppression was more than compensated by the activity and influence of the three great German universities which rose in the last century.

Munich, after having been completely reorganized, soon became a distinguished centre of study in all the faculties; and its numbers, allowing for two great wars, have been continuously on the increase, the eminence of its professoriate, among whom have been Döllinger, Liebig, Schelling, Zeuss and Giesebrecht, having attracted students from all parts of Europe.

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[1] Hamilton, *Discussions*, p. 381.

[2] "Volumus neminem in hanc nostram Academiam admitti, aut per rectorem in album recipi, qui non habeat privatum atque domesticum praeceptorem, qui ejus discipulum agnoscat, ad cujus judicium quisque pro sua ingenii capacitate atque Marte lecturas et publicas et privatas audiat, a cujus latere aut raro aut nunquam discedat." Koch expressly compares this provision with the discipline of Oxford and Cambridge, which, down to the commencement of the present century, was very much of the same character (Koch, *Gesch. des academischen Pädagogiums in Marburg*, p. 11).

Berlin.

The university of Berlin, known as the *Royal* Friedrich Wilhelm University, was founded in 1809, immediately after the peace of Tilsit, when Prussia had been reduced to the level of a third-rate Power. Under the guiding influence of Wilhelm von Humboldt, however, supported by the strong purpose of Frederick William III., the principles adopted in connexion with the new seat of learning not only raised it to a foremost place among the universities of Europe, but also largely conduced to the regeneration of Germany. It had not only incorporated at the time of its foundation the famous "Academy of Sciences" of the city, but expressly repudiated all attachment to any particular creed or school of thought, and professed subservience only to the interests of science and learning. "Each of the eminent teachers with whom the university began its life—F. A. Wolfe, Fichte, Savigny, Reil—represented only himself, the path of inquiry or the completed theory which he had himself propounded. Its subsequent growth was astonishing, and before the 19th century closed the number of its matriculated students exceeded that of every other university except Vienna."

Bonn.

The university of Bonn, founded in 1818 and also by Friedrich Wilhelm III., thus became known as the *Rhenish* Friedrich Wilhelm University—it being the design of the founder to introduce into the Rhine provinces the classic literature and the newly developed scientific knowledge of Germany proper. With this aim he summoned to his aid the best available talent, among the earlier instructors being Niebuhr, A. W. von Schlegel, with C. F. Nasse in the faculty of medicine and G. Hermes in that of theology. In the last-named faculty it further became noted for the manner in which it combined the opposed schools of theological doctrine—that of the Evangelical (or Lutheran) Church and that of the Roman Catholic Church here standing side by side, and both adorned by eminent names. After the war with Austria in 1859 the German universities underwent a considerable change owing to the enforced military service required by the law of 1867; and the events of 1870 were certainly not disconnected with the martial spirit which had been evoked in the student world, while in the universities themselves there had risen up a new and more lively interest in political affairs.

Fluctuations of numbers in the faculty of theology.

In 1878 a comparison of the numbers of the students in the different faculties in the Prussian universities with those for the year 1867 showed a remarkable diminution in the faculty of theology, amounting in Lutheran centres to more than one-half, and in Catholic centres to nearly three-fourths. In jurisprudence there was an increase of nearly two-fifths, in medicine a decline of a third, and in philosophy an increase of one-fourth.

Universities of United Provinces.

Leiden.

Franeker.

The universities of the United Provinces, like those of Protestant Germany, were founded by the state as schools for the maintenance of the principles of the Reformation and the education of the clergy, and afforded in the 16th and 17th centuries a grateful refuge to not a few of those Huguenot or Port-Royalist scholars whom persecution compelled to flee beyond the boundaries of France, as well as to the Puritan divines who were driven from England. The earliest, that of Leiden (in what was then the county of Holland), founded in 1575, commemorated the gallant and successful resistance of the citizens to the Spanish forces under Requesens. Throughout the 17th century Leiden was distinguished by its learning, the ability of its professors, and the shelter it afforded to the more liberal thought associated at that period with Arminianism. Much of its early success was owing to the wise provisions and the influence of the celebrated Janus Douza:—"Douza's principles," says Hamilton, "were those which ought to regulate the practice of all academical patrons; and they were those of his successors. He knew that at the rate learning was seen prized by the state in the academy, would it be valued by the nation at large. . . . He knew that professors wrought more even by example and influence than by teaching, that it was theirs to pitch high or low the standard of learning in a country, and that, as it proved easy or arduous to come up with them, they awoke either a restless endeavour after an even loftier attainment, or lulled into a self-satisfied conceit." Douza was, for Leiden and the Dutch, what Münchhausen afterwards was for Göttingen and the German universities. "But with this difference: Leiden was the model on which the younger universities of the republic were constructed; Göttingen the model on which the older universities of the empire were reformed. Both Münchhausen and Douza proposed a high ideal for the schools founded under their auspices; and both, as first curators, laboured with paramount influence in realizing this ideal for the same long period of thirty-two years. Under their patronage Leiden and Göttingen took the highest place among the universities of Europe; and both have only lost their relative supremacy by the application in other seminaries of the same measures which had at first determined their superiority." The appointment of the professors at Leiden was vested in three (afterwards five) curators, one of whom was selected from the body of the nobles, while the other two were appointed by the states of the province—the office being held for nine years, and eventually for life. With these was associated the mayor of Leiden for the time being. The university of Franeker was founded in 1585 on a somewhat less liberal basis than Leiden, the professors being required to declare their assent to the rule of faith embodied in the Heidelberg Catechism and the confession of the "Belgian Church." Its four faculties were those of theology, jurisprudence, medicine, and "the three languages and the liberal arts."[1] For a period of twelve years (*c.* 1610–22) the reputation of the university was enhanced by the able teaching of William Ames ("Amesius"), a Puritan divine and moralist who had been driven by Archbishop Bancroft from Cambridge and from England. His fame and ability are said to have attracted to Franeker students from Hungary, Poland and Russia.

Harderwijk.

Groningen.

Utrecht.

Ghent.

Liége.

With similar organization were founded the universities of Harderwijk (1600), Groningen (1614) and Utrecht (1634), the last-named being much frequented in the 18th century by both English and Scottish students who repaired thither to obtain instruction of a kind that Oxford and Cambridge at that time failed altogether to impart—more than a fourth of the students of Utrecht about the year 1736 being of those nationalities. In the 19th century, however, political considerations began seriously to diminish such intercourse between different centres, and during the first Napoleon's tenure of the imperial dignity the universities in both the "kingdom of Holland" and the Austrian Netherlands (as they were then termed) were in great peril. But on the settlement of Europe in 1814–15 the restoration of the house of Orange and consequent formation of the "kingdom of the Netherlands" brought both realms under a single rule. The universities of Franeker and Harderwijk were suppressed, and those of Ghent and Liége created, while a uniform constitution was given both to the Dutch and Belgian universities. It was also provided that there should be attached to each a board of curators, consisting of five persons, "distinguished by their love of literature and science and by their rank in society," to be nominated by the king, and at least three of them to be chosen from the province in which the university was situated, the other two from adjacent provinces. After the lapse of another fifteen years, however, the kingdom of the Netherlands having been reduced to its present limits and the kingdom of Belgium (identical for the most part with the Austrian Netherlands) newly created, an endeavour was made in dealing with the whole question of secondary education to give a fuller recognition to both traditional creeds and ethnic affinities. At Louvain, the chief Catholic centre, the faculties of law, medicine and philosophy had already, in 1788, been removed to Brussels —an almost unique example of a university which owed its origin neither to a temporal nor an ecclesiastical authority—and in 1834 Brussels was constituted a free and independent university with a new fourth faculty of natural science, and supported mainly by contributions from the Liberal party. Having, however, no charter, it continued incapable by law of possessing property. While Louvain and Brussels thus represented to a great extent the two chief political parties in the realm, the universities of Ghent on the Scheldt and Liége on the Meuse recruited their students mainly from the two chief races—the Flemish and the Walloon. In Holland, on the other hand, where no such marked racial differences exist, the universities of Groningen, Leiden and Utrecht have been assimilated (1876) in constitution, each being administered by a consistory of five rectors with a senate composed of the professors in the respective faculties. The foundation of the university of Amsterdam (1877) more than repaired the loss of Franeker and Harderwijk, and the progress of this new centre during the first ten years of its existence was remarkably rapid. The higher education of women has made some progress in the Netherlands.

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[1] *Statuta et Leges* (Franeker, 1647), p. 3.

Brussels.

Amsterdam.

Universities of Sweden and Norway.

Lund.

Upsala.

In Sweden the foundation of the university of Upsala, sanctioned in 1477 by Sixtus IV. as a studium generale on the model of Bologna, was followed at a long interval by that of Lund (1666), which was created during the minority of Charles XI. with statutes and privileges almost identical with those of Upsala and with an endowment largely derived from the alienated revenues of the chapter of the cathedral. The students were recruited from Denmark, Germany and Sweden; and Puffendorf, the civilian, was one of its first professors. During Charles's reign its resources were in turn confiscated, and the university itself was closed in 1676 in consequence of the war with Denmark. When again opened it remained for a long time in a very depressed condition, from which it failed to rally until the 19th century, when it took a new departure, and the erection of its handsome new buildings (1882) invested it with additional attractions. The royal university of Upsala, roused to new life in the 17th century by the introduction of the Cartesian philosophy, has been throughout (notwithstanding its singularly chequered history), the chief home of the higher Swedish education. In the 18th century lectures began to be delivered in Swedish; while the medieval division of the students into "nations" continued, as at Lund, until the second quarter of the 19th. The various changes and events during the interesting period 1872 to 1897 have been recorded at length in the national tongue by Reinhold Geijer in a handsome quarto which appeared in 1897. Gothenburg, on the other hand, with its society of science and literature, dating from 1841, has represented rather a popular institution, existing independently of the state, maintained chiefly by private contributions, and governed by a board called the *Curatorium*. For a long time it was not empowered to hold examinations. Stockholm (1878) still remains a gymnasium, but its curriculum is to a certain extent supplemented by its connexion with Upsala, from which it is little more than forty miles distant by rail. The university of Christiania in Norway, founded in 1811, and the Swedish universities are strongly Lutheran in character; and all alike are closely associated with the ecclesiastical institutions of the Scandinavian kingdoms. The same observation applies to Copenhagen—where, however, the labours of Rask and Madvig have done much to sustain the reputation of the university for learning.

Christiania.

Kiel.

The royal university of Kiel was founded in 1665 by Duke Christian Albrecht of Holstein (who himself assumed the office of rector) with faculties of theology, law, medicine and philosophy. It maintained its ground, although not without difficulty, amid the feuds that frequently arose between its dukes and the kings of Denmark, and under the rule of Catherine II. of Russia and after the incorporation of Schleswig-Holstein with the kingdom of Denmark made a marked advance. In the latter half of last century it acquired new buildings and rose into high reputation as a school of chemistry, physiology and anatomy, while its library in 1904 exceeded 250,000 volumes.

Genoa.

Messina.

Marseilles.

The number of universities founded in the last century is in striking contrast to the paucity which characterizes the two preceding centuries, an increase largely resulting, however, from the needs of English colonies and dependencies. In the Mediterranean, Genoa (1812), Messina (1838) and Marseilles (1854) were foundations which supplied a genuine want and have gradually attained to a fair measure of success. The first had previously existed as a school of law and medicine, but when, along with the rest of the Ligurian republic, it became incorporated in the empire under Napoleon I., the emperor, in order to conciliate the population, raised it to the rank of a university in 1812. The university subsequently fell into the hands of the Jesuits, who maintained their tenure of the principal chairs until the unification of the Italian kingdom under Victor Emmanuel, when Messina, which had been founded during the rule of the Bourbons over the Two Sicilies, became similarly included under Italian rule. Of Marseilles mention has above been made.

Dôle.

Dijon.

In France the fortunes of academic learning were even less happy than in Germany. The university of Dôle in Franche Comté had for two hundred years been a flourishing centre of higher education for the aristocracy, and was consequently regarded with envy by Besançon. In 1691, however, when the country had been finally ceded to France, and Savoy had been subjugated by the arms of Catina, Louis XIV. was induced, on the payment of a considerable sum, to transfer the university to Besançon. Here it forthwith acquired enhanced importance under the direction of the Jesuits. But in 1722, on the creation of a university at Dijon, the faculty of law was removed to that city, where it continued to exist until the Revolution.

University of Paris from the 17th century.

The university of Paris indeed was distracted, throughout the 17th century, by theological dissensions—in the first instance owing to the struggle that ensued after the Jesuits had effected a footing at the Collège de Clermont, and subsequently by the strife occasioned by the teaching of the Jansenists. Its studies, discipline and numbers alike suffered. Towards the close of the century a certain revival took place, and a succession of illustrious names—Pourchot, Rollin, Grenan, Coffin, Demontempuys, Crevier, Lebeau—appear on the roll of its teachers. But this improvement was soon interrupted by the controversies excited by the promulgation of the bull Unigenitus in 1713, condemning the tenets of Quesnel, when Rollin himself, although a man of singularly pacific disposition, deemed it his duty to head the opposition to Clement XI. and the French episcopate. At last, in 1762, the parlement of Paris issued a decree (August 6) placing the colleges of the Jesuits at the disposal of the university, and this was immediately followed by another for the expulsion of the order from Paris, the university being installed in possession of their vacated premises. Concurrently with this measure, the curriculum of prescribed studies assumed a more hopeful character, and both history and natural science began to be cultivated with a certain success. These innovations, however, were soon lost sight of in the more sweeping changes which followed upon the Revolution. On the 15th of September 1793 the universities and colleges throughout France, together with the faculties of theology, medicine, jurisprudence and arts, were abolished by a decree of the convention, and the whole system of national education may be said to have remained in abeyance, until, in 1808, Napoleon I. promulgated the scheme which in its essential features is almost identical with that which at present obtains—the whole system of education, both secondary and primary, being made subject to the control and direction of the state. In pursuance of this conception, the "university of France," as it was henceforth styled, became little more than an abstract term[1] signifying collectively the various centres of professional education in their new relations to the state. All France was divided into seventeen districts, designated "academies," each administered by its own rector and council, but subject to the supreme authority of the minister of public instruction, and representing certain faculties which varied at different centres in conformity with the new scheme of distribution for the entire country.

Lille, Lyons and Rennes.

Institution of "free faculties."

Aix-Marseille.

While, accordingly, three new "academies"—those of Lille, Lyons and Rennes—date their commencement from 1808, many of the pre-existing centres were *completely suppressed*. In some cases, however, the effacement of an ancient institution was avoided by investing it with new importance, as at Grenoble; in others, the vacated premises were appropriated to new uses connected with the department, as at Avignon, Cahors and Perpignan. Each rector of an "academy" was also constituted president of a local *conseil d'enseignement*, in conjunction with which he nominated the professors of lycées and the communal schoolmasters,[2] these appointments being subsequently ratified by a promotion committee sitting in Paris. In 1895, however, the government was prevailed upon to sanction the institution of certain "free faculties," as they were termed, to be placed under the direction of the bishop, and depending for support upon voluntary contributions, and each including a faculty of theology. The faculty at Marseilles, on the other hand, which originated in an earlier "faculty of sciences" founded in 1854, was now called upon to share the governmental grant with Aix, and the two centres became known as the Académie d'Aix-Marseille—the faculties in the latter being restricted to mathematics and natural science (including a medical school), while faculties of law and philosophy were fixed at Aix, which possesses also the university library properly so termed. In the capital itself, the university of Paris and the École Pratique des Hautes Études carried on the work of higher instruction independently of each other—the former with faculties of Protestant theology, law, medicine, science, letters and chemistry distributed over the Quartier Latin; the latter with schools of mathematics, natural science, history, philology, and history of religions centred at the Sorbonne.

Collège de France.

Strassburg.

The Collège de France, founded in the 16th century by Francis I., was from the first regarded with hostility both by the university and by the Sorbonne. It became, however, so highly esteemed as a school of gratuitous instruction in Latin, Greek and Hebrew, that it not only held its ground, but at the Revolution ultimately survived alike the universities and their hostility. As reconstituted in 1831 it became chiefly known as an institution for the instruction of adults, and its staff of professors, some fifty in number (including their deputies), has comprised from time to time the names of not a few of the most distinguished scholars and men of science in the country. The university of Strassburg, which in the latter part of the 18th century had been distinguished by an intellectual activity which became associated with the names of Goethe, Herder and others, was also swept away by the Revolution. It was revived in 1804 as a Protestant "academy," but four years later incorporated in the newly created "academy" of Nancy, with a faculty of Protestant theology which lasted only until 1818.

Switzerland.

Zürich.

Bern.

Lausanne.

Geneva.

Fribourg.

In Switzerland the universities shared in the conflicts handed down from the days when the Helvetic republic had been first created, and each with somewhat similar experiences. In 1832, Basel having joined the *Sarner Bund* or League of the Catholic Cantons, the Confederates divided the canton into two, and agreed to raise the flourishing Hochschule which already existed at Zürich to the rank of a university—a measure which may be said to mark a turning-point in the history of the higher education of the republic. In 1839, however, the teaching of D. F. Strauss, who had been installed in the chair of theology at Zürich soon after his expulsion from Tübingen, gave rise to a popular demonstration which not only brought about the overthrow of the governing body, but placed the existence of the university itself in jeopardy. But the storm was successfully weathered, and in 1859 the statutes were revised and a considerable addition made to the professoriate. The gymnasium of Bern, originally established under the teaching of Ulrich Zwingli, developed in 1834 into a university with all the faculties, those of medicine and philosophy rising with the advance of the century into high repute. As early as 1586 Lausanne had been a noted school for the education of Protestant ministers, but it was not until 1806 that chairs of philosophy and law were established, to which those of natural science and literature were added in 1836, and, somewhat later, that of medicine. It was not, however, until 1891 that Lausanne was formally constituted a university. At Geneva the famous academy of the 16th and 17th centuries, long distinguished as a centre of Calvinistic teaching, became merged in 1876 in a university, where the instruction (given mainly in the French language) was carried on by a staff of forty-one professors. With this was also incorporated an earlier school of science, in which De Saussure and De Candolle had once been teachers. Fribourg, founded in 1889 as a university of the canton so named, began with only two faculties—those of law and philosophy, to which one of theology was added in the following year. A certain spirit of innovation characterized most of the Swiss universities at this time, especially in connexion with female education. At Zürich, in 1872 (and somewhat later at Geneva and Bern), women were admitted to the lectures, and in 1892 were permitted themselves to lecture, a lady, Frau Dr Emilie Kempin, succeeding to the chair of Roman law. At Fribourg the proposition was first brought forward that all professors should be appointed only for a specified period, a limitation which along with other questions affecting the professorial body gave rise to much divergence of opinion.

Spain and Portugal.

Coimbra.

In Spain the act of 1857 introduced a radical change similar to that in France, the whole system of education being placed under the responsible control of the minister for that department, while the entire kingdom was at the same time divided into ten university districts—Madrid, Barcelona, Granada, Oviedo, Salamanca, Santiago, Seville, Valencia, Valladolid and Saragossa—the rector of the universities in each district representing the chief authority. The degrees to be conferred at each were those of bachelor, licentiate and doctor. Each university received a rector of its own, selected by the government from among the professors, and a precise plan of instruction was prescribed in which every hour had its appointed lecturer and subject. Philosophy, natural science, law and medicine were to be studied at all these universities, and at the majority a school of chemistry was subsequently instituted, except at Oviedo, which was limited to a faculty of law and a school for notaries. But at Salamanca, Valladolid, Seville and Saragossa no school of chemistry was instituted, and at the first three that of medicine ultimately died out. No provision was made for instruction in theology, this being relegated to the seminaries in the episcopal cities. The university of Manila in the Philippines was opened in 1601 as a school for the nobility, and ten years later the famous college of St Thomas was founded by the Dominican order; but it was not until 1857 that the university, properly speaking, was founded by royal Spanish decree. In Portugal, Coimbra, which narrowly escaped suppression in the 16th century and was removed from 1380 to 1537 to Lisbon, has long been a flourishing school. Its instruction is given gratis; but, as all members of the higher courts of judicature and administration in the realm are required to have graduated at the university, it is at the same time one of the most aristocratic schools in Europe. Of its five faculties, theology, jurisprudence, medicine, mathematics and philosophy, that of law is by far the most flourishing, the number of students in this faculty nearly equalling the aggregate of all the rest. In 1772 the university received new statutes and was to a great extent reorganized. There is a valuable library, largely composed of collections formerly belonging to suppressed convents. As a school of theology Coimbra has always been distinctly anti-ultramontane.

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[1] It retains a certain professional meaning, in that a student studying for the "university" is understood to be one who is himself aiming at the profession of a teacher in a *lycée*.

[2] The préfet of the department has since taken the place of the rector with regard to nominations.

Italy.

In Italy, as in Spain, education for the church has been relegated almost entirely to the numerous "seminaries," where it is of an almost entirely elementary character. In 1875 a laudable effort was made by R. Bonghi, the minister of education, to introduce reforms and to assimilate the universities in their organization and methods to the German type. His plans were, however, to a great extent reversed by his successor, Coppino.

Austria-Hungary.
Vienna.
Olmütz.
Graz.
Salzburg.
Lemberg.
Czernowitz.

In Austria the universities, being modelled on the same system as those of the German Empire, present no especially noteworthy features, except that the sphere of the functions of a rector corresponds precisely with that of the rector in those German universities which have no curator, and the faculties are represented by the ordinary professors as a body along with two representatives of the "Privatdozents." Vienna has long been chiefly distinguished for its school of medicine, which enjoyed in the last century a reputation almost unrivalled in Europe. The other faculties were, however, suffered to languish, and throughout the first half of the last century the whole university was in an extremely depressed state. From this condition it was in a great measure restored by the exertions of Count Thun. The university of Olmütz, founded in 1581, was formerly in possession of what is now the imperial library, and contained also a valuable collection of Slavonic works, which were carried off by the Swedes and ultimately dispersed. It was suppressed in 1853, and is now represented only by a theological faculty. The university of Graz, the capital of Styria, was founded in 1586, and has long been one of the most flourishing centres, with nearly 2000 students, chiefly in law and philosophy. The university of Salzburg, founded in 1623, was suppressed in 1810; that of Lemberg, founded in 1784 by the Emperor Joseph II., was removed in 1805 to Cracow and united to that university. In 1816 it was opened on an independent basis. In the bombardment of the town in 1848 the university buildings were burnt down, and the site was changed to what was formerly a Jesuit convent. The fine library and natural history museum were at the same time almost entirely destroyed. The most recent foundation is that of Czernowitz (1875), with faculties of theology (Greek Church), law and political economy, and philosophy.

Budapest.
Klausenburg.
Agram.
Debreczen.

The universities of the Hungarian kingdom are three in number:—Budapest, originally founded at Tyrnau in 1635 under the auspices of the Jesuits, now possessing four faculties—theology, jurisprudence, medicine and philosophy (number of professors in 1903, 180; students, 3223); Kolozsvar (Klausenburg), the chief Magyar centre, founded in 1872 and also comprising four faculties, but where mathematics and natural science supply the place of theology; Zágráb (Agram), the Slovack university, in Croatia, originally founded by Maria Theresa in 1776 from some suppressed schools of the Jesuits, and reopened in 1874 with three faculties, viz. jurisprudence, theology and philosophy. The chief centre of Protestant education is the college at Debreczen, founded in 1531, which in past times was not infrequently subsidized from England. It has faculties of law and theology, courses of instruction in philosophy, and a school for teachers, and possesses a fine library.

Japan.

In Japan there are two imperial universities—Tokyo (1868) and Kioto (1897)—the former representing the union of two pre-existing foundations, on which occasion it was placed under the control of the minister of instruction with yearly grants from the treasury. The ordinary course of studies was limited to three years, that of medicine being extended to four. Kioto was formed out of four previously existing colleges of law, medicine, science and engineering.

Athens.

The "National University" of Athens (founded May 22, 1837) was modelled on the university systems of northern Germany, on a plan originally devised by Professor Brandis. It originally included only four faculties, viz. theology, jurisprudence, medicine and philosophy, to which one of applied mathematics was subsequently added.

Turkey and Bulgaria.

In European Turkey the university of Jassy (1860) in Rumania was founded by its ruler, Prince Cuza, and together with the newly founded university of Bucharest received its completed organization in 1864. Both were constituted state institutions and were represented in the senate, although not receiving any fixed revenues from the government. Its students are instructed and examined gratuitously. In the university of Sophia (1888) in Bulgaria, faculties were established, in the course of the ensuing four years, of history, philology, physics, mathematics and jurisprudence, the main object in view being the training of competent teachers of schools and of lawyers, and affording them the means of gaining an intelligent insight into the real wants of the native population. The university of Constantinople was founded in 1900 at the jubilee festival in honour of the sultan's succession to the throne. It included five faculties and was placed under the control of a director and sub-director, the former being invested with authority over teachers and scholars alike.

The English universities since the medieval period.

The history of the two English universities during the 16th and following centuries has presented, for the most part, features which contrast strongly with those of the continental seats of learning. Both suffered severely from confiscation of their lands and revenues during the period of the Reformation, but otherwise have generally enjoyed a remarkable immunity from the worst consequences of civil and political strife and actual warfare. Both long remained centres chiefly of theological teaching, but their intimate connexion at once with the state and with the Church of England, as "by law established," and the modifications introduced into their constitutions, prevented their becoming arenas of fierce polemical contentions like those which distracted the Protestant universities of Germany.

Influence of the Renaissance.
The Reformation at Cambridge.

The influence of the Renaissance, and the teaching of Erasmus, who resided for some time at both universities, exercised a notable effect alike at Oxford and at Cambridge. The names of Colet, Grocyn and Linacre illustrate this influence at the former centre; those of Bishop Fisher, Sir John Cheke and Sir Thomas Smith at the latter. The labours of Erasmus at Cambridge, as the author of a new Latin version of the New Testament, with the design of placing in the hands of students a text free from the errors of the Vulgate, were productive of important effects, and the university became a centre of Reformation doctrine some years before the writings of Luther became known in England. The foundation of Christ's College (1505) and St John's College (1511), through the influence of Fisher with the countess of Richmond, also materially aided the general progress of learning at Cambridge. The Royal Injunctions of 1535, embodying the views and designs of Thomas Cromwell, mark the downfall of the old scholastic methods of study at both universities; and the foundation of Trinity College, Cambridge, in 1547 (partly by an amalgamation of two older societies), represents the earliest conception of such an institution in England in complete independence of Roman Catholic traditions. Trinity (1554) and St John's (1555) at Oxford, on the other hand, founded during the reactionary reign of Mary, serve rather as examples of a transitional period.

In the reign of Elizabeth Cambridge became the centre of another great movement—that of the earlier Puritanism, St John's and Queens' being the strongholds of the party led by Cartwright, Walter Travers and others. Whitaker, the eminent master of St John's, although he sympathized to some extent with these views, strove to keep their expression within limits compatible with conformity to the Church of England. But the movement continued to gather strength; and Emmanuel College, founded in 1584, owed much of its early prosperity to the fact that it was a known school of Puritan doctrine. Most of the Puritans objected to the discipline enforced by the university and ordinary college statutes—especially the wearing of the cap and the surplice and the conferring of degrees in divinity. The Anglican party, headed by such men as Whitgift and Bancroft, resorted in defence to a repressive policy, of which subscription to the Acts of Supremacy and Uniformity, and the Elizabethan statutes of 1570 (investing the "caput" with larger powers, and thereby creating a more oligarchical form of government), were the most notable results. Oxford, although the Puritans were there headed by Leicester, the chancellor, devised at the same time a similar scheme, the rigid discipline of which was further developed in the Laudian or Caroline statutes of 1636. It was under these respective codes—the Elizabethan statutes of 1570 and the Laudian statutes of 1636—that the two universities were governed until the introduction of the new codes of 1858. The fidelity with which both universities adhered to the royal cause in the Civil War caused them to be regarded with suspicion by the Puritan party, and under the Commonwealth both Oxford and Cambridge were for a brief period in great danger owing to the distrust, which culminated among the members of the "Nominated Parliament" (July–December 1653), of university education generally, as tending to foster contentiousness with respect to religious belief. It was even proposed by William Dell—himself the master of Caius College—to abolish the two universities altogether, as hopelessly pledged to antiquated and obsolete methods, and to establish in their place schools for the higher instruction throughout the country. They were saved, however, by the firmness of Cromwell, at that time chancellor of Oxford, and, although Aristotle and the scholastic philosophy no longer held their ground, a marked improvement was observable both in discipline and morality among the students, and the prescribed studies were assiduously pursued. At Oxford, under the influence and teaching of Dr Wilkins, Seth Ward and John Wallis, a flourishing school of mathematics was formed at a time when the study had died out at Cambridge.

Puritanism at Cambridge.

Elizabethan statutes of 1570.

Laudian statutes of 1636.

The Cambridge Platonist movement.

The Newtonian philosophy.

Methodism.

Simeonism.

Tractarianism.

Reforms of 1858.

After the Restoration Cambridge became the centre of a remarkable movement (a reflex of the influence of the Cartesian philosophy), which attracted for a time considerable attention. Its leaders, known as the Cambridge Platonists, among whom Henry More, Cudworth and Whichcote were especially conspicuous, were men of high character and great learning, although too much under the influence of an ill-restrained enthusiasm and purely speculative doctrines. The spread of the Baconian philosophy, and the example of a succession of eminent scientific thinkers, among whom were Isaac Barrow, master of Trinity (1673–77), the two Lucasian professors, Isaac Newton (prof. 1669–1702) and his successor William Whiston (prof. 1702–11), and Roger Cotes (Plumian prof. 1707–16), began to render the exact sciences more and more an object of study, and the institution of the tripos examinations in the course of the first half of the 18th century established the reputation of Cambridge as a school of mathematical science. At Oxford, where the study had in turn declined, and where the statutable requirements with respect to lectures and exercises were suffered to fall into neglect, the degeneracy of the whole community as a school of academic culture is attested by evidence too emphatic to be gainsaid. The moral tone at both universities was at this time singularly low; and the rise of Methodism as associated with the names of the two Wesleys and Whitefield at Oxford and that of Berridge at Cambridge, operated with greater effect upon the nation at large than on either of the two centres where it had its origin. With the advance of the next century, however, a perceptible change took place. The labours of Charles Simeon at Cambridge, in connexion with the Evangelical party, and the far more celebrated movement known as Tractarianism, at Oxford, exercised considerable influence in developing a more thoughtful spirit at either university. At both centres, also, the range of studies was extended: written examinations took the place of the often merely formal *viva voce* ceremonies; at Cambridge the study of the classics was raised in 1824 to the dignity of a new tripos. The number of the students at both universities increased, the matriculations at each rising to over four hundred. Further schemes of improvement were put forward and discussed. And in 1850 it was decided by the government to appoint commissioners to inquire what additional reforms might advantageously be introduced. Their recommendations were not all carried into effect, but the main results were as follows: "The professoriate was considerably increased, reorganized and re-endowed, by means of contributions from colleges. The colleges were emancipated from their medieval statutes, were invested with new constitutions, and acquired new legislative powers. The fellowships were almost universally thrown open to merit, and the effect of this was not merely to provide ample rewards for the highest academical attainments, but to place the governing power within colleges in the hands of able men, likely to promote further improvements. The number and value of scholarships were largely augmented, and many, though not all, of the restrictions upon them were abolished. The great mass of vexatious and obsolete oaths was swept away; and, though candidates for the M.A. degree and persons elected to fellowships were still required to make the old subscriptions and declarations, it was enacted that no religious test should be imposed at matriculation or on taking a bachelor's degree."[1]

Admission of non-collegiate students.

In 1869 a statute was enacted at Cambridge admitting students as members of the university without making it imperative that they should be entered at any hall or college, but simply be resident either with their parents or in duly licensed lodgings.

Abolition of tests.

The entire abolition of tests followed next. After being rejected on several occasions in parliament it was eventually carried as a government measure, and passed the House of Lords in 1871.

Reforms of 1877.

In 1877 the reports of two new commissions were followed by further changes, the chief features of which were the diversion of a certain proportion of the revenues of the colleges to the uses of the university, especially with a view to the encouragement of studies in natural science; the enforcement of general and uniform regulations with respect to the salaries, selection and duties of professors, lecturers and examiners; the abolition (with a few exceptions) of all clerical restrictions on headships or fellowships; and the limitation of fellowships to a uniform amount.

Affiliated universities and colleges.

That these successive and fundamental changes were on the whole in unison with the national wishes and requirements may fairly be inferred from the remarkable increase in numbers at both universities, especially at Cambridge, where the number of undergraduates, which in 1862 was 1526, rose in 1887 to 2979. In the academic year 1862–63 the number of matriculations was 448, and in 1906–7 1083. The following universities and colleges, twenty-two in number, have since, in the order of their enumeration, sought and received the privilege of affiliation: University College, Nottingham; university of Sheffield; university of Adelaide; St David's College, Lampeter; university of Calcutta; university college of Wales, Aberystwyth; university of New Zealand; university of the Cape of Good Hope; university of Allahabad; Punjab University; university of Bombay; university of Toronto; St Edmund's College, Ware; university of Madras; university of Sydney; M'Gill University, Montreal; university of Tasmania; university of New Brunswick; Hartley University

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[1] Brodrick, *University of Oxford*, pp. 136, 137.

College, Southampton; University College of South Wales and Monmouthshire, Cardiff; university of King's College, Windsor, Nova Scotia; university of Queen's College, Kingston, Ontario.

Further changes at Oxford and Cambridge.

The changes introduced by the legislation of 1877 have been gradually carried out as the occurrence of vacancies in the colleges has made possible the appropriation of portions of their revenue for the foundation of professorships and other university purposes, though in some cases the intentions of the commissioners have been frustrated by the effects of agricultural depression upon college revenues. The general effect of the revolution has been a marked diminution in the clerical character of the college teaching bodies, the conversion of the college teaching staff from a temporary employment for bachelors awaiting livings or other preferment into a permanent profession, and the growth of a resident and working university professoriate. At the same time a change of almost equal significance has taken place in the teaching system of the university through the gradual growth of "inter-collegiate lectures." At Oxford nearly all honour lectures given by college tutors and lecturers have been thrown open to all members of the university: the college tutor is now recognized by the university as a teacher in the faculty to which he belongs, and the institution of boards of faculties has done something to bring the organization of the university into harmony with that of universities outside the British Isles.[1] At Cambridge the system of inter-collegiate lectures has also developed itself, but to a considerably smaller extent. At both the old English universities the great widening of the courses of study open to senior students (honour men), which began about the middle of the 19th century, has been continued, while there has been some widening and modernizing of the studies by which a pass or "poll" degree can be obtained. At Oxford there are now the following "Final Honour Schools": Litterae Humaniores (Classics, Ancient History and Philosophy), Mathematics, Natural Science, Jurisprudence, Modern History, Theology, Oriental Languages, English Literature; and at Cambridge there are the following "Triposes": Mathematics, Classics, Moral Sciences, Natural Sciences, Theology, Law, History, Oriental Languages, Medieval and Modern Languages, Mechanical Sciences (Engineering). Degrees in letters and science have also been instituted at both Oxford and Cambridge. The doctorate is given for original work. At Oxford the B.Litt. and B.Sc. can be taken by dissertation or original research, without passing the examination for B.A. At Cambridge the B.A. can be obtained in a similar manner by advanced students.

The strenuous efforts of both universities fully to meet the constantly increasing requirements of scientific education have necessitated appeals for public aid which have met with much generous response. Among the latest instances is that of the late Sir W. G. Pearce, who appointed to Trinity College, Cambridge, a certain trust fund over which he had a general power of appointment, and also bequeathed to the society the residue of a considerable estate.

Durham.

So long ago as the year 1640 an endeavour had been made to bring about the foundation of a northern university for the benefit of the counties remote from Oxford and Cambridge. Manchester and York both petitioned to be made the seat of the new centre. Cromwell, however, rejected both petitions, and decided in favour of Durham. Here he founded the university of Durham (1657), endowing it with the sequestered revenues of the dean and chapter of the cathedral, and entitling the society "The Mentor or Provost, Fellows and Scholars of the College of Durham, of the foundation of Oliver, &c." This scheme was cancelled at the Restoration, and not revived until the present century; but on the 4th July 1832 a bill for the foundation of a university at Durham received the royal assent, the dean and chapter being thereby empowered to appropriate an estate at South Shields for the establishment and maintenance of a university for the advancement of learning. The foundation was to be directly connected with the cathedral church, the bishop of the diocese being appointed visitor, and the dean and chapter governors; while the direct control was vested in a warden, a senate and a convocation. A college, modelled on the plan of those at the older universities, and designated University College, Durham, was founded in 1837, Bishop Hatfield's Hall in 1846, and Bishop Cosin's Hall (which no longer exists) in 1851. The university includes all the faculties, and in 1865 there was added to the faculty of arts a school of physical science, including pure and applied mathematics, chemistry, geology, mining, engineering, &c. In 1871 the corporation of the university, in conjunction with some of the leading landed proprietors in the adjacent counties, gave further extension to this design by the foundation of a college of physical science at Newcastle-upon-Tyne (subsequently designated Armstrong College), designed to teach scientific principles in their application to engineering, mining, manufactures and agriculture. Students who had passed the required examinations were made admissible as associates in physical science of the university. There is also at Newcastle the College of Medicine which stands in similar relations to Durham, of which university Codrington College, Barbados, and Fourah Bay College, Sierra Leone, are likewise affiliated colleges.

University of London.

The university of London had its origin in a movement initiated in the year 1825 by Thomas Campbell, the poet, in conjunction with Henry (afterwards Lord) Brougham, Mr (afterwards Sir) Isaac Lyon Goldsmid, Joseph Hume and some influential Dissenters, most of them connected with the congregation of Dr Cox of Hackney. The scheme was originally suggested by the fact that Dissenters were practically excluded from the older universities; but the conception, as it took shape, was distinctly non-theological. The first council, appointed December 1825, comprised names representative of nearly all the religious denominations, including (besides those above mentioned) Zachary Macaulay, George Grote, James Mill, William Tooke, Lord Dudley and Ward, Dr Olinthus Gregory, Lord Lansdowne, Lord John Russell and the duke of Norfolk. On 11th February 1826 the deed of settlement was drawn up; and in the course of the year seven acres, constituting the site of University College, were purchased, the foundation stone of the new buildings being laid by the duke of Sussex 30th April 1827. The course of instruction was designed to include "languages, mathematics, physics, the mental and the moral sciences, together with the laws of England, history and political economy, and the various branches of knowledge which are the objects of medical education." In October 1828 the college was opened as the university of London. But in the meantime a certain section of the supporters of the movement, while satisfied as to the essential soundness of the primary design as a development of national education, entertained considerable scruples as to the propriety of altogether dissociating such an institution from the national church. This feeling found expression in the foundation and incorporation of King's College (14th August 1829), opened 8th October 1831, and designed to combine with the original plan instruction in "the doctrines and duties of Christianity, as the same are inculcated by the United Church of England and Ireland." This new phase of the movement was so far successful that in 1836 it was deemed expedient to dissociate the university of London from University College as a "teaching body," and to limit its action simply to the institution of examinations and the conferring of degrees—the college itself receiving a new charter, and being thenceforth designated as University College, London, while the rival institution was also incorporated with the university, and was thenceforth known as King's College, London. In the charter now given to the university it was stated that the king "deems it to be the duty of his royal office to hold forth to all classes and denominations of his faithful subjects, without any distinction whatsoever, an encouragement for pursuing a regular and liberal course of education." The charters of the university of London and of University College, London, were signed on the same day, 28th November 1836. In 1869 both the colleges gave their adhesion to the movement for the higher education of women which had been initiated elsewhere, and in 1880 women were for the first time admitted to degrees.

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[1] The proposed reforms initiated by Lord Curzon as chancellor of Oxford University, though largely administrative, may be mentioned here. In 1909 he issued his "Principles and Methods of University Reform." Committees of Council were formed to prepare definite schemes in the various directions indicated, and in 1910 a volume on the subject was issued to the members of Congregation. It was proposed, *inter alia*, to make Greek an optional subject in Responsions, thus foreshadowing changes in Moderations and final schools. Responsions itself was to be replaced by an entrance examination, though it has long practically served as such. The creation of "a diploma specially suitable for candidates contemplating a commercial career" was recommended. Additional provision to assist poor students, including the resignation of their emoluments by non-necessitous students in favour of exhibition funds for necessitous students in the colleges, and changes in the system of college fellowships, with especial reference to the encouragement of research in combination with tutorial work, were also indicated. Among purely administrative reforms, besides certain changes in the rules governing eligibility to the Hebdomadal Council and Congregation, it was proposed to reconstitute the method of election to and membership of the boards of faculties, at the same time creating a general board of the faculties, to control the individual boards, and to "relieve the Hebdomadal Council of the greater part of the business connected with *curricula* and examinations." A finance board was proposed to review the accounts of the university, all university institutions and colleges, and to act in an advisory and supervisory capacity.—[ED.]

By the University of London Act 1898, and the statutes of the commissioners named therein (issued in 1900), the university of London was reconstituted. The senate is composed of the chancellor and fifty-four members, of whom four are appointed by the king in council, sixteen by the convocation (*i.e.* doctors and proctors) of the university, sixteen by the various faculties, and the remainder by various public bodies or institutions. The senate is the supreme governing body, and has three standing committees, of which one is the academic council for "internal students," another the council for "external students" and the third a board to promote the extension of university teaching. Provision is made for the appointment of professors and other teachers by the university itself, and also for the recognition as teachers of professors and others teaching in such institutions in or near London as may be recognized as schools of the university. The following bodies are constituted schools of the university: University College and King's College, London; the Royal Holloway College, Egham, Bedford College, London, and Westfield College, Hampstead (colleges for women); the Imperial College of Science and Technology; the medical schools of the principal London hospitals, the London School of Economics and Political Science; the South-Eastern Agricultural College, Wye; the Central Technical College of the City and Guilds of London Institute, and the East London College; and several theological colleges. The "appointed" and "recognized" teachers in each group of subjects form the various faculties of the university. Of these there are eight—theology, arts, law, music, medicine, science, engineering, economics and political science (including commerce and industry). Each faculty elects its dean. Courses of study are to be provided by the university for its "internal" students, *i.e.* those who pursue their studies in one of the schools of the university. Its degrees remain open to "external" students as heretofore, but separate examinations are in future to be held for "internal" and for "external" students respectively, and the senate is to "provide that the degrees conferred upon both classes of students shall represent, as far as possible, the same standard of knowledge and attainments." The whole scheme may be described as a compromise between the views of various schools of reformers—as an attempt to create a teaching university without destroying the existing purely examining university or erecting two distinct universities of London, and at the same time, without any immediate endowments, to create a university which might hereafter expand by utilizing existing institutions. One of the most important of these, King's College, it may be observed, has, without losing its connexion with the Church of England, abandoned its theological test for members of its teaching body.

The Owens College, Manchester—so called after a wealthy citizen of that name, to whom it owed its foundation—was founded on the 12th of March 1851, for the purpose of affording to students who were unable, on the ground of expense, to resort to Oxford or Cambridge, an education of an equally high class with that given at those centres. The institution was, from the first, unsectarian in character; and, for more than a quarter of a century, students desirous of obtaining a university degree availed themselves of the examinations conducted by the university of London. In July 1877, however, a memorial was presented to the privy council petitioning for the grant of a charter whereby the college should be raised to the rank of a university with power to grant degrees. This petition having received a favourable hearing, it was at first decided that the new university should be styled the university of Manchester, and the New University College at Liverpool and the Yorkshire College at Leeds were invited to become affiliated institutions. But before the charter was issued, exception having been taken to the localization implied in the above title, it was resolved that the new institution should be styled the "Victoria University of Manchester," and under this name the university on the 20th of April 1880 received its charter. Since then, however, not only Liverpool (1881) and Leeds (1904), but the Mason University College at Birmingham (1900) and the University College at Sheffield (1905) have aspired to and attained like independence. The academic authorities at Manchester have accordingly since preferred, in other than legal documents, to revert to the original designation of the "university of Manchester."

The university of Manchester.

Changes in universities of Scotland.

In Scotland the next change to be noted in connexion with the university of St Andrews is the appropriation in 1579 of the two colleges of St Salvator and St Leonard to the faculty of philosophy, and that of St Mary to theology. In 1747 an act of parliament was obtained for the union of the two former colleges into one, while in 1880 the university college at Dundee was instituted as a general school both of arts and science in similar connexion. Glasgow, in the year 1577, received a new charter, and its history from that date down to the Restoration was one of almost continuous progress. The re-establishment of episcopacy, however, involved the alienation of a considerable portion of its revenues, and the consequent suspension of several of its chairs. With the Revolution of 1689 it took a new departure, and several additional chairs were created. In 1864 the old university buildings were sold, and a government grant having been obtained, together with private subscriptions, new buildings were erected from the joint fund. By the act of 1858 important measures were passed in connexion with all the four universities. In Aberdeen, King's College and Marischal College, with their independent powers of conferring degrees, were amalgamated. In Glasgow the distribution of the "nations" was modified in order more nearly to equalize their respective numbers. The right of returning two members of parliament was bestowed on the four universities collectively—one representing Aberdeen in conjunction with Glasgow, the other Edinburgh in conjunction with St Andrews. Other important changes were enacted, which, however, became merged in turn in those resulting from the commission of 1889, whereby, after investigations extending over nearly ten years, a complete transformation was effected of both the organization and the curriculum of each university.

The government was transferred from the senatus to the courts, which were enlarged so as to include representatives from the senatus, the general councils of graduates, and the municipality within which the university is situated. In addition to these representatives, the principal, the lord rector, his assessor, the chancellor's assessor, and the lord provosts of the cities of Aberdeen, Edinburgh and Glasgow, and the provost of St Andrews have seats in the courts of their respective universities. The provost of Dundee occupies a seat in the university court of St Andrews. The lord rector is the president of the court. To the court is entrusted the management of the property and finances, and, in most cases, such patronage as does not belong to the crown; but in the case of Edinburgh, the patronage of some of the older chairs is in the hands of a body of curators. Disciplinary powers are retained by the senatus, and the general council remains, as under the act of 1858, a purely advisory body. Another advisory body—the students' representative council—was added by the commission. The curriculum of all the faculties (except divinity) was reorganized: the most important alterations consisted in the abolition of the once sacred six as compulsory subjects in arts (Latin, Greek, Mathematics, Natural Philosophy, Logic and Moral Philosophy).[1] The curriculum was greatly widened, an elaborate scheme of "options" introduced, and a new system of honours degrees was established. The length of residence required was reduced from four years to three, and the courts were empowered to institute summer sessions, and to admit women to lectures and degrees in all faculties.

There has been since the act of 1858 a great development of student life, illustrated by the institution of student's unions in all four universities, by the publication of undergraduate magazines, and by the growth, in Edinburgh, of combined residences and settlements.

Parliamentary grants to Scottish universities.

All the four universities of Scotland were aided from time to time in the last century by grants from government, and in 1905 received a material addition to their resources by the magnificent donation of £2,000,000 from Mr Carnegie.

Trinity College, Dublin.

Trinity College, Dublin, was founded in 1591, under the auspices of Sir John Perrot, the Irish viceroy. A royal charter nominated a provost and a minimum number of three fellows and three scholars as a body corporate, empowered to establish among themselves "whatever laws of either of the universities of Cambridge or Oxford they may judge to be apt and suitable; and especially that no other persons should teach or profess the liberal arts in Ireland without the queen's special licence." The first five provosts of Trinity College were all Cambridge men, and under the influence of Archbishop Loftus, the first provost, and his successors, the foundation received a strongly Puritan bias. The original statutes were mainly the work of Temple, the fourth provost, modified by Bedell, the eminent bishop of Kilmore, and the policy of Laud and Wentworth was to make the college more distinctly Anglican as regards its tone and belief. At the Restoration its condition was found to be that of a well-ordered home of learning and piety, with its estates well secured and its privileges unimpaired. Under Bishop Jeremy Taylor, who succeeded to the vice-chancellorship, its progress in learning was considerable, and the statutes underwent a further modification. Prior to the year 1873 the provostship, fellowships and foundation scholarships could be held only by members of the Church of Ireland; but all such restrictions were abolished by Act 36 Vict. c. 21, whereby the requirement of subscription to any article or formulary of faith was finally abrogated.

Queen's University.

Royal University of Ireland.

Colleges at Belfast, Cork, and Galway.

University of Dublin.

The first departure from the above exclusive system dates from the creation of the Queen's University, incorporated by royal charter on the 3rd of September 1850. By this charter the general legislation of the university, together with its government and administration, was vested in the university senate. In 1864 the charter of 1850 was superseded by a supplementary charter, and the university reconstituted "in order to render more complete and satisfactory the courses of education to be followed by students in the colleges"; and finally, in 1880, by virtue of the act of parliament known as the University Education (Ireland) Act 1879, the Queen's University gave place to the Royal University of Ireland, which was practically a reconstitution of the former foundation, the dissolution of the Queen's University being decreed so soon as the newly constituted body should be in a position to confer degrees; at the same time all graduates of the Queen's University were recognized as graduates of the new university with corresponding degrees, and all matriculated students of the former as entitled to the same status in the latter. The university confers degrees in arts (B.A., M.A., D.Litt.), science, engineering, music, medicine, surgery, obstetrics and law. The preliminary pass examinations in arts were to be held at annually selected centres,—those chosen in 1885 being Dublin, Belfast, Carlow, Cork, Galway, Limerick and Londonderry—all honour examinations, and all examinations in other faculties, in Dublin. The Queen's Colleges at Belfast, Cork and Galway were founded in December 1845, under an act of parliament "to enable Her Majesty to endow new colleges for the advancement of learning in Ireland," and were subsequently incorporated as colleges of the university. Their professors were at the same time constituted professors in the university, and conducted the examinations. But in the reconstruction of 1880 the chief share in the conduct of the examinations and advising the senate with respect to them was vested in a board of fellows, elected by the senate in equal numbers from the non-denominational colleges and the purely Roman Catholic institutions. The colleges retained, however, their independence, being in no way subject to the control of the university senate except in the regulations with respect to the requirements for degrees and other academic distinctions. In 1907 a scheme was projected by Mr Bryce (then chief secretary for Ireland) for reconstructing the university, whereby Trinity College was to become merged in a new "University of Dublin," in which the Queen's Colleges and a new college for Roman Catholics were also to be included. The control of the entire community was to be vested in a board, partly nominated by the crown and partly by the colleges and the general body of students. The scheme, however, was strongly opposed by the Dublin University Defence Committee on the ground that the ideals which had hitherto dominated the aims and teaching of Trinity College were incompatible with a system in which regard for the principle of authority and the repudiation of scientific theorization (as it finds expression in the *Index*) are leading features. On the other hand, the Irish bishops, while admitting the need for more efficient scientific instruction of the Catholic youth throughout their respective dioceses, declined to give support to measures whereby such students would be attracted into an atmosphere inimical to their religious faith. It was consequently next proposed by the government to establish two new universities—one in Dublin (side by side with Trinity College) and one in Belfast—in which, although no religious tests were to be enforced, it should be tacitly agreed that the former was to be the resort for Catholics, the latter for Presbyterians, Trinity College remaining, as before, the recognized Episcopalian centre. To this considerable exception was taken—the nonconformists, more especially, maintaining that such an arrangement could not fail to be prejudicial to the higher interests of the people by imparting to education a denominational bias which it was most desirable to avoid—and eventually Mr Birrell's measure was brought forward and ultimately adopted, whereby Trinity College has been left intact, but two new universities were created, one in Dublin and one in Belfast, the former involving the erection of another college (towards the expense of which the government was pledged to contribute) and the incorporation of the Queen's Colleges at Cork and Galway; while the college in Belfast was to form the nucleus of the second university. In order further to ensure their representative character, the new university of Dublin had a nominated senate of 36 members, of whom all but seven were to be Roman Catholics; that of Belfast had a similar body, of whom all but one were to be Protestants. In all these new centres there were to be no religious tests either for professors or students. On the other hand, the obligation formerly imposed of a preliminary course of study at one or other of the colleges before admission to degrees had been abolished at the foundation of the Royal University, the examinations being now open, like those of the university of London, to all matriculated students on payment of certain fees.

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[1] At Edinburgh there was a *seventh*, viz. rhetoric and English literature.

Wales.

The university of Wales, which received the royal charter in 1893, incorporated three earlier foundations—the university colleges of Aberystwyth, Bangor and Cardiff. St David's College at Lampeter was founded in 1822 for the purpose of educating clergymen in the principles of the established Church of England and Wales, mainly for the supply of the Welsh dioceses, but, although affiliated to both Oxford and Cambridge, retained its independence and also the right of conferring the degrees of bachelor of arts and of divinity. Bangor in North Wales, on the other hand, which received its charter in 1885, is designed to "provide instruction in all the branches of a liberal education except theology."

India.

In India the three older universities all date from 1857—that of Calcutta having been incorporated January 24, Bombay July 18, Madras September 5, in that year. At these three universities the instruction is mainly in English. "A university in India is a body for examining candidates for degrees, and for conferring degrees. It has the power of prescribing text-books, standards of instruction, and rules of procedure, but is not an institution for teaching. Its governance and management are vested in a body of fellows, some of whom are *ex officio*, being the chief European functionaries of the state. The remainder are appointed by the Government, being generally chosen as representative men in respect of eminent learning, scientific attainment, official position, social status or personal worth. Being a mixed body of Europeans and natives, they thus comprise all that is best and wisest in that division of the empire to which the university belongs, and fairly represent most of the phases of thought and philosophic tendencies observable in the country. The fellows in their corporate capacity form the senate. The affairs of the university are conducted by the syndicate, consisting of a limited number of members elected from among the fellows. The faculties comprise arts and philosophy, law, medicine and civil engineering. A degree in natural and physical science has more recently been added" (Sir R. Temple, *India in 1880*, p. 145). The Punjab University was incorporated in 1883—the Punjab University College, prior to that date, having conferred titles only and not degrees. The main object of this university is the encouragement of the study of the Oriental languages and literature, and the rendering accessible to native students the results of European scientific teaching through the medium of their own vernacular. The Oriental faculty is here the oldest, and the degree of B.O.L. (bachelor of Oriental literature) is given as the result of its examinations. At the Oriental College the instruction is given wholly in the native languages, and the success of the institution was sufficiently demonstrated before the close of the 19th century by the fact that twelve centres of instruction at Lahore and elsewhere had been affiliated. The university of Allahabad was founded in 1887 as an examining university for the united provinces of Agra and Oudh. In 1887 the senate at Cambridge (mainly on the representations of Mr C. P. Ilbert, formerly vice-chancellor of the university of Calcutta) adopted resolutions whereby some forty-nine collegiate institutions already affiliated to the latter body were affiliated to the university of Cambridge, their students becoming entitled to the remission of one year in the requirements with respect to residence at Cambridge.

Australasia.

In Australia the university of Sydney was incorporated by an act of the colonial legislature which received the royal assent 9th December 1851, and on 27th February 1858 a royal charter was granted conferring on graduates of the university the same rank, style and precedence as are enjoyed by graduates of universities within the United Kingdom. Sydney is also one of the institutions associated with the university of London from which certificates of having received a due course of instruction may be received with a view to admission to degrees. The design of the university is to supply the means of a liberal education to all orders and denominations, without any distinction whatever. An act for the purpose of facilitating the erection of colleges in connexion with different religious bodies was, however, passed by the legislature during the session of 1884, and since that time colleges representing the Episcopalian, Presbyterian and Roman Catholic Churches have been founded. In the same year women were first admitted to degrees, and subsequently became an appreciable element, numbering before the close of the 19th century one-fifth of the entire number of students. The university of Melbourne, in the state of Victoria, was incorporated and endowed by royal act on the 22nd of January 1853. This act was amended on the 7th of June 1881. Here also no religious tests are imposed on admission to any degree or election to any office. The council is empowered, after due examination, to confer degrees in all the faculties (excepting divinity) which can be conferred in any university within the British dominions. It is also authorized to affiliate colleges; and, Trinity College (Church of England), Ormond College (Presbyterian) and Queen's College (Methodist) were all established in the 19th century. The university of Adelaide in South Australia (founded mainly by the exertions and munificence of Sir Walter Watson Hughes) was incorporated by an act of the colonial legislature in 1874, in which year it was further endowed by Sir Thomas Elder. In 1881 degrees conferred by the university were constituted of equal validity with those of any university of the United Kingdom. The university of Tasmania at Hobart was founded in 1890 by act of parliament as a state university with an annual grant, and was subsequently affiliated both to Oxford and Cambridge.

The university of New Zealand, founded in 1870, and reconstituted in 1874 and 1875, was empowered by royal charter to grant the several degrees of bachelor and master of arts, and bachelor and doctor in law, medicine and music. Women have since been made admissible to degrees. To this university, University College at Auckland, Canterbury College at Christchurch, and the university of Otago at Dunedin have successively been admitted into connexion as affiliated institutions, while the university of New Zealand itself has become affiliated to that of Cambridge. Otago was founded in 1869 by an order of the provincial council, with the power of conferring degrees in arts, medicine and law, and received as an endowment 100,000 acres of pastoral land. It was opened in 1871 with a staff of three professors, all in the faculty of arts. In 1872 the provincial council further subsidized it by a grant of a second 100,000 acres of land, and the university was thereby enabled to establish a lectureship in law, and to lay the foundations of a medical school. In 1874 an agreement was made between the university of New Zealand and that of Otago, whereby the functions of the former were restricted to the examination of candidates for matriculation, for scholarships and for degrees; while the latter bound itself to become affiliated to the university of New Zealand and to hold in abeyance its power of granting degrees. As the result of this arrangement, the university of Otago became possessed of 10,000 acres of land which had been set apart for university purposes in the former province of Southland. In 1877 a school of mines was established in connexion with the university.

Canada.

Prior to the union of the two provinces of Lower and Upper Canada, the M'Gill College and University in the former province had been instituted in Montreal by royal charter in 1821, on the foundation of the Honourable James M'Gill, who died in that city on the 19th of December 1813. It was designed to be Protestant but undenominational. With this a group of colleges in the same province—the Stanstead Wesleyan, Vancouver, Victoria, and King's—have since become associated as affiliated institutions, as also have the four Protestant colleges in Montreal itself, such affiliation, however, extending no further than the examinations in the faculty of arts. Into similar relation the Université Laval in Quebec, founded as a Catholic university in 1852, was admitted in 1878. Notwithstanding the difficulties presented by divergencies of race, Montreal has prospered during the chancellorship of Lord Strathcona, and numbers over 1100 students. The university of Toronto in Upper Canada, or Ontario, was originally established by royal charter in 1827, under the title of King's College, with certain religious restrictions, but in 1834 these restrictions were abolished. In 1849 the designation of the university was changed into that of the university of Toronto, and the faculty of divinity was abolished. In 1853 the university was constituted with two corporations, "the university of Toronto" and "University College," the latter being restricted to the teaching of subjects in the faculty of arts. In 1873 further amendments were made in the constitution of the university. The chancellor was made elective for a period of three years by convocation, which was at the same time reorganized so as to include all graduates in law, medicine and surgery, all masters of arts, and bachelors of arts of three years' standing, all doctors of science, and bachelors of science of three years' standing. The powers of the senate were also extended to all branches of literature, science and the arts, to granting certificates of proficiency to women, and to affiliating colleges. The whole work of instruction was now assigned to University College, which is maintained out of the endowment of the provincial university, and governed by a council composed of the residents and the professors. Its several chairs include classical literature, logic and rhetoric, mathematics and natural philosophy, chemistry and experimental philosophy, history and English literature, mineralogy and geology, metaphysics and ethics, meteorology and natural history, and lectureships on Oriental literature, German and French. Trinity College, in the same university, is the Church of England college, founded in 1852 in consequence of the abovementioned suppression of the theological faculty. Other universities and colleges with power to confer degrees are the Dalhousie College at Halifax, which obtained the rights of a university in 1841 and was subsequently organized as such in 1863, with the governor of Nova Scotia as supreme authority; the Victoria University at Cobourg (1836), supported by the Methodist Church of Canada; Queen's University, Kingston (1841).

In South America the beginning of the "national university" of Buenos Aires may be assigned (in the absence of any charter) to about the year 1890. Before the close of the century it had become a flourishing school of law, medicine and the exact sciences,

South America.

with professors in all the faculties and considerably over 2000 students. Monte Video in Uruguay had its origin in a faculty of medicine established in 1876, with courses of study extending over six years. It is here imperative when the diploma is taken by those who are not natives that it should be attested by the consul of their own country. Faculties of law and mathematics were subsequently created, and also a faculty of preparatory studies corresponding with the gymnasium or *Realschule* of Germany. The new "national university of La Plata" has recently (1905–1908) been opened in the city of that name, under the auspices of the university of Philadelphia. It claims to be the exponent of the most advanced theories in relation to subjects and methods of instruction and to university extension. In the north of the continent the academy at Caracas is little more than a branch of the royal Spanish academy for education in the Spanish language, and is subsidized by the Venezuelan government.

South Africa.

The university of the Cape of Good Hope (see CAPE COLONY) grants degrees, but is not a teaching institution. An inter-state commission, appointed in 1907, recommended the establishment of a Federal University for South Africa with constituent colleges. While the colleges would possess freedom in management and teaching, it was recommended that the university should test all candidates seeking admission to the colleges and for the final examinations for degrees, &c. At the opening of the first Union parliament in November 1910 the ministry announced that a scheme for a national South African University would be submitted. It was also announced that the Beit bequest of £200,000 for a university at Johannesburg (*q.v.*) would be diverted towards the creation of a teaching university at Groote Schuur, and that Sir Julius Wernher would make a donation towards it of £300,000.

In 1903 a highly influential conference was held at Burlington House to promote closer relations between British and colonial universities, the sittings being presided over by Mr Bryce, Lord Strathcona and Sir Gilbert Parker. The conference held that Great Britain should help the colonial universities to co-operate one with another, and increase their own efficiency by combination and specialization. (J. B. M.)

Universities in the United States.

Origins.

In the United States the word "university" has been applied to institutions of the most diverse character, and it is only since 1880 or thereabouts that an effort has been seriously made to distinguish between collegiate and university instruction; nor has that effort yet completely succeeded. Harvard, William and Mary, and Yale, the three pioneers of colonial times, were organized in the days of colonial poverty, on the plans of the English colleges which constitute the universities of Oxford and Cambridge. Graduates of Harvard and Yale carried these British traditions to other places, and similar colleges grew up in New York, New Jersey, Pennsylvania, New Hampshire and Rhode Island, and later in many other states. The underlying principle in these institutions was discipline—mental, moral and religious. Dormitories and commons were provided, and attendance upon religious worship in the chapel was enforced. Harvard and Yale were the children of the Congregational churches, Columbia was fostered by the Episcopalians, Princeton by the Presbyterians, Rutgers by the Dutch Reformed and Brown by the Baptists. Around or near these nuclei, during the course of the 19th century, one or more professional schools were frequently attached, and so the word "university" was naturally applied to a group of schools associated more or less closely with a central school or "college." Harvard, for example, most comprehensive of all, has seventeen distinct departments, and Yale has almost as many. Columbia and Pennsylvania have a similar scope. In the latter part of the 19th century Yale, Columbia, Princeton and Brown, in recognition of their enlargement, formally changed their titles from colleges to universities. The ecclesiastical, or religious, note was a strong characteristic of these foundations. Protestant evangelical doctrines were taught with authority, especially among the undergraduates, who were spoken of as constituting "the college proper." In the oldest and largest colleges this denominational influence has ceased to have the importance it once possessed.

Noteworthy innovations came when Thomas Jefferson, the philosophical statesman, returned to the United States from France, emancipated from some of the narrow views by which his countrymen were bound. He led the Virginians to establish, on a new plan, the university of Virginia as a child of the state; and the freshness of his advice, the importation of distinguished foreign teachers, and the freedom of the student from an enforced curriculum awakened admiration and emulation on the one hand, and animadversion on the other. But this university unquestionably led to broad conceptions of academic work, which appeared foreign and even questionable, if not irreligious, to the colonial universities already mentioned, although many of the features which were then regarded as doubtful peculiarities are now familiar everywhere. Following Virginia's example, many of the new states in the West established state universities, most of which included a central college of the colonial type and afterwards one or more professional schools. Freedom from ecclesiastical control is found in all the foundations that make up this second group—the state universities. Michigan, Wisconsin, Minnesota and California present distinguished examples of such organizations. In earlier days, Maryland, North and South Carolina, Georgia and other states of the South had anticipated in a limited way the state support of higher education which was made so conspicuous in Virginia. In their plans of education, intellectual and moral, they adhered closely to the college methods which the Northern institutions had introduced from English antecedents. Since 1865 another class of universities has arisen, quite distinct from the colonial establishments and from the wards of the state. These are independent foundations due to individual generosity. The gifts of Cornell, Johns Hopkins, Rockefeller (University of Chicago), Tulane, De Pauw, Clark and Leland Stanford have brought into being universities which have no dependence upon state control,[1] and when a denominational character is assured this fact is not made prominent.

Thus, looking at their origin, we see three impulses given to American high schools, from churches, states and individuals. It is true that all receive from the state some degree of authority as incorporations, but this authority is so easily obtained that in a single city there may be, and in some places there are, several incorporations authorized to bestow degrees and to bear the name of universities. A foreigner cannot understand nor can an American justify this anomaly. The most that can be said for it is that there is complete freedom of organization, and that the best, and only the best, are likely to survive. Another influence, proceeding from the national government, must also be borne in mind. During the Civil War, Congress, led by Senator Morrill of Vermont, bestowed upon every state a certain portion of the public domain in the Far West—"land-scrip," as it was called—the proceeds of its sale to be devoted to the establishment and maintenance of one or more colleges in each state, where instruction should be given in agriculture and the mechanic arts, not excluding liberal studies, and including military tactics. In some states this bounty was directed to existing universities. New departments were organized in old institutions. Elsewhere new institutions were created. While all these schools were regarded as practical and technical at the first, most of them as they developed became liberal and scientific; and when Congress made later large appropriations for "experiment stations" in the sciences relating to agriculture, an impulse of the most valuable character was given to many departments of scientific research.

This sketch would not be complete without the mention of two foundations, each unique. The Catholic University in Washington has been created by the pope, and in its government the hierarchy of the Roman Catholic Church is made dominant. Already the Roman Catholics had established, especially under the charge of the Jesuit fathers and of the Sulpicians, excellent colleges for liberal education, as well as schools of theology; but the newer metropolitan university was distinctly organized on a broader plan, in closer accordance with the universities of continental Europe, and with a pronounced recognition of the importance of science. The university of the State of New York is a supervisory (not a teaching) body exercising a general control over all the schools of higher instruction in the state, and especially guarding the conditions upon which degrees are conferred.

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[1] Cornell, however, received New York's share of the Congressional land grant of 1862, and the state is represented on its board of trustees. See CORNELL UNIVERSITY.

Organization.

Professional schools.

The interior organization of these institutions may now be considered. Some of them have but one department, the philosophical, which includes the liberal arts and sciences; others have two, three or many correlated departments. Clark University, for example, has but one faculty, the philosophical; Harvard, as already stated, has many departments, including philosophy, law, medicine and theology. So has Yale. Princeton has four. Johns Hopkins has two, the philosophical and the medical. In most American universities a sharp distinction is made between undergraduates and graduates, between those who are candidates for the baccalaureate degree (A.B., S.B., and Ph.B.) and those who are engaged in higher professional study, like law, medicine and theology, or in the manifold branches of modern science, like philology, historical and political science (including economics), philosophy (including logic, ethics and psychology), mathematics, physics, chemistry, biology, geology, &c. In certain places, as at Johns Hopkins, since 1876, emphasis is given to the idea that college instruction is disciplinary, requiring definite, but not uniform methods, and a certain deference to the authority of a master; while university instruction is much freer, and the scholar is encouraged to inquire rather than to accept; to test and observe rather than to hear and recite; to walk with a friendly guide rather than to obey a commander. This distinction is not universally recognized. Indeed, it has been made but recently in American institutions, so that older men are often heard asking, "What is the difference between a college and a university?" But generally it is admitted that college training is one thing, and work in a university is another; that thorough instruction in language, history, mathematics, natural and physical sciences, and in morals, should precede the discipline of professional schools and the pursuit of the higher and more advanced studies in letters and science. In a complete university provision should be made, according to ancient and widespread usages, for the study of law, medicine and theology; but unfortunately the development of such schools in the United States has been fettered by narrow conditions. The schools of theology, with rare exceptions, are under denominational control; and so established is this usage, that in the state universities, and in most of the private foundations (Chicago being an exception), theological departments are not encouraged, because of the dread of religious rivalries and dogmatism. Until recently there have been no endowments for medical schools to any adequate extent, and consequently the fees paid by students have been distributed among the teachers, who have usually been the real managers of the institution, although acting under the name of some university. It is nearly the same in law. There are many indications that changes are at hand in these particulars. Theological schools make their denominational characteristics less pronounced, and the old colleges no longer speak of the schools of law and medicine as "outside" departments. The rapid growth of the physical and natural sciences during the 19th century, and the extension of scientific methods of inquiry and verification to subjects which were formerly taught by the traditional methods of authority, have led to the development of laboratories and libraries. Everywhere special buildings, well equipped with the latest and best apparatus, are springing up, where the students of chemistry, physics, biology (in its numerous sub-departments—bacteriology among them) and electricity have every facility for study and research. The introduction of laboratories for psychology is specially noteworthy. Pathological laboratories have become essential in schools of medicine.

Libraries are—as they always have been and always will be—storehouses where the books and manuscripts of the past are preserved; but in American universities they have taken on another characteristic. Subdivided into special departments, or supplemented by fresh additions, they are the working-rooms of "seminaries," where capable teachers, surrounded by scholars properly qualified, are engaged in teaching, studying and writing. Seminaries and laboratories distinguish the modern philosophical departments from those of old, where the lecture-room was the seat of instruction. Numerous memoirs and monographs proceed from this active life. Books, periodicals and dissertations are contributions to the advancement of knowledge. Two agencies have effected these changes, most of which are the product of the last quarter of the 19th century. In the first place, gifts for higher education have been munificent, sometimes, especially in the East, from private citizens—often, especially in the West, from the treasuries of separate states. Quite as important has been the growth of liberal ideas. Very many of the foremost professors in American universities are the scholars of European teachers, especially Germans. Candidates for professorships are resuming the usages which prevailed early in the 19th century, of studying in France and Great Britain. On their return it is essential that they should keep themselves familiar with the latest literature in their departments, whatsoever may be the language in which it appears. Hence the American universities are no longer provincial. They must be judged, for better or for worse, by the standard of universities established in Europe. The bestowal of academic degrees ought to be strictly governed by some recognized authority, and according to ancient usages it is one of the highest functions of a university. In the United States there is but little restraint proceeding from law, tradition or public opinion. Every "college" is at liberty to exercise this privilege. Hence the variety of academic titles that have been introduced; hence, also, occasional and scandalous frauds in the issue of diplomas. The best institutions exercise due diligence; the public may be protected by requiring that every one who claims the privileges of his degree, or who appends to his name the usual abbreviations indicative of professional or academic authority, should make it clear where, when and how he received his title.

The institutions in the United States which claim to be universities, in the world-wide use of that designation, recognize these principles and, so far as their means allow, adhere to these methods: 1. There is a disciplinary stage in education which is the requisite introduction to the higher and freer work of the university. This is the sphere of the colleges. 2. The success of the higher work depends upon the intellectual and moral qualities of the professors. No amount of material prosperity is of value unless the dominant authorities are able to discover, secure and retain as teachers men of rare gifts, resolute will, superior training and an indomitable love of learning. 3. The professors in a university should be free from all pecuniary anxiety, so that their lives may be consecrated to their several callings. Pensions should be given them in cases of disability, and, in case of premature death, to their families. In methods of instruction they should have as large an amount of freedom as may be consistent with due regard for the co-operation of their colleagues and the plans of the foundation. 4. The steady improvement of the libraries and laboratories is essential if the institution is to keep in the front line. The newest books and the best apparatus are indispensable, for instruments and books quickly deteriorate and must be superseded. 5. For all these outlays large endowments are required. To a considerable extent reliance must be placed on wealthy and public-spirited citizens. In order to enlist such support, the members of a faculty should manifest their interest in public affairs, and by books, lectures and addresses should inform the public and interest them in the progress of knowledge. 6. Publication is one of the duties of a professor. He owes it not only to his reputation but also to his science, to his colleagues, to the public, to put together and set forth, for the information and criticism of the world, the results of his inquiries, discoveries, reflections and investigations. Qualified students should also be encouraged, under his guidance, to print and publish their dissertations.

College improvements.

Closely associated with the development of the university idea since 1875 is the improvement of the American college. Complaints are often made that the number of colleges is too large, and it is undoubtedly true that some institutions, inferior to city high schools, have usurped the names, the forms and some of the functions that should be restricted to establishments with larger endowments and better facilities for the promotion of scholarship; but while this is admitted, the great benefits which have resulted from the recognition, far and wide over the vast domain of the United States, of the value of higher education must not be forgotten. The support of churches of every name and the gifts of states, cities and private citizens, have been everywhere enlisted in behalf of learning. In every college worthy of the name, mathematics, ancient and modern languages, and the elements at least of modern science, are taught. More or less choice is permitted in the courses requisite to a bachelor's degree. Moral and religious influences are brought to bear on the formation of character. All this is favourable to the enlightenment of the people, and excuses, if it does not justify, the multiplication which is so often deprecated. The establishment of colleges for women, fully equal to the colleges for men, and in many places the admission of women to colleges and universities not originally intended for women, is one of the most noteworthy of the advances in higher education. Opinions are still divided in respect of the widsom of co-education, especially in the undergraduate period, but there is no longer any question as to the wisdom of giving to women the very best opportunities for intellectual culture; while the success that women have shown in the pursuit of many branches of science has led in many universities to their admission to the established laboratories and lecture-rooms. Separate colleges for women are now maintained in close connexion with Harvard, Columbia, Tulane and other institutions, and this mode of procedure seems likely to be introduced elsewhere. At the same time, independent foundations like Vassar, Smith, Wellesley, Bryn Mawr and Goucher are supported with so much vigour, and with such able faculties, that it is not easy to say which organization is the best, and indeed there is no occasion to raise the question. In the Western universities generally, as in Michigan, Wisconsin, California, Chicago, &c., women are admitted to all courses on the same terms as men. (D. C. G.)

Authorities.—On the earlier history and organization of the medieval universities, the student should consult F. C. von Savigny, *Gesch. d. römischen Rechts im Mittelalter* (7 vols., 1826–51); for the university of Paris, Du Boulay, *Historia Universitatis Parisiensis* (6 vols., Paris, 1665); Crevier, *Hist. de l'université de Paris* (7 vols., Paris, 1761); and C. Jourdain, *Hist. de l'université de Paris au XVIIe et au XVIIIe siècle* (Paris, 1862), and also articles on special points in the same writer's *Excursions historiques* (1888).

The work of Du Boulay (Bulaeus) is one of great research and labour, but wanting in critical judgment, while that of Crevier is little more than a readable outline drawn from the former. The views of Du Boulay have been challenged on many important points by P. H. Denifle in the first volume of his *Die Universitäten des Mittelalters bis 1400* (1885), and more particularly on those relating to the organization of the early universities. The results of Denifle's researches have been largely incorporated in Mr Rashdall's *Universities of Europe in the Middle Ages* (2 vols., Oxford, 1895), especially in connexion with the *origines* of Paris, Oxford and Cambridge; and the earlier works of Meiners, *Gesch. d. Entstehung und Entwickelung der hohen Schulen* (4 vols., 1802–5); and T. A. Huber, *Die englischen Universitäten* (Cassel, 1839–40), translation by F. W. Newman (3 vols., 1845), are thus to a great extent superseded. Much useful criticism on the comparative merits of the German and the English universities prior to the 19th century is to be found in the *Discussions* (1853) of Sir W. Hamilton. For the German universities exclusively, Zarncke's *Die deutschen Universitäten im Mittelalter* (Leipzig, 1857); Heinrich von Sybel, *Die deutschen Universitäten* (2nd ed., 1874); and Georg Kaufmann's *Gesch. der deutschen Universitäten* (2 vols.), are indispensable. Of the latter, vol. i. (1888) treats of the *origines*; vol. ii. (1896) carries the subject to the end of the middle ages, dealing generally with the history of academic institutions rather than the details of separate universities. Georg Voigt's *Die Wiederbelebung des classischen Alterthums* (2 vols., 1880–81) throws much light on the history of both Italian and German scholarship at the time of the Renaissance, and supplies a useful bibliography. The work of Professor Friedrich Paulsen, *Gesch. d. gelehrten Unterrichts auf den deutschen Schulen und Universitäten* (2nd ed., 2 vols., 1906; English translation by M. E. Sadler, London, 1906), is a masterly survey of the whole modern period down to the close of last century. Tholuck, *Das academische Leben des 17 Jahrhunderts* (2 vols., Halle, 1853–54); Dolch, *Gesch. des deutschen Studententhums* (1858); J. Conrad, *The German Universities for the Last Fifty Years*, translated by Hutchinson, preface by Bryce (Glasgow, 1885); T. Ziegler, *Der deutsche Student am Ende des 19 Jahrhunderts* (Stuttgart, 1895), all deal with special periods. Adolf Harnack, *Geschichte der königlich-preussischen Academie der Wissenschaften zu Berlin* (4 vols., 1900), is also of high value, the first two volumes for the medieval, the latter two for the modern period. To these may be added, as useful for reference, the *Geschichte der Erziehung vom Anfang an bis auf unsere Zeit* (Stuttgart, 1896–1901), by Dr K. A. and Georg Schmidt, containing critical bibliographies at the beginning of each chapter; while the *Bibliographie der deutschen Universitäten* by Wilhelm Erman and Ewald Horn (3 vols., Leipzig, 1904–6) is most complete for the literature of the entire subject down to the close of last century. For a comparative estimate of the history of the different faculties, *Die Universität Giessen von 1607 bis 1907* (2 vols., Giessen, 1907) is highly suggestive. The *Monumenta Germaniae Paedagogica* (20 vols., 1886–1900), though relating mainly to schools, often supplies valuable illustrative matter.

The statutes of the French universities, so far as ascertainable, have been edited by Fournier, *Statuts et privilèges des universités françaises* (1890); the *Chartularium* of the university of Paris, as edited by Denifle and Chatelain (4 vols., Paris, 1889–97), coming down to 1452. Works dealing with later history are Gréard, *Nos adieux à la vieille Sorbonne* (Paris, 1893); H. Schön, *Die französischen Hochschulen seit der Revolution* (Munich, 1896); L. Liard, *L'Enseignement supérieur en France, 1789–1894* (2 vols., Paris, 1894); Joseph Prost, *La Philosophie à l'académie protestante de Saumur, 1606–1685* (Paris, 1907).

For Italy, the *origines* of Bologna are dealt with by Chiapelli, *Lo Studio Bolognese* (Pistoia, 1888); Fitting, *Die Anfänge der Rechtsschule zu Bologna* (Bologna and Leipzig, 1888); Ricci, *I primordi d. Studio di Bologna* (2nd ed., Bologna, 1888). All the extant statutes are edited by Carlo Malagola, *Statuti d. univ. e dei collegi d. studio bolognese* (Bologna, 1888); and a new edition has appeared of the learned C. J. Sarti's *De claris Archigymnasii Bononiensis Professoribus* (Bologna, 1888, &c.). In connexion with Padua we have *Die Statuten der Juristen-Universität Padua vom Jahre 1331*, ed. H. Denifle, a reprint from the *Archiv*. For Spain, the work of De La Fuente (Madrid, 1855) gives a concise summary of the main facts in the growth of the universities and also of the other institutions for public instruction throughout the country; the *Libro Memoria*, by Solier and Vilches (1895) gives the necessary information down to a later period, in connexion with the central institution in Madrid. The history of the faculty of theology at the Portuguese university of Coimbra has been recorded on a more elaborate scale by Dr Manuel Eduardo da Motta Veiga (Coimbra, 1872). The *Universidades y Colegios* of Dr Joaquin v. González (Buenos Aires, 1907) contains an interesting account of the new university movement in Argentina. For Oxford there are the laborious collections by Anthony Wood, *History and Antiquities of the University and of the Colleges and Halls of Oxford*, edited with continuation by Rev. J. Gutch (5 vols., 1786–96), and *Athenae* and *Fasti Oxonienses*, edited by Dr P. Bliss (4 vols., 1813–20); *A History of the University of Oxford from the Earliest Times to 1530*, by H. C. Maxwell Lyte (1886); and *Statutes of the University of Oxford compiled in 1636 under Authority of Archbishop Laud*, ed. Griffiths (Oxford, 1888). The publications of the late Joseph Foster, *Alumni Oxonienses, 1500–1886* (8 vols.), supply the facts that are contained in the registers relating to the academic careers of graduates; his *Oxford Men and their Colleges, 1880–92* (2 vols., 1893) contains, vol. i., college life and antiquities, with illustrations; vol. ii., completion of *Alumni* and *Matriculation Register, 1880–92*. The publications of the Oxford Historical Society include some valuable histories of separate colleges, that of Pembroke (by Macleane), Corpus Christi (by Fowler), Merton (by Brodrick); also Anthony Wood's *Life and Times*, ed. Rev. Andrew Clark (4 vols.); Hearne's *Collections*, ed. Doble and Rannie (4 vols.); and *Early Oxford Press* (to 1640), by Falconer Madan. The series of *College Histories*, originally published by F. E. Robinson (now by Hutchinson & Co.), is often serviceable both to the historian and the biographer. For Cambridge, the researches of C. H. Cooper, greatly surpassing those of Wood in thoroughness and impartiality, are comprised in three series: (1) *Annals of Cambridge* (5 vols., 1842–1908); (2) *Athenae Cantabrigienses, 1500–1609* (2 vols., 1858–61); (3) *Memorials of Cambridge* (3 vols.; new ed. 1884). The *Architectural History of the University of Cambridge and of the Colleges*, by the late Robert Willis, edited and continued by J. Willis Clark (4 vols., 1886), is a work of admirable thoroughness and completeness. The *Grace Books*, in 3 vols., down to 1526, have been carefully edited and published by the University Press. J. B. Mullinger, *History of the University of Cambridge from the Earliest Times to Accession of Charles I.* (2 vols., 1873–85), vol. 3 at press, and *Cambridge Described and Illustrated*, by T. D. Atkinson and J. W. Clark (1897), deal chiefly with the course of education and learning, and with the antiquities respectively. To these may be added Thomas Baker's *History of the College of St John the Evangelist*, edited by Professor Mayor (2 vols., 1869); also, by same editor, *Admissions to St John's* (3 vols., 1630–1765); and *Records* of same society (2 series), edited by R. F. Scott—all three works being valuable aids both to the biography and history of contemporary times. Equally so is Dr Venn's excellent *Biographical History of Caius College* (3 vols., 1897–1901). Mr J. A. Venn's *Statistical Chart*, exhibiting conjointly the *Matriculation Statistics* at both universities from 1544 to 1906, has been reproduced, along with an explanatory article, in the *Oxford and Cambridge Review* for Lent term, 1908, and a similar chart for the colleges (in Cambridge) has been published by the same editor. For both universities see the *Documents* issued by the Oxford and Cambridge Commissions of 1858.

Mr M. E. Sadler's *Special Report to the Education Office on the Admission of Women to the Universities* is the most authoritative source of information on the subject. Of the existing endowments, faculties and professoriate of universities throughout the world, the serial entitled *Minerva*, edited by Dr K. Trubner (Trübner, Strassburg), has supplied trustworthy particulars since its first publication in 1891, together with concise information and references to original sources respecting the origin and history of the universities themselves. (J. B. M.)

ACADEMIC HOODS

1. *Great Britain and Ireland*

Aberdeen.—D.D., scarlet cloth, lined purple; B.D., black,[1] lined purple; LL.D., scarlet cloth, lined pale blue; LL.B., black, bordered pale blue; M.D., scarlet cloth, lined crimson; M.B., black, lined crimson; D.Litt., scarlet cloth, lined white; D.Phil., scarlet cloth, lined white; D.Sc., scarlet cloth, lined green; B.Sc., black, lined green; M.A., black, lined white.

Cambridge.—D.D., scarlet cloth, lined pink and violet shot, with loops of black cord; B.D., black, unlined; LL.M., black, lined white; LL.D., scarlet cloth, lined pink; LL.B., black silk or stuff, edged white fur; M.D. scarlet cloth, lined dark cherry colour; M.B., black, lined dark cherry colour; Mus.D., cream damask, lined cherry colour; Mus.B., dark cherry colour, lined white fur; Litt.D., scarlet cloth, lined scarlet; D.Sc., scarlet cloth, lined pink and light blue shot; M.A., black, lined white; B.A., black stuff or silk, edged white fur. Proctors as their Congregation habit wear the ruff and black and white hood; on other occasions they wear the hood "squared."

Dublin.—(The hoods are the same for the Royal University, except M.B., Mus.D. and divinity degrees, which it does not grant.) D.D., scarlet cloth, lined black; B.D., black, unlined; LL.D., scarlet cloth, lined pink; LL.B., black, bordered white; M.D., scarlet cloth, lined scarlet; M.B., black, lined white fur (Royal University, black, bordered scarlet); Mus.D., crimson cloth, lined white (Royal University, white damask, faced and lined rose satin); Mus.B., blue, lined white fur (rabbit-skin); Litt.D., scarlet cloth, lined white; D.Sc., scarlet cloth, lined blue; M.A., black, lined blue; B.A., black, edged white fur; Proctor, black silk, lined "ermine."

Durham.—D.D., scarlet "cassimere," lined "palatinate purple"; B.D., black, unlined; D.C.L., scarlet cassimere, lined white; B.C.L., palatinate purple, edged white fur; M.D., scarlet cassimere, lined scarlet, bordered palatinate purple; M.B., scarlet silk, lined palatinate purple, edged white fur; Mus.D., white brocade, lined palatinate purple; Mus.B., palatinate purple, edged white fur; Litt.D., scarlet cassimere, lined old-gold satin; Litt.B., old-gold satin, edged white fur; D.Sc., palatinate purple cassimere, lined scarlet; B.Sc., palatinate purple, edged white fur; M.A., black, lined palatinate purple; B.A., black stuff or silk, edged white fur.

Edinburgh.—D.D., black cloth, lined purple; B.D., black silk, lined purple, edged white fur; LL.D., black cloth, lined blue; LL.B., black silk, lined blue, edged white fur; B.L., black, bordered blue, edged white fur; M.D., black cloth, with cape attached, lined and faced crimson silk; M.B., black, lined crimson, edged white fur; Mus.D., scarlet cloth, lined white corded silk; Mus.B., scarlet silk, lined white, edged white fur; Litt.D., black cloth, lined royal blue shot with maize; D.Phil., black cloth, lined white, shot with "Vesuvius"; D.Sc., black cloth, lined green; B.Sc., black silk, lined green, edged white fur; M.A., black silk, lined white.

Glasgow.—D.D., scarlet cloth, lined white; B.D., black, lined light cherry colour, bordered scarlet cloth; LL.D., scarlet cloth, lined Venetian red; LL.B., black, lined Venetian red, bordered scarlet cloth; B.L., black, bordered Venetian red; M.D., scarlet cloth, lined scarlet; M.B., black, lined scarlet, bordered scarlet cloth; D.Sc., scarlet cloth, lined gold colour; B.Sc., black, lined gold colour, bordered scarlet cloth; M.A., black silk, lined "bell-heather" colour (purplish red); B.A., black silk or stuff, bordered bell-heather red.

London.—(Bachelors, if members of Convocation, have their hoods lined white silk, bordered with the colour of their faculty.) D.D., scarlet cloth, lined "sarum red"; B.D., black, bordered sarum red; LL.D., scarlet cloth, lined blue; LL.B., black, bordered blue; M.D., scarlet cloth, lined violet; M.B., and B.S., black, bordered violet; Mus.D., scarlet cloth, lined white, if a member of Convocation, if not, same as Mus.B., blue, lined white, watered silk; Litt.D., scarlet cloth, lined russet; D.Sc., scarlet cloth, lined gold colour; B.Sc., black, bordered gold colour; M.A., black, lined russet; B.A., black, bordered russet.

Oxford.—D.D., scarlet cloth, lined black; B.D., black, unlined; D.C.L., scarlet cloth, lined rose; B.C.L., light blue, edged white fur; M.D., scarlet cloth, lined rose; M.B., dark blue, edged white fur; Mus.D., white damask, lined crimson; Mus.B., light blue, edged white fur; Litt.D., scarlet cloth, lined slate colour; Litt.B., light blue, edged white fur; M.A., black, lined red; B.A., black silk or stuff, edged white fur; Proctors wear a "miniver" hood.

St Andrews.—D.D., violet silk or cloth, lined white satin; B.D., violet silk or cloth, lined white satin, edged white fur; LL.D., scarlet silk or cloth, lined white satin; LL.B., scarlet silk or cloth, lined white satin, edged white fur; M.D., crimson silk or cloth, lined white satin; M.B., crimson silk or cloth, lined white satin, edged white fur; Mus.D., cerulean blue silk or cloth, lined white satin; Mus.B., cerulean blue, lined white satin, edged white fur; D.Sc., "amaranth" silk or cloth, lined white satin; B.Sc., amaranth silk or cloth, lined white satin, edged white fur; M.A., black, lined red.

Victoria University.—LL.D., gold velvet or satin, lined light gold; LL.B., black, bordered violet; M.D., gold velvet or satin, lined light gold; M.B., black, bordered red; Litt.D., gold velvet or satin, lined light gold; D.Sc., gold velvet or satin, lined light gold; B.Sc., black, bordered pale red; M.A., black, lined pale blue; B.A., black, bordered pale blue.

University of Wales and Lampeter.—B.D. (Lampeter), black, lined violet, bordered white; B.A., black, bordered blue and green shot.

2. *Australia*

Sydney.—B.A., black stuff, edged white fur; M.A., black, lined blue; LL.B., black, bordered blue; LL.D., scarlet cloth, lined blue; B.Sc., black stuff, bordered amber; D.Sc., scarlet cloth, lined amber; B.E. (Engineering), black stuff, bordered light maroon; M.E., black, lined light maroon; M.B., black, bordered purple; M.C., black, lined French grey; M.D., scarlet cloth, lined purple.

Adelaide.—B.A., black, lined grey; M.A., black, lined dark grey; LL.B., black, lined blue; LL.D., dark blue, lined light blue; B.Sc., black, lined yellow; D.Sc., dark yellow, lined light yellow; M.B., black, lined rose; M.C. (Surgery), black, lined dark rose; M.D., dark rose, lined light rose; Mus.B., black, lined green; Mus.D., dark green, lined light green.

Melbourne.—B.A., black, lined dark blue; M.A., black, lined violet; Litt.D., black, lined dark blue; LL.B., black, lined white fur; LL.M., black cloth, edged red silk, lined white; LL.D., black, lined white; B.Sc., black, lined moss-green, edged white fur; M.Sc., black, lined moss-green; D.Sc., scarlet cloth, lined moss-green; B.E. (Engineering), black, lined light blue; M.E., black, lined yellow; M.B., black, lined white; M.C. (Surgery), black, lined dark amber; M.D., black, lined crimson; Mus.B., black, lined lavender, edged white fur; Mus.D., black, lined lavender.

New Zealand.—B.A., black, lined pink, edged white fur; M.A., black, lined pink; LL.B., black, lined blue, edged white fur; LL.D., black, lined light blue; B.Sc., black, lined dark blue, edged white fur; D.Sc., black, lined dark blue; M.B., black, lined mauve, edged white fur; M.D., black, lined mauve; Mus.B., black, lined white, edged white fur; Mus.D., black, lined white.

3. *Canada*

These follow the British model, with the exception of Laval, Quebec, which grants the same degrees as the University of France, the distinctive mark of which is the *scarf*.

Dalhousie (N.S.).—B.A., black stuff, lined white fur; M.A., black stuff, lined crimson; B.L. (Letters), black stuff, lined white, bordered light blue; M.L., black stuff, lined light blue; LL.B., black, lined white, bordered gold; LL.D., black, lined purple; B.Sc., black stuff, lined white silk, bordered crimson; M.Sc., black stuff, lined crimson; B.E. (Engineering), black stuff, lined white silk, bordered purple; M.C., scarlet cloth, bordered white; M.D., scarlet silk, bordered white; Mus.B., black stuff, lined white, bordered lavender.

Fredericton (N.B.).—B.A., black stuff, edged white fur; M.A., black, lined blue; B.C.L., black, lined blue silk, edged white fur; D.C.L., scarlet cloth, lined pink.

McGill (Montreal).—B.A., black stuff, edged white fur; M.A., black, lined blue; Litt.D. (Literature), scarlet cloth, lined pale blue; B.C.L., black, lined French grey, edged white fur; D.C.L., scarlet cloth, lined French grey; B.Sc., black, lined yellow, edged white fur; M.Sc., black, lined yellow; D.Sc., scarlet cloth, lined yellow; M.B., black, lined dark blue; M.D., scarlet cloth, lined dark blue; D.V.S. (Doctor of Veterinary Science), scarlet cloth, lined fawn.

Toronto.—D.D. (Trinity College), scarlet cloth, lined black; B.D. (Trinity College), black, unlined; B.A., black stuff, edged white fur; M.A., black, lined crimson; LL.B., blue, lined white fur; LL.D., scarlet cloth, lined pink; M.B., blue, lined white fur; M.D., scarlet cloth, lined pink.

Windsor (N.S.).—B.A., black stuff, edged white fur; M.A., black, lined crimson; B.C.L., blue, edged white fur; D.C.L., scarlet cloth, lined pink.

4. *India*

These follow the British model, but also give Oriental degrees, the distinctive mark of which is a sash. They also grant the degree of Licentiate in certain subjects, which has a hood.

Allahabad.—B.A., black, bordered amber; M.A., black, lined amber; LL.B., black, lined blue; LL.D., pale blue.

Bombay.—B.A., black stuff, bordered garter blue; M.A., garter blue, lined same; LL.B., black, bordered scarlet cloth; B.Sc., black stuff, bordered garter blue; L.C.E. (Engineering), black stuff, bordered brown; M.E., brown, lined garter blue; L.M. and S. (Medicine and Surgery), black stuff, bordered crimson; M.D., crimson, lined garter blue; L.Ag. (Agriculture), black stuff, bordered green.

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[1] Where not otherwise stated, the hood is of silk.

Calcutta.—B.A., black, bordered dark blue; M.A., black, lined blue; LL.B., black, bordered green; LL.D., scarlet, lined white satin; B.Sc., black, bordered light blue; B.E., black, bordered orange; M.E., black, lined green; M.B., black, bordered scarlet; M.D., black, lined scarlet.

Madras.—B.A., black, bordered crimson; M.A., black, lined crimson; LL.B., black, lined purple; M.L., purple silk; LL.D., scarlet silk; B.E., black, lined orange; M.B., black, lined light blue; L.M. and S., black, lined light blue; M.C., black, lined light blue; M.D., scarlet cloth, lined light blue; L.San.Sc. (Sanitary Science), black, bordered terra-cotta; L.T. (Teaching), black, lined gold.

Punjab.—B.A., purple, lined yellow; M.A., purple, lined claret; Litt.D., purple, lined scarlet; LL.B., white, lined blue; LL.D., scarlet silk; M.B., purple, lined purple cloth; M.D., purple, lined purple.

5. *South Africa*

Cape of Good Hope.—B.A., black, bordered orange-brown; M.A., black, lined orange-brown, bordered black; Litt.D., orange-brown, lined white, bordered black; LL.B., black, bordered red; LL.D., red, lined white, bordered black; B.Sc., black, bordered green; M.Sc., green, bordered black; D.Sc., green, lined white, bordered black; M.B., black, bordered blue; M.D., blue, lined white, bordered black; Mus.B., black, bordered purple; Mus.M., purple, bordered black; Mus.D., purple, lined white, bordered black.

6. *United States*

The American universities have adopted a uniform system, according to which the length and shape of the hood indicate the degree (bachelor, master, doctor), the silk lining displays the official colours of the university or college granting the degree (*e.g.* crimson for Harvard, blue for Yale, orange and black for Princeton, light blue and white for Columbia, royal purple and white for Cornell and red and blue for Pennsylvania), while the velvet trimming indicates the faculty or department. Thus the trimming for arts and letters is white, for theology scarlet, laws purple, philosophy blue, science gold-yellow, fine arts brown, medicine green, music pink, pharmacy olive, dentistry lilac, forestry russet, veterinary science grey and library science lemon. It is also usual in America for a graduate of a German university to wear a hood lined with the colours of the university charged with a trichevron of the German colours, black, white and red.

UNIVERSITY COURTS, in the English universities of Oxford and Cambridge, courts of inferior jurisdiction, administering principles of justice originally founded on the canon and civil law, but now defined and limited by the common law (see particularly *Ginnett* v. *Whittingham*, 1886, 16 Q.B.D. 769).

At Oxford the judge of the chancellor's court is the vice-chancellor, who is his deputy or assessor; the court has had since 1244 civil jurisdiction, to the exclusion of the king's courts, in all matters and suits wherein a scholar or privileged person of the university is one of the parties, except in actions relating to freehold. It had also, from 1290 downwards, jurisdiction of all injuries and trespasses against the peace, mayhem and felony excepted, but since the Summary Jurisdiction Acts this is possibly no longer exercisable, but the chancellor, vice-chancellor and the vice-chancellor's deputy are justices of the peace for Oxford, Oxfordshire and Berkshire, where scholars are concerned, and exercise this jurisdiction under the Summary Jurisdiction Acts. By the Oxford University Act 1854 the vice-chancellor's court now administers the common and statute law of the realm.

The criminal jurisdiction of Cambridge University in cases where any person not a member of the university is a party has ceased, and its jurisdiction over light women, which was founded on a charter and statute of Elizabeth, was taken away in 1894 by a private act of that year (c. 60), and an act of 6 Geo. IV. c. 97, dealing with them and applicable till then only to Oxford University, was extended to Cambridge University. Previous to 1891, women of light character, who had been convicted of consorting with or soliciting members of the university *in statu pupillari*, were detained in a house of correction called the *spinning house*, but in that year a conviction was held bad (*ex parte* Hopkins, 1891, 61 L.J.Q.B. 240; see also, however, *Kemp* v. *Nevill*, 1861, 10 C.B.N.S. 523).

UNNA, a town of Germany, in the Prussian province of Westphalia, 15 m. by rail E. of Dortmund, on the line to Hamm. Pop. (1905) 16,324. It has two Roman Catholic and two Protestant churches, a synagogue and several schools. Its chief industries are iron foundries, machine shops, salt works and breweries—other articles of manufacture being bricks and cement. In the middle ages Unna formed part of the electorate of Cologne. It received municipal rights in 1256 and was a member of the Hanseatic League.

UNTERWALDEN, one of the cantons of central Switzerland, extends to the south of the lake of Lucerne, 14 sq. m. of which are included within the canton (13 being in Nidwalden). It is composed of two valleys, through which run two streams, both called Aa, and both flowing into the lake of Lucerne. The more westerly of these glens is called Obwalden, and the more easterly Nidwalden. These names really come from the 13th century expression for the inhabitants, *homines intramontani* (men dwelling in the mountains), whether of *vallis superioris* (of the upper valley) or *vallis inferioris* (of the lower valley). But in the 14th century the relative position of the two valleys is defined as "upper" and "lower" with reference to the great Kerns forest (stretching between Stans and Kerns), and hence is derived the historically inaccurate name of "Forest cantons," now so well known. The total area of the canton is 295·4 sq. m. (Obwalden has 183·2 and Nidwalden 112·1, though it must be borne in mind that the upper portion of what should be the territory of Nidwalden is, as regards the Blacken Alp, in Uri, while the Engelberg region is in Obwalden). Of this area 238·2 sq. m. (154·1 in Obwalden and 84·1 in Nidwalden) are classed as "productive," forests covering 73·8 sq. m. (47 in Obwalden and 26·8 in Nidwalden), while of the rest glaciers occupy 5·2 sq. m. (3·9 in Obwalden and 1·3 in Nidwalden), the highest point in the canton being the Titlis (10,627 ft.) situated in the Obwalden half. The small lakes of Sarnen and of Lungern are wholly situated in Obwalden. Obwalden, as including the Engelberg region, is far more mountainous than Nidwalden, which is rather hilly than mountainous. The inhabitants in both cases are mainly devoted to pastoral and, in a lesser degree, to agricultural pursuits. In Obwalden there are 290 "alps," or mountain pastures, capable of supporting 13,399 cows, and of an estimated capital value of 5,474,400 fr.: the figures for Nidwalden are respectively 166, 5207 and 3,899,900. In 1900 the total population of the canton was 28,330 (15,260 in Obwalden and 13,070 in Nidwalden), of whom all but the most insignificant proportion were German-speaking and Romanists. Till 1814 the canton was in the diocese of Constance, but since then it is practically administered by the bishop of Coire, though legally included in no diocese. The capital of Obwalden is Sarnen (*q.v.*), and of Nidwalden Stans (*q.v.*). The other most considerable villages are all in Obwalden—Kerns (2392 inhab.), Engelberg (1973 inhab.) and Lungern (1828 inhab.). The canton is traversed by the Brünig railway line from Hergiswil (in Nidwalden) to the top of the pass (20 m.), but most of the electric line from Stansstad to Engelberg (14 m.) is in Nidwalden. The mountain lines up Pilatus (Obwalden), the Stanserhorn, and to the Bürgenstock (both in Nidwalden) are also in the canton. Each half forms a single administrative district, and has its own independent local institutions, while in Obwalden there are 7 communes and in Nidwalden 11. In each the supreme legislative authority is the "*Landsgemeinde*," or primitive democratic assembly (meeting in both cases on the last Sunday in April), composed of all male citizens of 20 (Obwalden) or 18 (Nidwalden) years of age. In both cases the *Landsgemeinde* elects the executive for three years (Nidwalden) or four years (Obwalden), while it is composed of 11 (Nidwalden) or 7 (Obwalden) members, out of whom the *Landsgemeinde* elects annually the chief officials. In each half there is also a sort of "standing committee" (the *Landrath*, Nidwalden, or *Kantonsrath*, Obwalden), which drafts measures to be submitted to the *Landsgemeinde*, supervises the cantonal administration, and is empowered to spend sums below a certain amount. In each case the *Landrat* is composed of the members of the executive, plus a certain number of members elected in each "commune," in the proportion of 1 member to every 250 inhabitants, or fraction over 125 (so Nidwalden, which allows them to hold office for six years), or 1 member to every 200 inhabitants (Obwalden, which allows them to hold office for four years). These *Landsgemeinden* are of immemorial antiquity, while the other constitutional details are settled by the constitution of 1877 in Nidwalden, and by that of 1902 in Obwalden. In each half the single member of the Federal *Ständerat* is elected by the *Landsgemeinde*, while the single member enjoyed by each in the Federal *Nationalrat* is chosen by a popular vote, but not by the *Landsgemeinde*. The people of the canton have always been very pious and religious. In the church of Sachseln (near Sarnen) still lie the bones of the holy hermit, Nicholas von der Flüe, fondly known as "Bruder Klaus" (1417–1487), while at Sarnen there are several convents, though the most famous of all the monasteries in the canton, the great Benedictine house of Engelberg (founded about 1120) is situated at the head of the Nidwalden valley, though politically in Obwalden. At the lower end of the Nidwalden valley is Stans, the home of the Winkelried family (*q.v.*).

It is very remarkable that in both valleys the old "common lands" are still in the hands of the old gilds, and "communes" consist of natives, not merely residents, though in Obwalden these contribute to the expenses of the new "political communes" of residents, while in Nidwalden the latter have to raise special taxes. In Engelberg (which still retains some independence) the poor are greatly favoured in the division of the common lands and their proceeds, and unmarried persons (or widowers and widows) receive only half of the share of those who are married.

Historically, both Obwalden (save a small bit in the Aargau) and Nidwalden were included in the Zürichgau. In both there were many great landowners (specially the abbey of Murbach and the Habsburgs) and few free men; while the fact that the Habsburgs were counts of the Aargau and the Zürichgau further delayed the development of political freedom. Both took part in the risings of 1245–47, and in 1247 Sarnen was threatened by the pope with excommunication for opposing its hereditary lord, the count of Habsburg. The alleged cruelties committed by the Habsburgs do not, however, appear in history till Justinger's *Chronicle*, 1420 (see TELL). On the 16th of April 1291, Rudolph the future emperor bought from Murbach all its estates in Unterwalden, and thus ruled this district as the chief landowner, as count and as emperor. On the 1st of August 1291 Nidwalden (Obwalden is not named in the text of the document, though it is named on the seal appended to it) formed the "Everlasting League" with Uri and Schwyz (this being the first known case in which its common seal is used). In 1304 the two valleys were joined together under the same local deputy of the count, and in 1309 Henry VII. confirmed to them all the liberties granted by his predecessor —though none is known to have been granted. However, this placed Unterwalden on an equal political footing with Uri and Schwyz; and as such it took part (1315) in Morgarten fight (also driving back an invasion over the Brünig Pass) and in the renewal of the Everlasting League at Brunnen (1315), as well as at Sempach (1386) and in driving back the Gugler or English freebooters (1375). For physical reasons, it was difficult for Unterwalden to enlarge its territories. Yet in 1368 it acquired Alpnach, and in 1378 Hergiswil. So too Obwalden shared with Uri in the conquest of the Val Leventina (1403) and in the purchase of Bellinzona (1419), as well as in the loss of both (1422). It was Nidwalden that, with Schwyz and Uri, finally won (1500) and ruled (till 1798) Bellinzona, the Riviera, and the Val Blernio; while both shared in conquests of the Aargau (1415), the Thurgau (1460), and Locarno, &c. (1512), and in the temporary occupation of the Val d' Ossola (1410–14, 1416–22, 1425–26, 1512–15). In the Burgundian war Unterwalden, like the other Forest cantons, long hung back through jealousy of Bern, but came to the rescue in time of need. In 1481 it was at Stans that the Confederates nearly broke up the League for various reasons, and it was only by the intervention then of the holy hermit Nicholas von der Flüe (of Sachseln in Obwalden) that peace was restored, and the great Federal agreement known as the compact of Stans concluded. Like the other Forest cantons, Unterwalden clung to the old faith at the time of the Reformation, being a member of the "Christliche Vereinigung" (1529) and of the Golden League (1586).

In 1798 Unterwalden resisted the Helvetic republic, but, having formed part of the short-lived Tellgau, became a district of the huge canton of the Waldstätten. Obwalden submitted at an early date, but Nidwalden, refusing to accept the oath of fidelity to the constitution mainly on religious grounds, rose in desperate revolt (September 1798), and was only put down by the arrival of 16,000 armed men and by the storming of Stans. In 1803 its independence as a canton was restored, but in 1815 Nidwalden refused to accept the new constitution, and Federal troops had to be employed to put down its resistance, the punishment inflicted being the transfer (1816) to Obwalden of the jurisdiction over the abbey lands of Engelberg (since 1462 "protected" by the four Forest cantons), which in 1798 had fallen to the lot of Obwalden and had passed in 1803 to Nidwalden. Since that time the history of Unterwalden has been like that of the other Forest cantons. It was a member of the "League of Sarnen" (1832), to oppose the reforming wishes of other cantons, and of the "Sonderbund" (1845); it was defeated in the war of 1847; and it voted against the acceptance of the Federal constitution both in 1848 and in 1874.

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UNTON (or UMPTON), **SIR HENRY** (*c.* 1557–1596), English diplomatist, was the second son of Sir Edward Unton, or Umpton (d. 1583), of Wadley, near Faringdon, Berkshire, his mother, Anne (d. 1588), being a daughter of Edward Seymour, duke of Somerset, the protector. Educated at Oriel College, Oxford, Unton became a member of parliament in 1584 and served with the English forces in the Netherlands in 1585 and 1586, being present at the skirmish of Zutphen. In 1586 he was knighted. In 1591, through the good offices of the earl of Essex, Unton was sent as ambassador to Henry IV. of France; he became very friendly with this king and accompanied him on a campaign in Normandy before he was recalled to England in June 1592. Again securing a seat in parliament he lost for a short time the favour of Queen Elizabeth; however, in 1593 he went again as ambassador to France. He died in the French camp at La Fère on the 23rd of March 1596, a collection of Latin verses being published in his memory at Oxford later in the year. This was edited by his chaplain, Robert Wright (1560–1643), afterwards bishop of Lichfield and Coventry.

There is an interesting picture in the National Portrait Gallery representing Unton and various scenes in his life. Many of his official letters are in the British Museum and in the Public Record Office, London. A collection of these was edited by Joseph Stevenson (1847), and some are printed in W. Murdin's *Burghley Papers* (1759).

UNYAMWEZI, a region of German East Africa, lying S. of Victoria Nyanza and E. of Lake Tanganyika. It is mentioned as early as the 16th century by the Portuguese and by Antonio Pigafetta, under the name Munemugi or "Land of the Moon," which is the exact equivalent of the name—Wu-nya-mwezi—by which the land is known to its own people. It is part of the plateau between the two great rift-valleys of East Africa, is rich in woods and grass, and has many villages surrounded by well cultivated farms and gardens. The western portions, however, are somewhat swampy and unhealthy. The people of Unyamwezi, called Wanyamwezi, are Bantu-negroes of medium size and negroid features, but with long noses and curly rather than woolly hair, suggestive of mixed blood. Dwelling on the main road from Bagamoyo to Tanganyika, the route by which J. H. Speke, Richard Burton, J. A. Grant, H. M. Stanley and others travelled, and having from early times had commercial relations with the Arabs, the Wanyamwezi are more civilized than the neighbouring races. They practise tattooing, file or extract the upper incisor teeth, and load their legs and arms with brass wire rings. The men look after the flocks and poultry, while the women do the field-work. They often keep bees; in some cases the hives are inside the huts, and the bees form an efficient protection against intruders. Inheritance is to the direct issue, not as is often the case among Negro races to the nephew. In some parts, one of twins is always killed. On Stanley's first visit in 1871, the Zanzibar Arabs were predominant in the country, but later the natives rose and, under Mirambo, who from a common porter rose to be a conquering chief—earning for himself the title of the "Black Bonaparte"—a Negro kingdom was formed. Since 1890 the country has been under German control and the power of the native chiefs greatly curtailed. As a people the Wanyamwezi are extremely vigorous and have shown great capacity for expansion, being energetic and enterprising.

See H. Brode, *Tippoo Tib: the Story of his Career in Central Africa* (1907); Sir H. H. Johnston, *The Uganda Protectorate* (1902); Sir Charles Eliot, *The East Africa Protectorate* (1905).

UNYORO, called by its people Bunyoro, a country of east central Africa lying N.W. of the kingdom of Buganda (Uganda) and bounded E. and N. by the Victoria Nile. On the west, Unyoro includes nearly all the eastern shores of Albert Nyanza and a strip of territory—incorporated in Belgian Congo in 1910—west of that lake. In 1896 a British protectorate was established over Unyoro, which now forms the S.W. part of the northern province of the Uganda Protectorate. The limits of Unyoro have varied according to the strength of its rulers; during the 19th century the states of Bunyoro and Buganda appear to have been rivals for the overlordship of the region between the Bahr-el-Jebel and the great lakes. The Banyoro (as its people call themselves) had a certain degree of civilization and were skilled in iron-work, pottery and wood-work. The ruling class is of Hima stock, the Bahima possessing large herds of cattle. The first Europeans to enter the country were J. H. Speke and J. A. Grant, who spent part of 1862 there, the king, Kamurasi, putting many obstacles in the way of the travellers continuing their journey down the Nile. Its next white visitors were Sir Samuel and Lady Baker, who in 1864 discovered the Albert Nyanza. At this time ivory and slave traders, nominally Egyptian subjects, penetrated as far south as Unyoro, and a few years later (1870–74) Baker, as governor-general of the Equatorial Provinces, extended Egyptian influence over the country and placed a garrison at Foweira on the Victoria Nile. He formally annexed Unyoro to the Egyptian dominions at Masindi on the 14th of May 1872. General Gordon, who succeeded Baker, established posts at Masindi and Mruli. With King Kabarega, a son of Kamurasi, the Egyptians had many encounters. Egyptian authority ceased altogether with the withdrawal of Emin Pasha in 1888, but not long afterwards British influence began to be felt in the country. Kabarega in 1891 found himself in conflict with Captain F. D. Lugard, who entered Unyoro from the south. From this point the history of Unyoro is traced in the article UGANDA. It need only be stated here that in 1899 Kabarega was captured by the British and deported to the Seychelles, and that one of his sons (Yosia, a minor) was subsequently recognized as chief in his place, though with very restricted powers, the province being virtually administered directly by the British government.

Unyoro has played rather an important rôle in the past (unwritten) history of Equatorial Africa as being the region from which the ancient Gala (Hamitic) aristocracy, coming from Nileland, penetrated the forests of Bantu Africa, bringing with them the Neolithic civilization, the use of metals, and the keeping of cattle. Unyoro, though not a large country, is in many ways remarkable. It is thought to contain gold in the north and north-east. In the west and south-west are the vast primeval forests of Budonga and Bugoma, containing large chimpanzees and a peculiar sub-species of straight-tusked elephants (only found in Unyoro).

See the works of Speke, Grant and Baker; also *Colonel Gordon in Central Africa* (4th ed., 1885); J. F. Cunningham's *Uganda and its Peoples* (1905); and Winston Churchill's *My African Journey* (1908). (H. H. J.)

UPAS, a Javanese word meaning poison, and specially applied to the poison derived from the gum of the anchar tree (*Antiaris toxicaria*), a member of the fig-family (Moraceae), and a native of the Sunda Islands, which was commonly used to envenom the darts of the natives. The name of the upas tree has become famous from the mendacious account (professedly by one Foersch, who was a surgeon at Samarang in 1773) published in the *London Magazine*, December 1783, and popularized by Erasmus Darwin in "Loves of the Plants" (*Botanic Garden*, pt. ii.). The tree was said to destroy all animal life within a radius of 15 m. or more. The poison was fetched by condemned malefactors, of whom scarcely two out of twenty returned. All this is pure fable, and in good part not even traditional fable, but mere invention. The milky juice of the tree contains an active principle named *antiarin*, which has been recommended as a cardiac stimulant. It is without any properties, however, that entitle it to clinical employment. The tree is described as one of the largest in the forests of Java, the straight cylindrical stem rising without a branch to the height of 60 to 80 ft. It has a whitish bark and on being wounded yields plentifully the milky juice from which the poison is prepared.

For a full account of the tree, see Bennett and Brown, *Plantae Javanicae rariores*, p. 52 (1838).

UPHOLSTERER, in modern usage, a tradesman who supplies coverings, cushions, padding and stuffing for chairs, sofas or beds, or who repairs the same, and more generally one who also provides carpets, curtains and household furniture. The word first appears as "upholder," then as "upholdster" or "upholster," and finally with repetition of -er, as in "poulterer," "upholsterer." The first meaning seems to have been a broker or dealer in small wares. Probably the name was given to a broker who sold such goods by auction, holding them up to public view as is the manner of auction-rooms.

UPPER SIND FRONTIER, a district of British India, in the Sind province of Bombay, with administrative headquarters at Jacobabad. Area, 2621 sq. m. In the north-east the country is hilly; the remainder consists of a narrow strip of level plain, one half being covered with jungle and subject to inundation, from which it is protected by artificial embankments. The land is watered by canals from the Indus, of which the chief are the Begari and Desert canals. The district contains several thriving timber plantations. The climate is remarkable for its dryness and for its extraordinary variations of temperature. The annual rainfall at Jacobabad averages less than 5 in. In 1901 the population was 232,045, showing an increase of no less than 33% in the decade, chiefly due to immigration from Baluchistan. The principal crops are millets, oil-seeds, pulses, wheat and rice. The internal trade is principally in grain, the greater part of which is sent to the sea-board; the transit trade from Central Asia into Sind crosses the district, bringing wool and woollen goods, fruits, carpets and horses. The district is crossed by the Quetta branch of the North-Western railway. The wild Baluchi inhabitants were pacified by General John Jacob between 1847 and his death in 1858.

UPPINGHAM, a market town of Rutland, England, 98 m. N.N.E. of London, on a branch of the London & North-Western railway. Pop. (1901) 2588. The church of St Peter and St Paul has Decorated portions in the nave, tower and spire. The pulpit is of the 17th century. Jeremy Taylor was rector here at the outbreak of the Civil War. The principal institution of Uppingham is the school. It is coeval with the grammar school of Oakham (1584), and had the same founder, Robert Johnson, archdeacon of Leicester. It rose in the last half of the 19th century to a place of distinction among English public schools, owing to the exertions of its headmaster (1853–77), the Rev. Edward Thring. A new group of school-buildings, with chapel, was erected in 1863 from the designs of G. E. Street. New (Tercentenary) class-rooms were opened in 1890, and a memorial chapel, containing a statue of Edward Thring, by T. Brock, R.A., was erected in 1891. The Victoria Building, containing museum, laboratory and lecture theatre, was opened in 1897. The quadrangle is by T. G. Jackson, R.A., and over the gateway is a statue of the founder, by G J. Frampton, R.A. The school contains about 450 boys. There are general exhibitions to the universities, and also several, in which scholars of this school and Oakham school have preference, at St John's, Clare, Emmanuel and Sidney Sussex colleges, Cambridge. The town of Uppingham has some agricultural trade.

UPSALA, or Uppsala, a city of Sweden, the seat of a university and of the archbishop of Sweden, chief town of the district (*län*) of Upsala, 41 m. N. of Stockholm by the Northern railway. Pop. (1900) 22,855. It has water-communication with Stockholm by the river Fyris and the northward arm of Lake Mälar, into which it flows. The older part of the city lies on its sloping west bank, the cathedral and castle occupying dominating heights, with the university buildings below. West and south is a girdle of gardens. The new town occupies the flat east bank, and the whole is set in a fertile plain.

The university, the chief and oldest in Sweden, was founded in 1477 by Archbishop Jakob Ulfsson. The university building, completed in 1887, lies west of the cathedral. It has a fine vestibule with galleries, lit from a cupola, a senate-hall, rooms for the governing body, and lecture rooms. The whole is very richly adorned. The library building was erected in 1819–41. It is on the site of the Academia Carolina, founded by Charles IX., and is known in consequence as *Carolina Rediviva*. Since 1707 the library has had the right of receiving a copy of every work printed in Sweden, and its MS. collection is also large and valuable. Among the MSS. is the famous *Codex Argenteus* (6th century), a translation of the Gospels in the Gothic of Bishop Ulfilas (4th century). Other university institutions are the chemical laboratory, the chemical, physical and pathological institutes, the anatomy house, and the collection of Northern antiquities. The last is situated in the old botanic garden, where Rudbeck and Linnaeus worked, and Linnaeus had his residence. The new botanic garden, W. of the castle hill, was given by Gustavus III. in 1787. The astronomical observatory was founded in 1730, though there was a professorial chair in the preceding century. The Victoria Museum contains Egyptian antiquities. The Royal Society of Sciences, founded in 1710 by Archbishop Erik Benzelius, occupies a house of its own and has a valuable library. Among other learned societies in the university are the Royal Association for Literary Science, and the Society for Swedish Literature. The annual expenditure of the university amounts to about £56,000, a large proportion of which is covered by a grant from parliament. The revenue of the university itself, however, amounts to about £25,000, a considerable part of which is still drawn from the property with which Gustavus Adolphus endowed it in 1624 from his private estates, amounting to 360 farms. There are about sixty professors, and a large number of assistants, lecturers and docents. The number of students is from 1500 to 2000, but it fluctuates considerably; the average in 1886–90 was 1825. Every student must belong to a "nation" (*landskap*), of which there are thirteen, each comprising mainly students from a particular part of the country. Each nation has generally its own club-house and fund. There are also societies for special branches of study, athletics and music, especially singing, for which the students have a deservedly high reputation. A cap of white velvet with a black border is worn by the students.

The cathedral stands nobly above the town; its tall western towers with their modern copper-sheathed spires are visible for many miles. It is of simple form, consisting of a nave with aisles and flanking chapels, short transepts, and choir with ambulatory and chapels and an apsidal eastern end. It is French in style (the first architect was a Frenchman, Étienne de Bonneuil) modified by the use of brick as building material. Ornamentation is thus slight except at the southern portal. The church was building from 1287 to 1435. It suffered from several fires, and a thorough restoration was completed in 1893. The easternmost chapel is the fine mausoleum of Gustavus Vasa. The castle was founded in 1548 by Gustavus I. but was not finished till a century later, when it was often used as a royal residence. It was destroyed by fire in 1702, and is still in part ruined, but part is used as the offices of the government of the *län* and the residence of the governor. Apart from the cathedral and a few insignificant buildings, there are no other medieval remains. Among institutions may be mentioned the Ultuna Agricultural Institute, immediately south of the city. The industries are unimportant.

The name of Upsala originally belonged to a place still called Old Upsala nearly 2 m. N. of the present city. This Upsala, mentioned as early as the 9th century, was famous throughout Scandinavia for its splendid heathen temple, which, gleaming with gold, made it the centre of the country, then divided into a great number of small kingdoms. Three huge grave mounds or barrows remain here. In the same place the first cathedral of the bishops of Upsala was also erected (*c.* 1100). On the destruction of this building by fire, the inconvenient situation caused the removal in 1273 of the archiepiscopal see to the present city, then called Ostra Aros,[1] but within a short time it came to be generally called Upsala. During the middle ages the cathedral and the see of the archbishop made Upsala a kind of ecclesiastical capital. Here the kings were crowned, after their election had taken place at the Mora Stones, 10 m. S.E. of Upsala. In 1567 Eric XIV. murdered in the castle five of the most eminent men of the kingdom, three of them belonging to the family of Sture. In 1593 was held the great synod which marks the final victory of Protestantism in Sweden; in the same year the university was restored by Charles IX. In the castle, Christina, daughter of Gustavus Adolphus, resigned her crown to Charles X. in 1654. In 1702 nearly the whole city, with the castle and the cathedral, was burnt down. Among the teachers of the university who have carried its name beyond the boundaries of their own country the following (besides Linnaeus) deserve to be mentioned: Olof Rudbeck the elder, the author of the *Atlantica* (1630–1702); Torbern Bergman (1735–1784), the celebrated chemist; and Erik Gustaf Geijer (1783–1847), the historian.

UR, one of the most important of the early Babylonian cities, represented to-day by the ruin mounds called Mughair (Moghair), or, more properly, Muqayyar (Muḳayyar), "the pitched," or "pitch-built." It lay 140 m. S.E. of Babylon (30° 95′ N., 46° 5′ E.), about 6 m. S. of the present bed of the Euphrates, half-way between that and the low, pebbly sandstone hills which form the border of the Syrian desert, and almost opposite the mouth of the Shatt-el-Haï, on the Sa'ade canal. It was the site of a famous temple, E-Nannar, "house of Nannar," and the chief seat in Babylonia of the worship of the moon-god, Nannar, later known as Sin (*q.v.*). Under the title Ur of the Chaldees, it is mentioned in the Bible as the original home of Abraham. It is worthy of notice that Haran, in upper Mesopotamia, which also was a home of Abraham, was likewise a famous site of worship of the god Sin, and that the name of that god also appears in Mount Sinai, which was historically connected with the origin of the Hebrew nation and religion. While not equal, apparently, in antiquity, and certainly not in religious importance, to the cities of Nippur, Eridu and Erech, Ur, from a very early period, played a most important part politically and commercially. Lying at the junction of the Euphrates and Tigris, at the head of the Persian Gulf, it enjoyed very extensive water-communications with rich and important regions. Lying close to the Syrian desert, at a natural point of communication with Arabia, it was the centre of caravan communication with interior, southern and western Arabia. In the Sumerian period, antedating the time of Sargon, about or before 3000 B.C., we find Ur exercising hegemony in Babylonia under a king whose name is read Lugal-Kigub-Nidudu. Comparatively early, however, it became a centre of Semitic influence and power, and immediately after the time of the Sargonids it comes to the front, under King Ur-Gur, or Ur-Engur, the great builder of *siggurats* (stage-towers) in the ancient Babylonian cities, as mistress of both northern and southern Babylonia, and even seems to have exacted tribute from countries as far remote as southern Syria. With relatively brief intervals, during which Erech and Isin come to the fore, Ur held the hegemony in Babylonia until or shortly before the Elamite invasion, when Larsa became the seat of authority. After the period of the Elamite dominion and the establishment of the empire of Babylon, under Khammurabi, about or shortly after 2000 B.C., Ur lost its political independence and, to a considerable extent, its political importance. The gradual filling up of the Persian Gulf had probably also begun to interfere with its trade supremacy. It continued, however, to be a place of religious and literary importance until the close of the Babylonian period. The ruins of the ancient site were partly excavated by Loftus and Taylor in 1854. They are egg-shaped, with the sharper end towards the north-west, somewhat elevated above the surrounding country, which is liable to be inundated by the Euphrates, and encircled by a wall 2946 yards in circumference, with a length of 1056 and a greatest breadth of 825 yds. The principal ruin is the temple of E—Nannar, in the north-western part of the mounds. This was surrounded by a low outer wall, within which rose a platform, about 20 ft. in height, on which stood a two-storeyed *siggurat*, or stage-tower, a right-angled parallelogram in shape, the long sides towards the north-east and south-west. The lower stage measured 198 ft. in length by 133 ft. in breadth, and is still standing to the height of 27 ft. The second storey was 14 ft. in height and measured 119 by 75 ft. The ascent to the first storey was by a stairway 8 ft. broad, on the north-east side. Access to the summit of the second storey was had on the same side, either by an inclined plane or a broad stairway—it is not clear which—extending, apparently, the whole length of that stage. Ruins on the summit show that there was a chamber on top, apparently of a very ornamental character, like that at Eridu. The bricks of the lower stage are laid in bitumen, and bear the inscription of Ur-Gur. The bricks of the upper stage are laid in mortar, and clay cylinders found in the four corners of this stage bore an inscription of Nabonidus, the last king of Babylon (639 B.C.), closing with a prayer for his son Belshar-uzur (Bel-sarra-Uzur), the Belshazzar of the book of Daniel. Between these two extremes were found evidences of restoration by Ishme-Dagan of Isin and Gimil-Sin of Ur, somewhere towards the middle of the 3rd millennium B.C., and of Kuri-galzu, a Cossaean (Kassite) king of Babylon, of the 14th century B.C. Nebuchadrezzar also claims to have rebuilt this temple. Taylor further excavated an interesting Babylonian building, not far from the temple, and part of an ancient Babylonian necropolis. All about the city he found abundant remains of burials of later periods. Apparently, in the later times, owing to its sanctity, Ur became a favourite place of sepulture, so that after it had ceased to be inhabited it still continued to be used as a necropolis. The great quantity of pitch used in the construction of these ruins, which has given them the name by which they are to-day known among the Arabs, is evidence of a peculiarly close relation with some pitch-producing neighbourhood, presumably Hit, which lay at the head of the Sa'ade canal on which Ur was located. Large piles of slab and scoria, in the neighbourhood of Ur, show, apparently, that the pitch was also used for manufacturing purposes, and that Ur was a manufacturing as well as a commercial city. Since Taylor's time Mughair has been visited by numerous travellers, almost all of whom have found ancient Babylonian remains, inscribed stones and the like, lying upon the surface. The site is rich in remains, and is relatively easy to explore.

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[1] The name first occurs in Snorro Sturluson in connection with events of the year 1018; it signifies "the mouth of the eastern river."

See J. E. Taylor, *Journal of the Royal Asiatic Society* (1855), vol. xv.; W. K. Loftus, *Chaldaea and Susiana* (1857); John P. Peters, *Nippur* (1897); H. V. Hilprecht, *Excavations in Assyria and Babylonia* (1904). (J. P. PE.)

URAL-ALTAIC, the general term for a group of languages (also called Turanian, Finno-Tatar, &c.) constituting a primary linguistic family of the eastern hemisphere. Its subgroups are Turkish, Finno-Ugrian, Mongol and Manchu. Philologists have differentiated various forms of the languages into numerous subdivisions; and considerable obscurity rests on the relationship which such languages as Japanese or ancient Accadian and Etruscan bear to the subgroups already named, which are dealt with in other articles.

In its morphology Ural-Altaic belongs to the agglutinating order of speech, differing from other languages of this order chiefly in the exclusive use of suffixes attached to the unmodified root, and partly blended with it by the principle of progressive vowel harmony, in virtue of which the vowels of all the suffixes are assimilated to that of the root. Thus the typical formula is R+R+R+R, &c., where R is the root, always placed first, and R, R, R . . . the successive postfixed relational elements, whose vowels conform by certain subtle laws of euphony to that of the root, which never changes. These suffixes differ also from the case and verbal endings of true inflecting languages (Aryan, Semitic) in their slighter fusion with the root, with which they are rather mechanically united (agglutinated) than chemically fused into a term in which root and relational element are no longer separable. Hence it is that the roots, which in Aryan are generally obscured, blurred, often even changed past the possibility of identification, inUral-Altaic are always in evidence, unaffected by the addition of any number of formative particles, and controlling the whole formation of the word. For instance, the infinitive element *mak* of the Osmanli *yaz-mak*=to write becomes *mek* in *sev-mek*=to love (vowel harmony), and shifts its place in *sev-il-mek*=to be loved (imperfect fusion with the root), while the root itself remains unchanged as to form and position in *sev-ish-il-mek*=to be impelled to love, or in any other possible combination with suffixed elements. The facility with which particles are in this way tacked on produces an exuberance, especially of verbal forms, which in Osmanli, Finnish, Magyar, Tungus and Mordvinian may be said to run riot. This is particularly the case when the numerous modal forms become further complicated by incorporating the direct pronominal object, as in the Magyar *varjak*=they await him, and the Mordvinian *palasa*=I embrace him. Thus arise endless verbal combinations, reckoned in Turki at nearly 30,000, and past counting in the Ugrian group.

Another marked peculiarity of the Ural-Altaic, at least as compared with the inflecting orders of speech, is weak subjectivity, the subject or agent being slightly, the object of the action strongly accentuated, so that "it was done by him" becomes "it was done with him, through him, or in his place" (*apud eum*). From this feature, which seems to be characteristic of all the branches, there follow some important consequences, such as a great preponderance of locative forms in the declension,—the nominative, and often even the possessive, being expressed by no special suffix. Hence also the object normally precedes the subject, while the idea of possession (to have) is almost everywhere replaced by that of being (to be), so that, even in the highly developed Osmanli, "I have no money" becomes "money-to-me not-is" (*Akchchĭm yokdür*). In fact the verb is not clearly differentiated from the noun, so that the conjugation is mainly participial, being effected by agglutinating pronominal, modal, temporal, negative, passive, causative, reciprocal,

reflexive and other suffixes to nominal roots or gerunds: I write = writing-to-me-is. Owing to this confusion of noun and verb, the same suffixes are readily attached indifferently to both, as in the Osmanli *jān* = soul, *jān-ler* = souls, and *yázār* = he will write, *yázār-ler* = they will write. So also, by assimilation, the Yakut *kötördör kötöllör* = the birds fly (from root *köt* = flying), where *kötöl* stands for *kötör*, and *dör* for *lör*, the Osmanli *ler*, or suffix of plurality.

But, notwithstanding this wealth of nominal or verbal forms, there is a great dearth of general relational elements, such as the relative pronoun, grammatical gender, degrees of comparison, conjunctions and even postpositions. Byrne's remark, made in reference to Tungus, that "there is a great scarcity of elements of relation, very few conjunctions, and no true postpositions, except those which are given in the declension of the noun,"[1] is mainly true of the whole family, in which nouns constantly do duty for formative suffixes. Thus nearly all the Ostiak postpositions are nouns which take the possessive suffix and govern other nouns in the genitive, precisely as in the Hindi: *ādmi-kī-ṭărăf* (*men*) *găyā* = man-of-direction (in) I went = I went towards the man, where the so-called postposition *ṭărăf*, being a feminine noun = direction, requires the preceding possessive particle to be also feminine (*kī* for *kē*).

As there are thus only two classes of words—the roots, which always remain roots, and the suffixes, which always remain suffixes—it follows that there can be no true composition or word-building, but only derivation. Even the numerous Magyar nominal and adjectival compounds are not true compounds, but merely two words in juxtaposition, unconnected by vowel harmony and liable to be separated in construction by intervening particles. Thus in *aran-sinu* = gold-colour = golden, the first part *aran* receives the particle of comparison, the second remaining unchanged, as if we were to say "golder-colour" for "more golden"; and *ata-fi* = relative becomes *ata-m-fi-a* = my relative, with intrusion of the pronominal *m* = my.

But, while these salient features are common, or nearly common, to all, it is not to be supposed that the various groups otherwise present any very close uniformity of structure or vocabulary. Excluding the doubtful members, the relationship between the several branches is far less intimate than between the various divisions of the Semitic and even of the Aryan family, so that, great as is, for instance, the gap between English and Sanskrit, that between Lapp and Manchu is still greater.

After the labours of Castrén, Csink, Gabelentz, Schmidt, Böhtlingk, Zenker, Almqvist, Radlov, Munkacsi-Berat and especially Winkler, their genetic affinity can no longer be seriously doubted. But the order of their genetic descent from a presumed common organic Ural-Altaic language is a question presenting even greater difficulties than the analogous Aryan problem. The reason is, not only because these groups are spread over a far wider range, but because the dispersion from a common centre took place at a time when the organic speech was still in a very low state of development. Hence the various groups, starting with little more than a common first germ, sufficient, however, to give a uniform direction to their subsequent evolution, have largely diverged from each other during their independent development since the remotest prehistoric times. Hence also, while the Aryan as now known to us represents a descending line of evolution from the synthetic to the analytic state, the Ural-Altaic represents on the contrary an upward growth, ranging from the crudest syntactical arrangements in Manchu to a highly agglutinating but not true inflecting state in Finnish.[2] No doubt Manchu also, like its congeners, had formerly possessive affixes and personal elements, lost probably through Chinese influences; but it can never have possessed the surprisingly rich and even superabundant relational forms so characteristic of Magyar, Finn, Osmanli and other western branches. As regards the mutual relations of all the groups, little more can now be said than that they fall naturally into two main divisions—Mongolo-Turkic and Finno-Ugro-Samoyedo-Tungusic—according to the several methods of employing the auxiliary elements. Certainly Turkic lies much closer to Mongolic than it does to Samoyedic and Tungusic, while Finno-Ugric seems to occupy an intermediate position between Turkic and Samoyedic, agreeing chiefly in its roots with the former, in its suffixes with the latter. Finno-Ugric must have separated much earlier, Mongolic much later, from the common connexion, and the latter, which has still more than half its roots and numerous forms in common with Turkic, appears on the whole to be the most typical member of the family. Hence many Turkic forms and words can be explained only by reference to Mongolic, which has at the same time numerous relations to Finno-Ugric and Samoyedic that have been lost in Turkic and Tungusic. It may therefore be concluded that the Finno-Ugric migrations to the north and west and the Tungusic to the east had been completed while the Turkic and Mongolic tribes were still dwelling side by side on the Altai steppes, the probable cradle of the Ural-Altaic peoples.

How profoundly the several groups differ one from the other even in their structure is evident from the fact that such assumed universal features as unchangeable roots and vowel harmony are subject to numerous exceptions, often spread over wide areas. Not only is assimilation of final consonants very common, as in the Osmanli *bulun-mak* for the Uighur *bulul-mak*, but the root vowel itself is frequently subject to *umlaut* through the influence of suffixed vowels, as in the Aryan family. Thus in the Surgut dialect of Ostiak the long vowels of nominal stems become modified before the possessive suffix, ā and ē to ī and ō to ū (Castrén). It is still more remarkable to find that the eastern (Yenisei) Ostiak has even developed verbal forms analogous to the Teutonic strong conjugation, the presents *tabdŭq'*, *abbatag'an* and *datpaq'* becoming in the past *tobdq'*, *abbatog'an* and *datpiyaq'* respectively; so also *taig, törg and tărg*, present, past and imperative, are highly suggestive of Teutonic inflexion, but more probably are due to Tibetan influences. In the same dialects many nouns form their plurals either by modifying the root vowel, in combination with a suffixed element, or by modification alone, the suffix having disappeared, as in the English *foot—feet, goose—geese*. So also vowel harmony, highly developed in Finnish, Magyar and Osmanli, and of which two distinct forms occur in Yakutic, scarcely exists at all in Cheremissian, Votyak and the Revel dialect of Esthonian, while in Mordvinian and Syryenian, not the whole word, but the final vowels alone are harmonized. The unassimilated Uighuric *kilur-im* answers to the Osmanli *kilur-um*, while in Manchu the concordance is neglected, especially when two consonants intervene between the root and the suffixed vowels. But too much weight should not be attached to the phenomenon of vowel harmony, which is of comparatively recent origin, as shown in the oldest Magyar texts of the 12th century, which abound in such discordances as *kaldi-nek, tissta-seg*, for the modern *halál-nak, tissta-sag*. It clearly did not exist in the organic Ural-Altaic speech, but was independently developed by the different branches on different lines after the dispersion, its origin being due to the natural tendency to merge root and suffix in one harmonious whole.

This progressive vocalic harmony has been compared to a sort of progressive *umlaut*, in which the suffixed vowels are brought by assimilation into harmony with those of the root. All vowels are broadly divided into two categories, the guttural or hard and the palatal or weak, the principle requiring that, if the root vowel be hard, the suffixed must also be hard, and vice versa. But in some of the groups there is an intermediate class of "neutral" vowels, which do not require to be harmonized, being indifferent to either category. In accordance with these general principles the vowels in some of the leading members of the Altaic family are thus classified by L. Adam:[3]—

	Gutturals.	Palatals.	Neutrals.
Finnish	u, o, a	ü, ö, ä	e, i
Magyar	u, o, a	ü, ö	e, i
Mordvinian	u, o, a	ä, i	..
Syryenian	ô, a	ä, i, e	..
Osmanli	u, o, a, e	ü, ö, e, i	..
Mongolian	u, o, a	ü, ö, ä	i
Buriat	u, o, a	ü, ö, ä	e, i
Manchu	ô, o, a	e	u, i

A close analogy to this law is presented by the Irish rule of "broad to broad" and "slender to slender," according to which under certain conditions a broad (*a, o, u*) must be followed in the next syllable by a broad, and a slender (*e, i*) by a slender. Obvious parallelisms are also such forms in Latin as *annus, perennis, ars, iners, lego, diligo*, where, however, the root vowel is modified by the affix, not the affix by the root. But such instances suffice to show that the harmonic principle is not peculiar to the Ural-Altaic, but only more systematically developed in that than in most other linguistic families.

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[1] *Gen. Prin. of Struct. of Lang.* i. 391 (London, 1885).

[2] "Meine Ansichten werden sich im Fortgange ergeben, so namentlich dass ich nicht entfernt die finnischen Sprachen für flexivische halten kann" (H. Winkler, *Uralaltaische Volker*, 1884, i. p. 54). Yet even true inflexion can scarcely be denied at least to some of the so-called Yenisei Ostiak dialects, such as Kotta and others still surviving about the middle Yenisei and on its affluents, the Agul and Kan (Castrén, *Yen., Ostjak und Kort. Sprachlehre*, 1858, Preface, pp. v-viii). These, however, may be regarded as aberrant members of the family, and on the whole it is true that the Ural-Altaic system nowhere quite reaches the stage of true inflexion.

[3] *De l'harmonie des voyelles dans les langues Ouralo-Altaïques* (Paris, 1874).

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URAL MOUNTAINS, a system of mountains which extends from the Arctic Ocean southwards nearly to the Caspian Sea, and is regarded as separating Europe from Asia. Russians describe them either as Kameñ (stone) merely, or by the appropriate name of Poyas (girdle), while the name of Urals (*Uraly*)—derived either from the Ostyak *urr* (chain of mountains) or from the Turkish *aral-tau* or *ural-tau*—has with them become a generic name for extensive mountain chains. Although the real structure of the Urals, both orographical and geological, is imperfectly ascertained, enough is known to warrant the statement that they have been affected by a series of separate upheavals, some having a north-western strike and some a north-eastern, and that they reach their maximum altitudes along a zone stretching nearly north and south. The composite nature of the Urals is best seen at the northern and southern extremities of the system, where the upheavals assume the character of distinct chains of mountains.

The Paĕ-khoy or coast ridge (Samoyedic "stony ridge") is quite independent of the Urals proper, from which it is separated by a marshy *tundra*, some 30 m. wide. It has a distinct north-north-westerly and north-westerly trend along the shores of the Kara Sea; and, although it is cut through by the Ugrian Strait (Yugorskiy-shar), there is no doubt that it is continued in Vaygach Island and Novaya-Zemlya. Its dome-shaped summits, which rise 1000 ft. above the *tundra* (Vozaipaë, 1312 ft.), are completely destitute of trees, and its stony crags are separated by broad marshy *tundras*.

The Obdorsk or Northern Urals, which begin within a few miles of the head of Kara Bay (Konstantinov Kameñ, in 68° 30′ N., 1465 ft.), and extend south-west as far as the 64th parallel, form a distinct range, stony and craggy, sloping steeply towards the south-east and gently towards the marshes of European Russia. Its highest elevations (*e.g.* Khard-yues, 3715 ft., and Paĕ-yer, 4650 ft.) are on the 66th and 67th parallels. Sometimes the main chain has on the west two or three secondary chains, formed by the upheaval of sedimentary rocks, and it is towards the southern extremity of one of these that the highest peaks of the Urals occur (Sablya, 5135 ft., in 64° 47′ N., and Töll-poz-iz or Muraĭ-chakhl, 5535 ft. in 63° 55′). Dense forests, chiefly fir, pine and larch, clothe the slopes of the mountains and the narrow valleys; but, as the less hospitable latitudes are approached, every species except the larch gradually disappears and the upper limit of vegetation (2400 ft. in the south) rapidly descends till it reaches the very base of the mountains towards the Arctic Circle, and forest vegetation disappears altogether about 65° N. (67° in the plains of Russia and Siberia).

Although usually reckoned to the Northern Urals, the section between 64° and 61° N. has again a wholly distinct character. Here the main chain (or, more correctly, the main water-parting) of the Urals is a succession of plateaus stretching in a north-westerly direction, and dimpled with broad, flat, marshy valleys, rising here and there into isolated dome-shaped, flattened summits, mostly under 3000 ft. (Yang-tump, 62° 43′ N., 4170 ft.). The whole region, except the mountain summits, is densely clothed with coniferous forests, birch appearing only occasionally in the south, and even the Scotch pine only in a few valleys. This part of the range is also uninhabited.

The Middle Urals, between 61° and 55° 30′ N. and about 80 m. in breadth, are the best known, as they contain the richest iron, copper and gold mines (Bogoslovsk, Goroblagodatsk and Ekaterinburg Urals). The Denezhkin Kameñ in the north (5355 ft.) and the Tara-tash in the south (2800 ft.) may be considered as marking the limits of this section. Here the orographical structure is still more complicated. In the north (61st to 60th parallel) there is a succession of chains with a distinct north-eastern trend; and it still remains an open question whether, for two degrees farther south, the whole of the Bogoslovsk Urals (4795 ft. in the Konzhakovski-Kameñ, and from 3000 to 4000 ft. in several other summits) do not consist of chains having the same direction. South of Kachkanar (2885 ft.), *i.e.* from the 58th to the 56th parallel, the Urals assume the appearance of broad swellings 1000 to 2000 ft. in height, deeply trenched by ravines. These low and ravine-broken plateaus, the higher parts of which can be reached from Russia on a very gentle gradient, have been utilized for centuries as the chief highway to Siberia. The water-parting between the Russian and Siberian rivers is here not more than 1245 ft. above sea-level on the great Russo-Siberian highway (W. of Ekaterinburg). The eastern slope is steeper, but even there Ekaterinburg is only 435 ft. below the water-parting. The valleys have a decidedly south-eastern direction, and such is also the course of the railway from Perm to Tyumeñ, as soon as it reaches the Siberian slope. The Middle Urals are densely forested. The valleys and lower slopes are covered with a thick sheet of rich humus and have become the site of large and wealthy villages. The mines also support a considerable population.

The Southern Urals (55° 30′ to 51° N.), instead of being made up of three chains of mountains radiating from Mount Yurma, as was formerly supposed, consist of three parallel chains running north-east and south-west, and therefore constitute a quite independent part of the Ural system. The Urals proper are a low sinuous chain extending due south-west and hardly exceeding 2200 to 2800 ft. in altitude. They slope gently towards the north-west and abruptly towards the south-east, where several short, low spurs (Ilmeñ, Irenly) rise in the basins of the Miyas and the Ui. In the west a chain, separated from the main range, or Ural-tau, by a longitudinal valley, accompanies it throughout its entire length. This, although pierced by the rivers which rise in the longitudinal valley just mentioned (Ai, Upper Byelaya), nevertheless rises to a much greater height than the main range. Its wild stony crest reaches an extreme altitude of 5230 ft. Farther west, another series of chains reach nearly the same altitudes. The gorges by which the rivers pierce the Devonian limestones on their way towards the lower terraces are most picturesque in the west, where the Urals assume an alpine character. The forests are no longer continuous; the gentle slopes of the hilly tracts are dotted with woods, mostly of deciduous trees, while the hollows contain rich pasture grounds. The whole region, formerly the exclusive abode of the Bashkirs, is being colonized by Russians.

Farther south, between the 53rd and 51st parallels, the main range continues in the same direction, and, except when deeply trenched by the rivers, assumes the appearance of a plateau which hardly reaches 1500 ft. It is continued farther south-west (towards the Volga) under the name of Obshchiy Syrt.

As a rule, the Urals are not considered to continue south of the great bend of the Ural river, where quite independent ranges of hills, or flat swellings, appear (*e.g.* Dzhaman-tau, Mugodzhar Hills). It appears, however, that the Mugodzhar Hills may safely be regarded as an actual prolongation of the upheavals which constitute the Urals. These consist of diorites and crystalline slates, and reach their maximum in Aïryuk (1885 ft.). A range of heights connects the Mugodzhar Hills with the Ust-Urt plateau (see TRANSCASPIAN REGION).

Geology.—The Ural Mountains are no more than the western edge of a broad belt of folding of which the greater part is buried beneath the Tertiary deposits of western Siberia. Throughout the greater portion of the chain a broad strip of granites, diorites, peridotites, gneisses and other crystalline rocks rises directly from the Siberian plain, and is covered towards the west by Silurian, Devonian, Carboniferous, Permian and Triassic strata, which are thrown into numerous folds parallel to the length of the chain and usually rise to much greater heights than the crystalline zone. In the north, however, folded sedimentary rocks lie to the east as well as to the west of the crystalline axis, and between 60° 40′ and 46° 50′ N. Fedorov distinguishes three zones: (i.) the eastern hill region, where one finds Mesozoic rocks (Chalk, Jurassic) in the north, and Devonian limestones, porphyrites and quartz-porphyries farther south; in this zone most gold placers are found; (ii.) the central mountain zone consists of various amphibolitic metamorphic slates, and also of syenite and gabbro; granites, gneisses, and occasionally serpentines and porphyrites are found subordinately; and (iii.) the western hilly zone consists chiefly of Carboniferous and Permo-Carboniferous deposits; Middle and Upper Devonian limestones and, occasionally, crystalline slates are found in a few meridional ridges. The crystalline rocks are usually believed to be of Archean age. The Carboniferous deposits—coal-bearing in the Middle and Southern Urals—although appearing at the surface only as a narrow strip in the west Urals, occupy an extensive area, but are concealed by the largely developed Permian deposits, and that series of sediments which must be considered as intermediate between the Carboniferous and the Permian. These latter, described as "Permo-Carbon" by Russian and German geologists, are largely developed in the west Urals. The Permian deposits cover a wide zone all along the western slope of the Urals from north to south, and are most important on account of their copper ores, salt beds and salt springs. They are also covered with variegated marls which are almost destitute of fossil organisms, so that their age is not yet quite settled.

Climatic, Geo-Botanical and Geo-Zoological Importance.—The importance of the Urals as a climatic and geo-botanical boundary can no longer be regarded as very great. Most European species of plants freely cross the Urals into Siberia, and several Siberian species travel across them into northern Russia. But, being a zone of hilly tracts extending from north to south, the Ural Mountains necessarily exercise a powerful influence in pushing a colder northern climate, as well as a northern flora and fauna, farther south along their axis. The harshness of the climate at the meteorological stations of Bogoslovsk, Zlatoust and Ekaterinburg is not owing merely to their elevation a few hundred feet above sea-level. Even if reduced to sea-level, the average temperatures of the Ural meteorological stations are such as to produce a local deflexion of the isotherms towards the south. The same is true with regard to the limits of distribution of vegetable and animal species. The reindeer, for instance, is met with as far south as the 52nd parallel. The Southern Urals introduce into the Cis-Caspian steppes the flora and fauna of middle Russia.

In the distribution of the races of mankind the Urals have played an important part. To the present day the Northern Urals are inhabited by Finnish races (Samoyedes, Syryenians, Voguls and Permians) who have been driven from their former homes by Slav colonization, while the steppes on the slopes of the Southern Urals have continued to be inhabited by the Turkish Bashkirs. The Middle Urals were in the 9th century the abode of the Ugrians, and their land, Bjarmeland or Biarmia (now Perm), was well known to the Byzantine historians for its mineral wealth,—there being at that time a lively intercourse between the Ugrians and the Greeks. Compelled to abandon these regions, they moved (in the 9th century) south along the Ural slopes towards the land of the Khazars, and through the prairies of south-eastern and southern Russia (the *Λεβεδία* of Constantine Porphyrogenitus) towards the Danube and to their present seat—Hungary—leaving but very few memorials behind them in the Northern and Middle Urals.[1] At present the Urals, especially the Middle and the Southern, are being more and more colonized by Great Russian immigrants, while the Finnish tribes are rapidly melting away.

Metallurgy and Mining.—The mineral wealth of the Urals was known to the Greeks in the 9th century, and afterwards to the Novgorodians, who penetrated there in the 11th century for trade with the Ugrians. When the colonies of Novgorod (Vyatka, Perm) fell under the rule of Moscow, the Russian tsars soon grasped the importance of the Ural mines, and Ivan III. sent out German engineers to explore that region. In 1558 the whole of the present government of Perm was granted by the rulers of Moscow to the brothers Stroganov, who began to establish salt-works and mines for iron and copper. Peter the Great gave a new impulse to the mining industry by founding several iron-works, and from 1745, when gold was first discovered, the Russian colonization of the Urals took a new departure. The colonization was of a double character, being partly free—chiefly by Nonconformists in search of religious freedom—and partly compulsory,—the government sending peasant settlers who became serfs at the iron and copper works. Until 1861 all work at the mines was done by serfs belonging either to private persons (the Stroganovs, Demidovs and others) or to the crown. Not only are the Urals very rich in minerals, but the vast areas covered with forests afford an almost inexhaustible supply of cheap fuel for smelting purposes. Thus for a long time the Urals were the chief mining region in Russia. But when coal began to be used for smelting purposes, south Russia generally, and Ekaterinoslav in particular, became the chief iron-producing region. Attention has, however, again been directed to the great mineral wealth locked up in the mountain region, and the last two years of the 19th century witnessed a "boom" in the purchase of iron and gold mines by foreign companies. The chief pig-iron and iron-works are at Nizhniy-Tagilsk, and the principal steel-works at Bogoslovsk. The manufacture of agricultural machinery has increased in the southern Urals, especially at Krasno-ufimsk, and the manufacture of tea-urns has grown in importance at Perm.

Gold is met with in the Urals both in veins and in placers; the output increased from about 30,000 oz. in 1883 to three times that amount at the end of the century. The Urals have also rich placers of platinum, often mixed with gold, iridium, osmium and other rare metals, and supply annually some 13,000 lb, *i.e.* 95% of all the platinum obtained in the world. Silver, mercury, nickel, zinc and cobalt ores are found. Rich mines of copper are found at Turinsk, Gumishev and other places, yielding as much as 5% of pure copper; nickel is obtained at Revdinsk, and the extraction of iron chromates has developed. Coal exists in many places on the western slope of the Urals, mainly on the Yaiva river, in the basin of the Kama, and on the Usva (basin of the Chusovaya), and about 500,000 tons are raised annually. Several beds of coal have been found on the eastern slope; excellent anthracite exists at Irbit and good coal at Kamyshlov. Sapphires, emeralds beryls, chrysoberyls, tourmalines, aquamarines, topaz, amethysts, rock-crystals, garnets and many kinds of jade, malachite and marble are cut and polished at several stone-cutting works, especially at Ekaterinburg; and diamond-mining may prove successful. Good asbestos is extracted, and pyrites is worked for the manufacture of sulphuric acid Many varieties of mineral waters occur in the Urals, the best being those at Serginsk, Klyuchevsk and Elovsk.

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(P. A. K.; J. T. BE.)

URALSK, a province of Asiatic Russia, lying N. of the Caspian Sea, with an area of 140,711 sq. m. It is bounded by the government of Astrakhan on the W., Samara and Orenburg on the N., Turgai and the Sea of Aral on the E., and the Caspian Sea and Transcaspian region on the S. It is geographically situated mostly within the boundaries of Asia, *i.e.* E. of the Ural river, and both its physical features and its inhabitants are, to a very large extent, Asiatic. Administratively, it belongs to the "Kirghiz provinces," or governor-generalship of the Steppes. Apart from a narrow strip of land in the north, where the slopes of the Obshchiy-Syrt plateau, covered with fertile black earth and stretches of forest, descend towards the Ural river, and the gentle slopes of the Mugojar Hills in the north-east, Uralsk consists of arid steppes and deserts, which incline with an imperceptible gradient towards the Caspian. Most of the province is below sea-level, the zero altitude line running from Kamyshin on the Volga to the south of the town of Uralsk.

Uralsk is drained by the river Ural or Yaik, which rises in Orenburg and flows south, west and south, entering the Caspian after a course of 900 m. Its chief tributaries, the Sakmara, the Qr and the Ilek, are in the north; along its lower course the Great and Little Uzeñ and many small streams on the left bank become lost in lakes before reaching the Ural. The Emba, which flows through the north of the Ust-Urt plateau, reaches the Caspian by a series of shallow lagoons, which were navigable in the 18th century.

The climate is influenced by the Central Asian steppes. A cold and dry winter is succeeded by a hot and still drier summer, during which the grass, and sometimes all the crops, are destroyed by the burning heat. Uralsk, although lying wholly to the south of 52° N., has the same average yearly temperature as Moscow and south Finland (39°·5); its January is colder than that of north Finland (3°), while July averages 73°.

The estimated population in 1906 was 730,300. It consists of three different elements—Ural Cossacks, who constitute about one-fifth; some 15,000 Russian peasants, and Kirghiz. The Kirghiz are almost entirely dependent on pastoral pursuits. The Cossacks, descendants of those independent communities of free settlers and Raskolniks who are so often mentioned in Russian history under the name of Yaik Cossacks, owing to their unwillingness to submit to the rule of the tsars, are fine representatives of the Great Russian race, though not without some admixture of Tatar and Kalmuck blood. Their chief occupations are live-stock breeding and fishing.

History.—In the first half of the 16th century Uralsk was occupied by the Nogai horde, a remnant of the Mongol Golden Horde, which retired there after the fall of Astrakhan and Kazan; the khans resided at Saraichik on the river Ural. At the same time the lower parts of the Ural were occupied by Russian runaway serfs and free Cossacks who did not recognize the authority of Moscow. They took Saraichik in 1560 and formed an independent community, like that of the Zaporogian Cossacks. When the Moscow princes attempted to bring them under their rule and prosecuted them for nonconformity, the Cossacks revolted, first under Stenka Razin (1667–71) and afterwards under Pugachev (1773–75). After the latter rising, the name of Ural was officially given to the Yaik river and the Yaik Cossacks. The disbanding of their artillery, the planting of Russian garrisons within the domains of the *voisko*, and the interference of Russian officials in their interior organization during the 19th century occasioned a series of smaller outbreaks, the latest of which, in 1874, resulted in the deportation of 2500 Cossacks, with their families, to Turkestan.

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[1] Comp. *Moravia and the Madiars*, by K. J. Groth; Zabyelin's *History of Russian Life*, and the polemics on the subject in *Izvestia* of the Russ. Geogr. Soc., xix. (1883).

URALSK, a town of Asiatic Russia, the capital of the province of the same name, on the Ural river, 165 m. W.S.W. of Orenburg, and 270 m. by rail E. of Saratov. Pop. (1885) 26,055; (1901) 38,919. It is rapidly developing owing to its trade with the nomad Kirghiz in cattle, sheep and animal products, all of which are exported to Russia; it is also a centre for trade in grain. It has two cathedrals, founded, one in the 18th century, the other in 1837; a small museum, a school farm, a people's palace, free libraries, and branches of the Russian Geographical and the Fisheries Societies.

URANIUM [symbol U, atomic weight 238·5 ($O=16$)], a metallic chemical element. In 1789 Klaproth isolated from pitchblende a yellow oxide which he viewed as the oxide of a new metal, which he named uranium, after the newly discovered planet of Herschel. By reducing the oxide with charcoal at a high temperature, he obtained a product which he took to be metallic uranium. Berzelius about 1823 found that the yellow oxide, when treated with excess of sulphuric acid, gave a sulphate not unlike the ferric salt. He concluded that the uranium salt was $Ur_2O_3 3SO_3$, where Ur_2O_3, according to his analysis, represents 864 parts of yellow oxide ($O=16$). Like Fe_2O_3, the yellow oxide lost 48 parts of oxygen per Ur_2O_3 ($=864$ parts) as water, while $Ur_2=816$ parts of metal remained. These results were adopted until Péligot in 1840 discovered that Berzelius's (and Klaproth's) metal contains oxygen, and that his $(Ur_2)O_3$ really is $(U_6O_6)\cdot O_3=3U_2O_3$, where $U=120$ is one equivalent weight of real uranium. Péligot's results, though called in question by Berzelius, have been amply confirmed by all subsequent investigators; only now, on theoretical grounds, first set forth by Mendeléeff, we double Péligot's atomic weight, so that U now signifies 240 parts of uranium, while UO_3 stands as the formula of the yellow oxide, and UO_2 as that of Berzelius's metal.

The only practically available raw material for the extraction of uranium is pitchblende (*q.v.*). Pure pitchblende is U_3O_8, which, in relatively good specimens, forms some 80% or more of the whole. It is remarkable as always containing helium (*q.v.*) and radioactive elements (see RADIOACTIVITY). To extract the metal, the pitchblende is first roasted in order to remove the arsenic and sulphur. In one process the purified ore is disintegrated with hot nitric acid to produce nitrates, which are then converted into sulphates by evaporation with sulphuric acid. The sulphates are treated with water, which dissolves the uranium and other soluble salts, while silica, lead sulphate, &c., remain; these are removed by filtration. From the solution the arsenic, copper, &c., are precipitated by sulphuretted hydrogen as sulphides, which are filtered off. The filtrate contains the uranium as uranous and the iron as ferrous salt. These are oxidized and precipitated conjointly by excess of ammonia. The precipitate, after having been collected and washed, is digested with a warm concentrated solution of ammonium carbonate, which dissolves the uranium as a yellow solution of ammonium uranate, while the hydrated oxide of iron, the alumina, &c., remain. These are filtered off hot, and the filtrate is allowed to cool, when crystals of the uranate separate out. The mother liquor includes generally more or less of nickel, cobalt, zinc and other heavy metals, which, as Wöhler showed, can be removed as insoluble sulphides by the addition of ammonium sulphide; uranium, under the circumstances, is not precipitated by this reagent. The filtrate, on being boiled down, yields a second crop of uranate. This uranate when ignited in a platinum crucible leaves a green oxide of the composition U_3O_8, *i.e.* artificial pitchblende, which serves as a starting-point for the preparation of uranium compounds. The green oxide, as a rule, requires to be further purified. One method for this purpose is to convert it into a solution of the nitrate $UO_2(NO_3)_2$, and from it to precipitate the metal as oxalate by oxalic acid (Péligot). The latter ($UO_2\cdot C_2O_4$) yields a purer oxide, UO_2, or, in the presence of air, U_3O_8, on ignition.

Metallic uranium, as shown by Péligot, can be obtained by the reduction of a mixture of dry chloride of potassium and dry uranous chloride, UCl_4, with sodium at a red heat. A better process is that of H. Moissan (*Compt. rend.*, 1896, 122, p. 1088), in which the oxide is heated with sugar charcoal in the electric furnace. Uranium is a white malleable metal, which is pretty hard, though softer than steel. Its specific gravity has the high value 18·7; its specific heat is 0·02765, which, according to Dulong and Petit's law, corresponds to $U=240$. It melts at bright redness. The compact metal when exposed to the air tarnishes only very slowly. The powdery metal when heated in air to 150° or 170° C. catches fire and burns brilliantly into U_3O_8; it decomposes water slowly at ordinary temperatures, but rapidly when boiling. It burns in oxygen at 170°, in chlorine at 180°, in bromine at 210°, in iodine at 260°, in sulphur at 500°, and combines with nitrogen at about 1000°. Dilute sulphuric acid attacks it but slowly; hydrochloric acid, especially if strong, dissolves it readily, with the formation, more immediately, of a hyacinth-coloured solution of U_2Cl_6, which, however, readily absorbs oxygen from the air, with the formation of a green solution of UCl_4, which in its turn gradually passes into one of yellow uranyl salt, $UO_2\cdot Cl_2$.

Uranium is chemically related to chromium, molybdenum and tungsten. If forms two series of salts, one, the uranous compounds, are derived from the oxide UO_2, the other, the uranyl compounds, contain the divalent group UO_2.

Uranous Compounds.—Uranium dioxide, UO_2 (Berzelius's metal), is a brown to copper-coloured powder, obtained by heating U_3O_8 or uranyl oxalate in hydrogen. It fires when heated in air, and dissolves in acids to form uranous salts. It may be obtained as jet black octahedra (isomorphous with thoria) by fusion with borax. Uranous hydrate is obtained as reddish-brown flakes by precipitating a uranous solution with alkali. The solution in sulphuric acid deposits green crystals of the sulphate, $U(SO_4)_2\cdot 8H_2O$, on evaporation. Uranous chloride, UCl_4, was first prepared by Péligot by heating an intimate mixture of the green oxide and charcoal to redness in a current of dry chlorine; it is obtained as sublimate of black-green metallic-looking octahedra. The chloride is very hygroscopic. By heating in hydrogen it yields the trichloride, UCl_3, and by direct combination with chlorine the pentachloride, UCl_5. With hydroflouric acid it yields uranous fluoride, UF_4, which forms double salts of the type $MF\cdot UF_4$. Uranous bromide, UBr_4, and uranous iodide, UI_4, also exist.

Uranyl or Uranic Compounds.—Uranic oxide, UO_3 or $UO_2\cdot O$, is obtained by heating uranyl nitrate to 250° as a yellow solid, insoluble in water, but soluble in acids with the formation of uranyl salts. Various hydrates have been described, but they cannot be formed by precipitating a uranyl salt with an alkali, this reagent giving rise to salts termed *uranates*. These salts generally resemble the bichromates; they are yellow in colour, insoluble in water, soluble in acids, and decomposed by heat. Sodium uranate, $Na_2U_2O_7$, is used as a pigment for painting on glass and porcelain under the name of uranium yellow. It is manufactured by heating pitchblende with lime, treating the resulting calcium uranate with dilute sulphuric acid, and adding sodium carbonate in excess. Dilute sulphuric acid precipitates uranium yellow, $Na_2U_2O_7\cdot 6H_2O$, from the solution so obtained. Ammonium uranate heated to redness yields pure U_3O_8, which serves as a raw material for uranium compounds. Uranyl nitrate, $UO_2(NO_3)_2\cdot 6H_2O$, is the most important uranium salt. It is obtained as fine lemon yellow deliquescent prisms by evaporating a solution of any of the oxides in nitric acid. By electrolysis it yields uranium dioxide as a pyrophoric powder, and peruranic hydroxide, $UO_4\cdot 2H_2O$, when treated with hydrogen peroxide. The latter gives rise to salts, the peruranates, *e.g.* $(Na_2O_2)_2UO_4\cdot 8H_2O$. Uranyl nitrate is used in photography, and also in analytical chemistry as a precipitant for phosphoric acid (as uranyl ammonium phosphate, $UO_2\cdot NH_4\cdot PO_4$). Uranyl chloride, UO_2Cl_2, is a yellow crystalline mass formed when chlorine is passed over uranium dioxide at a red heat. It is also obtained by dissolving the oxide in hydrochloric acid and evaporating. It forms double salts with metallic chlorides and with the hydrochlorides of organic bases. Uranyl sulphide, UO_2S, is a black precipitate obtained by adding ammonium sulphide to a uranyl solution. Exposed to air this mixture is oxidized to the pigment *uranium red*, $U_4(NH_4)_2SO_9$, which is a fine blood-coloured amorphous powder.

Analysis.—A borax bead dissolves uranium oxides in the reducing flame with a green, in the oxidizing flame with a yellow, colour. Solutions of uranyl salts (nitrate, &c.) behave to reagents as follows: sulphuretted hydrogen produces green uranous salt with precipitation of sulphur; sulphide of ammonium in neutral solutions gives a black precipitate of UO_2S, which settles slowly and, while being washed in the filter, breaks up partially into hydrated UO_2 and sulphur; ammonia gives a yellow precipitate of uranate of ammonia, characteristically soluble in hot carbonate of ammonia solution; prussiate of potash gives a brown precipitate which in appearance is not unlike the precipitate produced by the same reagent in cupric salts.

URANUS, in astronomy, the seventh major planet in the order of distance from the sun, and denoted by the symbol ⛢ or ♅. It was discovered by the elder Herschel on the

13th of March 1781. He saw it as a round nebulous disk, slowly moving among the stars, and at first supposed it to be a comet, and announced it as such to the Royal Society. But a few weeks' observation showed it to be moving in a nearly circular orbit at a distance from the sun about nineteen times that of the earth. Its planetary character was thus established, and Herschel named it the *Georgium Sidus* in honour of his royal patron. This name was long recognized in England, and "the Georgian" was officially used in the Nautical Almanac up to 1850. But it was never received with favour on the continent of Europe, nor was that of the discoverer, which was proposed by Lalande. The name Uranus was proposed by Bode, and adopted everywhere outside of England.

As seen in a telescope of the highest power, Uranus presents to the eye the appearance of a disk about four seconds in diameter of a faint sea-green tint. No trace of a marking can be seen on the surface, and, so far as measures have yet been made on it, no deviation of the disk from a circular form has been established. Nothing is therefore known as to its axial rotation. Although the planet is commonly considered a telescopic one, it is really of the sixth magnitude, and therefore faintly visible to the naked eye if one knows precisely where to look for it. Long before its discovery it had been observed as a fixed star by J. Flamsteed. P. C. Lemonnier also made eight observations of it during the opposition of 1768–69, which would have revealed its planetary character had he reduced and compared them. For other particulars relating to Uranus, its spectrum, &c., see PLANET

Satellites of Uranus.—In January 1787 Herschel detected two satellites of Uranus of which the inner one, now known as Titania, had a period of 9 days, the outer, Oberon, of 13½ days. He also on other occasions saw what he supposed to be two additional satellites, but careful investigation of his observations has shown that the supposed objects could not have been of this character. But in 1851–52 William Lassell at Malta, in conjunction with his assistant A. Marth, observed two satellites yet nearer the planet than those of Herschel. These are now known as Ariel and Umbriel. Their periodic times are about 2½ and 4 days respectively. Lassell's telescopes, which were reflectors, were superior to others of his time in light-power, and these inner satellites were not seen by other astronomers for more than twenty years after their discovery. Indeed, doubts of their reality sometimes found expression until, in 1873, they were observed with the Washington 26-inch telescope, and observations upon them showed their identity with the objects discovered by Lassell. The greater difficulty in seeing the inner than the outer satellites arises from their proximity to the planet. There is no very great difference in the actual brightness of the four objects. It is found that Umbriel, though less easy to see than Titania, actually exceeds it in light. But none of them has been seen except in a few of the most powerful telescopes. The most remarkable feature of these bodies is that, instead of the planes of their orbits being near that of the ecliptic, they are actually inclined to it nearly 90°. The result is that, as the planet performs its orbital revolution, there are two opposite points near which the orbits are seen edgewise, and the satellites seem to us to swing north and south on each side of the planet. This was the case in 1882, and will be the case again in 1924. At the points midway between these two, through which the planet passed in 1861 and 1903, and will pass again in 1945, the orbits are seen almost perpendicularly, so that the apparent orbit, like the real one, is nearly circular.

Orbits of the Satellites of Uranus.—So far as has yet been determined, the four satellites all revolve in the same plane, the position of which, referred to the Earth's equator and equinox, is—

R.A. of ascending node, 166°·05+0°·01420t.
Inclination of orbit, 75°·28−0°·0013t.

None of the orbits seems to have a measurable eccentricity. The positions of the satellites in the orbits at any time may be found from the following elements, where u is the angular distance from the node upon a plane parallel to that of the Earth's equator, and the motion is that in a Julian year.

Satellite.	u at Epoch.	Annual Motion.	Daily Motion.	Mean Dist.
Ariel .	22°·61	579 rev. +242°·64	142°·836	13″·78
Umbriel . .	136°·49	352 „ +195°·31	86°·869	19″·20
Titania . .	229°·93	167 „ +294°·20	41°·351	31″·48
Oberon . .	154°·90	108 „ +186°·27	26°·739	42″·10

The epoch force is 1872, January 0, Washington mean noon. The mean distance is the angle subtended by the radius of the orbit as seen at the mean distance of Uranus from the Sun (log a=1·28310).

BIBLIOGRAPHY.—Details as to Uranus are found in Chambers's *Descriptive Astronomy*, and all the current treatises on popular astronomy. For researches on the spectrum of the planet see Sir William Huggins in *Proceedings of the Royal Society*, vol. xix., (1871); H. C. Vogel, *Astrophysical Journal*, vol. i.; and P. Lowell, *Bulletin of the Lowell Observatory*, No. 13. Tables of the motions of this planet were published by Alexis Bouvard in 1813, S. Newcomb in 1873 (*Smithsonian Contributions to Knowledge*, No. 262), Leverrier in 1877 (*Annales de l'observatoire de Paris, Mémoires*, tome xiv.), and Newcomb again in *Astronomical Papers of the American Ephemeris*, vol. vii. Tables of the four satellites are found in Newcomb, *Uranian and Neptunian Systems* (Appendix I. to *Washington Observations* for 1873). Observations are found in the Bulletins of the Lick Observatory and elsewhere. (S. N.)

URANUS (Heaven), in Greek mythology, the husband of Gaea (Earth), and father of Cronus (Saturn) and other deities. As such he represents the generative power of the sky, which fructifies the earth with the warmth of the sun and the moisture of rain. For the legend of his treatment by Cronus and its meaning, see SATURN. Uranus and other Greek gods anterior to Zeus were probably deities worshipped by earlier barbarous inhabitants of the land.

The Roman Caelus (or Caelum) is simply a translation of the Greek Οὐρανός, not the name of a distinct national divinity. There is no evidence of the existence of a cult of Caelus, the occurrence of the name in dedicatory inscriptions being due to Oriental influences, the worship of the sky being closely connected with that of Mithras. Caelus is sometimes associated with Terra, represented in plastic art as an old, bearded man holding a robe stretched out over his head in the form of an arch.

See Wissowa, *Religion der Römer* (1902), p. 304, and his article in Pauly-Wissowa's *Realencyclopädie*, iii. pt. 1 (1897); also Steuding in Roscher's *Lexikon der Mythologie* and De Vit's *Onomasticon* (suppt. to Forcellini's *Lexicon*).

URA-TYUBE, or ORA-TEPE, a town of Russian Turkestan, in the province of Samarkand, lying 37 m. S.W. of Khojent, on the road from Ferghana to Jizak across the Zarafshan range. Pop. (1900) 22,088, chiefly Uzbegs. It is surrounded by a wall and has a citadel. The inhabitants carry on trade in horses and camel-wool cloth, and manufacture cottons, boots and shoes, oil, and camel's-hair shawls. Ura-tyube is supposed to have been founded by Cyrus under the name of Cyropol, and was taken in 329 B.C. by Alexander the Great of Macedon. Later it was the capital of an independent state, though often held by either Bokhara or Kokand. The Russians took it in 1866.

URBAN (Urbanus), the name of eight popes.

St URBAN, first pope of that name, was bishop of Rome from 222 to 230. He had been preceded by Calixtus, and was followed by Pontianus.

URBAN II. (Odo or Otho or Eudes de Lagary), pope from the 12th of March 1088 to the 29th of July 1099, was born of knightly rank at Lagary (or Lagery or Lagny), near Reims. He studied for the church, became archdeacon of Auxerre, and later joined the congregation of Cluny. Displaying great ability as reformer and theologian, he was chosen subprior of the celebrated monastery. He was created cardinal-bishop of Ostia in 1078 by Gregory VII., to whom he displayed such loyalty, especially as papal legate in Germany (1084), that he was imprisoned for a time by Henry IV. He was designated by Gregory as one of four men most worthy to succeed him, and, after a vacancy of more than five months following the decease of Victor III., he was elected pope on the 12th of March 1088 by forty cardinals, bishops, and abbots assembled at Terracina, together with representatives of the Romans and of Countess Matilda. He frankly took up the policy of Gregory VII., but, while pursuing it with equal determination, showed greater flexibility and diplomatic skill. Throughout the major part of his pontificate he had to reckon with the presence of the powerful antipope Clement III. (Guibert of Ravenna) in Rome; but a series of well-attended synods at Rome, Amalfi, Benevento and Troia, supported him in renewed declarations against simony, lay investiture, and clerical marriages, and in a policy of continued opposition to Henry IV. He maintained an alliance with the Norman Duke Roger, Robert Guiscard's son and successor, and united the German with the Italian opposition to the emperor by promoting the marriage of the Countess Matilda with young Welf of Bavaria. He aided Prince Conrad in his rebellion against his father and crowned him king of the Romans at Milan in 1093, and likewise encouraged the Empress Praxedis in her charges against her husband. By excommunicating Philip I. of France for matrimonial infidelity in 1095, Urban opened a struggle which was not terminated until after his death. Invited to Tuscany by the Countess Matilda, he convoked a council at Piacenza in March 1095, attended by so vast a number of prelates and laymen that its sessions were held in the open air, and addressed by ambassadors of Alexis, the Byzantine emperor, who sought aid against the Mussulmans. Urban crossed the Alps in the summer, and remained over a year in France and Burgundy, being everywhere reverently received. He held a largely attended council at Clermont in November 1095, where the preaching of the First Crusade marked the most prominent feature of Urban's pontificate. Thenceforth until his death he was actively engaged in exhorting to war against the infidels. Crusaders on their way through Italy drove the antipope Clement III. finally from Rome in 1097, and established Urban firmly in the papal see. With a view to facilitating the crusade, a council was held at Bari in October 1098, at which religious differences were debated and the exiled Anselm of Canterbury combated the Eastern view of the Procession of the Holy Ghost. Urban died suddenly at Rome on the 29th of July 1099, fourteen days after the capture of Jerusalem, but before the tidings of that event had reached Italy. His successor was Paschal II.

It is well established that Urban preached the sermon at Clermont which gave the impetus to the crusades. The sermon was written out by Bishop Baudry, who heard it, and is to be found in full in J. M. Watterich, *Pontif. Roman. Vitae.* Letters of Urban are published in J. P. Migne, *Patrol. Lat.*, vol. 151.

See J. Langen, *Geschichte der römischen Kirche von Gregor VII. bis Innocenz III.* (Bonn, 1893); F. Gregorovius, *Rome in the Middle Ages*, vol. 4, trans. by Mrs G. W. Hamilton (London, 1900–2); K. J. von Hefele, *Conciliengeschichte*, vol. 5 (2nd ed., 1873–90); Jaffé-Wattenbach, *Regesta pontif. Roman.* vol. 1 (1885–88); H. H. Milman, *History of Latin Christianity*, vol. 3 (London, 1899); M. F. Stern, *Zur Biographie des Papstes Urbans II.* (Berlin, 1883); A. de Brimont, *Un Pape au moyen age—Urbain II.* (Paris, 1862); W. Norden, *Das Papsttum und Byzanz* (Berlin, 1903); Gigalski, "Die Stellung des Papstes Urbans II. zu den Sacramentshandlungen der Simonisten, Schismatiker und Häretiker," in the *Tübinger theol. Quartalschrift* (1897).

Urban III. (Uberto Crivelli), pope from the 25th of November 1185 to the 20th of October 1187, was a Milanese, and had been made cardinal-priest of St Lorenzo in Damaso and archbishop of Milan by Lucius III., whom he succeeded. His family had suffered greatly at the hands of Frederick I., and he now took up vigorously his predecessor's quarrels with the emperor, including the standing dispute about the territories of the Countess Matilda. His opposition to the pretensions of the Roman senate to govern the Papal States, moreover, compelled him to remain in exile through his pontificate. He suspended the patriarch of Aquileia for crowning the emperor's son, Henry, king of Italy (January 1186), in violation of his own rights as archbishop of Milan; and only the entreaties of the citizens of Verona, where he was stopping, prevented him from excommunicating Frederick. In 1187 he exhorted the Christian kings to renewed endeavours in the Holy Land, and the fall of Jerusalem on the 2nd of October is said to have caused his death. He died at Ferrara and was succeeded by Gregory VIII. His letters are in J. P. Migne, *Patrol. Lat.*, vol. 202.

See J. Langen, *Geschichte der römischen Kirche von Gregor VII. bis Innocenz III.* (Bonn, 1893); Jaffé-Wattenbach, *Regesta pontif. Roman.* (1885–88); F. Gregorovius, *Rome in the Middle Ages*, vol. 4, trans. by Mrs G. W. Hamilton (London, 1896); P. Scheffer-Boichorst, *Friedrichs I. letzter Streit mit der Curie* (Berlin, 1866); W. Meyer, "Zum Streite Kaiser Friedrichs I. mit Papst Urban III.," in *Forschungen zur deutschen Geschichte*, vol. 19 (1879).

Urban IV. (Jacques Pantaléon), pope from the 29th of August 1261 to the 2nd of October 1264, was the son of a shoemaker of Troyes. Having received a monastic education, he became archdeacon of Liége and papal legate of Innocent IV. to Poland and Prussia; he was consecrated bishop of Verdun in 1253, and two years later was translated to the patriarchate of Jerusalem. While on a trip to Italy to explain at court a quarrel with the Hospitallers he was elected to succeed Alexander IV., after a three months' vacancy in the Holy See. He never visited Rome, but lived most of his pontificate at Orvieto. He favoured his own countrymen, and under him began that preponderance of the French in the curia which later led to the papal residence at Avignon, and indirectly to the Great Schism. He endeavoured without success to stir up Louis IX. of France to undertake a new crusade. In 1264 he instituted the festival of Corpus Christi. His chief domestic problems arose out of the competing claims for the crown of the Two Sicilies. He favoured Charles of Anjou, and declared in June 1263 that the papal grant of the kingdom to Edmund, son of Henry III. of England, had expired because of the latter's inability to oust the usurper Manfred. Urban died before the arrival of Charles of Anjou, and was succeeded by Clement IV.

The registers of Urban IV. have been published by L. Dorez and J. Guiraud in the *Bibliothèque des écoles françaises d'Athènes et de Rome* (Paris, 1892).

See F. Gregorovius, *Rome in the Middle Ages*, vol. 5, trans. by Mrs G. W. Hamilton (London, 1900–2); H. H. Milman, *Latin Christianity*, vol. 6 (London, 1899); K. Hampe, "Urban IV. und Manfred" in *Abhandlungen zur mittleren u. neueren Geschichte* (Heidelberg, 1905); Sievert, "Das Vorleben Papst Urbans IV." in *Die römische Quartalschrift* (1898); A. Potthast, *Regesta pontif. Roman.* (Berlin, 1875).

Urban V. (Guillaume Grimoard or Grimaud de Beauvoir), pope from the 28th of October 1362 to the 19th of December 1370, was born in 1309 near Lozère in Languedoc, and entered the Benedictine priory of Chiriac. After receiving orders he became successively professor of canon law at Avignon and Montpellier, vicar-general of the dioceses of Clermont and Uzès, abbot of St Germain d'Auxerre, abbot of St Victor at Marseilles, administrator of the bishopric of Avignon, and papal legate to Naples. He was returning from his mission to Italy when news reached him at Corneto that he had been chosen to succeed Innocent VI. He announced his acceptance from Marseilles, and was consecrated at Avignon on the 6th of November 1362. Urban witnessed the completion of the work of tranquillizing Italy under the able Cardinal Albornoz, and in 1364, in the interests of peace, made heavy concessions to Bernabo Visconti. Moved by Peter of Lusignan, king of Cyprus, and by the celebrated Carmelite Peter Thomas, who had come to Avignon in February 1363, the pope proclaimed another crusade, which found some echo in France and resulted in the temporary occupation of Alexandria (1365). Urban, yielding to the entreaties of the Emperor Charles IV. and of Petrarch, left Avignon on the 30th of April 1367, despite the opposition of the French cardinals, and made his entry into Rome on the 16th of October. The following year he was visited by Charles IV., and crowned the Empress Elizabeth (1st of November); and in 1369 he received the Greek emperor, John Palaeologus, who renounced the schism but for whom the pope was unable to secure assistance. Urban sanctioned the order of Jesuates and founded the medical school at Montpellier. On account of the poor repair of Rome, the restlessness of the Romans and the discontent of the French cardinals in Italy, he at length announced his intention of returning to France, avowedly to settle trouble between France and England. He took ship at Corneto on the 5th of September 1370, and, arriving at Avignon on the 24th of the same month, died on the 19th of December. Urban was serious and humble, opposed to all nepotism, simony, and secular pomp He was himself of blameless morality and reformed many abuses in the curia. He was honoured as a saint immediately after his death, and beatified by Pius IX. in 1870. Urban's successor was Gregory XI.

See H. J. Tomaseth, "Die Register u. Secretäre Urbans V. u. Gregors XI." in *Mitteilungen des Instituts für österreichische Geschichtsforschung* (1898); Baluzius, *Vitae Pap. Avenion.*, vol. 1 (Paris, 1693); L. Pastor, *History of the Popes*, vol. 1, trans. by F. I. Antrobus (London, 1899); F. Gregorovius, *Rome in the Middle Ages*, vol. 6, trans. by Mrs G. W. Hamilton (London, 1900–2); J. P. Kirsch, *Die Rückkehr der Päpste Urban V. u. Gregor XI. von Avignon nach Rom* (Paderborn, 1898); J. H. Albanès, *Actes anciens concernant le bienheureux Urbain V.* (Paris, 1897); J. B. Magnan, *Histoire d'Urbain V.* (2nd ed., Paris, 1863); H. J. Wurm, *Cardinal Albornoz* (Paderborn, 1892); H. H. Milman, *Latin Christianity*, vol. 7 (London, 1896); J. B. Christophe, *Histoire de la papauté pendant le XIV*^{me} *siècle*, vol. 2 (Paris, 1853).

URBAN VI. (Bartolommeo Prignano), pope from the 8th of April 1378 to the 15th of October 1389, was born at Naples in 1318. He was made bishop of Acerenza in 1364, and in 1377 was translated to the archiepiscopal see of Bari and placed in charge of the papal chancery. On the death of Gregory XI., who had finally returned to Rome from Avignon, he was elected pope in a conclave held under circumstances of great excitement, owing to popular apprehension of an intention of the French cardinals to elect a French pope and again abandon Rome. The populace broke into the hall after the election had been made and dispersed the cardinals, but the latter returned and confirmed their action on the following day. Urban VI. turned his attention at once to the reformation of the higher clergy, and, in spite of the warnings of Catherine of Siena, so angered the cardinals by his harsh and ill-tempered measures that they assembled at Anagni in July 1378, and revoked his election, in which they declared they had acted under fear of violence. On the 20th of September they elected at Fondi the Cardinal Robert of Geneva, who called himself Clement VII. and took up his residence at Avignon. Urban, on the other hand, remained at Rome, where he appointed twenty-six new cardinals and excommunicated Clement and his adherents. Thus began the Great Schism which divided the Western Church for about fifty years. Urban deposed Joanna of Naples (21st of April 1380) for adhering to France and Savoy in support of the antipope, and gave her kingdom to Charles of Durazzo. Charles was crowned at Rome on the 1st of June 1381, but three years later quarrelled with the pope and shut him up in Nocera. Urban succeeded in escaping to Genoa, where he put several of his cardinals to death for suspected disloyalty. On the death of Charles he set out with an army apparently to seize Naples for his nephew if not for himself. To raise funds he proclaimed, by bull of the 11th of April 1389, a jubilee for every thirty-three years, but before the celebration could be held he died of injuries caused by a fall from his mule. Urban was frugal and never practised simony, but harshness, lack of tact, and fondness for unworthy nephews disgraced his pontificate. He was succeeded by Boniface IX.

The chief sources for the life of Urban VI. are in Baluzius, *Vitae Pap. Avenion.* (Paris, 1693); *Theoderici de Nyem De schismate Libri tres*, ed. by G. Erler (Leipzig, 1890); Sauerlande, "Actenstücke zur Gesch. des Papstes Urban VI.," in *Hist. Jahrbuch der Görres-Gesellschaft*, xiv. (1893); "Acta Urbani VI. et Bonifatii IX.," ed. C. Krofta, in *Monumenta vaticana res gestas Bohemicas illustrantia* (Prague, 1905); *Der Liber Cancellariae Apostolicae vom Jahre 1380*, ed. by G. Erler (Leipzig, 1888); *Il Trattato di S. Vincenzo Ferrer intorno al grande schisma d'Occidente*, ed. by A. Sorbelli (Bologna, 1906).

See L. Pastor, *History of the Popes*, vol. 1, trans. by F. I. Antrobus (London, 1899); M. Souchon, *Die Papstwahlen in der Zeit des grossen Schismas*, vol. 1 (Brunswick, 1898); N. Valois, *La France et le grand schisme d'Occident* (Paris, 1896–1902); M. Creighton, *History of the Papacy*, vol. 1 (London, 1899); F. Gregorovius, *Rome in the Middle Ages*, vol. 6, trans. by Mrs G. W. Hamilton (London, 1900–2); R. Jahr, "Die Wahl Urbans VI." in *Hallische Beiträge zur Geschichtsforschung* (1892); T. Lindner, "Papst Urban VI.," in *Zeitschrift für Kirchengeschichte*, iii. (1879); W. St C. Baddeley, *Charles III. of Naples and Urban VI.* (1894); J. B. Christophe, *Histoire de la papauté pendant le XIV*^{me} *siècle*, vol. 3 (Paris, 1853). (C. H. Ha.)

URBAN VII. (Giovanni Battista Castagna), successor of Sixtus V., was born on the 4th of August 1521. He became governor of Bologna, archbishop of Rossano, and was long nuncio to Spain. Gregory XIII. made him a cardinal, 1583; and in 1590 he was elected pope by the Spanish faction, but died twelve days later, on the 27th of September 1590, and was succeeded by Gregory XIV.

See Ciaconius, *Vitae et res gestae summorum Pontiff. Rom.* (Rome, 1601–2); Cicarella, continuator of Platina, *De vitis Pontiff. Rom.* (both contemporary; the latter prolix and tedious); Arrigho, *Vita Urbani VII.* (Bologna, 1614); and Ranke, *Popes* (Eng. trans., Austin), ii. 227.

URBAN VIII. (Maffeo Barberini), pope from 1623 to 1644, was born in 1568, of a wealthy Florentine family. He early entered the prelacy, became prefect of Spoleto, twice nuncio to France, cardinal (1606), and finally, on the 6th of August 1623, succeeded Gregory XV. as pope. Urban was vain, self-willed and extremely conscious of his position; he accepted the papacy chiefly as a temporal principality, and made it his first care to provide for its defence and to render it formidable. He built Castelfranco on the northern frontier; fortified the port of Civita Vecchia; and strengthened the Castel Sant' Angelo, equipping it with cannon made from the bronze of the Pantheon, an act of vandalism which the Romans punished by the epigram, "Quod non fecerunt barbari, fecerunt Barberini." He also established an arsenal and a factory of arms. But all this provision was to no purpose. The only territory gained during Urban's pontificate, the duchy of Urbino, the last addition to the papal states, was acquired by reversion (1631); and in his one war, with the duke of Parma, for the district of Castro, he met defeat and humiliation (1644). The Thirty Years' War Urban professed to regard as waged for political, not for religious, ends. He therefore took counsel merely with his interest as a temporal prince, threw in his lot with France, supported the duke of Nevers in the Mantuan Succession, and, under stress of fear of Habsburg supremacy, suffered himself to be drawn into closer relations with the Protestants than beseemed his office, and incurred the reproach of rejoicing in the victories of heretics. Later, in keeping with his position, he opposed all concessions to the Protestants; but still showed himself so vacillating that the papacy ceased to be regarded as a serious political factor, and was entirely ignored in the final settlement of Westphalia, 1648.

Urban was the last pope to practise nepotism on a grand scale. He failed to found a princely house; but he enriched his family to an extent that astonished even the Romans. Urban bore a hand in the condemnation of Galileo. He acknowledged the genius of the astronomer, and had not approved of the action of the Inquisition in 1616; but subsequently, believing himself to have been caricatured in the *Dialogo*, he permitted the Inquisition to have its way and to compel an abjuration (1633). Urban also denounced the doctrines of Jansen, 1644 (see JANSENISM). He promulgated the famous bull *In Coena Domini* in its final form, 1627; published the latest revision of the Breviary, 1631; founded the College of the Propaganda for the education of missionaries, 1627; and accorded the title of "eminence" to the cardinals, 1630. Urban did much to embellish the city. Conspicuous among his works are the Barberini Palace, the College of the Propaganda, the Fountain of the Triton, and the baldachin of St Peter's. His hymns and poems, which have frequently been published, are evidence of his literary taste and ability. Urban died on the 29th of July 1644, and was succeeded by Innocent X.

For contemporary accounts of Urban see: Tommasucci, in Platina, *De vitis Pontiff. Rom*; Oldoin, continuator of Ciaconius, *Vitae et res gestae summorum Pontiff. Rom.*; and Simonin, *Gesta Urbani* (Antwerp, 1637). A rich collection of materials was made by Andrea Niccoletti, *Della vita di Papa Urbano VIII. e storia del suo pontificato*, never published, but extensively used by Ranke and others. See also Ranke, *Popes* (Eng. trans., Austin), ii. 552 seq., iii. 1 seq., 21 seq.; v. Reumont, *Gesch. der Stadt Rom*, iii. 2, 611 seq., 702 seq.; Santa Pieralisa, *Urbano VIII. e Galileo Galilei* (Rome, 1875); Gregorovius, *Urban VIII. im Widerspruch zu Spanien u. dem Kaiser* (Stuttgart, 1879); and Weech, *Urban VIII.* (London, 1905). (T. F. C.)

URBANA, a city and the county-seat of Champaign county, Ohio, U.S.A., about 47 m. W. by N. of Columbus. Pop. (1890) 6510; (1900) 6808, including 796 negroes and 405 foreign-born; (1910) 7739. Urbana is served by the Erie, the Pittsburg, Cincinnati, Chicago & St Louis, and the Cleveland, Cincinnati, Chicago & St Louis railways, and by the Ohio Electric inter-urban line. It has a public library (1890) and a county children's home (1892), and is the seat of Urbana University (co-educational), founded in 1850 under the auspices of the New Church. The city is situated in a fertile farming region. Its manufactures include furniture, telephones, woollen goods, paper, foundry and machine-shop products, &c. Urbana was laid out in 1805 by Colonel William Ward, of Greenbriar, Va., who owned the land included in the original survey and gave many lots to the county on condition that the proceeds from their sale should be used for public improvements; it was incorporated as a village in 1816 and was chartered as a city in 1867. Colonel Ward was the grandfather of the sculptor J. Q. A. Ward, who was born here and here first pursued, unaided, his study of art. Urbana was also the home for several years (after 1802), and is the burial place, of Simon Kenton, the famous pioneer and Indian fighter.

URBINO (anc. *Urvinum Mataurense*), a city and archiepiscopal see of the Marches, Italy, in the province of Pesaro and Urbino, 19 m. direct S.W. of Pesaro and 50 m. by rail N. by W. of Fabriano, a junction on the line from Ancona to Rome. Pop. (1901) 6809 (town), 18,244 (commune). It is picturesquely situated on an abrupt hill 1480 ft. above sea-level; its streets are narrow and crooked, and the town has a medieval aspect. It is dominated by the ducal palace erected by Luciano da Laurana, a Dalmatian architect, in 1460-82, for Federigo Montefeltro, and regarded by the contemporaries of the founder as the ideal of a princely residence. The sculptured doorways, chimneys and friezes of the interior are especially fine. Some are by Domenico Rosselli of Florence, others by Ambrogio d'Antonio da Milano. The rich and beautifully executed intarsia work may be due to Baccio Pontelli. The massive irregularity of the exterior is due to the unevenness of the site. The decoration of the exterior was never completed, but the arcaded courtyard is the finest of the Renaissance, except perhaps that of the Cancelleria at Rome (Burckhardt). The palace is now partly used for government purposes, and also contains the municipal archives, a collection of ancient inscriptions, formed by the epigraphist Raffaele Fabretti (many of them from Rome), a gallery of sculpture of various periods and a picture gallery. This last contains a small but interesting collection of pictures, including works by Paolo Uccello, Giovanni Santi, Justus of Ghent, Timoteo della Vite, and other 15th-century artists, also a "Resurrection" by Titian (a late work). The picture of the "Last Supper" by Justus is specially valuable from its containing fine portraits of the Montefeltro family and members of the ducal court. The cathedral, a building of no special interest, stands in the great piazza close to the ducal palace. It was erected in 1801 after the collapse of the former structure. In the sacristy there is a very beautiful miniature-like painting of the "Scourging of Christ," by Piero della Francesca, and other pictures by later artists. In the crypt there is a fine pietà in marble by Giovanni da Bologna. Opposite the palace is the church of S. Domenico, a Gothic building with a good early Renaissance portal and a relief in the lunette by Luca della Robbia (1449). The interior was spoilt in the 17th century. S. Francesco has a fine 14th-century loggia and campanile, and a handsome portal of a chapel in the interior by Constantino Trappola (15th century). S. Bernardino, outside the town, is a plain early Renaissance structure. On the walls of the chapel of the gild or confraternity of San Giovanni Battista are some valuable early frescoes, painted by Lorenzo and Giacomo Salimbene da San Severino in 1416. In the church of S. Spirito are two paintings by Luca Signorelli, the "Crucifixion" and the "Day of Pentecost," originally intended for a processional banner. The modest house where Raphael was born and spent his boyhood is preserved. It is now the property of a society of artists. Its rooms form a museum of engravings and other records of Raphael's works, together with a picture of the Madonna by his father, Giovanni Santi, formerly thought to be by Raphael himself. A monument was erected to him in the piazza in 1897. The theatre, decorated by Girolamo Genga, is one of the earliest in Italy; in it was performed the first Italian comedy, the *Calandria* of Cardinal Bibbiena, the friend of Leo X. and Raphael. The magnificent library formed by the Montefeltro and Della Rovere dukes was removed to Rome, and incorporated in the Vatican library (but with a separate numbering) in 1657. There is a free university founded in 1564 which has two faculties (with 163 students in 1902-03), and also a technical school. The town has manufactures of silk, majolica and bricks.

The ancient town of *Urvinum Mataurense* (taking its name from the river Mataurus or Metaurus) is mentioned a few times in classical literature, and many inscriptions relating to it exist. The course of its walls can still be traced. It was an important place in the Gothic wars, and is frequently mentioned by Procopius. At the end of the 12th or beginning of the 13th century it came into the possession of the family of Montefeltro. Of this by far the most important member was Federigo da Montefeltro, lord of Urbino from 1444 to 1482, one of the most successful condottieri chiefs of his time, and not only a man of great military and political ability, but also an enthusiastic patron of art and literature, on which he lavished immense sums of money. Federigo much strengthened his position, first by his own marriage with Battista, one of the powerful Sforza family, and secondly by marrying his daughter to Giovanni della Rovere, the favourite nephew of Pope Sixtus IV., who in return conferred upon Federigo the title of duke. Federigo's only son Guidubaldo, who succeeded his father, married in 1489 the gifted Elizabeth Gonzaga, of the ruling family in Mantua. In 1497 he was expelled from Urbino by Caesar Borgia, son of Alexander VI., but regained his dukedom in 1503, after Caesar's death. Guidubaldo was the last duke of the Montefeltro line; at his death in 1508 he bequeathed his coronet to Francesco Maria della Rovere, nephew of Julius II., and for about a century Urbino was ruled by its second dynasty of the Della Rovere family. In 1626 the last descendant of Francesco, called Francesco Maria II., when old and childless abdicated in favour of Pope Urban VIII., after which time Urbino, with its subject towns of Pesaro, Fano, Fossombrone, Gubbio, Castel Durante, Cagli and about 300 small villages, became part of the papal states until the suppression of the temporal power in 1870.

During the reigns of Federigo and Guidubaldo, Urbino was one of the foremost centres of activity in art and literature in Italy. The palace erected by Federigo has already been mentioned. It was at his court that Piero della Francesca wrote his celebrated work on the science of perspective, Francesco di Giorgio Martini his *Trattato d' architettura* (published by Saluzzo, Turin, 1841), and Giovanni Santi his poetical account of the chief artists of his time. The refined magnificence of Guidubaldo's court is eloquently described by Baldassare Castiglione (*q.v.*) in his *Cortegiano*. When Henry VII. of England conferred the order of the Garter on Guidubaldo, Castiglione was sent to England with a letter of thanks and with the small picture, now in the Louvre, of "St George and the Dragon," painted by Raphael in 1504, as a present to the English king. This painting was among Charles I.'s collection which was sold by order of the Commonwealth in 1649.

Throughout the whole of the 16th century the state of Urbino was one of the chief centres for the production of majolica, especially the towns of Gubbio and Castel Durante. Most of the finest pieces of Urbino ware were made specially for the dukes, who covered their sideboards with the rich storied *piatti di pompa*. Among the distinguished names which have been associated with Urbino are those of the Ferrarese painter and friend of Raphael, Timoteo della Vite, who spent most of his life there, and Bramante, the greatest architect of his age. The Milanese sculptor, Ambrogio, who worked so much for Federigo, married a lady of Urbino, and was the progenitor of the Baroccio family, among whom were many able mathematicians and painters. Federigo Baroccio, Ambrogio's grandson, was a very popular painter, some of whose works still exist in the cathedral and elsewhere in Urbino. This city was also the birthplace of Pope Clement XI., of several cardinals of the Alban family, and of Bernardino Baldi, Fabretti, and other able scholars. An interesting view of Urbino, in the first half of the 16th century, occurs among the pen drawings in the MSS. *Arte del vasajo*, by the potter Piccolpasso, now in the Victoria and Albert Museum.

See also E. Calzini, *Urbino e i suoi monumenti* (1897); G. Lipparini, *Urbino* (Bergamo, 1903).

URBS SALVIA (mod. *Urbisaglia*), an ancient town of Picenum, Italy, about 8 m. S. of the modern Macerata, and 10 m. S. of Ricina. It was the meeting-point of several ancient roads; the road leading south from Ancona through Ricina and Falerio to Asculum was crossed here at right angles by that from Fanum to Tolentinum, Septempeda (S. Severino) and Nuceria Camellaria, while another led north-east from Urbs Salvia to Pausulae and the coast at Potentia (near mod. Porto Recanati). It seems to have been also called Pollentia. The date of its foundation is unknown, but it became a colony in the time of Trajan, and its importance seems to begin from this period. It was utterly destroyed by Alaric, and both Procopius (*B.G.* ii. 16, 17) and Dante (*Paradiso*, xvi. 73) speak of its desolation. The *arx* is occupied by the modern village; below it considerable remains of the city walls and of the buildings within them, alike of brickwork of the imperial period, are preserved—an amphitheatre 328×249 ft., with an arena 190×112 ft., a theatre, baths, tombs, &c. A subterranean aqueduct and a number of inscriptions have been found on the site. Close by is a little chapel with paintings of the early 16th century. The Romanesque abbey church of the Fiastra, about 3 m. to the north, is noticeable. The territory of Urbs Salvia probably extended as far as the old Romanesque church of S. Maria di Rambona, 8 m. to the north-west.

URDŪ, the name of that variety of Hindostani which borrows a great part of its vocabulary from Persia and Arabic, as contrasted with "Hindi," the variety which eschews such words, but borrows from Sanskrit instead. It is spoken by Mussulmans and those Hindus who have come under Mussulman influences, and has a considerable literature. See HINDOSTANI and HINDOSTANI LITERATURE.

UREA, or CARBAMIDE, $CO(NH_2)_2$, the amide of carbonic acid, discovered in 1773 by H. M. v. Rouelle, is found in the urine of mammalia, birds and some reptiles; human urine contains approximately 2–3%, a grown man producing about 30 grammes daily. It is also a constituent of the blood, of milk, and other animal fluids. Its synthesis in 1828 by F. Wöhler (*Pogg. Ann.*, 1828, 12, p. 253) is of theoretical importance, since it was the first organic compound obtained from inorganic materials. Wöhler oxidized potassium ferrocyanide to potassium cyanate by fusing it with lead or manganese dioxide, converted this cyanate into ammonium cyanate by adding ammonium sulphate, and this on evaporation gives urea, thus:—

$$K_4Fe(NC)_6 \rightarrow KCNO \rightarrow NH_4CNO \rightarrow CO(NH_2)_2.$$

It may also be prepared by the action of ammonia on carbonyl chloride, diethyl carbonate, chlorcarbonic ester or urethane; by heating ammonium carbamate in a sealed tube to 130–140° C.; by oxidizing potassium cyanide in acid solution with potassium permanganate (E. Baudrimant, *Jahresb.*, 1880, p. 393); by the action of 50 % sulphuric acid on cyanamide: $CN{\cdot}NH_2+H_2O=CO(NH_2)_2$; by the action of mercuric oxide on oxamide (A. Williamson): $(CONH_2)_2+HgO=CO(NH_2)_2+Hg+CO_2$; by decomposing potassium cyanide with a dilute solution of sodium hypochlorite, followed by adding ammonium sulphate (A. Reychler, *Bull. Soc. Chim.*, 1893 [3], 9, p. 427); and by oxidation of uric acid. It may be obtained from urine by evaporating to dryness on the water bath, taking up the residue in absolute alcohol and evaporating the alcoholic solution to dryness again. The residue is then dissolved in water, decolorized by animal charcoal and saturated at 50° C. with oxalic acid. The urea oxalate is recrystallized and decolorized and finally decomposed by calcium carbonate (J. J. Berzelius, *Pogg. Ann.*, 1830, 18, p. 84). As an alternative method, A. N. E. Millon (*Ann. chim. phys* [2], 8, p. 235) concentrates the urine and precipitates the urea by nitric acid. The precipitate is dissolved in boiling water, decolorized by potassium permanganate and decomposed by barium carbonate. The solution is then evaporated to dryness and extracted by alcohol.

Urea crystallizes in long needles or prisms which melt at 132° C. and sublime when heated *in vacuo*. It is readily soluble in water and in alcohol, but is insoluble in chloroform and ether. When heated above its melting-point, it yields ammonia, cyanuric acid, biuret and ammelide. On warming with sodium, it yields cyanamide. Dry chlorine gas passed into melted urea decomposes it with formation of cyanuric acid and ammonium chloride, nitrogen and ammonia being simultaneously liberated. Alkaline hypobromites or hypochlorites or nitrous acid decompose urea into carbon dioxide and nitrogen. It is also decomposed by warm aqueous solutions of caustic alkalis, with evolution of ammonia and carbon dioxide. When heated with alcohol in sealed tubes, it yields carbamic esters; with alcohol and carbon bisulphide at 100° C., carbon dioxide is liberated and ammonium sulphocyanide is formed. Acid potassium permanganate oxidizes it to carbon dioxide and nitrogen. It acts as a monacid base.

Urea may be recognized by its crystalline oxalate and nitrate, which are produced on adding oxalic and nitric acids to concentrated solutions of the base; by the white precipitate formed on adding mercuric nitrate to the neutral aqueous solutions of urea; and by the so-called "biuret" reaction. In this reaction urea is heated in a dry tube until it gives off ammonia freely; the residue is dissolved in water, made alkaline with caustic soda, and a drop of copper sulphate solution is added, when a fine violet-red coloration is produced. Several methods are employed for the quantitative estimation of urea. R. Bunsen (*Ann.*, 1848, 65, p. 875) heated urea with an ammoniacal solution of barium chloride to 220° C., and converted the barium carbonate formed into barium sulphate, which is then weighed (see also E. Pflüger and K. Bohland, *Zeit. f. anal. Chem.*, 1886, 25, p. 599; K. A. H. Mörner, *ibid.*, 1891, 30, p. 389). Among the volumetric methods used, the one most commonly employed is that of W. Knop (ibid., 1870, 9, p. 226), in which the urea is decomposed by an alkaline hypobromite and the evolved nitrogen is measured (see A. H. Allen, *Commercial Organic Analysis*). J. v. Liebig (*Ann.*, 1853, 85, p. 289) precipitates dilute solutions of urea with a dilute standard solution of mercuric nitrate, using alkaline carbonate as indicator. In this process phosphates must be absent, and the nitric acid liberated during the reaction should be neutralized as soon as possible. Chlorides also prevent the formation of the precipitate until enough of the mercury solution has been added to convert them into mercuric chloride (see also E. Pflüger, *Zeit. f. anal. Chem.*, 1880, 19, p. 378). E. Riegler (ibid., 1894, 33, p. 49) decomposes urea solutions by means of mercury dissolved in nitric acid, and measures the evolved gas.

Urea chlorides are formed by the action of carbonyl chloride on ammonium chloride (at 400° C.), or on salts of primary amines. They are readily hydrolysed by water, and combine with bases to form alkyl ureas, and with alcohols to form carbamic esters. Substituted urea chlorides are formed by the direct action of chlorine (F. D. Chattaway and D. F. S. Wunsch, *Jour. Chem. Soc.*, 1909, 95, p. 129). Urea chloride, $NH_2{\cdot}CO{\cdot}Cl$ (L. Gattermann, *Ann.*, 1888, 244, p. 30), melts at 50° C. and boils at 61–62° C. In the presence of anhydrous aluminium chloride it reacts with aromatic hydrocarbons to form the amides of aromatic acids. *Nitro-urea*, $H_2N{\cdot}CO{\cdot}NH{\cdot}NO_2$, prepared by adding urea nitrate to well-cooled concentrated sulphuric acid (J. Thiele and A. Lachmann, *Ann.*, 1895, 288, p. 281), is a crystalline powder, soluble in water, and which decomposes on heating. It is a strong acid and is stable towards oxidizing agents. Diazomethane converts it into the methyl derivatives of isocyanic acid, and nitramide, NH_2NO_2. *Amidourea*, or semicarbazide, $NH_2\cdot CO\cdot NH\cdot NH_2$, is best prepared from hydrazine sulphate and potassium cyanate (J. Thiele and O. Stange, *Ber.*, 1894, 27, p. 31). It may also be obtained by reducing nitrourea in acid solution with zinc dust. It crystallizes in prisms, which melt at 96° C., and are easily soluble in water. It reduces Fehling's solution in the cold. It reacts with carbonyl compounds, giving *semi-carbazones*, and in consequence is frequently used for characterizing such substances. *Hydroxy-urea*, $NH_2\cdot CO\cdot NH\cdot OH$, is produced from hydroxylamine and cyanic acid (W. F. Dresler and R. Stein, *Ann.*, 1869, 150, p. 242), or from ammonium hypochlorite and potassium cyanate (A. Hantzsch, *Ann.*, 1898, 299, p. 99). It crystallizes in needles, which melt at 128–130° C., and is decomposed on long heating. It is readily soluble in water and reduces warm silver solutions. Hyponitrous acid is formed by passing nitrous fumes into its methyl alcohol solution.

Alkyl ureas are formed by the action of primary or secondary amines on isocyanic acid or its esters: $CONH+NH_2R=R\cdot NHCONH_2$; $CONR+NHR_2=NR_2\cdot CO\cdot NHR$; by the action of carbonyl chloride on amines: $COCl_2+2NHR_2=CO(NR_2)_2+2HCl$; and in the hydrolysis of many ureides. The tetra-alkyl derivatives are liquids, the remainder being solids. Hydrolysis by alkalis decomposes them into carbon dioxide, amines and ammonia. The symmetrically substituted ureas are generally tasteless, while the asymmetrical derivatives are sweet. For example, *αα*-dimethyl urea is sweet, *αβ*-dimethyl urea is tasteless; *p*-phenetol carbamide or dulcin, $NH_2\cdot CO\cdot NH\cdot C_6H_4\cdot OC_2H_5$, is sweet, while the di-*p*-phenetol carbamide, $CO(NH\cdot C_6H_4\cdot OC_2H_5)_2$, is tasteless.

The derivatives of urea containing acid radicles are known as *ureides*. Those derived from monobasic acids, obtained by the action of acid chlorides or anhydrides on urea, decompose on heating and do not form salts. Those containing more than one acyl group are formed by the action of carbonyl chloride on acid amides:

$$COCl_2+2CH_3CONH_2=CO(NHCOCH_3)_2+2HCl.$$

Acetyl urea, $NH_2\cdot CO\cdot NH\cdot COCH_3$, formed by the action of acetic anhydride on urea, crystallizes in needles which melt at 212° C. and, on heating, strongly decomposes into acetamide and cyanuric acid. *Methyl acetyl urea*, $CH_3NH\cdot CO\cdot NHCOCH_3$, is formed by the action of potash on a mixture of bromine (1 mol.) and acetamide (2 mols.) (A. W. v. Hofmann, *Ber.*, 1881, 14, p. 2725), or of methylamine on acetylurethane (G. Young, *Jour. Chem. Soc.*, 1898, 73, p. 364). When heated with water it is decomposed into carbon dioxide, ammonia, methylamine and acetic acid. *Bromural* or *α*-bromisovaleryl urea, $NH_2\cdot CO\cdot NH\cdot CO\cdot CHBr\cdot CH(CH_3)_2$, has been introduced as an hypnotic; its action is mild, and interfered with by the presence of pain, cough or delirium.

The ureides of oxy-acids and dibasic acids form closed chain compounds (see Allantoin; Alloxan; Hydantoin; Purin). *Parabanic acid* (oxalyl urea), $CO[NH\cdot CO]_2$, is formed by oxidizing uric acid; or by condensing oxalic acid and urea in the presence of phosphorus oxychloride. It crystallizes in needles and is readily hydrolysed by alkalis. It behaves as a monobasic acid and forms unstable salts. When heated with urea, it forms oxalyl diureide, $H_2N\cdot CO\cdot CO\cdot NH\cdot CO\cdot NH\cdot CO\cdot NH_2$. *Dimethylparabanic acid* (cholesterophane), $CO[NCH_3\cdot CO]_2$, is formed by oxidizing caffeine or by methylating parabanic acid. It crystallizes in plates, which melt at 145·5° C., and is soluble in cold water. Hydrochloric acid at 200° C. decomposes into oxalic acid, carbon dioxide and methylamine, whilst an alcoholic solution of a caustic alkali gives dimethyl urea and oxalic acid. *Barbituric acid* (malonyl urea), $CH_2[CO\cdot NH]CO\cdot 2H_2O$, formed by condensing malonic acid with urea (E. Grimaux, *Bull. Soc. Chem.*, 1879, 31, 146), crystallizes in prisms, which decompose on heating. It yields a nitroso derivative, is nitrated by nitric acid to dilituric acid and brominated by bromine. It is a dibasic acid. *Veronal* (*q.v.*) is diethyl malonyl urea. For isobarbituric acid see T. B. Johnson and E. V. McCollum, *Jour. Biol. Chem.*, 1906, 1, p. 437. *Tartronyl urea* (dialuric acid), $CO[NH\cdot CO]CH\cdot OH$, formed by the reduction of alloxan (J. v. Liebig and F. Wöhler, *Ann.*, 1838, 26, p. 276), or of alloxantin (A. Baeyer, *Ann.*, 1863, 127, p. 12), crystallizes in needles or prisms and possesses a very acid reaction. It becomes red on exposure, and in the moist condition absorbs oxygen from the air, giving alloxantin. *Allophanic acid*, $NH_2\cdot CO\cdot NH\cdot CO_2H$, is not known in the free state, as when liberated from its salts, it is decomposed into urea and carbon dioxide. Its esters are formed by passing the vapours of cyanic acid into alcohols (W. Traube, *Ber.*, 1889, 22, p. 1572):

$$CONH\rightarrow NH_2\cdot CO_2R\rightarrow NH_2CO\cdot NH\cdot CO_2R;$$

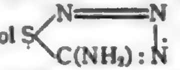
by the action of chlorcarbonic esters on urea (H. Schiff, *Ann.*, 1896, 291, p. 367); and by the action of urethanes on urea chloride (L. Gattermann, *Ber.*, 1888, 21, p. 293 R). They are readily decomposed by alkalis, yielding cyanuric acid and ammonia. *Biuret* (allophanamide), $NH_2\cdot CO\cdot NH\cdot CO\cdot NH_2$, is formed by heating urea; by the action of ammonia on allophanic ester; and by heating urea to 140° C. and passing chlorine into the melt at 140–150° C. (J. Thiele, *Ann.*, 1898, 303, p. 95 Anm.). It crystallizes in needles which melt at 190° C. (with decomposition), and is readily soluble in hot water. When heated strongly it is decomposed into ammonia and cyanuric acid. Baryta water hydrolyses it to carbon dioxide, ammonia and urea. With silver nitrate and caustic soda it yields a silver salt, $Ag_2C_2H_3N_3O_2$. With nitric acid in the presence of sulphuric acid it yields a nitro derivative.

Thiourea, or sulphocarbamide, $CS(NH_2)_2$, is formed by prolonged fusion of ammonium thiocyanate (E. Reynolds, *Ann.*, 1869, 150, p. 224), by passing sulphuretted hydrogen into an ethereal solution of cyanamide (E. Baumann, *Ber.*, 1873, 6, p. 1375), or by heating isopersulpho-cyanic acid (F. D. Chattaway, *Jour. Chem. Soc.*, 1897, 71, p. 612). It crystallizes in thick prisms which melt at 180° C. and is readily soluble in water. When heated for some time with water to 140° C. in a sealed tube, it is transformed into ammonium thiocyanate, a similar result being obtained by heating the base alone for some hours to 160–170° C. On heating alone for some hours to 170–180° C. it is converted into guanidine thiocyanate. It is hydrolysed by alkalis, giving carbon dioxide, ammonia and sulphuretted hydrogen. It is readily desulphurized by silver oxide, mercuric oxide or lead oxide. Potassium permanganate oxidizes it to urea (R. Maly, *Monats.*, 1890, 11, p. 278). It acts as a weak base and forms salts with one equivalent of an acid.

The alkyl derivatives of thiourea are obtained by the action of ammonia and of primary and secondary amines on the mustard oils (A. W. Hofmann, *Ber.*, 1867, 1, p. 27):

$CSNR+NH_3=NH_2\cdot CS\cdot NHR$; $CSNR+NH_2R=R\cdot NH\cdot CS\cdot NHR$, or by heating the amide salts of the alkyl dithio-carbaminic acids, viz., $NR\cdot CS\cdot S(NH_3R)$. The monoalkyl derivatives are desulphurized by lead hydroxide in the presence of sodium carbonate, the *αβ* dialkyl and trialkyl derivatives being unaffected (A. E. Dixon, *Jour. Chem. Soc.*, 1893, 63, p. 325). The dialkyl thioureas when digested with mercuric oxide and amines give guanidines. $CS(NHR)_2+NH_2R+HgO\rightarrow HgS+RN{:}C(NHR)_2$.

Thiourea and many of its unsymmetrical derivatives have marked physiological action; thiourea causes a slowing of the pulse and respiration, cardiac failure, and death in convulsions; phenyl-, ethyl- and acetyl-thiourea are actively toxic. The most important derivative pharmacologically is allyl-thiourea, also known as thiosinamine or rhodallin, $NH_2\cdot CS\cdot NH\cdot CH_2\cdot CH{:}CH_2$.

Thiosemicarbazide, $NH_2\cdot CS\cdot NH\cdot NH_2$, prepared from hydrazine sulphate, potassium carbonate and thiocyanate (N. Freund, *Ber.*, 1895, 28, p. 946; 1896, 29, p. 2501), crystallizes in long needles, which melt at 181–183° C. The addition of sodium nitrite to an aqueous solution of its hydrochloride converts it into amido-triazsulphol  The hydrochloride with potassium cyanate gives hydrazothio-carbonamide, $NH_2\cdot CO\cdot NH\cdot NH\cdot CS\cdot NH_2$.

Medicine.—Urea has been given in medicine in doses of 10 to 60 grs. either in mixture or hypodermically. It has been used with success as an antiperiodic and antipyretic in ague, and also as a diuretic in gout and kidney affections. Thiosinamine is given internally in doses of ½ to 1 gr. in capsule. Larger doses usually upset the digestion. It has been used for the cure of lupus and of keloid, in which case it is administered hypodermically. In keloid 20 minims of a 10% solution is injected directly into the part. It causes a local reaction with absorption of the scar tissue. For this reason it is used to remove corneal opacities, deafness due to thickening of the membrane, stricture of the oesophagus and hypertrophy of the pylorus, it has also been successful in the treatment of adhesive parametritis. Fibrolysin is a modified form of thiosinamine made by mixing it with sodium salicylate Fibrolysin is freely soluble and may be given in hypodermic or intra-muscular injection. Like thiosinamine it has a specific action on scar tissue and has been used in urethral strictures. Both these preparations should only be used in cases where it is possible to exclude any tuberculous foci, or by their action it breaking down protective fibrous tissues they may cause a quiescent lesion to become active. In large doses toxic symptoms are produced, death following on coma.

URETHANE, $NH_2CO_2C_2H_5$, the ethyl ester of carbamic acid, is synthesized from ammonia and chlorcarbonic ester or diethyl carbonate; by prolonged boiling of urea with alcohol (A. W. Hofmann, *Ber.*, 1871, 4, p. 268); by the action of alcoholic hydrochloric acid on cyanogen; by the action of alcohol on urea chloride (L. Gattermann, *Ann.*, 1888, 244, p. 40); and by warming alcoholic hydrochloric acid with an alcoholic solution of potassium cyanate (O. Folin, *Amer. Chem. Jour.*, 1897, 19, p. 341). It crystallizes in large plates, readily soluble in water and melting at 49–50° C. When heated with ammonia to 180° C., it gives urea. Cold alcoholic potash decomposes it into potassium cyanate and alcohol.

Nitroso-urethane, $NO\cdot NH\cdot CO_2C_2H_5$, formed by reducing ammonium nitro-urethane with zinc dust and glacial acetic acid (J. Thiele, *Ann.*, 1895, 288, p. 304), crystallizes in needles which melt at 51–52° C. (with decomposition). It is decomposed by alkalis and by acids:

$$C_3H_6N_2O_3 = CO_2 + C_2H_5OH + N_2 \quad \text{(alkalis)},$$
$$2C_3H_6N_2O_3 = 2CO_2 + C_2H_5OH + 2N_2 + H_2O + C_2H_4 \quad \text{(acids)}.$$

On oxidation it yields nitro-urethane. With a methyl alcoholic solution of potash it yields a yellow precipitate, which is probably the potassium salt of nitrosocarbamic acid, $NK{\cdot}NO{\cdot}CO_2K$. *Nitro-urethane*, $NO_2{\cdot}NH{\cdot}CO_2C_2H_5$, formed by dissolving urethane in concentrated sulphuric acid and adding ethyl nitrate to the well-cooled mixture (J. Thiele, ibid.), crystallizes in plates which melt at 64° C. and is soluble in water. It has a strongly acid reaction, its salts, however, being neutral. Its silver salt with methyl iodide gives a methyl ether, which is readily split by ammonia into methyl nitramine and methyl urethane (cf. A. P. Franchimont, *Rec. trav. chim.*, 1894, 13, p. 309). On reduction with zinc dust and acetic acid it yields hydrazine carboxylic ester. *Phenyl urethane*, $C_6H_5NH{\cdot}CO_2C_2H_5$, is formed by the action of cyanformic ester on aniline at 100° C.; by the action of absolute alcohol on benzoyl azoimide (T. Curtius, *Jour. prak. Chem.* [2], 52, p. 214); and by the action of bromine and sodium ethylate on benzamide (E. Jeffreys, *Amer. Chem. Jour.*, 1899, 22, p. 41). It crystallizes in long needles which melt at 51–52° C. and boil at 227–228° C. (with partial decomposition). It is easily soluble in alcohol and when heated in a sealed tube yields aniline and urea. With phosphorus pentasulphide it yields phenyl mustard oil.

Physiologically urethane has a rapid hypnotic action, producing a calm sleep and having no depressant effect on the circulation. It is much used as an anaesthetic for animals. Di-urethane, $NH(CO_2C_2H_5)_2$, and hedonal, $NH_2CO_2CH(CH_3){\cdot}(C_3H_7)$, are also narcotics, the latter being, in addition, a powerful diuretic. Phenyl urethane or euphorin has a physiological action more like that of acetanilide and phenacetin than of urethane. It depresses the temperature and is an analgesic. It is of little value as an hypnotic.

URFÉ, HONORÉ D', MARQUIS DE VALBROMEY, COMTE DE CHÂTEAUNEUF (1568–1625), French novelist and miscellaneous writer, was born at Marseilles on the 11th of February 1568, and was educated at the Collège de Tsarnon. A partisan of the League, he was taken prisoner in 1595, and, though soon set at liberty, he was again captured and imprisoned. During his imprisonment he read Ronsard, Petrarch and above all the *Diana enamorada* of George de Montemayor and Tasso's *Aminta*. Here, too, he wrote the *Epîtres morales* (1598). Honoré's brother Anne, comte D'Urfé, had married in 1571 the beautiful Diane de Châteaumorand, but the marriage was annulled in 1598 by Clement VIII. Anne D'Urfé was ordained to the priesthood in 1603, and died in 1621 dean of Montbrison. Diane had a great fortune, and to avoid the alienation of the money from the D'Urfé family, Honoré married her in 1600. This marriage also proved unhappy; D'Urfé spent most of his time separated from his wife at the court of Savoy, where he held the charge of chamberlain. The separation of goods arranged later on may have been simply due to money embarrassments. It was in Savoy that he conceived the plan of his novel *Astrée*, the scene of which is laid on the banks of the Lignon in his native province of Forez. It is a leisurely romance in which the loves of Céladon and Astrée are told at immense length with many digressions. The recently discovered circumstances of the marriages of the brothers have disposed of the idea that the romance is autobiographical in its main idea, but some of the episodes are said to be but slightly veiled accounts of the adventures of Henry IV. The shepherds and shepherdesses of the story are of the conventional type usual to the pastoral, and they discourse of love with a casuistry and elaborate delicacy that are by no means rustic. The two first parts of *Astrée* appeared in 1610, the third in 1619, and in 1627 the fourth part was edited and a fifth added by D'Urfé's secretary Balthazar Baro. *Astrée* set the fashion temporarily in the drama as in romance, and no tragedy was complete without wire-drawn discussions on love in the manner of Céladon and Astrée. D'Urfé also wrote two poems, *La Sireine* (1611) and *Sylvanire* (1625). He died from injuries received by a fall from his horse at Villafranca on the 1st of June 1625 during a campaign against the Spaniards. The best edition of *Astrée* is that of 1647 In 1908 a bust of D'Urfé was erected at Virien (Ain), where the greater part of *Astrée* was written.

URGA (the Russian form of the Mongol Orgo = palace of a high official), a city of Mongolia, and the administrative centre of the northern and eastern Kalka tribes, in 48° 20′ N., 107° 30′ E., on a tributary of the Tola river. It is the holy city of the Mongols and the residence of the "Living Buddha," metropolitan of the Kalka tribes, who ranks third in degree of veneration among the dignitaries of the Lamaist Church. This "resplendently divine lama" resides in a sacred quarter on the western side of the town, and acts as the spiritual colleague of the Chinese amban, who controls all temporal matters, and who is specially charged with the control of the frontier town of Kiakhta and the trade conducted there with the Russians.

Hurae, as the Mongols call Urga (Chinese name, K'ulun), stands on the high road from Peking to Kiakhta (Kiachta), about 700 m. N.W. of Peking and 165 m. S. of Kiakhta. There are three distinct quarters: the *Kuren* or monastery, the residence of the "Living Buddha"; the Mongol city proper (in which live some 13,000 monks); and the Chinese town, two or three miles from the Mongol quarter. Besides the monks the inhabitants number about 25,000. The Chinese town is the great trading quarter. The houses in this part are more substantially built than in the Mongol town, and the streets have a well-to-do appearance. The law which prohibits Chinamen from bringing their wives and families into the place tends to check increase. There is considerable trade between the Russians, Mongols and Chinese, chiefly in cattle, camels, horses, sheep, piece-goods and milk. Until the second half of the 19th century bricks of tea formed the only circulating medium for the retail trade at Urga, but Chinese brass cash then began to pass current in the markets. The trade of Urga is valued at over £1,000,000 a year.

The temples in the Mongol quarter are numerous and imposing, and in one is a gilt image of Maitreya Bodhisattva, 33 ft. in height and weighing 125 tons. When in 1904, on the occasion of the British expedition to Tibet, the Dalai Lama withdrew from Lhassa he went to Urga, where he remained until 1908. During his residence there the Dalai Lama would have no communication with the Urga Lama—described as a drunken profligate (see *The Chinese Empire*, ed. M. Broomhall, London, 1907, p. 357). The Chinese contemplate building a railway from Peking to Urga. The first section, to Kalgan, was completed in 1909 (see CHINA, § *Communications*).

URI, one of the cantons of central Switzerland, and one of the earliest members of the confederation. The name is probably connected with the same obscure root as Reuss and Ursern, and is popularly derived from Urochs or Auerochs (wild bull), a bull's head having been borne for ages as the arms of the region. The total area of the canton is 415·3 sq. m., of which 184·3 are reckoned as "productive" (forests covering 43·9 sq. m.), while of the rest 44·3 are occupied by glaciers and 7½ sq. m. by the cantonal share of the Lake of Lucerne. The highest summit in the canton is the Dammastock (11,920 ft.). The canton is composed of the upper valley of the Reuss, a mountain torrent that has cut for itself a deep bed, save in case of the basin of Ursern, near its upper end, and the plain of Altdorf, just before it forms the Lake of Lucerne. Hence, save in these two cases, the canton is made up of a wild Alpine valley, very picturesque in point of scenery, but not offering much chance of cultivation. Through nearly the whole of this savage glen runs the main line of the St Gotthard railway (opened in 1882), the part (28½ m.) in the canton being that between Sisikon, on the Lake of Lucerne, and Göschenen, at the northern mouth of the great tunnel (9¼ m.) through the Alps, and at the lower end of the wild Schöllenen gorge that cuts it off from the basin of Ursern. The most remarkable engineering feats are near Wassen. There is also an electric tramway from Altdorf to its port, Flüelen. On the other hand, several magnificent carriage roads are within the borders of the canton, leading to or over the mountain passes that give access either to Glarus (the Klausen Pass, 6404 ft.), or to Ticino (St Gotthard Pass, 6936 ft.), or to the Grisons (Oberalp Pass, 6710 ft.), or to the Valais (Furka Pass, 7992 ft.). Owing to the physical conformation of the canton, it was difficult for it to extend its rule save towards the south (see below), but since very early days it has held the splendid pastures of the Urnerboden, on the other slope of the Klausen Pass, as well as the Blacken Alp, at the head of the Engelberg valley, though the northernmost slope of the St Gotthard Pass still belongs to Ticino. In 1900 the population of the canton was only 19,700, of whom 18,685 were German-speaking, 947 Italian-speaking (this number varied much during the construction of the St Gotthard railway, mainly by Italian navvies), and 24 French-speaking, while 18,924 were Romanists, 773 Protestants, and 1 a Jew. The capital is Altdorf (*q.v.*), indissolubly connected with the legend of William Tell (*q.v.*). The only other important villages are Erstfeld (2416 inhab.), a great railway centre, where the mountain engines are put on, and Silenen (1892 inhab.). The population is all but exclusively pastoral, natural causes limiting much effort in the way of agriculture, save near Altdorf. In the canton there are 102 "alps" or mountain pastures, capable of supporting 10,354 cows, and of an estimated capital value of 5,771,000 fr. Till 1814 Uri formed part of the diocese of Constance (save Ursern, which has always been in that of Coire), while since that date it is administered by the bishop of Coire, though legally in no diocese. The inhabitants are very industrious and saving, though not rich in worldly goods, as their land is so barren. They are extremely conservative, and passionately attached to their religion. Wooden sandals are still commonly worn in the Alpine glens. Of recent years the canton has been much visited by travellers, who have brought much money into it. It forms a single administrative district, which comprises twenty communes. The legislature of the canton is the time-honoured primitive democratic assembly, called the *Landsgemeinde*, composed of all male citizens of 20 years of age, and meeting once annually near Altdorf on the first Sunday in May. It has retained many curious antique ceremonies and customs. It elects the single member of the Federal *Ständerat*, as well as the cantonal executive of seven members (holding office for four years), two of whom are the highest officials, the Landammann and his deputy. There is also a sort of standing committee, called the *Landrat*, which is charged with the administration and minor legislative matters. It is composed of members elected for four years by a popular vote in the proportion of one to every 400 (or fraction over 200) inhabitants, though each commune, even if not attaining this standard of population, is entitled to a member. The single member of the Federal *Nationalrat* is elected by a popular vote. The constitutional details, apart from the *Landsgemeinde*, are settled by the cantonal constitution of 1888 (since revised slightly).

Uri is first mentioned in 732 as the place of banishment of Eto, the abbot of Reichenau, by the duke of Alamannia. In 853 it was given by Louis the German to the nunnery (*Frauenmünster*) at Zürich which he had just founded, and of which his daughter, Hildegard, was the first abbess. Hence the "abbey folk" in Uri enjoyed, as such, the privilege of exemption from all jurisdictions save that of the king's *Vogt* or "steward of the manor" at Zürich, this *Vogtei* being cut off from the country of the Zürichgau. The rule of the abbess was mild, so that the other inhabitants of Uri either became her tenants or obtained similar privileges. Little by little the gathering together of all the inhabitants for the purpose of regulating the customary cultivation of the land created a corporate feeling and led to a sort of local government. On the extinction of the Zäringen dynasty (1218), the *Vogtei* reverted to the king, who gave it to the Habsburgs. But in 1231 King Henry bought Uri from them, and thus it became again immediately dependent on the king, the purchase being perhaps due to the rising importance of the route over the St Gotthard Pass (first distinctly mentioned in 1236). As early as 1243 Uri had a common seal, and in the confirmation of its privileges (1274) granted by Rudolf of Habsburg mention is made of its "head-man" (*Amman*) and of the "commune" (*universitas*). Uri therefore was quite ready to take part, with Schwyz and Unterwalden, in founding the "Everlasting League" (germ of the later Swiss confederation) on the 1st of August 1291, defending its liberty in the fight of Morgarten (1315) and renewing the League of the Three at Brunnen (1315). Later it took part in the victory of Sempach (1386). In 1403, with the help of Obwalden, it won the Val Leventina from the duke of Milan, but it was lost in 1422, though in 1440 Uri alone reconquered it and kept it (winning the bloody fight of Giornico in 1478) till 1798. In 1419, with Obwalden, Uri bought Bellinzona, but lost it at the battle of Arbedo (1422), though, with Schwyz and Nidwalden, it won it back in 1500, keeping it also till 1798. In 1512 Uri shared in the conquest of Lugano, &c., by the Confederates, her natural position forcing her to extend her rule towards the south, though many attempts on and temporary occupations of the Val d'Ossola (1410–1515) ultimately failed. In 1410 a perpetual alliance was made with the valley of Ursern or Val Orsera, the latter being allowed its own head-man and assembly, and courts under those of Uri, with which it was not fully incorporated till 1888. Ursern originally belonged to the great Benedictine monastery of Disentis, at the head of the Vorder Rhine valley, and was most probably colonized in the 13th century by a German-speaking folk from the Upper Valais. At the Reformation Uri clung to the old faith, becoming a member of the "Christliche Vereinigung" (1529) and of the Golden League (1586). In 1798, on the formation of the Helvetic republic, Uri became part of the huge canton of the Waldstätten and lost all its Italian possessions. In September 1799 Suworoff and the Russian army, having crossed the St Gotthard to Altdorf, were forced by the French to pass by the Kinzigkulm Pass into Schwyz, instead of sailing down the lake to Lucerne. In 1803 Uri became an independent canton again, with Ursern, but without the Val Leventina. It tried hard to bring back the old state of things in 1814–15, and opposed all attempts at reform, joining the League of Sarnen in 1832 to maintain the pact of 1815, opposing the proposed revision of the pact, and being one of the members of the Sonderbund in 1845. Despite defeat in the civil war of 1847, Uri voted against the Federal constitution of 1848, and by a crushing majority against that of 1874.

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URIC ACID, $C_5H_4N_4O_3$, in organic chemistry, an acid which is one of the penultimate products of the tissue waste in the human body. While the bulk of the nitrogen of the albuminoids passes off through the bladder as urea, a small portion of it stops at the uric acid stage. Human urine contains only a fraction of a per cent. of the acid, chiefly as sodium salt; abundance of uric acid is met with in the excrement of serpents and birds, with whom it is the principal nitrogenous product of tissue waste. For its preparation guano is boiled repeatedly with a solution of borax in 120 parts of water. The filtered solution is acidified with hydrochloric acid, when impure uric acid separates out as a brown precipitate, which is washed with cold water, it is then dissolved in hot dilute caustic potash or soda, the solution filtered, and the filtrate saturated with carbon dioxide. An almost insoluble urate is precipitated, which is filtered, washed and decomposed by hot dilute hydrochloric acid. Uric acid separates as a white precipitate, which is filtered off, washed and dried, to be repurified by a repetition of the alkali process or otherwise. Pure uric acid forms a snow-white micro-crystalline powder, devoid of smell or taste, soluble in 1800 parts of boiling and in 14,000 parts of cold water, but insoluble in alcohol and in ether. For its detection in urine, the urine is mixed with excess of hydrochloric acid, and allowed to stand, when the uric acid separates out, generally coloured reddish by impurities. The precipitate is dissolved in a few drops of nitric acid and the solution cautiously evaporated to dryness. The residue when exposed to ammonia gas assumes the intense purple colour of murexide.

The acid, which was discovered by C. Scheele in 1776 in urinary calculi, was afterwards investigated by Liebig and Wöhler. The determination of its constitution, and its relation to other vegetable and animal products, followed from the researches of A. von Baeyer and E. Fischer (see PURIN).

URICONIUM (more correctly *Viroconium*), a large Romano-British country town, chef-lieu of the Cornovii, now Wroxeter on the Severn, 5 m. E. of Shrewsbury. At first perhaps (A.D. 45-55) a Roman legionary fortress, held by Legio XIV. Gemina against the Welsh hill-tribes, its garrison was soon removed and it became a flourishing town with stately town hall, baths and other appurtenances of a thoroughly civilized and Romanized city. It was larger and probably richer than—for example—Silchester. The lines of its walls can still be traced, enclosing an area of 170 acres, and parts of the town hall and baths have been uncovered. Its originally Celtic name seems to survive in the names of Wroxeter and the neighbouring hill, Wrekin.

See *Victoria History of Shropshire*, i. 215-56. (F. J. H.)

URIM AND THUMMIM, in the Bible. These descriptive terms are applied to one of the methods of divination employed by the ancient Hebrews, which, it is now generally agreed, consisted in a species of sacred lot. Together with "dreams" and the prophetic oracle it formed the recognized channel by which divine communications were given (cf. 1 Sam. xxviii. 6). That some method of casting lots is denoted by the terms is evident from 1 Sam. xiv. 41 f. The Hebrew text in this passage, as emended by the LXX and in this form generally accepted, runs as follows: "And Saul said: 'O Jehovah, God of Israel, why dost Thou not answer Thy servant to-day? If this fault be in me or in Jonathan my son, give Urim, and if it be in Thy people Israel, give Thummim.' And the lot fell upon Saul and Jonathan, and the people escaped. And Saul said: 'Cast (the lot) between me and Jonathan my son, and on whomsoever Jehovah shall cause the lot to fall let him die.' So they cast (the lot) between him and Jonathan his son, and Jonathan was taken."

From this illuminating passage it is clear (*a*) that by means of the Urim and Thummim the guilt or innocence of the suspected parties was determined; (*b*) that this was effected by a series of categorical questions implying the simple alternative of "yes" or "no," or something positive or negative. A further inference (*c*) from a comparison of 1 Sam. xiv. 41 f. with ver. 36 (Greek text) is that this method of casting the sacred lot was closely connected with divination by the ephod (*q.v.*), and was the prerogative of the priests. This last point appears explicitly in the "Blessing of Moses" (Deut. xxxiii.), where the opening words of the Benediction on Levi run thus (text as emended by Ball, following LXX; *P.S.B.A.* 1896, 118 f.):—

> "Give to Levi Thy Thummim,
> And Thy Urim to the man of Thy favour."

Similar modes of divination were practised, it would seem, among the pre-Islamic Arabs. The following custom is cited by Professor G. F. Moore,[1] on the testimony of Moslem writers, as having been in vogue: "Two arrow shafts (without heads or feathers), on one of which was written 'Command,' on the other 'Prohibition,' or words of similar purport, were placed in a receptacle, and according as one or the other of them was drawn out it was known whether the proposed enterprise was in accordance with the will of the god and destined to succeed or not" (cf. Prov xvi. 33; Acts i. 26).

Regarding the form and material of the Urim and Thummim no details are given in the Old Testament. They seem to have fallen into desuetude at a comparatively early period. No mention is made of their use in the historical books after the time of David and Solomon, though it is probable that such use is implied in passages where the ephod is mentioned (*e.g.* Hosea iii. 4). In the post-exilic Priestly Code (*i.e.* the bulk of the Levitical legislation of the Pentateuch), however, the Urim and Thummim figure as part of the equipment of the high priest (cf. Ex. xxviii. 30; Lev. viii. 8; Num. xxvii. 21). Here it is stated that they are kept in a square pouch which is worn upon the high priest's breast ("the breastplate of judgment"), and attached to the ephod. Thus the association of the Urim and Thummim with the ephod, which appears in the oldest narratives, is retained in the Priestly Code (P). It is doubtful, however, whether P had any clear notion as to what exactly the Urim and Thummim were. The priestly writer gives no directions as to how they were to be made. They were retained in his ideal legislation, apparently, because their use was already invested with the mystery of a long-vanished past, and they were regarded as having formed one of the most venerable adjuncts of the priesthood. That this method of divination was not in actual use after the Exile is shown by Neh. vii. 65 (Ezra ii. 63; 1 Esdras v. 40) where an important point affecting the priestly families is reserved "till there stood up a priest with Urim and Thummim." Later references (Ecclus. xlv. 10; in Josephus and the Talmud) prove that no real tradition survived on the subject. The identification of them with the jewels of the breastplate and on the shoulders of the high priest (which apparently has the authority of Josephus) is unwarranted; other ancient guesses are equally baseless. Nor has any satisfactory explanation of the names Urim and Thummim been proposed. As vocalized in the Massoretic Hebrew text the names = "Lights and perfection." But the Greek translators read the former *'orim* and connected it with *torah*, "decision"; it would thus = "doctrine"; so Symmachus, cf. 1 Esd. v. 40, where "a high priest wearing Urim and Thummim" (R.V.) is given as "a high priest clothed in doctrine and truth" in A.V. Nor can the attempt of the American scholar Muss-Arnolt to explain them as cognate with the Babylonian Tablets of Destiny be pronounced successful. Perhaps the conjecture least open to objection is that which regards the terms Urim and Thummim as the names of two lots[2] (perhaps actually written on them) of opposite import. In this case the former of the two names might be derived from the root *'arar*, "to curse"; the other from a root meaning "to be without fault." The one would thus signify "that a proposed action was satisfactory to God, the other that it provoked His wrath" (Professor G. F. Moore). But all such explanations are highly precarious.

BIBLIOGRAPHY—For the older views, see Spencer, *De leg. Hebr. rit.* Diss. VII.; and a useful summary by Plumptre in Smith's *Bib. Dict.* For modern discussions, see the articles "Urim and Thummim" in the Bible dictionaries; the relevant sections in the treatises on archaeology; and W. Muss-Arnolt, *The Urim and Thummim* (reprinted from the *American Journal of Semitic Languages*, July 1900). (G. H. Bo.)

URINARY SYSTEM. The urinary system in the fully developed human being consists of (1) the kidneys, (2) the ureters, (3) the urinary bladder, and (4) the urethra.

As the greater part of the male urethra is a generative as well as a urinary canal, its description will be found in the article on the REPRODUCTIVE SYSTEM.

Kidneys.

The *kidneys* are two bean-shaped granular masses, firm in consistence and reddish brown in colour, about 4½ in. long, and placed obliquely behind the other abdominal viscera—one on each side of the last thoracic and three upper lumbar vertebrae. Each is imperfectly covered on its ventral surface by peritoneum and is moulded to some extent by the viscera which press on it. Around them there is usually a considerable amount of fat and areolar tissue, by which, as well as by the peritoneum and by the presence of the surrounding viscera, the kidneys are retained in their place. In rare cases the kidney may slip from its usual place in the loins to a lower position (movable kidney), and may even be movable in the abdominal cavity (floating kidney)—a condition often productive of serious consequences. The kidney in the foetus is lobulated, but the intervals between the lobes become smoothed out in later years of childhood. Each gland is invested by a firm, closely adherent, fibrous capsule, under which is an imperfect lamina of unstriped muscle. The inner and ventral margin of each kidney is concave, and into this *hilum* or concavity the renal artery from the aorta passes. Here also the renal vein escapes and joins the vena cava inferior. The ureter or metanephric duct, always behind and below the blood vessels, emerges here and passes downward to the bladder. When the kidney is longitudinally divided from hilum to outer edge, the cut surface is seen to consist of two parts—an outer layer, the cortex, and an inner part, the medulla (fig. 1). The latter consists of a series of eight to sixteen pyramids, whose bases and sides are invested with cortical matter, and whose apices or papillae project into the hilum, where they are severally surrounded by membranous tubes (calices), which by their union make up the ureter. The part of the ureter situated in the hilum is dilated, and is named the pelvis of the kidney.

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[1] *Encycl. Biblica*, iv. (col. 5236), where further details are given.

[2] The lots may have been small pebbles, or small tablets of wood or bone.

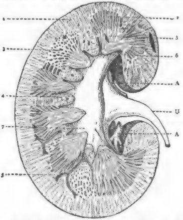
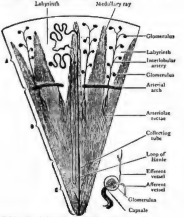


FIG. 1.—Vertical Section through the Kidney. A, branch of renal artery; U, ureter. 1, cortical substance with cortical pyramids, and labyrinth substance of tortuous tubes; 2 and 3, medullary pyramids of straight tubules; 4, fatty masses around blood vessels (5); 6, papilla; 7, pelvis.



From A. F. Dixon, Cunningham's *Text-Book of Anatomy*.

FIG. 2.—Diagrammatic Representation of the Structures forming a Kidney Lobe.

In the middle part of the figure the course of one of the kidney tubules is indicated, and in the lateral parts the disposition of the larger arteries. A, cortex; B, intermediate zone; C, papillary portion.

The diagram at the right-hand side of the lower part of the figure illustrates the connexions of the structures composing a Malpighian corpuscle.

In minute structure the kidney is the most complex gland in the body. Each of the papillae consists of a large number of straight tubes—collecting tubules—which open by pores on its surface. When these are traced into the pyramid, they are seen to divide several times, their fine end-branches projecting in little tufts into the cortical matter at the base of each pyramid. Here the branches coming from the tube change in structure and become convoluted in the cortex—the convoluted tubules. Next, each suddenly dips back again as a long straight loop—the loop of Henle—into the pyramid, reaching nearly to the papillary region; then turning sharply on itself, passes back straight to the cortex, where it again becomes convoluted, ultimately ending by dilating into a flask-like bulb called a Malpighian corpuscle. The renal artery, after breaking up into branches between the pyramids, ends in minute end-arteries in the cortex. Each of these pierces into one of the flasks just described, and there becomes branched, the branches being collected into a little ball or glomerulus which nearly fills the flask. From this an efferent vessel escapes, which, joining with its neighbouring vessels of the same kind, makes a close network around the convoluted tubes, ultimately ending in the renal vein. It is supposed that the different constituents of the urine are eliminated in different parts of these tubes—some, especially the watery parts, in the flask, and some, especially the more solid constituents, in the convoluted tubular apparatus. A peculiar form of glandular epithelium lines the two convoluted areas of the tubes and the limb of the loop nearer the straight or collecting tubes.

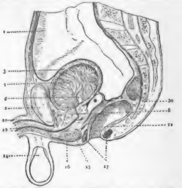
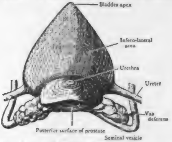


FIG. 3.—Vertical Section through Pelvis, showing urinary bladder and rectum *in situ*. 1, peritoneum; 2, pubic symphysis; 3, muscular coat of bladder; 5, mucous membrane folded and wrinkled; 6, opening of ureter; 8, prostate; 10, vena dorsalis penis; 12, corpus spongiosum; 14, testis in its sac; 15, bulbocavernosus muscle; 16, bulb; 17, sphincters of the anus; 22, anal opening; 30, coccyx; *, vesicula seminalis.

Bladder and urethra.

The *ureter* or duct of the kidney begins at the hilum and descends on the back wall of the abdominal cavity to open into the bladder. It is usually about 12 in. in length and as thick as a goose quill. At its termination it passes obliquely through the coats of the bladder, so that when the bladder is distended the lumen of its end is closed. The *urinary bladder* is a membranous bag lying in the pelvic cavity directly behind and above the dorsal surface of the pubes. In the foetus and infant, however, the bladder lies in the abdomen, not in the pelvis. During life it is seldom distended so as to hold more than about 10 oz., but when the abdomen is opened it can be dilated to more than double that size. When distended it rises and is applied closely against the back of the ventral abdominal wall. The bladder has a strong muscular investment of unstriped muscle in several layers, which are innervated by branches from the sacral nerves. It has a peculiar epithelial lining of several strata, the superficial cells of which are cubical when the sac is collapsed, but become flattened and scale-like when it is distended. At the lower part of the bladder there is a triangular space known as the trigone, the angles of which are formed by the openings of the two ureters and the urethra. In this space the mucous membrane is smooth and firmly bound to the subjacent muscle; elsewhere it is thrown into numerous folds when the bladder is empty. A muscular band called the torus uretericus or Mercier's bar joins the orifices of the ureters. The female urethra is only 1½ in. in length and is comparable only with that part of the male urethra which extends from the bladder to the openings of the seminal ducts (fig. 3).

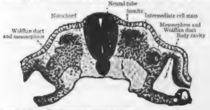


From A. F. Dixon, Cunningham's *Text-Book of Anatomy.*

FIG. 4.—The Bladder, Prostate and Seminal Vesicles, viewed from below. Taken from a subject in which the viscera were hardened *in situ.* The bladder contained but a small amount of fluid.

Embryology.

The excretory organs of the embryo are developed as a series of small tubes in the intermediate cell mass (see fig. 5), the ventral part of which projects to form the Wolffian ridge. Three sets of these tubes appear in succession and occupy the whole length of the body from the cervical to the lumbar region. The most anterior—*pronephros* or *head kidney*—is represented in man by only two or three small tubules on each side which appear as ingrowths from the neighbouring coelom (fig. 6, Pro.N.). From the study of comparative anatomy it is probable that these are mere vestiges. Although the pronephros is rudimentary, the duct which in lower types carries away its excretion is well developed. This is the *Wolffian duct*, which appears in man before the pronephric tubes are formed, and runs longitudinally back in each intermediate cell mass to open into the cloaca (fig. 6, W.D.). In certain parts of its course it is at an early date in very close relation with the skin on the dorsal side of the intermediate cell mass, and many embryologists hold that it is originally ectodermal in origin, and has sunk into the mesoderm secondarily. Others think that it is primarily mesodermal but has gained secondary connexions with the ectoderm. From a morphological point of view, as will be explained in the comparative anatomy section, the former view seems the more likely.



From A. F. Dixon, Cunningham's *Text-Book of Anatomy.*

FIG. 5.—Transverse Section through the Body of a Fowl Embryo.

When the pronephric tubules disappear, which they do at an early stage of the embryo's development, the Wolffian duct persists and acts as the drain for another and much more important series of tubules, which are formed in the intermediate cell mass behind the region of the pronephros, and make up the *mesonephros* or *middle kidney* (fig. 6, M.N.). There is some doubt as to whether these tubes are strictly homologous and in series with those of the pronephros; but they are certainly of later development.

By about the sixth week of intra-uterine life these tubules reach their maximum development and form the *Wolffian body*, which projects into the coelom as the now very definite *Wolffian ridge* and acts as the functional excretory organ of the embryo (see fig. 7). When the permanent kidney is formed this organ degenerates and its ultimate fate is discussed in the article on the REPRODUCTIVE SYSTEM.

The *metanephros* or *hind kidney* begins as a diverticulum from the dorsal side of the Wolffian duct close to its opening into the cloaca (see fig. 6, Mt.N.); this occurs about the fourth week of intra uterine life, and the diverticulum grows forward (cephalad), dorsal to the hind end of the Wolffian body. In doing this it forms a duct—the *metanephric duct* or *ureter*—the cephalic end of which enlarges and divides to form the calices of the kidney. From the calices numerous smaller ducts grow into the mesoderm of the hind (caudal) end of the intermediate cell mass and become the collecting tubes of the kidney. While this is going on another set of tubules, probably in series with the mesonephric tubules, develop independently in the intermediate cell mass and so form all the rest of the tubular system of the kidney. Toward these tubules, at one point, branches from the aorta push their way and invaginate each tube, thus forming the Malpighian corpuscles.

By the eighth week the kidney is definitely formed and takes over the excretory work of the mesonephros, which now atrophies; its surface is distinctly lobulated, a condition which persists until after birth.

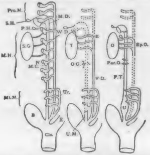
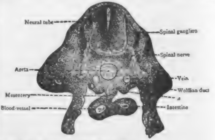


FIG. 6.—Diagram of the Formation of the Genito-Urinary Apparatus. The first figure is the generalized type, the second the male and the third the female specialized arrangements. Suppressed parts are dotted.

Pro N.	Pronephros.	N.	Nephrotome.
M. N.	Mesonephros.	M. C.	Malpighian corpuscle.
Mt. N.	Metanephros.	T.	Testis.
B.	Bladder.	E.	Epididymis.
Clo.	Cloaca.	O. G.	Organ of Giraldès.
R.	Rectum.	V. D.	Vas deferens.
M. D.	Mullerian duct.	U. M.	Uterus masculinus.
W. D.	Wolffian duct.	O.	Ovary.
Ur.	Ureter.	Ep. O	Epoophoron.
S. H.	Sessile hydatid.	Par. O.	Paroophoron.
P. H.	Pedunculated hydatid.	F. T.	Fallopian tube.
S. G.	Sexual gland.	U.	Uterus.



From A. F. Dixon, Cunningham's *Text Book of Anatomy.*

FIG. 7.—Transverse Section through the Body of a Rat Embryo. The position where the germinal epithelium arises is indicated at *a.*

At first, as has been stated, the ureters open into the Wolffian ducts, but later on each gains a separate opening into the cloaca, and eventually these shift in a ventral direction until they reach their permanent connexion with the allantoic bladder.

The *bladder* is developed from that part of the cloaca from which the allantois has grown out, and also from that part of the allantois which is nearest the cloaca. At first it is a tubular structure, but after the second month becomes more pyriform, the stalk of the pear corresponding to the fibrous *urachus* which reaches the umbilicus. Most of that part of the tubular allantois which lies between the permanent openings of the ureters and the Wolffian ducts becomes the *urinary sinus* and does not dilate in the same way that the permanent bladder does. This, in the female, forms the whole of the urethra, and in the male the upper part of the prostatic urethra. Behind (caudad) the urinary sinus is the urogenital sinus, which is treated of in the article on the Reproductive System.

The *Müllerian ducts* (fig. 6, M.D.) are formed after the Wolffian ducts are fully developed. A ridge appears in the intermediate cell mass ventral to the Wolffian duct, and into the anterior (cephalic) end of this a tubular process of the coelom forces its way backward (caudad). Before reaching the cloaca the two Müllerian ducts coalesce and open between the orifices of the two Wolffian ducts. These ducts, as is shown in the article on the Reproductive System, form the oviducts, uterus and at least part of the vagina.

For further details and literature see Quain's *Anatomy*, vol. i. (Longmans, Green & Co., London, 1908); J. M'Murrich, *The Development of the Human Body* (Rebman, London, 1906), and A. Keith, *Human Embryology and Morphology* (Arnold, London).

Comparative Anatomy.

In the Acrania (Amphioxus) the nephridial tubules are segmentally arranged and are only found in the pharyngeal region; each opens into the coelom by several ciliated funnels called nephrostomes, and also into the atrium, which is practically the exterior of the animal, by an opening called the nephridiopore. There is reason to believe that we have here a pronephros of a very primitive type and arranged on the same plan, in many respects, as the simple nephridia of such lowly forms as the earthworm. There is nothing to indicate that a mesonephros is present, nor are there any Malpighian corpuscles or longitudinal ducts.

Among the Cyclostomata (lampreys and hags) the pronephros persists throughout life in Bdellostoma and probably in the hag (Myxine), but a Wolffian (archinephric) duct has been evolved so that the tubules no longer open on the surface by nephridiopores. It has been surmised that in a transitional type the tubules opened into a groove on each side of the surface of the animal and that the edges of this, coming together, formed a duct. At any rate the superficial openings of the primitive nephridia make it probable that the Wolffian duct was originally of ectodermal origin. A mesonephros has now appeared behind (caudad) the pronephros, though it is not certain whether its tubules (mesonephridia) are in series with those of the pronephros or whether they are structures on a more dorsal plane; but they certainly open into the Wolffian duct, which also drains the pronephros, and so this duct is functionally simply a ureter and has nothing to do with the sexual glands. No Müllerian duct has yet been evolved.

In the Teleostomi (bony and ganoid fish) the pronephros is usually aborted in the adult and the mesonephros is the functional kidney. As the genital glands have special coelomic relations the Wolffian duct is still merely a ureter, and in the Teleostei at least there is no true Müllerian duct.

In the Elasmobranchii (sharks and rays) the pronephros is more completely and more early aborted than in the last subclass, and the mesonephros is divided into an anterior or genital part, which receives the vasa efferentia in the male from the testis and thus is the first appearance phylogenetically of an epididymis and a posterior or renal part. The Wolffian duct therefore acts both as a vas deferens for the sperm and a ureter for the urine, though in the female it is merely a ureter. In the hindmost part of the mesonephros there are separate ducts which are called ureters and open into the lower part of the Wolffian duct in the same way that the metanephric ducts of the Amniota do; it is, however, very doubtful whether they are really homologous with these ducts. The Müllerian duct (see Reproductive System) is present in elasmobranchs and according to modern views arises as a backgrowth from the coelom as in the Amniota.

The Dipnoi or mudfish are remarkable for having a cloacal caecum which probably functions as an urinary bladder. It is situated on the dorsal wall of the cloaca and is not homologous with the allantoic bladder of higher forms. A good deal of the kidney (mesonephros) as it appears to the naked eye is composed of lymphoid tissue.

In the Amphibia the snake-like forms (Gymnophiona) show a very primitive arrangement of the kidney tubules, each having its nephrostome, Malpighian capsule and short convoluted part leading to the Wolffian duct which acts both as ureter and vas deferens.

In the adult Anura (frogs and toads) the nephrostomes lose their connexion with the nephridia and communicate with the renal veins. In the amphibians a true allantoic bladder first appears as a diverticulum from the ventral wall of the cloaca; in different forms it may be single, bilobed or even double.

In Reptilia the hind kidney or metanephros is developed and takes over all the excretory work; it is usually lobulated, its nephridia are never provided with nephrostomes and its duct (the ureter) opens into the Wolffian duct or vas deferens before reaching the cloaca. The allantoic bladder is present in the Lacertilia (lizards) and Chelonia (turtles), but is absent in others. Birds resemble reptiles very closely in their urinary system except that there is never any bladder and that the ureters and vasa deferentia open independently into the cloaca.

In the Mammalia the bean shape of the kidney is fairly characteristic. In foetal life the organ is always lobulated, and this sometimes persists throughout adult life as in the ox, bear, seal and whale. More often the lobulation disappears on the surface and is only imperfectly represented, on making a section, by the pyramids; even these in some cases fuse so closely that their apices appear as a single papilla. This is the case in many monkeys, carnivores and rodents.

In the Monotremata (Ornithorhynchus and Echidna) there is an allantoic bladder, but the ureters open into the cloaca as they do in birds. In all other mammals they have reached the bladder and open into it by valvular orifices.

On comparing the embryology (ontogeny) of the urinary system with its comparative anatomy (phylogeny) the harmony of the two from a broad point of view is very striking.

For further details see Parker and Haswell, *Text-Book of Zoology* (Macmillan, London, 1897); Wiedersheim's *Comparative Anat. of Vertebrates*, translated by W. N. Parker (London, 1907); Gegenbaur, *Vergleich. Anat. der Wirbeltiere* (Leipzig, 1901).

URMIA (the name as written by the Persians is *Urūmieh* and *Urmieh*; the inhabitants of the place say *Urmi*), a town in the province of Azerbaijan in Persia, situated at an elevation of 4400 ft., in an extremely fertile and highly cultivated plain, 78 m. S.W. of Tabriz (120 by road), 11 to 12 m. from the western shore of the lake of the same name, in 37° 34′ N. and 45° 4′ E. It is surrounded by a wall and deep dry ditch that can be flooded, and is encircled by orchards and gardens which extend all round for miles and even penetrate the heart of the town. The streets are broader than is usual in Persian cities, and most of them have a stream of water running down the middle. There are a busy bazaar and some old mosques. The population is about 35,000, and there are post and telegraph offices. The only building of importance is the ark, or citadel, a walled building in the centre of the town containing an arsenal and barracks for a small garrison. Urmia has for many years been the headquarters of various missions to the Nestorians of the neighbourhood: an American mission (since 1835) representing the "Board of the Foreign Missions of the Presbyterian church of the United States of America"; the French Lazarists (since 1840); British, "The Anglican Mission" founded by Archbishop Benson (1884), and a Russian mission (Orthodox, since 1902). Urmia is the capital of a fertile district 50 m. long and about 20 m. broad, having the same name and containing more than 300 flourishing villages. It exports great quantities of dried fruit and excellent *tutun*, tobacco for chibuks, or Turkish pipes.

URMIA, LAKE OF (also spelt Urumiah), a lake in north-western Persia, between 37° 10′ and 38° 20′ N. and between 45° 10′ and 46° E., which takes its name (Pers. *Deryacheh i Urmia*, Turk. *Urmi göl*) from the town of Urmia, situated near its western shore, but is also known as the Deryacheh i Shahi and Shahi göl. The limits of the lake vary much, the length, N.-S., from 80 to 90 m., the width, E.-W., from 30 to 45, being greater in the season of high water—in spring when the snows melt—and considerably less in the season of low water. A rise of the level by only a few inches extends the shore of the lake for miles inland, and it may be estimated that the surface covered by the lake during high water is half as much again as that during low water. The Shahi peninsula, which juts out into the lake from the eastern bank, is an island during the season of high water and also sometimes after heavy autumnal rains, separated from the mainland by several miles of shallow water. The mean depth of the lake is 15 to 16 ft., and its greatest depth probably does not exceed 50 ft. The lake has in recent years exhibited extraordinary changes of level, and it is not certain whether some occasional extraordinary rises of level were due to a movement of the earth's crust or merely to an increase of rainfall as compared with evaporation. Günther calculated that the lake covered 1795 sq. m., but he did not state whether during high or low water. De Morgan gives 4000 and 6000 sq. kilometres (1544 and 2317 sq. m.) for low and high water respectively. In the southern half of the lake is a cluster of about fifty rocky islands composed of Miocene strata with marine shells, echinoderms and corals, much resembling the beds of the Vienna basin. The largest of these islands, Koyun daghi, *i.e.* "Sheep-mountain," is 3 to 4 m. long and has a spring of sweet water near which a few people settle occasionally for looking after herds of goats and sheep taken there for grazing. All the islands are uninhabited and some are mere bare rocks of little extent. Although fed by many rivers and streams of sweet water the lake is very saline and its water is about three-fifths as salt as the water of the Dead Sea—far too salt to permit the existence of fish life. The specific gravity of the water is 1·155 during low water and 1·113 during high water. The principal salts contained in solution are sodium chloride, bromide and iodide and sulphates of magnesia, soda and iron. The only organisms living in the lake are a species of artemia, a crustacean known from other brine lakes in Europe and North America, the larva of a species of dipterous insect, probably allied to ephydra, and green vegetable masses composed of bacterial zoogloeae covered with a species of diatom. The rivers which flow into the lake drain an area of nearly 20,000 sq. m.; chub and roach are found in all of them, silurus in some. The lake is navigated by a few round-bottomed boats with round bows and flat sterns, each of about 20 tons burden and carrying an enormous square sail.

Strabo (xi. c. 13, 2) mentions the lake with the name Spauta, a clerical error for Kapauta, from Pers. *Kapaut*, New Pers. *Kebud*, meaning "blue." Old Armenian writers have Kapoit-dzov, "the blue sea." In the *Zendavesta* and *Bundahish* it is called "Chaechasta," and Firdousi in his *Shahnamah* (11th century) has "Chichast."

See J. de Morgan, *Mission scientifique en Perse* (1894); R. T. Günther, "Lake Urmi and its Neighbourhood," *Geogr. Journ.* (November 1899). (A. H.-S.)

URN (Lat. *urna*, either from root of *urere*, to burn, being made of burnt clay, or connected with *urceus*, Gr. ὕρχα, jar), a vessel or vase, particularly one with an oviform body and a foot. The Roman term *urna* was used primarily of a jar for carrying or drawing water, but was also specifically applied to the vessel in which the voting-tablets (*tabellae*) and lots (*sortes*) were cast, whence its figurative use for the urn of fate from which are drawn the varying lots of man's destiny. The ashes of the cremated dead were deposited in cinerary urns, a custom perpetuated by the marble or other urns placed upon funeral monuments. The Roman *urna* was also a liquid measure containing half an *amphora*, or about 3½ gallons. Modern usage has given the name to large silver or copper vessels containing tea or coffee with a tap for drawing off the liquids and heated either by a spirit lamp or, as in the older forms, by the insertion of a hot iron in a special receptacle placed in the body of the vessel.

UROTROPIN (hexamethylenetetramine), known also in the United States under the name *Uritone*, a medicinal preparation due to the action of ammonia on formaldehyde. It consists of colourless granular crystals freely soluble in water and having an alkaline reaction. Urotropin is among the most powerful of urinary antiseptics. It was formerly thought that its action was due to the setting free of formaldehyde in the urine, but it is now known by the researches of P. Cammidge that this is not so. It is used to render the urine acid in cases where it is alkaline, loaded with phosphates or purulent, and is thus useful in cases of cystitis. It is slightly diuretic. Experimentally it has been shown to have a solvent action on uric acid, but its action in this direction in the body requires confirmation. Urotropin is very valuable in sterilizing the urine of patients who have suffered from typhoid fever and thus preventing the spread of the disease by what are known as "typhoid carriers." Analogous preparations are cystamine, helmitol and hetralin. Chinotropin is urotropin quinate, and borovertin is urotropin triborate.

URQUHART, DAVID (1805–1877), British diplomatist and publicist, born at Braelangwell, Cromarty. He came of a good Scottish family and was educated in France, Switzerland and Spain, and then at St John's College, Oxford. In 1827 he went under Lord Cochrane (Dundonald) to fight for the Greeks in the War of Independence; he was present at the action of the 28th of September when Captain Hastings destroyed the Turkish squadron in the Bay of Salona, and as lieutenant of the frigate "Hellas" he was severely wounded in the attack on Scio. In November 1828 he left the Greek service. In 1830 he privately examined the new Greek frontier as determined by the protocol of March 22, 1829, and the value of his reports to the government led to his being named British commissioner to accompany Prince Leopold of Coburg to Greece, but the appointment fell to the ground with that prince's refusal of the Greek throne. His knowledge of the local conditions, however, led to his being appointed in November 1831 attaché to Sir Stratford Canning (Lord Stratford de Redcliffe, *q.v.*), ambassador extraordinary to the sultan, for the purpose of finally deliminating the frontiers of Turkey and Greece. On his return to England he published in 1833 *Turkey and its Resources*, a violent denunciation of Russia. In 1833 he was sent on a secret mission to Turkey to inquire into possible openings for British trade, and at Constantinople he gained the complete confidence of the Turkish government. The situation, however, was a delicate one, and Urquhart's outspoken advocacy of British intervention on behalf of the sultan against Mehemet Ali, the policy of Stratford Canning, made him a danger to international peace; he was consequently recalled by Palmerston. At this time appeared his pamphlet *England, France, Russia and Turkey*, the violent anti-Russian character of which brought him into conflict with Richard Cobden. In 1835 he was appointed secretary of embassy at Constantinople, but an unfortunate attempt to counteract Russian aggressive designs in Circassia, which threatened to lead to an international crisis, again led to his recall in 1837. In 1835, before leaving for the East, he founded a periodical called the *Portfolio*, and in the first issue printed a series of Russian state papers, which made a profound impression. From 1847 to 1852 he sat in parliament as member for Stafford, and carried on a vigorous crusade against Lord Palmerston's foreign policy. The action of England in the Crimean War provoked indignant protests from Urquhart, who contended that Turkey was in a position to fight her own battles without the assistance of other Powers. To attack the government, he organized "foreign affairs committees" which became known as "Urquhartite," throughout the country, and in 1855 founded the *Free Press* (in 1866 renamed the *Diplomatic Review*), which numbered among its contributors the socialist Karl Marx. In 1860 he published his book on *The Lebanon*. From 1864 until his death Urquhart's health compelled him to live on the continent, where he devoted his energies to promoting the study of international law. He died on the 16th of May 1877. His wife (Harriet Chichester Fortescue), by whom he had two sons and two daughters, and who died in 1889, wrote numerous articles in the *Diplomatic Review* over the signature of "Caritas."

To Urquhart is due the introduction into Great Britain of hot-air Turkish baths. He advocated their use in his book called *Pillars of Hercules* (1850), which attracted the attention of the Irish physician Dr Richard Baxter (1802–1870), and the latter introduced them in his system of hydropathy at Blarney, Co. Cork. The Turkish baths in Jermyn Street, London, were built under Urquhart's direction.

URQUHART, or URCHARD, **SIR THOMAS** (1611–1660), Scottish author and translator of Rabelais, was the son of Sir Thomas Urquhart of Cromarty, the representative of a very ancient family, and of Christian, daughter of the fourth Lord Elphinstone. Sir Thomas was hard pressed by his creditors, and after part of the family estate had been alienated received a "letter of protection" from his creditors from Charles I. in 1637. In the same year, his son Thomas and a younger one were accused of forcibly detaining their father in an upper room, but the matter was settled without further proceedings. Thomas was educated at King's College, Aberdeen, spending his spare time in the pursuit of physical science. On leaving the university he travelled over Europe, succeeded to his embarrassed inheritance, and got together a remarkable library, which, however, fell into the hands of his creditors. All his later life was disturbed by pecuniary and political difficulties. He was an enthusiastic Royalist; and, so far as religious matters went, his principles may be judged from his favourite signature, "C. P.," for Christianus Presbyteromastix. He took part in the "Trot of Turriff" in 1639, and was rewarded by being knighted on 7th April 1641 by the king's own hand at Whitehall. He took occasion by this visit to London to see through the press his first work, a collection of *Epigrams* of no great merit. Four years later, in 1645, he produced a tract called *Trissotetras*, a treatise on logarithms, adjusted to a kind of memoria technica, like that of the scholastic logic. In 1649 he was proclaimed a rebel and traitor at the Cross of Edinburgh for taking part in the abortive rising at Inverness on behalf of Charles II. in that year; but no active proceedings were taken against him. He took part in the march to Worcester, and was there wounded and taken prisoner. His MSS. were destroyed after the battle, with the exception of a few pages of the preface to his *Universal Language*. Urquhart was imprisoned in the Tower and at Windsor, but was released by Cromwell's orders in 1651. He published in rapid succession during 1652 and 1653 three tracts with quaint titles and quainter contents. *Παντοχρονοχανον* is an amazing genealogy of the house of Urquhart up to Adam, with the names extemporized for the earlier ages in a kind of gibberish. *'Εκσκυβαλαυρον* is supposed to be a treatise on the virtues of a jewel found in the streets of Worcester. The jewel is the recovered sheets of his manuscript. The defence of his system for a universal language was supplemented by a eulogy of the Scottish character, as shown in the Admirable Crichton and others. Finally, in *Logopandecteision* he again handled the subject of a universal language. The *Translation of Rabelais* (Books I. and II.), which Urquhart produced in 1653, is of the highest value as literature, and, by general testimony, one of the great masterpieces of translation. Though by no means a close rendering, it reproduces the spirit of the original with remarkable felicity. The translation was reprinted in 1664; and in 1693 that of the Third Book was added. Next to nothing is known of Urquhart after 1553; it is said that he sought refuge, like other cavaliers, on the continent, and died (1660) of a fit of laughing, brought on by joy at hearing of the Restoration.

His original *Works*, with such scanty particulars of his life as are known, and with reproductions of two original and curious frontispieces, which represent him as a handsome and dandified wearer of full cavalier costume, were published by the Maitland Club (1834). See also *Sir Thomas Urquhart of Cromartie*, by John Willcock (1899), and the articles in the *New Review* (July 1897) and *Dict. Nat. Biog.* The Rabelais has been frequently reprinted; Peter Motteux's translation of the whole appeared in 1708, and Ozell's in 1737, each incorporating Urquhart's portions. Theodore Martin in 1838, and Henry Morley in 1883, published editions of Urquhart's text.

URSA MAJOR ("The Great Bear"), in astronomy, a constellation of the northern hemisphere, supposed to be referred to in the Old Testament (Job ix. 9, xxxviii. 22), mentioned by Homer, *Ἄρκτος θ', ἣν καὶ ἄμαξαν ἐπίκλησιν καλέουσιν* (*Il.* 18. 487), Eudoxus (4th century B.C.) and Aratus (3rd century B.C.). The Greeks identified this constellation with the nymph Callisto (*q.v.*), placed in the heavens by Zeus in the form of a bear together with her son Arcas as "bear-warder," or Arcturus (*q.v.*); they named it Arctos, the she-bear, Helice, from its turning round the pole-star. The Romans knew the constellation as *Arctos* or *Ursa*; the Arabians termed the quadrilateral, formed by the four stars α, β, γ, δ, *Na'sh*, a bier, whence it is sometimes known as *Feretrum majus*. The Arabic name should probably be identified with the Hebrew name *'Ash* and *'Ayish* in the book of Job (see G. Schiaparelli, *Astronomy in the Old Testament*, 1905). Ptolemy catalogued 8 stars, Tycho 7 and Hevelius 12. Of these, the seven brightest (α of the 1st magnitude, β, γ, ε, ζ, η of the 2nd magnitude, and δ of the 3rd magnitude) constitute one of the most characteristic figures in the northern sky; they have received various names—Septentriones, the wagon, plough, dipper and Charles's wain (a corruption of "churl's wain," or peasant's cart). With the Hindus these seven stars represented the seven Rishis. α and β are called the "pointers," since they are collinear with, or point to, the pole-star. ξ *Ursae majoris* is a beautiful binary star, its components having magnitudes 4 and 5; this star was one of the first to be recognized as a binary— *i.e.* having two components revolving about their common centre of gravity—and the first to have its orbit calculated. ζ *Ursae majoris* is perhaps the best known double star in the northern hemisphere, the larger component is itself a spectroscopic double. The nebula M. 97 *Ursae majoris* is of the planetary type; the earl of Rosse observed two spiral condensations turning in opposite directions,—hence its name,—the "Owl nebula."

URSA MINOR ("The Little Bear"), in astronomy, a constellation of the northern hemisphere, mentioned by Thales (7th century B.C.) and by Eudoxus and Aratus. By the Greeks it was sometimes named *Cynosura* (Gr. *κυνὸς*, dog's; *οὐρά*, tail), alleging this to be one of the dogs of Callisto, who became *Ursa major*. The Phoenicians named it Phoenice, or the Phoenician constellation, possibly in allusion to the fact that the brightest star is α *Ursae minoris* or the pole-star, which being situated very close to the north pole is of incalculable service to navigators. Ptolemy catalogued 8 stars, Tycho Brahe 7 and Hevelius 12. α *Ursae minoris*, more generally known as the pole-star or *Polaris*, a star of the 2nd magnitude, describes a circle of 2° 25′ daily about the north pole; it has a 9th-magnitude companion, and is also a spectroscopic binary.

URSINS, MARIE ANNE DE LA TRÉMOILLE, Princess des (1642–1722), lady of the Spanish court, was the daughter of the duke of Noirmontier and his wife Renée Julie Aubri. She was born in 1642, and was married young to Adrien Blaise de Talleyrand, Prince de Chalais. Her husband, having been concerned in the duel of four against four, in which the duke of Beauvilliers was killed in 1663, was compelled to fly the country. He died soon afterwards in Spain, and his widow established herself in Rome. In 1675 she married Flavio Orsini, duke of Bracciano. The marriage was far from harmonious, but her husband left her his fortune. It brought her a series of lawsuits and troubles with Livio Odescalchi, who claimed that he had been adopted by the duke. At last the widow sold the title and estates to Odescalchi. She then assumed the title of Princess des Ursins, a corruption of Orsini, and was tacitly allowed to use it, though it had no legal existence. The Princess des Ursins had indulged in a great deal of unofficial diplomacy at Rome, more particularly with Neapolitans and Spaniards of rank, whom it was desirable to secure as French partisans in view of the approaching death of Charles II. of Spain, and the plans of Louis XIV. for placing his family on the Spanish throne. Her services were rewarded in 1699 by a pension which her spendthrift habits made necessary to her. When Philip, duke of Anjou, grandson of the French king, was declared heir by the will of Charles II., the princess took an active part in arranging his marriage with a daughter of the duke of Savoy. Her ambition was to secure the post of *Camarera Mayor*, or chief of the household to the young queen, a mere child of twelve. By quiet diplomacy, and the help of Madame de Maintenon, she succeeded, and in 1701 she accompanied the young queen to Spain. Till 1714 she was the most powerful person in the country. Her functions about the king and queen were almost those of a nurse. Her letters show that she had to put them to bed at night, and get them up in the morning. She gives a most amusing description of her embarrassments when she had to enter the royal bedroom, laden with articles of clothing and furniture. But if the *Camarera Mayor* did the work of a domestic servant, it was for a serious political purpose. She was expected to look after French interests in the palace, and to manage the Spanish nobles, many of whom were of the Austrian party, and who were generally opposed to foreign ways, or to interferences with the absurdly elaborate etiquette of the Spanish court. Madame des Ursins was resolved not to be a mere agent of Versailles. During the first period of her tenure of office she was in frequent conflict with the French ambassadors, who claimed the right of sitting in the council and of directing the government. Madame des Ursins wisely held that the young king should rely as much as possible on his Spanish subjects. In 1704 her enemies at the French court secured her recall. But she still had the support of Madame de Maintenon, and her own tact enabled her to placate Louis XIV. In 1705 she returned to Spain, with a free hand, and with what was practically the power to name her own ministry. During the worst times of the war of the Spanish Succession she was the real head of the Bourbon party, and was well aided by the spirited young queen of Philip V. She did not hesitate to quarrel even with such powerful personages as the Cardinal Archbishop of Toledo, Portocarrero, when they proved hostile, but she was so far from offending the pride of the nation, that when in 1709 Louis the XIV., severely pressed by the allies, threatened, or pretended, to desert the cause of his grandson, she dismissed all Frenchmen from the court and threw the king on the support of the Castilians. Her influence on the sovereigns was so strong that it would probably have lasted all through her life, but for the death of the queen. Madame des Ursins confesses in her voluminous correspondence that she made herself a burden to the king in her anxiety to exclude him from all other influence. She certainly rendered him ridiculous by watching him as if he were a child. Philip was too weak to break the yoke himself, and could only insist that he should be supplied with a wife. Madame des Ursins was persuaded by Alberoni to arrange a marriage with Elizabeth Farnese of Parma, hoping to govern the new queen as she had done the old. Elizabeth had, however, stipulated that she should be allowed to dismiss the *Camarera Mayor*. Madame des Ursins, who had gone to meet the new queen at Quadraque near the frontier, was driven from her presence with insult, and sent out of Spain without being allowed to change her court dress, in such bitter weather that the coachman lost his hand by frostbite. After a short stay in France, she went to Italy, and finally established herself in Rome, where she had the satisfaction of meeting Alberoni after his fall, and where she died on the 5th of December 1722. Madame des Ursins has the credit of having begun to check the overgrown power of the church and the Inquisition in Spain, and of having attempted to bring the finances to order.

A readable life of Madame des Ursins was published in Paris in 1858 by N. F. Combes, and there is an English life by C. Hill, *The Princess des Ursins in Spain* (London, 1899). See her *Lettres inédites*, edited by A. Geoffroy (Paris, 1859), and her correspondence with Madame de Maintenon (Paris, 1826).

URSINUS, ZACHARIAS (1534–1583), German theologian, and one of the authors of the *Heidelberg Catechism* (*q.v.*), was born at Breslau on the 18th of July 1534, and became a disciple of Melanchthon at Wittenberg. He afterwards studied divinity at Geneva under Calvin, and Hebrew at Paris under Jean Mercier. In 1561 he was appointed professor in the Collegium Sapientiae at Heidelberg, where in 1563 at the instance of the elector-palatine, Frederick III., he drew up the *Catechism* in co-operation with Kaspar Olevian. The death of the elector in 1576 led to the removal of Ursinus, who from 1578 till his death in 1583 occupied a professorial chair at Neustadt-an-der-Haardt.

His *Works* were published in 1587–89, and a more complete edition by his son and two of his pupils, Pareus and Reuterus, in 1612.

URSULA, ST, and her companions, virgins and martyrs, are commemorated by the Roman Catholic church on the 21st of October. The *Breviary* gives no legend; but in current works, such as Butler's *Lives of the Saints*, it is to the effect that "these holy martyrs seem . . . to have met a glorious death in defence of their virginity from the army of the Huns. . . . They came originally from Britain, and Ursula was the conductor and encourager of the holy troop." The scene of the martyrdom is placed near the lower Rhine.

The date has been assigned by different writers to 238, *c.* 283 and *c.* 451. The story, however, is unknown both to Jerome and to Gregory of Tours—and this though the latter gives a somewhat detailed description of the Cologne church dedicated to that Theban legion with which the tradition of the martyred virgins was very early associated. The story of their fate is not entered under 21st October in the martyrology of Bede (*ob. c.* 735), of Ado (*c.* 858), of Usuard (*ante* 877), Notker Balbulus (896) or Hrabanus Maurus (845); but a 9th-century life of St Cunibert (*ob.* 663) associates a prominent incident in the life of this saint with the basilica of the sacred virgins at Cologne (Surius vi. 275, ed. 1575). Not only does Archbishop Wichfrid attest a grant to the church of the sacred virgins outside the walls of Cologne (in 927), but he was a large donor in his own person. Still earlier a Cologne martyrology, written, as Binterim (who edited it in 1824) argues, between 889 and 891, has the following entry under 21st October: "xi. virg. Ursule Sencie Gregorie Pinose Marthe Saule Britule Satnine Rabacie Saturie Paladie." Much shorter entries are found in two of the old martyrologies printed in Migne (cxxxviii. 1207, 1275). A more definite allusion to the legend may be found (*c.* 850) in Wandelbert of Prüm's metrical martyrology (21st October):

> "Tunc numerosa simul Rheni per littora fulgent
> Christo virgines erecta tropaea maniplis
> Agrippinae urbi, quarum furor impius olim
> Millia mactavit ductricibus inclyta sanctis."

The full legend first makes its appearance in a festival discourse (*sermo*) for the 21st of October, written, as internal evidence seems to show, between 731 and 839. This *sermo* does not mention St Ursula, but makes Pinnosa or Vinnosa the leader of these spiritual "amazons," who, to avoid Maximian's persecution, left their island home of Britain, following their bridegroom Christ towards that East whence their faith had come a hundred years before. The concurrent traditions of Britain, Batavia, *i.e.* the Netherlands (where many chapels still preserved their memory), and Cologne are called in evidence to prove the same origin. The legend was already very old and the festival "nobis omni tempore celeberrima"; but, as all written documents had disappeared since the burning of the early church erected over the sacred bones, the preacher could only appeal to the continuous and careful memory of the society to which he belonged (*nostrates*). Even in his time there were sceptics who pointed dubiously to the full-grown bones of "widows" and of men among the so-called virgin relics. The author of the *sermo* pointedly rejects the two theories that connected the holy virgins with the Theban band and brought them as pilgrims from the East to the West; but he adds that even in his days there still existed an inscription in the church, showing how it had been restored from its foundations by a certain "*Clematius, vir consularis, ex partibus Orientis.*"

Two or three centuries later the *Passio XI. MM. SS. Virginum*, based apparently on the revelations made to Helentrude, a nun of Heerse near Paderborn, gives a wonderful increase of detail. The narrative in its present form may date somewhere between 900 and 1100, while Helentrude apparently flourished before 1050. According to her account, the son of a powerful pagan king demands in marriage Ursula, the beautiful daughter of Deonotus, a king "in partibus Britanniae." Ursula is warned by a dream to demand a respite of three years, during which time her companions are to be 11,000 virgins collected from both kingdoms. After vigorous exercise in all kinds of manly sports, to the admiration of the populace, they are carried off by a sudden breeze in eleven triremes to Thiel on the Waal in Gelderland. Thence they sail up the Rhine by way of Cologne to Basel, at which place they make fast their vessels and proceed on foot to Rome. Returning, they re-enter their ships at Basel, but are slaughtered by the Huns when they reach Cologne. Their relics are then collected and buried "sicut hodie illic est cernere," in a spot where "to this day" no meaner sepulture is permitted. Then follows the usual allusion to Clematius; the date is expressly fixed at 238, and the whole revelation is seemingly ascribed to St Cordula, one of the 11,000 who, after escaping death on the first day by hiding in one of the vessels, on the morrow gave herself up to death of her own accord. Towards the beginning of the 12th century Sigebert of Gembloux (*ob.* 1112) gives a brief *résumé* of the same story. He is the first to introduce the name of Attila, and dates the occurrence 453.

Passing over the visions and exhumations of the first half of the 12th century, we come to the singular revelations of St Elizabeth of Schönau. These revelations, delivered in Latin, German or a mixed jargon of both languages, were turned into simple Latin by Elizabeth's brother Egbert, from whose words it would seem that in 1156 an old Roman burial-ground had lately been laid open near Cologne. The cemetery was naturally associated with the legend of St Ursula; and, this identification once accepted, it is not unlikely that when more careful investigations revealed male skeletons and tombstones bearing the names of men, other and more definite epitaphs were invented to reconcile the old traditions with the facts of such a damaging discovery. Hence perhaps the barefaced imposture: "Cyriacus, papa Romanus, qui cum gaudio suscepit sanctas virgines et cum eis Coloniam reversus martyrium suscepit." One or two circumstantial forgeries of this kind would form the basis of a scheme for explaining not a few other problems of the case, such as the plain inscription "Jacobus," whom St Elizabeth promptly transformed into a supposititious British archbishop of Antioch, brother to the equally imaginary British Pope Cyriacus. For these epitaphs, with others of a humbler kind, were brought before St Elizabeth to be identified in her ecstatic converse with St Verena, her cousin St Ursula, and others. Elizabeth herself at times distrusted her own revelations: there was no Cyriac in the list of the popes; Antherus, who was said to be his successor (235–36), died more than two centuries before Attila, to whom common report assigned the massacre; and it was hardly credible that James of Antioch could cut 11,000 epitaphs in less than three days. Every doubt, however, was met by the invention of a new and still more improbable detail. According to St Verena, the virgins suffered when Maximus and "Africanus" were *principes* at Rome (? 387–88).

In 1183 the mantle of St Elizabeth fell upon Hermann Joseph, a Praemonstratensian canon at Steinfeld. He had to solve a more difficult problem than St Elizabeth's; for the skeletons of little children, ranging in age from two months to seven years, had now been found buried with the sacred virgins. But even such a difficulty Hermann explains away: the little children were brothers, sisters or more distant relatives of the 11,000. Hermann's revelations are mainly taken up with an attempt to show the mutual relationship of nearly all the characters he introduces. The names are a most extraordinary mixture. Among British bishops we have Michael, William, James and Columbanus. Sovereign princes—an Oliver, a Clovis and a Pepin—start out in every page, till the writer finds it necessary to apologize for the number of his kings and his own blunders. But, for all this, Hermann exposes his own doubts when he tells that often, as he was preparing to write, he heard a voice bidding him lay down the pen, "for whatever you write will be an unmixed lie." Hermann makes St Ursula a native of Brittany, and so approximates to the version of the story given by Geoffrey of Monmouth (*Historia Britonum*), according to whom Maximian, after fleeing from Rome and acquiring Britain by marriage, proceeds to conquer Brittany and settle it with men from the island opposite. For these settlers he has to find British wives, and to this end collects 11,000 noble and 60,000 plebeian virgins, who are wrecked on their passage across. Certain of the vessels being driven upon "barbarous islands," their passengers are slain by Guanius and Melga, "kings of the Huns and Picts," whom Gratian had called in to his aid against Maximian. In this version St Ursula is a daughter of Dionotus, king of Cornwall. Hermann alludes more than once to the *Historia Britonum*, and even to King Arthur.

The legend of St Ursula is perhaps the most curious instance of the development of an ecclesiastical myth. Even in the earliest form known to us this legend is probably the complex growth of centuries, and any claim to the discovery of the first germ can hardly approve itself to the historic sense. These remarks apply especially to that venerable rationalization which evolves the whole legend from a misreading of *Undecimilla*, the name of Ursula's companion, into *undecim millia*, *i.e.* 11,000. A more modern theory makes St Ursula the Christianized representative of the old Teutonic goddess Freya, who, in Thuringia, under the name of Hörsel or Ursel, and in Sweden Old Urschel, welcomed the souls of dead maidens. Not a few singular coincidences seem to point in the same direction, especially the two virgins, "Martha and Saula," whom Usuard states to have suffered "cum aliis pluribus" on the 20th of October, whence they were probably transferred to the 21st. It is curious to note that Jerome and many of the earliest martyrologies extant have on the 21st of October the entry, "Dasius Zoticus, Gaius *cum duodecim militibus*." Even in copies of Jerome this is transformed into *millibus*; and it is perhaps not impossible that to this misreading we may indirectly owe the "thousands" in the Ursula legend. The two entries seem to be mutually exclusive in all the early martyrologies mentioned in this article, and in those printed in Migne, cxxxvii. The earlier "Dasius" entry seems to disappear steadily, though slowly, as the Ursula legend works its way into current martyrologies.

See H. Crombach, *Vita et Martyrium S. Ursulae* (Cologne, 1647), and the Bollandist *Acta Sanctorum*, 21st October, where the story fills 230 folio pages. The rationalization of the story is to be found in Oscar Schade, *Die Sage von der heiligen Ursula* (Hanover, 1854), of which there is a short *résumé* in S. Baring-Gould's *Lives of the Saints*. See also S. Baring-Gould, *Popular Myths of the Middle Ages*; A. G. Stein, *Die Heilige Ursula* (Cologne, 1879). The credibility of some of the details was doubted as early as the 13th century by Jacobus de Voragine in the *Legenda aurea*. For further works, especially medieval, see A. Potthast, *Bibliotheca hist. med. aevi* (Berlin, 1896), p. 1616. (T. A. A.; A. J. G.)

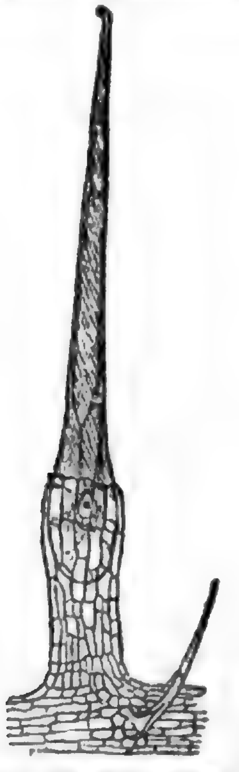
URSULINES, a religious order founded at Brescia by Angela Merici (1470–1540) in November 1535, primarily for the education of girls and the care of the sick and needy. It was approved in 1544 by Paul III., and in 1572 Gregory XIII., at the instance of Charles Borromeo, declared it a religious order under the rule of St Augustine. In the following century it was powerfully encouraged and supported by St Francis of Sales. In most cases, especially in France, the sisters adopted enclosure and took solemn vows; they were called the "religious" Ursulines as distinct from the "congregated" Ursulines, who preferred to follow the original plan. There were Ursulines in Canada in 1639, who taught the catechism to Indian children, and subsequently helped to preserve a religious spirit among the French population and to humanize the Indians and half-breeds. Towards the beginning of the 18th century, the period of its greatest prosperity, the order embraced some 20 congregations, with 350 convents and from 15,000 to 20,000 nuns. The members wear a black dress bound by a leathern girdle, a black sleeveless cloak, and a close-fitting head-dress with a white veil and a longer black veil. Their patron is the St Ursula mentioned above. The founder was beatified by Clement VIII. in 1768 and canonized as St Agnes of Brescia by Pius VII. in 1807. The Irish Ursulines were established at Cork in 1771 by Miss Nano Nagle. The Ursulines do not increase now as rapidly as they did, congregations taking simple vows like the Sisters of Mercy being apparently more adapted to modern needs.

URSWICK, CHRISTOPHER (1448–1522), English diplomatist, was born at Furness in Lancashire and was probably educated at Cambridge. He became chaplain to Margaret, countess of Richmond and Derby, and was employed by her to forward the schemes for securing the English throne for her son, Henry of Richmond, afterwards Henry VII. He crossed from Harfleur to Wales with Henry in August 1485, and was present at the battle of Bosworth; then followed for him a series of ecclesiastical preferments, the most important of which was to the deanery of York. He was sent on several weighty embassies, including one to Ferdinand and Isabella of Spain to arrange the marriage between Prince Arthur and Catherine of Aragon, and another to France in 1492, when he signed the treaty of Etaples. In 1495 he became dean of Windsor, and he died on the 24th of March 1522. Urswick was very friendly with Erasmus and with Sir Thomas More. He did some building at Windsor, and one of the chapels in St George's chapel there is still called the Urswick chapel. Urswick's kinsman, Sir Thomas Urswick, was a Yorkist partisan, who was recorder of London and chief baron of the exchequer.

See Urswick, *Records of the Family of Urwick or Urswick* (1893).

URTICACEAE (nettle family), in botany, an order of Dicotyledons belonging to the series Urticiflorae, which includes also Ulmaceae (elm family), Moraceae (mulberry, fig, &c.) and Cannabinaceae (hemp and hop). It contains 41 genera, with about 500 species, mainly tropical, though several species such as the common stinging nettle (*Urtica dioica*) are widely distributed and occur in large numbers in temperate climates. Two genera are represented in the British Isles, *Urtica* (see NETTLE) and *Parietaria* (pellitory, *q.v.*).

The plants are generally herbs or somewhat shrubby, rarely, as in some tropical genera, forming a bush or tree. The simple, often serrated, leaves have sometimes an alternate sometimes an opposite arrangement and are usually stipulate—exstipulate in *Parietaria*. The position of the stipules varies in different genera; thus in *Urtica* they are lateral and distinct from the leaf-stalk, in other cases they are attached on the base of the leaf-stalk or stand in the leaf-axil when they are more or less united. Stinging hairs often occur on the stem and leaves (fig. 1). The bast-fibres of the stem are generally long and firmly attached end to end, and hence of great value for textile use. Thus in ramie (*q.v.*, *Boehmeria nivea*) a single fibre may reach nearly 9 in. in length, and in stinging nettle as much as 3 in. The small inconspicuous regular flowers (figs. 3 and 4) are arranged in definite (cymose) inflorescences often crowded into head-like clusters. They are unisexual and monoecious or dioecious. The four or five green perianth leaves (or sepals) are free or more or less united; the male flowers (fig. 2) contain as many stamens, opposite the sepals, which bend inwards in the bud stage, but when mature spring backwards and outwards, the anther at the same time exploding and scattering the pollen. The flowers are thus adapted for wind-pollination. The female flower contains one carpel bearing one style with a brush-like stigma and containing a single erect ovule. The fruit is dry and one-seeded; it is often enclosed within the persistent perianth. The straight embryo is surrounded by a rich oily endosperm.



From Strasburger's *Lehrbuch der Botanik*, by permission of Gustav Fischer.

FIG. 1.—Stinging Hair of *Urtica dioica*, with a portion of the epidermis, and, to the right, a small bristle

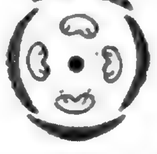
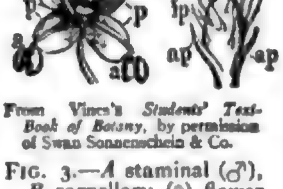


FIG. 2.—Male Flower of the Nettle (*Urtica*). The four sepals are arranged symmetrically, an outer median and an inner lateral pair. A stamen is opposite each sepal, and in the centre of the flower is the rudiment of a pistil.



From Vines's *Students' Text-Book of Botany*, by permission of Swan Sonnenschein & Co.

FIG. 3.—*A* staminal (♂), *B* carpellary (♀) flower of the Nettle. *p*, perianth; *a*, stamen; *n'*, rudimentary ovary of the ♂ flower; *ap*, outer, *ip*, inner, whorl of the perianth; *n*, stigma of the ♀ flower (enlarged).

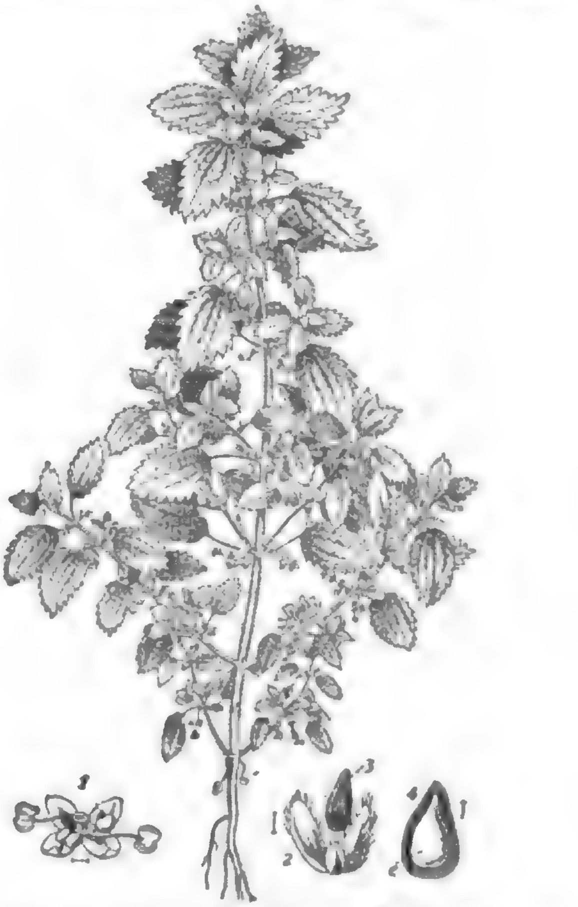


FIG. 4.—*Urtica urens* (after Curtis, *Flora Londinensis*).
1, male flower; 2, female flower in fruiting stage—the dry compressed fruit 3 escaping from the persistent perianth; 4, fruit cut open, revealing the seed within the large straight embryo *e*. 1, 2, 3, enlarged.

URUGUAY (officially the *Oriental Republic of the Uruguay*, and long locally called the *Banda Oriental*, meaning the land on the eastern side of the river Uruguay, from which the country takes its name), the smallest independent state in South America. It runs conterminous with the southern border of Brazil, and lies between 30° and 35° S. and between 53° 25′ and 57° 42′ W. (for map, see ARGENTINA). It has a seaboard on the Atlantic Ocean of 120 m., a shore-line to the south on the Rio de la Plata of 235 m., and one of 270 m. along the Uruguay on the west. The boundaries separating it from Rio Grande do Sul, a province of Brazil, are Lake Mirim, the rivers Chuy, Jaguarão and Quarahy, and a *cuchilla* or low range of hills called Santa Ana. The extent of the northern frontier is 450 m. The southern half of the country is mostly undulating grass land, well watered by streams and springs. The northern section is more broken and rugged; barren ridges and low rocky mountain-ranges, interspersed with fertile valleys, being its characteristic features. There is no forest, timber of any size being found only in the valleys near running water. Uruguay is intersected nearly from west to north-east by the river Negro and its affluent the Yi. The Uruguay is navigable all the year by steamers from the island of Martin Garcia at the mouth to Salto (200 m.). Above this place the navigation is interrupted by rapids. The ordinary volume of water in the Uruguay averages 11 millions of cub. ft. per minute. Excluding the Uruguay, the Negro, of which the principal port is Mercedes, is the principal navigable river. Others are navigable only for short distances by steamers of light draught. Besides the rivers mentioned, the chief streams are the Santa Lucia, which falls into the Plata a little west of Montevideo; the Queguay, in Paysandú; and the Cebollati, rising in the sierras in Minas and flowing into Lake Mirim. These rivers as well as the Uruguay are fed by innumerable smaller streams or *arroyos*, such as the Arapey in Salto, the Dayman in Paysandú, the Jaguary (an affluent of the Negro) in Tacuarembo, the Arroyo Grande between the departments of Soriano and San José, and the San José (an affluent of the Santa Lucia). None of the sierras or mountains in Uruguay exceeds (or perhaps even attains) a height of 2000 ft.; but, contrasting in their tawny colour with the grassy undulating plains, they loom high and are often picturesque. They are ramifications of the highlands of Brazil. The main chains are the Cuchilla de Haedo on the north and west and the Cuchilla Grande on the south and east.

Geology.—Little is known of the geology of Uruguay. There is a foundation of schists and crystalline rocks upon which rests a series of sandstones. The latter is, no doubt, identical with the similar sandstone series which is found in the neighbouring Brazilian province of Rio Grande do Sul, and which has there yielded plants which prove it to belong to the Permian or the upper part of the Carboniferous. The plains are covered by a formation similar to that of the Argentine pampas and by the alluvial deposits of the present rivers.

Climate.—Uruguay enjoys the reputation of possessing one of the most healthy climates in the world The geographical position ensures uniformity of temperature throughout the year, the summer heat being tempered by the Atlantic breezes, and severe cold in the winter season being unknown. Endemic diseases are unknown and epidemics are rare. In the interior, away from the sea and the shores of the great rivers, the temperature frequently rises in summer to 86° F. and in winter falls to 35°·6. In the districts bordering on the coast the thermometer seldom falls below 37°; and only for a few moments and at long intervals has it been known to rise as high as 105°. The annual rainfall is about 43 in.

Flora.—The pastoral wealth of Uruguay, as of the neighbouring Argentine Republic, is due to the fertilizing constitutents of "pampa mud," geologically associated with gigantic antediluvian animals, whose fossil remains are abundant. The country is rich in hard woods, suitable for cabinet work and certain building purposes. The principal trees are the alder, aloe, palm, poplar, acacia, willow and eucalyptus. The *montes*, by which are understood plantations as well as native thickets, produce among other woods the algarrobo, a poor imitation of oak; the guayabo, a substitute for boxwood; the quebracho, of which the red kind is compared to sandalwood; and the urunday, black and white, not unlike rosewood. Indigenous palms grow in the valleys of the Sierra José Ignacio, also to some extent in the departments of Minas, Maldonado and Paysandú. The myrtle, rosemary, mimosa and the scarlet-flowered ceibo are common. The valleys within the hill ranges are fragrant with aromatic shrubs. In the plains below, the swards are gay with the scarlet and white verbena and other brilliant wild flowers. The country abounds in medicinal plants. The sarsaparilla even colours the water of the Rio Negro and gives it its name—the "black river."

Fauna.—Among wild animals the tiger or ounce—called in the Guaraní language the *ja-guá* or "big dog"—and the puma are found on the frontier of Brazil and on the wooded islets and banks of the larger rivers. The tapir, fox, deer, wild cat, wild dog, carpincho or water hog and a few small rodents nearly complete the list of quadrupeds. A little armadillo, the mulita, is the living representative of the antediluvian giants *Mylodon*, *Megatherium*, &c. The ostrich—*Rhea americana*—roams everywhere in the plains; and there are a few specimens of the vulture tribe, a native crow (lean, tall and ruffed), partridges and quails. Parakeets are plentiful in the *montes*, and the lagoons swarm with waterfowl. The most esteemed is the *pato real*, a large duck. Of the birds of bright plumage the humming-bird and the cardinal—the scarlet, the yellow and the white—are the most attractive. The fish of the lagoons and streams are coarse, and some of them primitive in type; but two or three kinds, found generally in the large rivers, are much prized. The varieties of fish on the sea coast are many and excellent. More than 2000 species of insects have been classified. The scorpion is rare, but large and venomous spiders are common. The principal reptiles are a lizard, a tortoise, the *vivora de la cruz* (a dangerous viper, so called from marks like a cross on its head) and the rattlesnake in Maldonado and the stony lands of Minas.

Area and Population.—The area of the republic is estimated at 72,210 sq. m., and has a population of 1,042,668 according to the census of 1908 (in 1900 it was 915,647). The country is divided into 19 departments, the area and the population of which, according to the census of 1908, are given in the subjoined table:—

Departments.	Area, Sq. Miles.	Population, 1908.
Artigas	4,392	26,298
Canelones	1,833	87,931
Cerro Largo	5,753	44,806
Colonia	2,192	54,679
Durazno	5,525	42,313
Flores	1,744	16,158
Florida	4,763	45,393
Maldonado	1,584	28,804
Minas	4,844	51,170
Montevideo	256	309,231
Paysandú	5,115	38,528
Rio Negro	3,269	19,909
Rivera	3,790	35,653
Rocha	4,280	34,110
Salto	4,863	46,304
San José	2,687	46,267
Soriano	3,560	39,431
Tacuarembo	8,074	46,927
Treinta-y-Tres	3,686	28,756
Total	72,210	1,042,668

The average density of population on the above figures is 12·9 per sq. m., ranging (exclusive of Montevideo) from 47·9 in Canelones to 5·8 in Tacuarembo and 6 in Artigas. The great majority of the foreign population are Italians or Spaniards, with lesser numbers, in descending scale, of Brazilian, Argentine and French birth. British, Swiss and Germans are comparatively few. In 1907, 26,105 Italian immigrants arrived, 21,927 Spanish, 2355 British, 2315 French and 1823 German.

The natives of Uruguay, though living in conditions similar to those of the Argentine population, are in general more reserved, showing more of the Indian type and less of the Spaniard. In the north there is a strong Brazilian element and the people are intensely conservative. The average annual birth-rate is about 35 per 1000, and the death-rate about 15·5. About 26% of the births are illegitimate. The principal towns are Montevideo, Salto, Paysandú and San José.

Agriculture.—The condition of agriculture is fairly satisfactory. In 1885 Uruguay imported most of her breadstuffs; now not only is wheat grown in sufficient quantities to meet the local demand, but a surplus (about 20,000 metric tons in 1908–9) is annually available for export. Land for farming purposes is expensive, and wages are high, leaving small profit, unless it happens that a man, with his family to assist him, works his own land. The farmers are chiefly Italians, Canary Islanders and Frenchmen. The principal crops in addition to wheat are oats, barley, maize, linseed and bird seed. Since 1890 the cultivation of the grape and the manufacture of wine have considerably extended, especially in the department of Salto, Montevideo, Canelones and Colonia. Red wine, a smaller quantity of white, grape alcohol and wine alcohol are produced. The olive-planting industry is becoming important; the trees thrive well, and the area devoted to their cultivation is annually increasing. Tobacco is also cultivated.

Cattle-breeding and sheep-farming, however, are the principal industries, The lands are admirably adapted for cattle-breeding purposes, although not capable of fattening animals. The cattle are destined chiefly for the *saladero* establishments for the preparation of *tasajo*, or jerked beef, for the Brazilian and Cuban markets, and for the Liebig factory, where large quantities of extract of meat are prepared for the European trade. Cattle-breeding is carried on in all parts of the republic, but chiefly in the departments of Salto, Paysandú and Rio Negro. In the southern districts, where the farmers are Europeans, the breed of cattle is being steadily improved by the introduction of Durham and Hereford bulls. Dairy-farming is making some progress, especially in the Swiss colony near San José.

Sheep-farming flourishes chiefly in Durazno and Soriano. Uruguayan wool is favourably regarded in foreign markets, on account of the clean state in which it is shipped, this being largely due to the natural conditions of the land and climate. The business of shipping live sheep and frozen mutton has not been attempted on a large scale, owing principally to the lack of facilities for loading at the port of Montevideo or elsewhere.

Mining.—Minerals are known to exist in the northern section of the republic, and gold-mining is carried on to a small extent. Expert opinions have been advanced stating that gold-mining in Uruguay is capable of development into an important industry. The other minerals found are silver, lead, copper, magnesium and lignite coal.

Commerce.—The economic development of Uruguay was retarded by the corruption of successive governments, by revolutionary outbreaks, by the seizure of farm stock, without adequate compensation, for the support of military forces, by the consequences of reckless borrowing and over-trading in 1889 and 1890, and also by the transference of commercial undertakings from Montevideo to Buenos Aires between 1890 and 1897, on the opening of the harbour and docks at that port. The annual value of the imports (4·7 dollars taken at £1) was £5,101,740 in 1900 and £7,365,703 in 1908; that of exports was £6,257,600 in 1900 and £7,932,026 in 1908.

The principal imports consist of machinery, textiles and clothing, food substances and beverages, and live stock. The chief exports are animal products and agricultural products. Of the imports about 27 % in value are from Great Britain, 14 % from Germany, and smaller proportions from France, Argentina, Italy, Spain, the United States and Belgium. Of the exports, France, Argentina, Belgium and Germany take the bulk. Trade is controlled by foreigners, the British being prominent in banking, finance, railway work and the higher branches of commerce; Spaniards, Italians and French in the wholesale and retail trade. Uruguayans find an insignificant place in commerce. The foreign trade passes mainly through Montevideo, where the port has been greatly improved.

In addition to the natural lines of communication provided by the rivers bordering on or belonging to the republic, there are about 2240 m. of national road, besides more than 3000 m. of departmental roads. The railways had a length of 1380 m. open for traffic, and the system is steadily extending. There are over 170 m. of tramway in operation.

Government.—The legislative power of the state rests with the general assembly, consisting of two chambers, one of senators (19 in number) and one of representatives (75). The deputies of the lower house are elected for three years directly by the people, one deputy for every 3000 male adults who can read and write. One senator is named for each department by an electoral college, whose members are elected directly by the people. The senators are elected for six years, and one-third of their number retire every two years. The executive power is exercised by the president of the republic, who is elected by the general assembly for a four years' term. He is assisted by a council of ministers representing the departments of the interior, foreign affairs, finance, war and marine, industry, labour and instruction and public works. Each department or province of the republic has a governor appointed by the executive, and an administrative council, whose members are chosen by popular vote. The judicial power is vested in a high court and many subordinate courts. The general assembly elects the five judges who compose the high court. There are civil, commercial and criminal courts in Montevideo, a departmental court in each departmental capital, and a justice of the peace in each of 205 judicial districts into which the republic is divided, with sub-district courts under deputy judges in addition. The administration of justice in Uruguay has long been of bad repute. It was reformed on the above lines in 1907.

Education is much neglected, and the public-school system is inefficient. The attendance of children at the schools is small, and the instruction they receive is inferior. Primary instruction is nominally obligatory; nevertheless at the beginning of the 20th century nearly half the population over six years of age was illiterate. Montevideo possesses a university and a number of preparatory schools, a state-supported technical school and a military college. The state religion is Roman Catholic, and there is an archbishop of Montevideo with two suffragan bishops. A number of seminaries are maintained throughout the republic. Other religions are tolerated.

Army.—There is a standing army with a peace strength of about 7000 officers and men. Service is nominally voluntary, though it appears that a certain amount of compulsion is exercised. In addition to this there is compulsory service in the National Guard (*a*) in the first class, consisting of men between seventeen and thirty years of age, liable for service with the standing army, and numbering some 15,000; (*b*) in the second class, for departmental service only, except in so far as it may be drawn upon to make up losses in the more active units in time of war, consisting of men from thirty to forty-five years of age, and (*c*) in the third class, for local garrison duty, consisting of men between forty-five and sixty years old. The army and guard are well equipped with modern arms.

Finance.—Of the national revenue nearly half is derived from customs duties, taxes being levied also on real estate, licences, tobacco, stamped paper and in other ways. Nearly half the expenditure goes to meet debt charges, while government, internal development and defence absorb most of the remainder. The receipts for the years specified were as follows, Uruguayan dollars being converted into sterling at the par value, 4·7 = £1:—

Years.	Revenue.	Expenditure.
1894–1895	£3,403,324	..
1899–1900	3,236,300	..
1904–1905	3,438,300	£3,438,510
1909–1910[1]	4,971,660	4,704,500

[1] Estimate.

In 1891, when the debt of the republic amounted to $87,789,973, or about £18,678,710, the government suspended payment of interest, and an arrangement was made with the bondholders. A new consolidated debt of £20,500,000 was issued at 3½ % interest, and, as security for payment of interest, 45 % of the customs receipts at Montevideo was assigned. At the same time the interest guaranteed to the railway companies was reduced from 7 to 3½ %. In 1896 a 5 % loan of £1,667,000 was issued, and the debt was subsequently increased, until on January 1, 1909, it was £27,692,795, and in the same year the annual debt charge amounted to £2,185,347.

The Bank of the Republic was established in 1896 with a nominal capital of $12,000,000, and in 1899 it received the right to issue further shares amounting to $5,000,000. Its note issue (for which it has an exclusive right) may not exceed the value of half the subscribed capital. Besides a number of local banks, branches of German, Spanish, French and several British banks are established in Montevideo.

There is no Uruguayan gold coin in circulation, but the theoretical monetary unit is the gold *peso nacional*, weighing 1·697 grammes, ·917 fine. The silver peso weighs 25 grammes, ·900 fine. A half, fifth and tenth of a peso are coined in silver, in addition to bronze coins.

The metric system of weights and measures has been officially adopted, but the old Spanish system is still in general use.

History.—In 1512 Juan Diaz de Solis entered the Paranaguazu or "sealike" estuary of the Plata and landed about 70 miles east of the present city of Montevideo. Uruguay at that time was inhabited by Indians, of whom the dominant tribe was called Charrua, a people described as physically strong and well-formed, and endowed with a natural nobility of character. Their habits were simple, and they were disfigured neither by the worst crimes nor by the primitive superstitition of savages. They are said to have revealed no vestige of religion. The Charruas are generally classified as a yellow-skinned race, of the same family as the Pampa Indians; but they are also represented as tanned almost black by the sun and air, without any admixture of red or yellow in their complexions. Almost beardless, and with thin eyebrows, they had on their heads thick, black, lustrous hair, which neither fell off nor turned grey until extreme old age. They lived principally upon fish, venison and honey. In the Guarani language "Charrua" means turbulent, and by their enemies the Charruas were accounted as such, and even ferocious, although admitted to be generous to their captives. They were a curiously taciturn and reticent race. Their weapons were the bow and arrow and stones.

Solis, on his second visit, 1515–1516, was slain by the Charruas in Colonia. Eleven years later Ramon, the lieutenant of Sebastian Cabot, was defeated by the same tribe. In 1603 they destroyed in a pitched battle a veteran force of Spaniards under Saavedra. During the next fifty years three unsuccessful attempts were made by the Spaniards to subdue this courageous people. The real conquest of Uruguay was begun under Philip III. by the Jesuit missions. It was gradually consummated by the military and commercial settlements of the Portuguese, and subsequently by the Spaniards, who established themselves formally in Montevideo under Governor Zavala of Buenos Aires in 1726, and demolished the rival Portuguese settlement in Colonia in 1777. From 1750 Montevideo enjoyed a provincial government independent of that of Buenos Aires. The American rebellion, the French Revolution and the British invasions of Montevideo and Buenos Aires (1806–7), under Generals Auchmuty (1756–1822) and John Whitelocke (1757–1833), all contributed to the extinction of the Spanish power on the Rio de la Plata. During the War of Independence, Montevideo was taken in 1814 by the Buenos-Airean general Alvear (see further MONTEVIDEO). A long struggle for dominion in Uruguay between Brazil and the revolutionary government of Buenos Aires was concluded in 1828, through the mediation of Great Britain, Uruguay being declared a free and independent state. The republic was formally constituted in 1830. Subsequently Juan Manuel Rosas, dictator of Buenos Aires, interfered in the intestine quarrels of Uruguay; and Montevideo was besieged by his forces, allied with the native partisans of General Oribe, for nine years (1843–52).

After the declaration of independence the history of Uruguay becomes a record of intrigues, financial ruin, and political folly and crime. The two great political factors for generations have been the Colorados and the Blancos. So far as political principles are concerned, there is small difference between them. Men are Colorados or Blancos largely by tradition and not from political conviction. The Colorados have held the government for many years, and the attempts of the Blancos to oust them have caused a series of revolutions. The military element, moreover, has frequently conspired to elect a president amenable to its demands. In 1875 General Latorre headed a conspiracy against President Ellauri and at first placed Dr Varela in power as dictator, but in 1876 proclaimed himself. In the following year Latorre caused himself to be elected president, but political unrest caused him to resign in March 1880. The president of the senate, Dr Vidal, nominally administered the government for two years, when General Santos, who had held the real power, became president. His administration was so vicious and tyrannical that the opposition organized a revolution. Their forces, however, were surprised by the government troops at Quebracho, on the Rio Negro, and defeated. Ultimately the Colorados themselves exiled Santos. He had plundered the national revenues and scorned constitutional government. The Colorados now made General Tajes president, the practical direction of the administration being in the hands of Julio Herrera y Obes. In March 1890 General Tajes handed over the presidency to Herrera y Obes, a clever but unscrupulous man, who filled every official post with his own friends and ensured the return of his supporters to the chamber. In 1891 he was obliged to suspend the service of the public debt and make arrangements by which the bondholders accepted a reduced rate of interest. The country was at this period conducted practically as if it were the private estate of the president, and no accounts of revenue or expenditure were vouchsafed to the public. In 1894 the Colorados nominated Señor Idiarte Borda for the presidency. He seemed at first inclined to govern honestly, but corruption soon became as marked as under the preceding régime. The Blancos, using the fraudulent elections in 1896 as a pretext, now broke out in armed revolt under the leadership of Aparicio Saraiva. The president made no attempt to conciliate them, and in March 1897 a body of government troops suffered a reverse. On the 25th of August 1897 Borda, after attending a Te Deum at the cathedral in Montévideo, was shot dead by a man named Arredondo, who was sentenced in 1899 to two years' imprisonment. The defence was that the murder was a political offence, and therefore not punishable as an ordinary case of assassination for personal motives.

The president of the senate, Juan Cuestas, in accordance with the constitution, assumed the duties of president of the republic. He arranged that hostilities should cease on the conditions that representation of the Blancos was allowed in Congress for certain districts where their votes were known to predominate; that a certain number of the *jefes politicos* should be nominated from the Blancos; that free pardon be extended to all who had taken part in the revolt; that a sufficient sum in money be advanced to allow the settlement of the expenses contracted by the insurgents; and that the electoral law be reformed on a basis allowing the people to take part freely in elections. Cuestas, on attempting to reform corrupt practices, was soon threatened with another revolution, and on the 10th of February 1898 he assumed dictatorial powers, dissolved the Chambers and suspended all constitutional guarantees. In the following year he resigned and was re-elected to the presidency on the 1st of March 1899. His second term was marked by premonitions of further disorder. In July 1902 a plot for his assassination was frustrated, and in 1903, on the election of José Battle to the presidency, civil war broke out. On September 3, 1904, the revolutionary general Saraiva died of wounds received in battle; and later in the year peace was declared. Claudio Williman became president in 1907. The Colorados favoured Battle as his successor, and before the elections to the chamber in November 1910 the Blancos were again in arms.

See F. Bauza, *La Dominacion Española en el Uruguay* (Montevideo, 1880); F. A. Berro, A. de Vedia and M. de Pena, *Album de la Republica Oriental del Uruguay* (Montevideo, 1882); R. L. Lomba, *La Republica Oriental del Uruguay* (Montevideo, 1884); *The Uruguay Republic, Territory and Conditions*, reprinted by order of the Consul-General of Uruguay (London, 1888); V. Arreguine, *Historia del Uruguay* (Montevideo, 1892); M. G. and E. T. Mulhall, *Handbook of the River Plata* (London, 1892); H. Roustan and C. M. de Pena, *Uruguay en la Exposicion . . . de Chicago* (Montevideo, 1893); O. Aranjo, *Compendio de la Geografia Nacional* (Montevideo, 1894); *Uruguay, its Geography, History*, &c. (Liverpool, 1897); P. F. Martin, *Through Five Republics* (London, 1905); *Anuario Estadistico* and *Anuario Demografico* (official, Montevideo); British and American *Consular Reports*; Publications, Bureau of American Republics.

URUGUAYANA, a city and river port of the state of Rio Grande do Sul, Brazil, on the left bank of the Uruguay river, 348 ft. above sea-level (at the R. R. station) and about 360 m. in a direct line W. of Porto Alegre. Pop. (1900) 13,638. A railway connects with Quarahim (47 m.) on the Uruguayan frontier, and thence by a Uruguayan line with Montevideo by way of Paysandú. The same line extends N. 62 m. to the naval station of Itaquy. A cross-country line was under construction in 1909 to Cacequy, which is in direct communication with Porto Alegre and the city of Rio Grande. The upper Uruguay is navigable from the Quarahim to the town of São Tomé, and small river steamers ply regularly between Ceibo, on the Argentine side, and the latter. Opposite Uruguayana is the Argentine town of Restauracion, or Paso los Libres. The river is 2 m. wide at this point, and 154 ft. above sea-level. Uruguayana is prettily situated on a low hill rising gently from the riverside and its low houses are surrounded by orange groves. There are large military barracks near the shore, a theatre and a custom-house. The surrounding country is chiefly pastoral, but there is a small area under vineyards, and in addition to grapes some other fruits are produced. Uruguayana was captured by a Paraguayan force under General Estigarribia on the 5th of August 1865, and was recaptured without a fight by the allied forces under General Bartolomé Mitre on the 18th of September. The Paraguayan occupation left the town partially in ruins, and it remained in a decadent condition until near the end of the century, when reviving industries in the state and a renewal of railway construction promoted its commercial activity and growth.

USAS (from the root *vas*, to shine, and cognate to Latin *Aurora* and Greek 'Ηώς,) in Hindu mythology, the goddess of dawn. She is celebrated in some twenty hymns of the Rig Veda, and is the most graceful creation of Vedic poetry. She is borne on a shining car drawn by ruddy cows or bulls. She is the daughter of the sky and the sun is her lover. She is described as "rising resplendent as from a bath, showing her charms she comes with light . . . ever shortening the ages of men she shines forth . . . she reveals the paths of men and bestows new life . . . she opens the doors of darkness as the cows their stalls." Scarcely the name of the goddess survives to-day, so completely was she associated with the Vedism long dead and gone.

See A. A. Macdonell, *Vedic Mythology* (Strassburg, 1897).

USEDOM, an island of Germany, in the Prussian province of Pomerania, lying off the Baltic coast, and separated by the Swine from the island of Wollin, which together with it divides the Stettiner Haff from the open sea. It is 31 m. in length, 13 broad and 160 sq. m. in area. The surface is generally flat (only a few sand-hills rising to any height) and is diversified by moor, fen, lakes and forest. Agriculture, cattle-rearing, fishing and other maritime pursuits are the chief occupations of the inhabitants. Swinemünde and Usedom (pop. 1700) are the chief towns, and Heringsdorf, Ahlbeck and Zinnowitz are frequented watering-places. Pop. (1900) 33,000.

See Gadebusch, *Chronik der Insel Usedom* (Anklam, 1863), and C. Müller, *Die Seebäder der Inseln Usedom und Wollin* (6th ed., Berlin, 1896).

USELIS (mod. *Usellus*), an ancient town of Sardinia, situated in the hills to the S.E. of Oristano, 900 ft. above sea-level. A bronze tablet of A.D. 158 (a *tabula patronatus*, setting forth that M. Aristius Balbinus had accepted the position of patron of the town for himself and his heirs) speaks of the place as *Colonia Julia Augusta Uselis*. From this it would seem that it had become a colony under Augustus, were it not that Pliny (*H.N.* iii. 85) asserts that Turris Libisonis was the only colony in Sardinia at his time. It may be that civic rights were obtained from Augustus (Th. Mommsen in *Corp. Inscr. Lat.* x. p. 816). The site of the ancient town is marked by the church of S. Reparata, and various antiquities have been found there. The episcopal see was transferred to Ales in the 12th century, though the old name is still officially used.

USES, in law, equitable or beneficial interests in land. In early law a man could not dispose of his estate by will nor could religious houses acquire it. As a method of evading the common law arose the practice of making feoffments to the *use* of, or upon trust for, persons other than those to whom the seisin or legal possession was delivered, to which the equitable jurisdiction of the chancellor gave effect. To remedy the abuses which it was said were occasioned by this evasion of the law was passed the famous Statute of Uses (1536), which, however, failed to accomplish its purpose. Out of this failure of the Statute of Uses arose the modern law of TRUSTS, under which heading will be found a full history of uses. See also CONVEYANCING.

USHAK, a town of Asia Minor, altitude 3160 ft. in the Kutaiah sanjak of the Brusa vilayet, situated in a fertile district, on a tributary of the Menderes, and connected with Smyrna and Konia by rail. Pop. 9000 Moslems and 2000 Christians. It is noted for its heavy pile carpets, *khali*, known as "Turkey carpets." The Oriental character of the carpets has been almost destroyed by the adoption of aniline dyes and the introduction of Western patterns. The town has a trade in valonia, cereals and opium.

USHANT (Fr. *Ouessant*), the most westerly of the islands off the coast of France, about 14 m. from the coast of Finistère, of which department it forms a canton and commune. Pop. (1906) 2761. Ushant is about 3850 acres in extent and almost entirely granitic, with steep and rugged coasts accessible only at a few points, and rendered more dangerous by the frequency of fogs. The island affords pasturage to a breed of small black sheep, and about half its area is occupied by cereals or potatoes. The male inhabitants are principally pilots and fishermen, the women working in the fields. Ushant was ravaged by the English in 1388. The lordship was made a marquisate in 1597 in favour of René de Rieux de Sourdéac, governor of Brest. In 1778 a naval action without decisive result was fought off Ushant between the English under Keppel and the French under the Count d'Orvilliers.

USHER (or USSHER), **JAMES** (1581–1656), Anglican divine and archbishop, was born in the parish of St Nicholas, Dublin, on the 4th of January 1581. He was descended from the house of Nevill, one of whose scions, accompanying John Plantagenet to Ireland in the capacity of usher in 1185, adopted his official title as a surname. James Usher was sent to a school in Dublin opened by two political agents of James VI. of Scotland, who adopted this manner of averting the suspicions of Elizabeth's government from their real object, which was to secure a party for James in Ireland in the event of the queen's death. In 1594 Usher matriculated at the newly founded university of Dublin, whose charter had just been obtained by his uncle, Henry Usher, archbishop of Armagh. He proved a diligent student, devoting much attention to controversial theology, graduated as M.A. in 1600 and became a fellow of Trinity College. On the death of his father in 1598 he resigned the family estate to his younger brother, reserving only a small rent-charge upon it for his own maintenance, and prepared to take orders. When he was but nineteen he accepted a challenge put forth by Henry Fitzsimons, a learned Jesuit, then a prisoner in Dublin, inviting discussion of Bellarmine's arguments in defence of Roman Catholicism, and acquitted himself with much distinction. In 1600 he was appointed proctor of his college and catechetical lecturer in the university, though still a layman, and was ordained deacon and priest on the same day, in 1601, while still under the canonical age, by his uncle the primate. In 1607 he became regius professor of divinity and also chancellor of St Patrick's cathedral, Dublin. He was a frequent visitor to England, and made the acquaintance of contemporary scholars like Camden, Selden, Sir Thomas Bodley and Sir Robert Cotton. In 1613 he published his first printed work, though not his first literary composition—*Gravissimae Quaestionis de Christianarum Ecclesiarum, in Occidentis praesertim partibus, ab Apostolicis temporibus ad nostram usque aetatem, continua successione et statu, Historica Explicatio*, wherein he took up the history of the Western Church from the point where Jewel had left off in his *Apology for the Church of England*, and carried it on from the 6th till past the middle of the 13th century, but never completed it. In 1615 he took part in an attempt of the Irish clergy to impose a Calvinistic confession, embodying the Lambeth Articles of 1595, upon the Irish Church, and was delated to King James in consequence. But on his next visit to England in 1619 he brought with him an attestation to his orthodoxy and high professional standing, signed by the lord deputy and the members of the privy council, which, together with his own demeanour in a private conference with the king, so influenced the latter that he nominated Usher to the vacant see of Meath, of which he was consecrated bishop in 1621. In 1622 he published a controversial *Discourse of the Religion anciently Professed by the Irish and British*, designed to show that they were in agreement with the Church of England and opposed to the Church of Rome on the points in debate between those churches. In 1623 he was made a privy councillor for Ireland, and in the same year was summoned to England by the king that he might more readily carry on a work he had already begun upon the antiquity of the British churches. While he was detained on this business the archbishop of Armagh died in January 1625, and the king at once nominated Usher to the vacant primacy; but severe illness and other causes impeded his return to Ireland until August 1626.

For many years Usher was actively employed both in the government of his diocese and in the publication of several learned works, amongst which may be specified *Emmanuel* (a treatise upon the Incarnation), published in 1638, and *Britannicarum Ecclesiarum Antiquitates*, in 1639. In 1629 he discountenanced Bishop William Bedell's proposal to revive the Irish language in the service. In 1634 he took part in the convocation which drafted the code of canons that formed the basis of Irish ecclesiastical law till the disestablishment of the Irish Church in 1869, and defeated the attempt of John Bramhall, then bishop of Derry and later his own successor in Armagh, to conform the Irish Church exactly to the doctrinal standards of the English. He put the matter on the ground of preserving the independence of the Irish Church, but the real motive at work was to maintain the Calvinistic element introduced in 1615. In 1640 he paid another visit to England on one of his usual scholarly errands, meaning to return when it was accomplished. But the rebellion of 1641 broke out while he was still at Oxford, and he never saw his native country again. He published a collection of tracts at Oxford in that year, including a defence of episcopacy and the doctrine of non-resistance. All Usher's property in Ireland was lost to him through the rebellion, except his books and some plate and furniture, but he was assigned the temporalities of the vacant see of Carlisle for his support. In 1643 he was offered a seat in the Assembly of Divines at Westminster, but declined it publicly in terms which drew upon him the anger of the House of Commons, and an order for the confiscation of his library was averted only by the interposition of Selden. He quitted Oxford in 1645 and went into Wales, where he remained till 1646, when he returned to London, and was in 1647 elected preacher to the Society of Lincoln's Inn, an office which he continued to hold until near his death. During his residence in Wales a hyper-Calvinistic work entitled *A Body of Divinity; or the Sum and Substance of the Christian Religion*, was published under his name by John Downham; and, although he repudiated the authorship in a letter to the editor, stating that the manuscript from which it was printed was merely a commonplace-book into which he had transcribed the opinions of Cartwright and other English divines, often disapproving of them and finding them dissonant from his own judgment, yet it has been persistently cited ever since as Usher's genuine work, and as lending his authority to positions which he had long abandoned, if he ever maintained them. In 1648 he had a conference with Charles I. in the Isle of Wight, assisting him in the abortive negotiations with parliament on the question of episcopacy. About this time Richelieu offered him a pension. In 1650–54 he published the work which was long accounted his most important production, the *Annales Veteris et Novi Testamenti*, in which he propounded a now disproved scheme of Biblical chronology, whose dates were inserted by some unknown authority in the margin of reference editions of the Authorized Version. In 1655 Usher published his last work, *De Graeca LXX Interpretum Versione Syntagma*. He died on the 20th of March 1656, in Lady Peterborough's house at Reigate, and was buried in Westminster Abbey. He was long remembered, not only for his great learning but for his modesty and kindly disposition. His daughter sold his library to the state, and in 1661 it was placed in the library of Trinity College, Dublin, of which it still forms a part.

Usher's works are very numerous, and were first collected by C. R. Elrington and J. H. Todd, Dublin (1847–64, in 17 vols.). See *Life* by Carr (1895); W. B. Wright, *The Ussher Memoirs* (1889).

USHER (O. Fr. *ussier*, *uissier*, mod. *huissier*, from Lat. *ostiarius*, a door-keeper, *ostium*, doorway, entrance, *os*, mouth), properly an official or servant who guards the entrance to a building, admits those who have the right of admission and keeps out strangers; such functions as the introduction of those who are admitted, the conducting them to their seats or to the presence of the persons receiving them and the keeping of order and silence are also performed by them. The "ushers" of a law-court are familiar officials of this kind. The name is also applied to various members of the British royal household, in which there are several "gentlemen-ushers." The four principal British orders of knighthood style one of their chief officers "usher"; thus there is a gentleman-usher of the Black Rod, who is also one of the high officials of the House of Lords (see further, BLACK ROD, and KNIGHTHOOD AND CHIVALRY, § *Orders of Knighthood*). A common usage of the word, now obsolescent, is for an undermaster at a school.

USK, THOMAS (d. 1388), the author of *The Testament of Love*, was born in London. His name was first added to the history of English literature in 1897 by Mr Henry Bradley's discovery that *The Testament of Love*, an important prose work hitherto attributed to Chaucer, bore in the initial letters of its chapters a statement of authorship—"Margarete of virtw, have merci on thin Usk." By the light of this perception, various autobiographical statements became luminous, and there remained no possible doubt that the author was Thomas Usk, who was clerk of the closet to John of Northampton when he was mayor of London from 1381 to 1383. In July 1384 Usk was seized and put in prison, but was released on promise of bringing charges against the mayor. Usk had no wish to be what he called "a stinking martyr," and he freely produced evidence which sent John of Northampton to gaol. For this he was not forgiven by the duke of Gloucester's party, although he continued to hold confidential posts in London until the close of 1386, when he was appointed sub-sheriff of Middlesex. But he fell with the king, in the triumph of the duke of Gloucester, and on the 3rd of February 1388 Usk, among others, was tried for treason and condemned. He was sentenced "to be drawn, hung and beheaded, and that his head should be set up over Newgate." John of Malvern, in his continuation of Ralph Higden's *Polychronicon*,[1] gives a horrid description of his execution, which occurred on the 4th of March 1388, in circumstances of rude barbarity; it took thirty blows of a sword to sever Usk's head from his shoulders. Professor Skeat has shown that the date of his book must be about 1387, for in it he reviews the incidents of his career, including the odd facts that, after his first imprisonment in 1384, he challenged any one who "contraried" his "saws"—that is to say, denied his allegations—to fight, but that no one took up his wager of battle. From 1381 to 1383, while Chaucer was comptroller of customs, Usk was collector, and they were doubtless acquainted. In *The Testament of Love*, the god is made to praise "mine own true servant, the noble philosophical poet in English," who had composed "a treatise of my servant Troilus." Usk had at one time been a Lollard, but in prison he submitted to the Church and thought he was forgiven. His solitary work is remarkable, and the most elaborate production in original English prose which the end of the 14th century has bequeathed to us. It is, however, excessively tedious, and of its obscurity and dullness a very amusing proof is given by the fact that successive editors—and even Dr Henry Bradley and Professor Skeat—did not discover till too late that the leaves of the original MS. had been shuffled and the body of the treatise misarranged. No MS. of *The Testament of Love* has been preserved; it was first printed by W. Thynne in his edition of *Chaucer*, 1532. In 1897 Professor Skeat, with cancelled sheets to cover the unlucky mistake above referred to, issued a revised and annotated text in his *Chaucerian and other Pieces*.

(E. G.)

USK, a river of Wales and England, rising on the borders of Carmarthenshire and Brecknockshire, and flowing to the Bristol Channel with a course of 70 m., and a drainage area of 540 sq. m. The source lies at an elevation of 1700 ft. on the north flank of Carmarthen Van, a summit of the Brecon Beacons; and the course is at first northerly, but soon turns east through a beautiful valley closely beset with lofty hills. The river passes the finely situated town of Brecon, and then turns south-east past Crickhowell and south past Abergavenny. Between these towns it forms a short stretch of the Welsh boundary before entering England (Monmouthshire). The valley now broadens, and the course of the river becomes sinuous as it flows by the ancient towns of Usk and Caerleon. The scenery throughout is most beautiful. Not far from the mouth lies Newport, with its extensive docks, to which the estuary gives access. Except in this part, the Usk is not used for navigation, but the Monmouthshire and Brecon and Abergavenny canals, in part following the valley, carry a small trade up to Brecon. The Usk is noted for its salmon and trout fishing.

USK, a small market town, is beautifully situated on the right bank of the Usk river, 10 m. N.N.E. of Newport. Pop. of urban district (1901), 1476. It unites with Newport and Monmouth to form the Monmouth parliamentary district of boroughs, returning one member. It is of high antiquity, occupying the site of a Roman-British village or fort; and there are picturesque ruins of an ancient castle erected in defence of the Welsh marches, and as such, a scene of frequent strife from Norman times until the days of the warlike Owen Glendower, about 1400. The church of St Mary originally belonged to a Benedictine nunnery of the 12th century.

USKOKS, or USCOCS. During the early years of the 16th century, the Turkish conquest of Bosnia and Herzegovina drove large numbers of the Christian inhabitants from their homes. A body of these *Uskoks*, as they were called, from a Serbo-Croatian word meaning "refugee," established itself in the Dalmatian fortress of Clissa, near Spalato, and thence waged continual war upon the Turks. Clissa, however, became untenable, and the Uskoks withdrew to Zengg, on the Croatian coast, where, in accordance with the Austrian system of planting colonies of defenders along the Military Frontier, they were welcomed by the Emperor Ferdinand I., and promised an annual subsidy in return for their services. Their new stronghold, screened by mountains and forests, was unassailable by cavalry or artillery, but admirably suited to the light-armed Uskoks, whose excellence lay in guerilla warfare. The Turks, on their side, organized a body of equally effective troops called *Martelossi*, for defence and reprisals. Thus, checked on land, and with their subsidy rarely paid, the Uskoks turned to piracy. Large galleys could not anchor in the bay of Zengg, which is shallow and exposed to sudden gales, so the Uskoks fitted out a fleet of swift boats, light enough to navigate the smallest creeks and inlets of the Illyrian shore, and easily sunk and recovered, if a temporary landing became necessary. With these they preyed upon the commerce of the Adriatic. Their ranks were soon swelled by outlaws from all nations, and by their own once peaceful neighbours, from Novi, Ottočac and other Croatian towns. After 1540, however, Venice, as mistress of the seas, guaranteed the safety of Turkish merchant vessels, and provided them with an escort of galleys. The Uskoks retaliated by ravaging the Venetian islands of Veglia, Arbe and Pago, and by using the Venetian territories in Dalmatia as an avenue of attack upon the Turks. Meanwhile the corsairs of Greece and Africa were free to raid the unprotected southern shores of Italy; and Venice was besieged with complaints from the Porte, the Vatican, the Viceroy of Naples and his sovereign, the king of Spain. An appeal to Austria met with little success, for the offences of the Uskoks were outweighed by their services against the Turks; while, if Minucci may be trusted, a share of their spoils, in silk, velvet and jewels, went to the ladies of the Archducal Court of Graz, where the matter was negotiated. From 1577 onwards, Venice endeavoured to crush the pirates without offending Austria, enlisting Albanians in place of their Dalmatian crews, who feared reprisals at home. For a time the Uskoks only ventured forth by night, in winter and stormy weather. In 1592 a Turkish army invaded Croatia, hoping to capture Zengg, but it was routed and dispersed in the following year. Austria being thus involved in war with Turkey, the Venetian Admiral Giovanni Bembo blockaded Trieste and Fiume, whither the pirates forwarded their booty for sale. They also erected two forts to command the passages from Zengg to the open sea. In 1602 a raid by the Uskoks upon Istria resulted in an agreement between Venice and Austria, and the despatch to Zengg of the energetic commissioner Rabatta with a strong bodyguard. All these measures, however, availed little. Rabatta was murdered, the fugitive Uskoks returned to Zengg and piracy was resumed, with varying fortunes, until 1615, when a grosser outrage than usual led to open war between Venice and Austria. By the treaty of peace concluded at Madrid, in 1617, it was arranged that the Uskoks should be disbanded, and their ships destroyed. The pirates and their families were, accordingly, transported to the interior of Croatia, where they gave their name to the *Uskoken Gebirge*, a group of mountains on the borders of Carniola. Their presence has also been traced near Monte Maggiore, in Istria, where such significant family names as *Novlian* (from Novi), *Ottocian* (from Ottočac) and *Clissan* (from Clissa), were noted by Franceschi in 1879.

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[1] Ed. J. R. Lumby, Rolls Series (1886), vol. ix. p. 147.

See Minuccio Minucci, *Historia degli Uscochi* (Venice, 1603); enlarged by P. Sarpi, and translated into French as a supplement to Amelot de la Houssaye's *Histoire du gouvernement de Venise* (Amsterdam, 1705). Minucci was one of the Venetian envoys at Graz. See also the conciser narratives in C. de Franceschi's *L'Istria*, chap. 37 (Parenzo, 1879); and T. G. Jackson's *Dalmatia, the Quarnero and Istria*, chap. 27 (Oxford, 1887).

USKÜB, USCUP, or SKOPIA (anc. *Scupi*, Turk. *Üshküb*, Slav. *Skoplye*), the capital of the vilayet of Kossovo, European Turkey; on the left bank of the river Vardar, and at the junction of the railways from Nish and Mitrovitza to Salonica. Pop. (1905) about 32,000, consisting chiefly of Slavs (Serbs and Bulgars), Turks, Albanians and a few gipsies. Usküb occupies a picturesque and strategically important position at the foot of a valley which severs two mountain ranges, the Shar Planina and Kara Dagh. Main roads radiate N.W. to Prizren, W. to Gostivar, an important centre of distribution, E.N.E. to Kumanovo, and thence into Bulgaria, and S. to Koprülü and Monastir. The city is the headquarters of an army corps, and the see of an Orthodox Greek archbishop, of the archbishop of the Roman Catholic Albanians and of a Bulgarian bishop. Its principal buildings are the citadel, the palace of the vali or provincial governor, the Greek and Bulgarian schools, numerous churches and mosques and a Roman aqueduct. The industries include dyeing, weaving, tanning and the manufacture of metal-work, wine and flour, but Usküb is chiefly important as the commercial centre of the whole vilayet of Kossovo (*q.v.*). The Imperial Ottoman Bank and the Banque de Salonique have branches in the city, and French is to a remarkable extent the language of commerce. Usküb retains in a modified form the name of Scupi, one of the chief cities of northern Macedonia. A few unimportant ruins mark the ancient site, about 1½ m. N.W. Scupi was destroyed by an earthquake in A.D. 518, but was rebuilt by Justinian under the name of Justiniana Prima. Up to the 14th century it was at times the capital of the Servian tsars.

USTARANA, a Pathan tribe who inhabit the outer hills opposite the extreme south portion of Dera Ismail Khan district in the North-West Frontier Province of India. Originally the Ustaranas were entirely a pastoral and trading tribe; but a quarrel with their neighbours, the Musa Khel, put a stop to their annual westward immigration, and they were forced to take to agriculture, and have since acquired a good deal of the plain country below the hills. Their territory includes only the eastern slopes of the Suliman mountains, the crest of the range being held by the Musa Khel, Isots and Zmarais (see SULIMAN HILLS). The Ustaranas are venturesome traders, carrying goods from Kandahar as far as Bengal. They are a fine manly race, quiet and well-behaved, and many of them enlist in the Indian army and police.

USTICA, an island off the N. coast of Sicily, 41½ m. N.N.W. of Palermo. Pop. (1861) 2231; (1901) 1916. It is the Osteodes of the Greeks, but in Roman times was known as Ustica. The island is entirely volcanic and subject to earthquakes, and is fertile. There is a considerable penal colony. There are some Roman tombs excavated in the rock.

USTYUG VELIKIY, a town of Russia, in the government of Vologda, 216 m. N.E. from the city of Vologda, on the navigable Sukhona river, near its confluence with the Yug. Pop. (1885) 8119; (1897) 11,309. It manufactures hosiery, woollens and linens, has sawmills, and carries on an active trade in corn, hemp, flax, bristles and butter, which it exports. It has two important yearly fairs. Its artisans are famous for their jewelry, for engraving upon silver and the fabrication of boxes with secret locks.

USURY. An ancient legal conception, it has been said, corresponds not to one but to several modern conceptions; and the proposition is equally true when economic is substituted for legal. Until quite recent times the term "usury" (Lat. *usura*, use, enjoyment, interest, from *usus*, use) covered a number of essentially different social phenomena. "Thou shalt not lend upon usury to thy brother; usury of money, usury of victuals, usury of anything that is lent upon usury. Unto a stranger thou mayest lend upon usury; but unto thy brother thou shalt not lend upon usury, that the Lord thy God may bless thee" (Deut. xxiii. 19, 20). In this sentence we find interest of all kinds blended together, and the natural economic tendencies directly counteracted by the moral and religious law. At the present day, "usury," if used in the old sense of the term, would embrace a multitude of modes of receiving interest upon capital to which not the slightest moral taint is attached.

The man who does not in some shape or other lend his capital upon "usury" is, in the modern world, generally considered as lacking in his duty to himself or his family. The change in the moral attitude towards usury is perhaps best expressed by saying that in ancient times so much of the lending at interest was associated with cruelty and hardship that all lending was branded as immoral (or all interest was usury in the moral sense), whilst at present so little lending takes place, comparatively, except on commercial principles, that all lending is regarded as free from an immoral taint. This change in the attitude of common-sense morality in respect to "anything that is lent upon usury" is one of the most peculiar and instructive features in the economic progress of society.

"It is worthy of remark," says Grote (*History of Greece*, iii. 144), "that the first borrowers must have been for the most part men driven to this necessity by the pressure of want, and contracting debt as a desperate resource without any fair prospect of ability to pay; debt and famine run together in the mind of the poet Hesiod. The borrower is in this unhappy state rather a distressed man soliciting aid than a solvent man capable of making and fulfilling a contract; and if he cannot find a friend to make a free gift to him in the former character he would not under the latter character obtain a loan from a stranger except by the promise of exorbitant interest and by the fullest eventual power over his person which he is in a position to grant." This remark, though suggested by the state of society in ancient Greece, is largely applicable throughout the world until the close of the early middle ages. Borrowers were not induced to borrow as a rule with the view of employing the capital so obtained at a greater profit, but they were compelled of necessity to borrow as a last resort. The conditions of ancient usury find a graphic illustration in the account of the building of the second temple at Jerusalem (Neh. v. 1–12). The reasons for borrowing are famine and tribute. Some said, "We have mortgaged our lands, vineyards and houses, that we might buy corn, because of the dearth." Others said, "We have borrowed money for the king's tribute, and that upon our lands and vineyards ... and, lo, we bring into bondage our sons and our daughters to be servants, ... neither is it in our power to redeem them, for other men have our lands and vineyards." In ancient Greece we find similar examples of the evil effects of usury, and a law of bankruptcy resting on slavery. In Athens about the time of Solon's legislation (594 B.C.) the bulk of the population, who had originally been small proprietors or metayers, became gradually indebted to the rich to such an extent that they were practically slaves. Those who still kept their property nominally were in the position of Irish cottiers: they owed more than they could pay, and stone pillars erected on their land showed the amount of the debts and the names of the lenders. Usury had given all the power of the state to a small plutocracy. The remedy which Solon adopted was of a kind that we are accustomed to consider as purely modern. In the first place, it is true that according to ancient practice he proclaimed a general *seisachtheia*, or shaking off of burdens: he cancelled all the debts made on the security of the land or the person of the debtor. This measure alone would, however, have been of little service had he not at the same time enacted that henceforth no loans could be made on the bodily security of the debtor, and the creditor was confined to a share of the property. The consequence of this simple but effective reform was that Athens was never again disturbed by the agitation of insolvent debtors. Solon left the rate of interest to be determined by free contract, and sometimes the rate was exceedingly high, but none of the evils so generally prevalent in antiquity were experienced.

When we turn to Rome, we find exactly the same difficulties arising, but they were never successfully met. As in Athens in early times, the mass of the people were yeomen, living on their own small estates, and in time they became hopelessly in debt. Accordingly, the legislation of the XII. Tables, about 500 B.C., was intended to strike at the evil by providing a maximum rate of interest. Unfortunately, however, no alteration was made in the law of debt, and the attempt to regulate the rate of interest utterly failed. In the course of two or three centuries the small free farmers were utterly destroyed. By the pressure of war and taxes they were all driven into debt, and debt ended practically, if not technically, in slavery. It would be difficult to overestimate the importance of the influence of usury on the social and economic history of the Roman republic. In the provinces the evils of the system reached a much greater height. In 84 B.C. the war tax imposed by Sulla on the province of Asia was at first advanced by Roman capitalists, and rose within fourteen years to six times its original amount. It is interesting to observe that the old law of debt was not really abolished until the dictatorship of Julius Caesar, who practically adopted the legislation of Solon more than five centuries before; but it was too late then to save the middle class. About this time the rate of interest on first-class security in the city of Rome was only about 4%, whilst in the provinces from 25 to 50% were rates often exacted. Justinian made the accumulation of arrears (*anatocismus*) illegal, and fixed the rate at 6%, except for mercantile loans, in which the rate received was 8%. On the whole, it was truly said of usury during the republic and early years of the empire: "Sed vetus urbi faenebre malum et seditionum discordiarumque creberrima causa." Even when it came to be authorized by Roman law under certain restrictions, it was still looked upon as a pernicious crime. "Cicero mentions that Cato, being asked what he thought of usury, made no other answer to the question than by asking the person who spoke to him what he thought of murder."

It was only natural, considering the evils produced by usury in ancient Greece and Rome, that philosophers should have tried to give an a priori explanation of these abuses. The opinion of Aristotle on the barrenness of money became proverbial, and was quoted with approval throughout the middle ages. This condemnation by the moralists was enforced by the Fathers of the church on the conversion of the empire to Christianity. They held usury up to detestation, and practically made no distinction between interest on equitable moderate terms and what we now term usurious exactions.[1] The consequence of the condemnation of usury by the church was to throw all the dealing in money in the early middle ages into the hands of the Jews. A full account of the mode in which this traffic was conducted in England is given by Madox in chapter vii. of his *History of the Exchequer* (London, 1711). The Jews were considered as deriving all their privileges from the hand of the king, and every privilege was dearly bought. There can be no doubt that they were subjected to most arbitrary exactions. At the same time, however, their dealings were nominally under the supervision of the Jews' exchequer, and a number of regulations were enforced, partly with the view of protecting borrowers and partly that the king might know how much his Jews could afford to pay. It was probably mainly on account of this money-lending that the Jews were so heartily detested and liable to such gross ill-treatment by the people. A curious illustration of this popular animosity is found in the insertion of a clause in the charters granted by Henry III. to Newcastle and Derby, forbidding any Jew to reside in either place. Ultimately in 1290 the Jews were expelled in a body from the kingdom under circumstances of great barbarity, and were not allowed to return until the time of Cromwell. Before the expulsion of the Jews, however, in spite of canonical opposition, Christians had begun to take interest openly; and one of the most interesting examples of the adaptation of the dogmas of the Church of Rome to the social and economic environment is found in the growth of the recognized exceptions to usury. In this respect the canonical writers derived much assistance from the later Roman law. Without entering into technicalities, it may be said generally that an attempt was made to distinguish between usury, in the modern sense of unjust exaction, and interest on capital. Unfortunately, however, the modifications which were really admitted were not openly and avowedly made by a direct change in the statutes, but for the most part they were effected (as so many early reforms) under the cover of ingenious legal fictions. One of the most curious and instructive results of this treatment has been well brought out by Walter Ross in the introduction to his *Lectures on the Law of Scotland* (1793). He shows, in a very remarkable manner and at considerable length, that "to the devices fallen upon to defeat those laws (*i.e.* against usury) the greatest part of the deeds now in use both in England and Scotland owe their original forms" (i. 4). One of the consequences of this indirect method of reforming the law was that in some cases the evil was much exaggerated. "The judges," says Ross, "could not award interest for the money; that would have been contrary to law, a moral evil, and an oppression of the debtor; but, upon the idea of damages and the failure of the debtor in performance, they unmercifully decreed for double the sum borrowed." He may well remark that imagination itself is incapable of conceiving a higher degree of inconsistency in the affairs of men (compare Blackstone, iii. 434, 435).

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[1] For a popular account of the reasons given in support of the canonical objections to usury, and of the modifications and exceptions admitted in some quarters, see W. Cunningham's *Usury*.

In the limits assigned to this article it is impossible to enter further into the history of the question (see also MONEYLENDING), but an attempt may be made to summarize the principal results so far as they bear upon the old controversy, which has again been revived in some quarters, as to the proper relation of law to usury and interest. (1) The opinion of Bentham that the attempt directly to suppress usury (in the modern sense) will only increase the evil is abundantly verified. Mere prohibition under penalties will practically lead to an additional charge as security against risk. The evils must be partly met by the general principles applicable to all contracts (the fitness of the contracting parties, &c.) and partly by provisions for bankruptcy. Peculiar forms of the evil, such as mortgaging to excessive amounts in countries largely occupied by peasant proprietors, may be met by particular measures, as, for example, by forbidding the accumulation of arrears. (2) The attempt to control interest in the commercial sense is both useless and harmful. It is certain to be met by fictitious devices which at the best will cause needless inconvenience to the contracting parties; restraints will be placed on the natural flow of capital, and industry will suffer. (3) In the progress of society borrowing for commercial purposes has gradually become of overwhelming importance compared with borrowing for purposes of necessity, as in earlier times. By far the greater part of the interest now paid in the civilized world is, in the language of the English economists, only a fair reward for risk of loss and for management of capital, and a necessary stimulus to saving.

See *Capital and Interest* (Eng. trans., 1890), by E. Boehm von Bawerk; *Nature of Capital and Income*, by Irving Fisher (1906).

(J. S. N.)

UTAH,[1] one of the Central Western states of the United States of America. It lies between latitudes 37° and 42° N. and between longitudes 32° and 37° W. from Washington (*i.e.* about 109° 1′ 34″ and 114° 1′ 34″ respectively W. of Greenwich). The state is bounded wholly by meridians and parallels, and is bordered on the N. by Idaho and Wyoming, on the E. by Wyoming and Colorado, on the S. by Arizona, and on the W. by Nevada. Utah has an area of 84,990 sq. m., of which 2806 sq. m. are water surface, including Great Salt, Utah and other lakes. The state has a maximum length of 345 m. N. and S., and a maximum width of about 280 m. E. and W.

Physical Features.—The eastern portion of Utah consists of high plateaus, and constitutes a part of the Colorado Plateau province. The remaining western portion of the state is lower, belongs in the Great Basin province, and is characterized by north-south mountain ranges separated by desert basins. The high plateaus consist of great blocks of the earth's crust which are separated from each other by fault-lines, and which have been uplifted to different heights. Erosion has developed deep and sometimes broad valleys along the fault-lines and elsewhere, so that many of the blocks and portions of blocks are isolated from their neighbours. As a rule the blocks have not been greatly tilted or deformed, but consist of nearly horizontal layers of sandstone, shales and limestone. In some cases these sedimentary rocks lie deeply buried under lavas poured out by volcanoes long extinct. The plateau summits rise to elevations of 9000, 10,000 and 11,000 ft., are generally forested, but are too difficult of access to be much inhabited. The people live along the streams in the valleys between the plateaus. In the southern part of the state the high plateaus are terminated by a series of giant terraces which descend to the general level of the Grand Canyon Platform in northern Arizona. The terraces represent the out-cropping edges of hard sandstone layers included in the series of plateau sediments, and are named according to the colour of the rock exposed in the south-facing escarpments, the Pink Cliffs (highest), White Cliffs and Vermilion Cliffs. A still lower terrace, terminating in the Shinarump Cliffs, is less conspicuous; but the higher ones afford magnificent scenery. The northernmost member of the high plateaus is a broad east-west trending arch known as the Uinta Mountains. Local glaciation has carved the higher levels of this range into a maze of amphitheatres containing lakes, separated from each other by *arêtes* and alpine peaks. Among the peaks are King's Peaks (13,498 ft. and 13,496 ft.), the highest points in the state; Mt. Emmons (13,428 ft.); Gilbert Peak (13,422 ft.); Mt. Lovenia (13,250 ft.); and Tokewanna Peak (13,200 ft.). In the south-eastern part of the state are lower desert plateaus, and several mountain groups which do not properly belong to the plateau system. Most interesting among these are the Henry Mountains, formed by the intrusion of molten igneous rock between the layers of sediments, causing the overlying layers to arch up into dome mountains. Stream erosion has dissected these domes far enough to reveal the core of the igneous rock and to give a rugged topography. The highest peaks exceed 11,000 ft. By far the greater part of the high plateau district is drained by the Colorado river and its branches, the most important of which are the Green, Grand and San Juan, portions of whose courses lie in canyons of remarkable grandeur. The western members of the high plateaus drain into the Great Basin for the most part, and in this drainage system the Sevier river is perhaps most prominent. Inasmuch as the streams entering the basin have no outlet to the ocean, their waters disappear by evaporation, either directly from alluvial slopes over which they pass, or from saline lakes occupying depressions between the mountain ranges.

The lower basin portion of Utah is separated from the high plateaus by a series of great fault scarps, by which one descends abruptly to a level of but 5000 or 6000 ft. One of the fault scarps is known as the Hurricane Ledge, and continues as a prominent landmark from a point south of the Grand Canyon in Arizona to the central part of Utah, where it is replaced by other scarps farther east. The floor of the Basin Region is formed of alluvium washed from the high plateaus and mountain ranges, a part of which has accumulated in alluvial fans, and part in the greatly expanded lakes which existed here in the glacial period. This alluvium gives gently sloping or level desert plains, from which isolated mountain ranges rise like islands from the sea. The barren "mud flats," frequently found on the desert floor, result from the drying up of temporary shallow lakes, or playas. Lake Bonneville is the name given to the most important of the much greater lakes of the glacial period, whose old shore-lines are plainly visible on many mountain slopes. Great Salt Lake (*q.v.*) is a shrunken remnant of Lake Bonneville. The mountain ranges of the Basin Region are most frequently formed by faulted and tilted blocks of the earth's crust, which have been carved by stream erosion into rugged shapes. Oquirrh, Tintic, Beaver, House and Mineral Mountains are typical examples of these north-south "basin ranges," which rise abruptly from the desert plains and are themselves partial deserts. The Wasatch Mountain range constitutes the eastern margin of the Great Basin in central and northern Utah, and resembles the true basin ranges in that it is formed by a great block of the earth's crust uptilted along a north-south fault-line. Its steep fault scarp faces west, and rises from 4000 to 6000 ft. above the basin floor; the eastern slope is more gentle, but both slopes are much scored by deep canyons, some of which have been modified in form by ancient glaciers. Among the highest summits are Timpanogos Peak (11,957 ft.), Mt. Nebo (11,887 ft.), Twin Peak (11,563 ft.), and Lone Peak (11,295 ft.). At the western base of the Wasatch are Salt Lake City, Ogden, Provo and other smaller towns, situated where streams issue from the mountains, soon to disappear on the desert plains. In such places agriculture is made possible by irrigation, and the Mormon villages, both here and farther south along the base of the Hurricane Ledge, depend largely on this industry. Important mining operations are carried on in the Wasatch Mountains and in a number of the basin ranges. Mercur, Tintic, Bingham and Park City are well-known mining centres.

Fauna.—In the open country the mule deer, the pronghorn antelope and the coyote are found, and the bison formerly ranged over the north-eastern part of the state; the side-striped ground-squirrel, Townsend's spermophile, the desert pack-rat and the desert pack-rabbit inhabit the flat country. In the mountainous districts and high plateaus are the grizzly, formerly more common, the black bear, the four-striped chipmunk and the yellow-haired porcupine. Various species of small native mice and voles are abundant.

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[1] The name is that of a Shoshonean Indian tribe, more commonly called Ute.

In the marshes of the Salt Lake breed grebes, gulls and terns, and formerly the white pelican. Many ducks breed here, and many others pass through in migration: of the former, the most numerous are mallard and teal; of the latter, pintail, shoveler, scaup, ring-neck ducks, and mergansers. Wood and glossy ibises are commonly seen, and the white ibis breeds in numbers; the sand-hill crane is less common than formerly. A few varieties of shore birds breed here, as the Western willet, the Bartramian sandpiper, and the long-billed curlew. Gambel's partridge is resident in the southern part of the state, and the sage-hen and sharp-tail grouse on the plains. The dusky grouse and grey ruffed grouse are confined to the mountains and plateaus. The California vulture is very rare; various species of hawks and golden and bald eagles are common. The burrowing owl is found on the plains, and various species of small birds are characteristic of the different physical divisions of the state. A few lizards are found in the arid districts. The trout of the Utah mountain streams is considered a distinct species.

Flora.—Western Utah and vast areas along the Colorado river in the east and south-east are practically treeless. The lower plateaus and many of the basin ranges, as well as the basins themselves, are deserts. The higher plateaus, the Uinta and Wasatch mountains, bear forests of fir, spruce and pine, and the lower slopes are dotted with piñon, juniper, and scrub cedar. On the slopes of mountain valleys grow cedars, dwarf maples and occasional oaks. Willows and cottonwoods grow along streams. The west slope of the Wasatch has been largely denuded of its forests to supply the demands of the towns at its base. Among other plants common to the state are the elder, wild hop, dwarf sunflower, and several species of greasewood and cacti. The sagebrush, artemisia, is characteristic of the desert areas. Bunch grass is abundant on the hillsides the year round, and affords valuable pasturage.

Climate.—On account of its great diversity in topography, the state of Utah is characterized by a wide range in climatic conditions. Extremely cold weather may occur on the lofty plateaus and mountain ranges, while the intervening valleys and basins have a milder climate. The mean temperature of the state ranges from 58° in the extreme south to 42° in the north. Winter temperatures as low as 36° below zero are known for the higher altitudes; in the south, summer temperatures of 110° and higher have been recorded. At Salt Lake City the mean winter temperature is 31°, the mean summer temperature 73°. Corresponding figures for St George, in the south-western part of the state, are 38° and 80°. In general Utah may be said to have a true continental climate, although the presence of Great Salt Lake has a modifying effect on the climate of that portion of the Basin Region in which it lies. Killing frosts occur early in September and as late as the last of May, and in the higher valleys they may occur at any time. The mean annual precipitation is only 11 in., the greater part of which occurs in the form of snow in the winter months, summer being the dry season. At Salt Lake City the annual precipitation is 15.8 in., of which 2 in. fall in summer. For St George the figures are: annual precipitation, 6.6 in.; summer, 1.3 in. Both Salt Lake City and St George are near the boundary between the Basin Region and the high plateaus. Well out in the basin deserts the precipitation is still less; and the same holds true for the low desert plateaus in the south-eastern part of the state, where Hite has an annual precipitation of only 2.3 in., of which 0.4 in. falls in the summer. On the other hand, the precipitation on the high plateaus probably exceeds 30 in. in places. In the inhabited parts of the state, irrigation is generally necessary for agriculture.

Soil.—The alluvium of the desert basins furnisnes much good soil, which produces abundant crops where irrigated. Alkali soils are also common in the basins, but when water is available they can often be washed out and made productive. Very rich floodplain soils occur along the larger streams. Vast areas of unreclaimable desert exist in the west and south-east. In the protected valleys between the high plateaus alluvial soils are cultivated; but the plateau summits are relatively inaccessible, and, being subject to summer frosts, are not cultivated. Comparatively poor, sandy soil is found on the lower desert plateaus in the south-east, where population is scanty.

Forests.—The forest resources of Utah are of little value: the total wooded area was about 10,000 sq. m. in 1900, or about 12½ % of the land area of the state. The only timber of commercial importance is found in the Uinta Range in the north-eastern corner of the state, and is chiefly yellow pine. The timber of the Wasatch Range is small and scattering. In 1910 there were in the state fourteen national forests varying in size from 1,250,610 acres (the Uinta reserve), 947,490 acres (the Ashley reserve), and 786,080 acres (the Manti reserve), down to the smallest Pocatello (10,720) on the Idaho border. The total area of these reserves was 7,436,327 acres.

Irrigation.—Under the Federal Reclamation Fund, established in 1902, $830,000 was allotted to Utah in 1902–9, and $200,000 more in 1910, for the development of the Strawberry Valley project. This project, which was about one-third completed in the beginning of 1910, provides for the irrigation in Strawberry Valley (Utah and Wasatch counties, S. of Provo), of 60,000 acres, by a 6800-acre reservoir of 110,000 acre-feet capacity, on Strawberry river; by a tunnel, 19,000 ft. long, connecting the reservoir with Diamond Fork, a tributary of Spanish Fork river; by a storage dam, 50 ft. high, of 60,000 cub. yds. contents, diverting water from Spanish Fork river into two canals, one on each side of the river, for the irrigation of land in the valley of Utah lake; by a hydro-electric power plant about 3 m. below the diversion dam; and by the enlargement of existing canal systems. The diversion dam, the power canal, and the first unit of the power plant were completed in 1909. Irrigation of the arid western regions of the United States began in the Great Basin of Utah when the Mormon pioneers in 1847 diverted the waters of City Creek upon the parched soil of Salt Lake Valley. In 1900 nearly 90 % of the land reclaimed by irrigation in the whole state lay within the Great Basin. Between 1889 and 1899 the number of irrigators in the state (exclusive of Indian reservations) increased from 9724 to 17,924, or 84.3 %, and the number of acres irrigated from 263,473 to 629,293, or 138.8 %. In 1900, of the total improved acreage (1,029,226 acres) 61.2 % (629,293 acres) was irrigated; and in 1899, of the 686,374 acres in crops, 537,588 acres, or 78.3 %.

Agriculture.—The number of farms in Utah (not including those of less than 3 acres and of small productivity) in 1880 was 9452, in 1890, 10,517; and in 1900, 19,007. their average size in 1880 was 69.4 acres; in 1890, 125.9 acres, and in 1900, 216.6 acres. The total number of all farms in the state in 1900 was 19,387; and the number of white farmers, 19,144. The greatest number of farms were between 100 acres and 500 acres—1916 in 1880, and 5565 in 1900. Other holdings were as follows: between 20 acres and 50 acres, 3688 in 1880, and 5261 in 1900; between 50 acres and 100 acres, 2056 in 1880 and 3741 in 1900; less than 10 acres, 434 in 1880 and 1622 in 1900; 1000 acres and more, 9 in 1880 and 248 in 1900. The proportion of farms operated by owners decreased from 95.4 % (9019 farms) in 1880 to 91.2 % (17,674 farms) in 1900; those operated by cash tenants increased from 0.6 % (60 farms) in 1880 to 2.6 % (506 farms) in 1900, and those operated by share tenants from 4 % (373 farms) in 1880 to 6.2 % (1207 farms) in 1900. The total area of farms increased from 655,524 acres in 1880 to 4,116,951 acres in 1900, but the proportion of improved land decreased from 63.5 % (416,105 acres) in 1880 to 25.1 % (1,032,117 acres) in 1900, indicating the great increase in land used for grazing.

The value of farm property, including land with improvements, implements and machinery, and live-stock was $19,333,569 in 1880 and $75,175,141 in 1900; the average value per farm was $2045 in 1880 and $3878 in 1900; and the average value per acre of farm land was $29.49 in 1880 and $18.26 in 1900. The value of all farm products was $3,337,410 in 1879 and $16,502,051 in 1899, and the amount expended for fertilizers increased only from $11,394 to $14,300.

In 1899 hay and grain furnished the principal income from 35.4 % of all farms in the state, and live-stock from 28.1 % of all farms. In 1899, 255,699 acres, or 37.3 % of the acreage of all crops, was sown to cereals, which were valued at $2,386,789, or 29 % of the value of all crops. The production of cereals (which grow chiefly in the northern counties of the state) was 130,842 bu. in 1849, 770,287 bu. in 1869, 2,395,744 bu. in 1889, and 5,381,125 bu. in 1899. The principal cereal was wheat, the value of which was $1,575,064 (3,413,470 bu.) in 1899, and $5,481,000 (6,090,000 bu.) in 1909.[1] The value and product of oats in 1899 was $553,847 (1,436,225 bu.), and in 1909, $1,319,000 (2,536,000 bu.); of Indian corn, in 1899, $121,872 (250,020 bu.), and in 1909, $355,000 (408,000 bu.); of barley, in 1899, $121,826 (252,140 bu.), and in 1909, $343,000 (520,000 bu.); of rye in 1899, $13,761 (28,630 bu.), and in 1909, $46,000 (66,000 bu.). The value of the hay and forage crop in 1899 was $3,862,820, or 46.9 % of the value of all crops, and its acreage was 388,043 acres, or 56.5 % of the acreage of all crops; in 1909, the acreage in hay was 375,000 acres, and its value was $9,792,000. Alfalfa (or lucerne) formed the principal part of the hay crop in 1899, and was produced chiefly in the counties of Utah (95,316 tons), Salt Lake (91,266 tons), Cache (64,543 tons) and Boxelder (50,019 tons), all in the northern part of the state.

The vegetable crop in 1899 occupied 24,042 acres, or 3.5 % of the acreage of all crops, and its value was $1,250,713, or 15.2 % of the value of all crops. The product of potatoes increased very rapidly from 519,497 bu. in 1889 to 1,483,570 bu. valued at $487,816 in 1899, and to 2,700,000 bu. valued at $1,161,000 in 1909. The production of other vegetables in 1899 was as follows: water-melons, 620,440; musk-melons, 516,500; tomatoes, 254,052 bu.; cabbages, 997,690 heads, and sweet corn, 16,192 bu. For the important sugar-beet crop, see below under *Manufactures*. On Gunnison and Hat islands in Great Salt Lake are valuable guano deposits which are used as fertilizers for vegetable gardens.

The value of live-stock on farms and ranges in 1890 was $9,914,766; on farms in 1900, $21,474,241. The number of neat cattle in 1900 was 343,690, valued at $7,152,844; on January 1, 1910,[2] 415,000,

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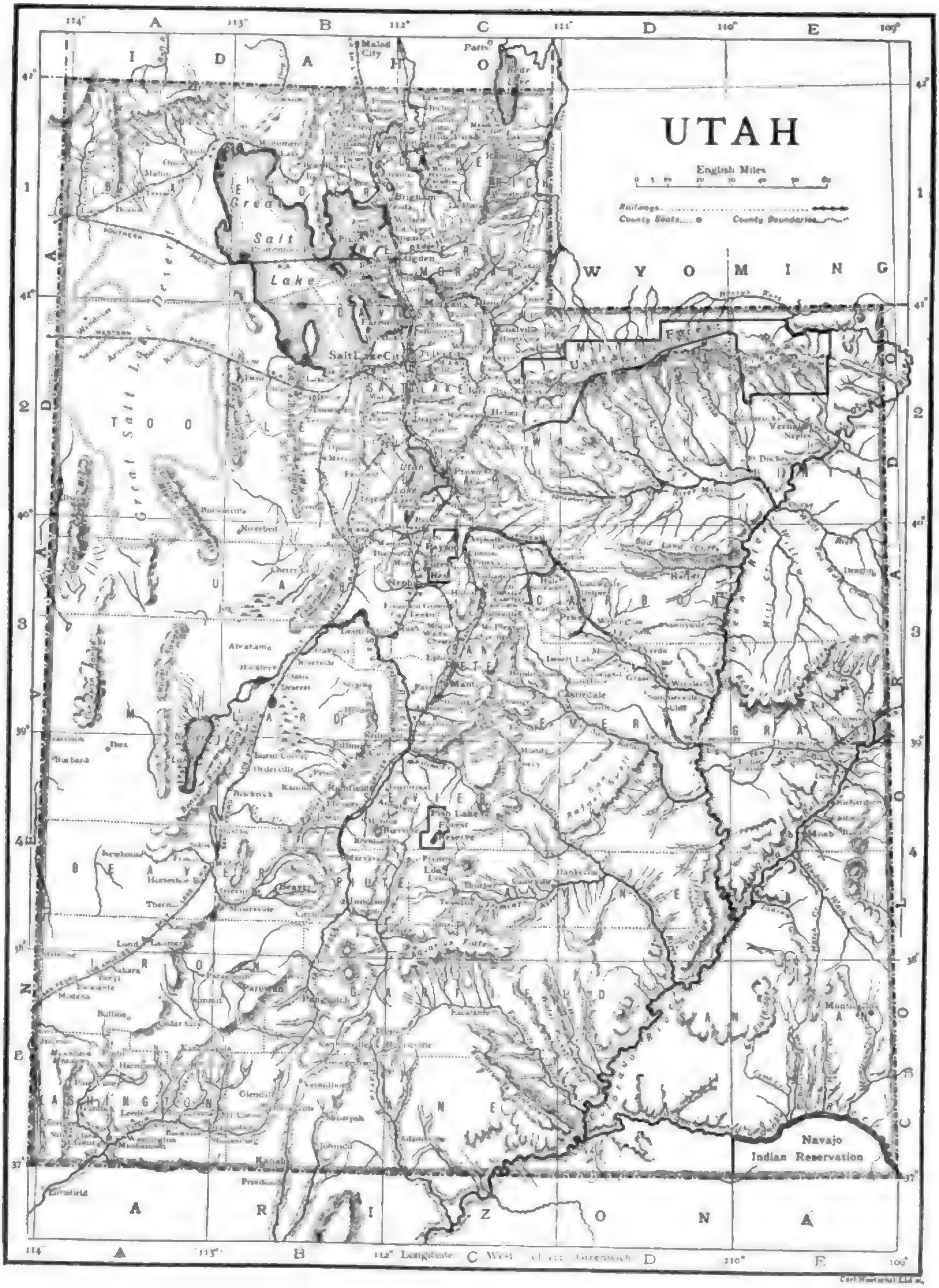
[1] 1909 statistics are from the *Year Book* of the U.S. Department of Agriculture.

[2] These 1910 figures for live-stock are taken from the *Year Book* (1909) of the United States Department of Agriculture.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COLORADO
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Ogden
Brigham
Malad City
Paris
Bear Lake
Utah Lake
Nephi
Manti
Fillmore
Richfield
Beaver
Parowan
Panguitch
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Cedar City
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valued at $8,976,000, of which 88,000 were milch cows valued at $2,992,000. The number and value of other live-stock were as follows: sheep, in 1900, 3,818,423 ($10,256,488), and on January 1, 1910, 3,177,000 ($13,026,000); horses, in 1900, 115,884 ($3,396,313), and in 1910, 130,000 ($11,050,000); mules, in 1900, 2116 ($58,850), and in 1910, 3000 ($240,000); swine, in 1900, 65,732 ($293,115), and in 1910, 61,000 ($549,000).

The total value of dairy products in 1899 was $1,522,932. The principal products were: milk, in 1890, 8,614,694 gals., and in 1899, 25,124,642 gals. (received from sales, $645,550); butter, in 1890, 1,759,354 lb and in 1899, 2,812,122 lb (received from sales, $214,910); cheese, in 1890, 163,539 lb, and in 1899, 169,215 lb (received from sales, $122,933). The value of all poultry raised in 1899 was $262,503; the product of eggs was 3,387,340 doz., and their value, $424,628.

The product of wool in 1890 (exclusive of wool shorn after the 1st of June) was 9,685,513 lb, in 1900, 17,050,977 lb, and in 1910, 14,850,000 lb. The value of the honey and wax produced in 1899 was $94,364. Honey was a large crop with the early settlers, who put a hive and honey-bees on the state-seal of Deseret and of Utah.

Mining.—The mineral resources of Utah are varied and valuable, but their development was retarded for many years by the policy of the Mormon Church, which practically forbade its members to do any mining; more recently the development has been slow because of inadequate transportation facilities, and the inaccessibility of some of the deposits. In 1902 the state ranked fourteenth among the states in the value of its mineral products, $12,378,350, and took thirteenth rank in 1907, with a product of $38,099,756, but dropped to the fifteenth rank in 1908, when the total value of its product was $26,422,121.[1] The value of products manufactured from minerals in 1902 was $9,123,228, or 43·1% of all the manufactures in the state. The relative importance of mining and manufacturing may be shown thus: in 1902 the mines and quarries of the state employed 5712 wage-earners and paid to them $5,089,122, and in 1900 manufacturing industries employed 6615 wage-earners, who received $3,388,370 in wages.

Systematic prospecting for the precious metals did not begin in Utah until 1862, when Colonel Patrick E. Connor (1820–1891) of the Third California Infantry established Camp Douglas near Salt Lake City. He permitted many members of his regiment who had been prospectors in California to prospect the territory, with the result that mines were located at Stockton, Bingham Canyon, Little Cottonwood and elsewhere; but attempts to smelt lead-silver ore near Stockton about 1866 were not successful, and the mining of precious metals did not become an established industry in the Territory until about 1870. Ores of good quality are now known to be quite generally distributed throughout the state. In 1902 the state ranked third in the value of its gold and silver production, $8,500,904; in 1908 it ranked sixth in gold, $3,946,700 (a decrease of $1,174,900 since 1907), and fourth in silver, $4,520,600 (a decrease of $3,007,900 since 1907). In 1908 the richest producers of gold were Salt Lake (60,872·63 oz.), Juab (58,679·17 oz.) and Tooele (41,969·96 oz.) counties, which produced about nine-tenths of the total for the state; in Salt Lake and Juab counties the principal source was copper ore, but in Tooele county almost all the gold was from siliceous ores. For the whole state, of a total of 179,054·60 oz. in 1908, 111,086·12 were from copper ore, 47,439·15 from siliceous ores, and 19,986·36 from lead ores. In the same year the largest producing gold mines were the Centennial Eureka in Juab county, the Mercur in Tooele county, and the Utah Consolidated and the Utah Copper in Salt Lake county. The principal silver regions in 1908 were the Tintic, in Juab and Utah counties, and the Park City, in Summit and Wasatch counties. Of the total production, 8,451,338 oz. (valued at $4,479,209) in 1908, 2,748,289 oz. (of which more than two-thirds was from copper ores) were from Juab county; 2,463,735 oz. (all but 9586 oz., which were from lead zinc ore, being from lead ores) were from Summit and Wasatch counties; 1,561,983 oz. (all from lead ore, except 1158 oz. from copper ore) were from Utah county; 1,125,209 oz. (704,358 from copper ore, 329,276 from lead ore, 47,130 from copper-lead ore and 44,445 from siliceous ore) were from Salt Lake county; and 378,373 oz. (of which 341,375 oz. were from lead ore) were from Tooele county. The principal source of the silver was the lead ores mined, from which in 1908 about two-thirds of the total of the silver was secured.

Far larger in value than either gold or silver, and larger than both together, was the output of copper in Utah in 1907 ($12,851,377) and in 1908 ($11,463,383). Up to 1905 the output of silver in the state was greater than that of copper. In the production of copper in 1908 Utah ranked fourth among the states. Most of the metal was produced in the Bingham, or West Mountain district, Salt Lake county, where there were four mines in 1908 with an output of more than 1,000,000 lb; the Tintic district in Juab county; the Frisco district in Beaver county; and the Lucin district in Boxelder county. In 1908 more than two-thirds of the total output was from the low-grade porphyry ores mined at Newhouse, Beaver county, and at Bingham, Salt Lake county. There are copper smelters at Garfield, Copperton and Binghamton. An anti-smoke injunction in 1908 closed the furnaces in the immediate vicinity of Salt Lake City. The production of copper in 1883 was 341,885 lb; in 1890, 1,006,636 lb; in 1895, 2,184,708 lb; in 1900, 18,354,726 lb; in 1904, 46,417,234 lb; in 1907, 64,256,884 lb; and in 1908, 81,843,812 lb.[2]

Third in value (less than copper or silver) in 1908, but usually equalling silver in value, was the state's output of lead. The maximum production, 125,342,836 lb, was in 1906; in 1908 the output was 88,777,498 lb (valued at $3,728,655). The decrease in output and value is largely due to the lower price of lead in the market and the higher smelting rate. In 1908 the following mines produced more than 5,000,000 lb each of lead: Silver King at Park City, the Colorado in the Tintic district, the Daly West and the Daly Judge in the Park City district, and the Old Jordan and the Telegraph at Bingham, and there were fifteen other mines that produced between 1,000,000 and 3,000,000 lb of lead.

Zinc has been produced in commercial quantities in Summit, Tooele and Beaver counties. In 1906 the output was 6,474,615 lb, valued at $394,952; in 1908 it was 1,460,554 lb, valued at $68,646, and almost the entire output was from Summit county.

The apparently inexhaustible supplies of iron ore in southern Utah, and especially in Iron county, had been little worked up to 1910 on account of their inaccessibility. The beds of magnetite and hematite, in the southern portion of the Wasatch Mountains, are the largest in the western United States; in 1902 the four productive mines in Milford, Juab and Utah counties produced 16,240 tons of ore, valued at $27,417. There are valuable manganese deposits in the sandstone of the eastern plateau.

Coal was first discovered in Utah in 1851 along Coal Creek near Cedar City (in what is now Iron county) in the south-western part of Utah, and there was some mining of coal at Wales, Sanpete county, as early as 1855, but there was no general mining until about twenty years later, and the industry was not well established until 1888. Thereafter its development was rapid, and the discovery of outcroppings throughout the central and southern parts of the state gave evidence of the existence of great bodies of the mineral. The only important region of coal mining in the state up to 1910 was in Carson county, where more than nine-tenths of the total output of the state was mined in 1907 and in 1908. The production in 1870 was 5800 tons; in 1880, 14,748 tons (probably an under-estimate); in 1890, 318,159 tons; in 1900, 1,147,027 tons; in 1903, 1,681,409 tons; in 1907, 1,947,607 tons (the maximum); and in 1908, 1,846,792 tons. The total production from 1870 to 1908 was 20,683,974 tons, or allowing for coal lost, about 31,000,000 tons, which is estimated to represent 0·016% of the original supply. In 1909 the United States Geological Survey reported workable beds of coal aggregating 13,130 sq. m. in area, and 2000 sq. m. more in which it seemed probable that coal might be found. The shales of Utah, Sanpete, Juab and San Juan counties may furnish a valuable supply of petroleum if transportation facilities are improved; and there are rich supplies of asphalt—19,033 tons (valued at $100,324) was the output for 1908.

Salt is obtained by solar evaporation chiefly of the waters of Great Salt Lake and other brine found in that vicinity; at Nephi City, Juab county; near Gunnison, Sanpete county; in Sevier and Millard counties, and at Withee Junction in Weber county. The value of this product in 1907 was $199,779 (345,557 bbls.), and in 1908, $169,833 (242,678 bbls.).

Of other non-metallic products, among the most important were limestone—valued in 1902 at $186,663, and in 1908 at $253,088—and sandstone—valued in 1902 at $105,011 and in 1908 at $25,097. Some marble is quarried at Beaver in Beaver county, and Utah onyx has been used for interior decoration, notably in the city and county building of Salt Lake City. The clay products of the state in the same year were valued at $658,517. There are considerable deposits of sulphur, of varying degrees of richness, near Black Rock in Beaver county. Many semi-precious and precious stones are found in Utah, including garnet (long sold to tourists by the Navaho Indians), amethyst, jasper, topaz, tourmaline, opal, variscite (or "Utahlite"), malachite, diopside and Smithsonite. In 1908 the reported value of precious stones from Utah was $20,350.

Manufactures.—The manufacturing industry was long comparatively unimportant, being largely for local markets. It is still largely dependent on local raw material. But, with the growth of the mineral industry and of the cultivation of sugar beets, there was a remarkable growth in manufacturing between 1900 and 1905: the amount of capital increased from $13,219,039 to $26,004,011, or 96·7%, the average number of wage-earners from 5413 to 8052, or 48·8; and the value of factory products from $17,981,648 to $38,926,464, or 116·5%. In the period under discussion, urban establishments (*i.e.* those in the two municipalities—Salt Lake City and Ogden—having a population in 1900 of at least 8000), increased in number from 205 to 256 or 24·9%, and rural establishments decreased in number from 370 to 350 (5·4%); the capitalization of urban establishments increased from $4,212,972 to $7,700,750 (82·8%), and that of the rural from $9,006,067 to $18,303,361 (103·2%); the average number of wage-earners in urban establishments increased from 2832 to 3859 (36·3%), and those in rural establishments from 2581 to 4193 (62·5%); the value of the products of urban establishments increased from $5,521,140 to $10,541,040 (90·9%) and that of rural establishments from $12,460,508 to $28,385,424 (127·8%). This unusual predominance of rural over urban manufacturing is further shown by the fact that in 1900, 64·3% of the establishments reporting, and 69·3% of the value of their products were from factories classified as rural, and in 1905 the proportion of rural factories was 58·8%, and the value of their products 72·9% of the total. This predominance was largely due to the smelting and refining industry, the smelters being chiefly in the rural districts.

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[1] The 1907 and 1908 statistics are from the *Mineral Resources of the United States*, published by the United States Geological Survey.

[2] These statistics for 1904, 1907 and 1908 are from *Mineral Resources of the United States for 1908.*

The flour and grist mill industry was the most important in the state, with products valued at $1,659,223 in 1900, and $2,425,791 in 1905. The values of the products of other industries in 1900 and 1905, in the order of their importance, were as follows: Car and general shop construction and repairs by steam railway companies, in 1900, $1,306,591, and in 1905, $1,886,651; printing and publishing, in 1900, $770,848, and in 1905, $1,466,549; confectionery, in 1900, $403,379, and in 1905, $1,004,601; canning and preserving fruit and vegetables in 1900, $300,349, and in 1905, $801,958. The value of the products of industries of lesser importance in 1905 were: slaughtering and meat packing (wholesale), $653,314; malt liquors, $636,688; and foundry and machine shop products, $587,484.

The beet sugar industry is one of growing importance in Utah: there were in 1900 3 refineries, having a daily total capacity of 1100 tons of beets; in 1905, 4, with a daily total capacity of 2850 tons; and in 1909,[1] 5, which treated 455,064 tons of beets and produced 48,884 tons of sugar. In 1853 a sugar factory bought in England was erected at Provo, but no sugar was manufactured there, and none was successfully refined until 1889. Sugar beets were first grown by irrigation in Utah; under that system it becomes possible to estimate closely the tonnage of the product. Slicing stations established at distances of from 12 to 25 m. from a factory receive the beets, extract the juice and force it through pipes to the factory.

Transportation.—The first trade route to be established by white men within the present boundaries of Utah was the old Spanish trail from Santa Fé to Los Angeles. The trail entered what is now Utah, just east of the Dolores river, crossed the Grand river near the Sierra La Salle and the Green river at the present crossing of the Denver & Rio Grande railway, proceeded thence to the Sevier river and southward along its valley to the headwaters of the Virgin river, which it followed southward, and then westward, so that its line left the present state near its south-west corner. The presence of this and other trails to California was of great importance during the gold excitement of 1849, when many miners outfitted at Salt Lake City and the Mormons grew rich in this business. The first considerable railway enterprise in the territory was the Union Pacific, which was completed to Ogden in 1869. This system (which includes the Oregon Short line) has since been supplemented by the Denver & Rio Grande, the Southern Pacific, the San Pedro, Los Angeles & Salt Lake, and various connecting lines. The railway mileage in 1870 was 257 m.; in 1890, 1265 m.; and in 1909, 1962·87 m.

Population.—The population in 1850 was 11,380; in 1860, 40,273; in 1870, 86,786; in 1880, 143,963; in 1890, 207,905; in 1900, 276,749; and in 1910, 373,351. Of the population in 1900, 219,661 were native whites, 53,777, or 19·4%, were foreign-born, 2623 were Indians (of whom 1472 were not taxed), 672 were negroes, 572 were Chinese and 417 were Japanese. The reservation Indians in 1909 were chiefly members of the Uinta, Uncompahgre and White River Ute tribes on the Uinta Valley reservation (179,194 acres unallotted) in the north-eastern part of the state.[2] Of the 1900 native-born population 3870 were born in Illinois, 3032 in New York, 2525 in Ohio and 2519 in Pennsylvania. Of the foreign-born by far the largest number, 18,879, were natives of England, 9132 were Danes, 7025 were Swedes; and natives of Scotland, Germany, Wales and Norway were next in numbers. The large English immigration is to be ascribed to the successful proselytizing efforts of the Mormons in England. The same influence may be traced in the other immigration figures. There was, however, a relative decrease in the number of foreign-born in the state from 1890 to 1900. Of the total 1900 population 169,473 were of foreign parentage (*i.e.* either one or both parents were foreign-born), and 42,735 were of English, 18,963 of Danish and 12,047 of Swedish parentage, both on the father's and on the mother's side. The Latter-Day Saints (Mormons) are far more numerous than any other sect, this church having a membership in 1906 of 151,525 (of these 493 were of the Reorganized Church of Jesus Christ of Latter-Day Saints) out of a total of 172,814 in all denominations; there were 479 members of this denomination to every 1000 of the population in the state, and the next largest sect, the Roman Catholics, had only 26 per 1000 of population and no Protestant body more than 6 per 1000. In the same year there were 8356 Roman Catholics, 1902 members of the Northern Presbyterian Church, 1537 members of the Northern Methodist Episcopal Church, 1174 Congregationalists, and 987 Baptists (of the Northern Conference). The state in 1900 had 3·4 inhabitants to the sq. m. While this approached the average—3·5 for all the states west of the Rocky Mountains taken together, with the exception of Colorado, which had 5·2—it was noticeably higher than that of its immediate neighbours, Idaho (1·9), Arizona (1·1) and Nevada (0·4). At the census of 1880 the density of the population was 1·8 and in 1890 it was 2·6. From 1890 to 1900 the urban population (*i.e.* the population of places having 4000 inhabitants or more) increased from 69,456 to 81,480, or 17·3%, the urban population in 1900 being 29·4% of the total; the semi-urban population (*i.e.* population of incorporated places, or the approximate equivalent, having less than 4000 inhabitants) increased from 36,867 to 83,740, 71·1% of the total increase in population; while the rural population (*i.e.* population outside of incorporated places) increased from 104,456 to 111,529, 10·7% of the total increase. The principal cities of the state are: the capital, Salt Lake City, pop. (1910) 92,777; Ogden, 25,580; Provo, 8925; and Logan, 7522.

Administration.—The state is governed under the first constitution adopted on the 5th of November 1895, and amended in November 1900, November 1906, and November 1908. An amendment may be submitted to the people at the next general election by a two-thirds vote of the members elected to each house of the legislature, and only a majority of the electors voting thereon is required for approval. By a two-thirds majority the legislature may recommend that a constitutional convention be called; and if a majority of the electors at the next general election approve, the legislature shall provide for the convention, but the approval of a majority of the electors voting is necessary for ratification of the work of the convention. Article III., which guarantees religious freedom, forbids sectarian control of public schools, prohibits polygamy and defines the relation of the state to the public lands of the United States, is irrevocable except by consent of the United States. Every citizen of the United States, male or female, twenty-one years old or over, who has lived one year within the state, four months within the county and sixty days within the precinct has the right of suffrage, except that idiots, insane, and those convicted of treason or crime against the elective franchise are disfranchised; but in elections levying a special tax, creating indebtedness or increasing the rate of state taxation, only those who have paid a property tax during the preceding year may vote. A form of the Australian ballot with party columns is provided at public expense. As in so many of the newer Western states, the constitution specifies minutely many details which in the older instruments are left to be fixed by statute. For example, the employment of women or of children under fourteen in mines and the leasing of convict labour by contract are forbidden, and eight hours must constitute a day's work in state, county or municipal undertakings.

Executive.—The executive department consists of the governor, secretary of state, auditor, treasurer, attorney-general and superintendent of public instruction, all elected by the people at the time of the presidential election, and holding office for four years from the first day of January following. All these officers must be qualified electors and must have resided within the state for five years preceding their election. The auditor and treasurer may not succeed themselves, and governor and secretary of state must be at least thirty years old. The governor may call the legislature in extraordinary session or may summon the Senate alone. With the consent of the Senate he appoints all officers whose election or appointment is not otherwise provided for, including the bank examiner, state chemist, dairy and food commissioners, the boards of labour and health, the directors of the state institutions, &c., and fills all vacancies in elective offices until new officers are chosen and qualified. The governor, justices of the supreme court and the attorney-general constitute a board of pardons. The governor and other state officers form other boards, but the legislature is given power to establish special boards of directors. The veto of the governor, which extends to separate items in appropriation bills, can be overcome only by a two-thirds vote of each house of the legislature; but if the bill is not returned to the legislature, within five days it becomes a law without the governor's approval. The governor may not be elected to the United States Senate during his gubernatorial term.

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[1] *Year Book* of the United States Department of Agriculture.

[2] The *Report* of the commissioner of Indian Affairs for 1909 gives the following figures for the Indian population: under the Panguitch School, Kanab Kaibab, 81, Shivwitz Paiute, 118; under the Uinta and Ouray Agency, Uinta Ute, 443, Uncompahgre Ute, 469, White River Ute, 296; not under agency, Paiute 370.

Legislative.—The legislative power is vested in (1) the legislature, consisting of the Senate and House of Representatives, and (2) in the people of Utah. The legislature meets biennially on the second Monday in January of the odd-numbered years. No person is eligible to either house who is not a citizen of the United States, twenty-five years of age, a resident of the state for three years and of the district from which he is chosen for one year. Senators are elected for four years, but one-half the membership of the Senate retires every two years. The representatives are elected for two years. No person who holds any office of profit or trust under the state or the United States is eligible to the legislature, and no member, during the term for which he was chosen, shall be appointed or elected to any office created, or the emoluments of which have been increased during his term. Each house is the judge of the election and qualification of its own members. The membership of each house is fixed by law every five years, but the number of senators must never exceed thirty, and the number of representatives must never be less than twice nor more than three times the number of senators. In 1909 the Senate had eighteen and the House forty-five members. The legislature is forbidden to pass any special act where a general law can be made applicable, and is specifically forbidden to pass special acts on a number of subjects, including divorce, the rate of interest, and the incorporation of cities, towns or villages, or the amendment of their charters, &c. Neither the state nor any political subdivision may lend its credit or subscribe to the stock of any private corporation. The powers of the houses are the same, except that the Senate confirms or rejects the governor's nominations and sits as an impeachment court, while the Representatives initiate impeachments. By an amendment of 1900, the legislature was instructed to provide that a fixed fraction of the voters might cause any law to be submitted to the people, or that they might require any legislative act (except one passed by a two-thirds vote of each house) to be so submitted before going into effect, but up to 1910 no law had been passed putting the amendment into force.

Judiciary.—The judicial power is vested in the Senate sitting as a court of impeachment, in the Supreme Court, the district courts, in justices of the peace, and in "such inferior courts as may be established by law." The Supreme Court is composed of three justices (but the number may be increased to five whenever the legislature shall deem it expedient) each of whom must be thirty years old, learned in the law, and a resident of the state for five years preceding his election. They are elected by the people for a term of six years, but the term of one expires every two years, and that justice who shall have the shortest time to serve acts as chief justice. The court has original jurisdiction to issue writs of *mandamus*, *certiorari*, prohibition, *quo warranto* and *habeas corpus*. Otherwise its jurisdiction is exclusively appellate, and every final decision of a district court is subject to review. The court holds three terms yearly in the capital. The state is divided into seven districts, in which from one to four judges are elected for terms of four years. They must be twenty-five years old, residents of the state for three years, and of the district in which they are chosen. They have original jurisdiction of civil, criminal and probate matters, not specifically assigned to other tribunals, and appellate jurisdiction from the inferior courts. At least three terms yearly must be held in each county. In cities of the second class (5000–30,000 inhabitants) municipal courts may be established. In cities of the first class (30,000 or more) a city court was established in 1901. Special juvenile courts may be established in cities of the first and second class. Each precinct elects a justice of the peace, who has civil jurisdiction when the debt or damage claimed does not exceed three hundred dollars, and has primary criminal jurisdiction.

Local Government.—The county is the unit of local government. The chief fiscal and police authority is the Board of County Commissioners of three members, two elected every two years, one for two years and one for four. They create and alter subdivisions, levy taxes, care for the poor, construct, maintain and make regulations for roads and bridges, erect and care for public buildings, grant franchises, issue licences, supervise county officers, make and enforce proper police regulations (but the authority does not extend to incorporated towns or cities), and perform such other duties as may be authorized by law. Other county officers are the clerk (who is *ex officio* clerk of the district court and of the commissioners), sheriff, treasurer, auditor, recorder, surveyor, assessor, attorney and superintendent of district schools, but where the assessed valuation of any county is less than $20,000,000 the clerk is *ex officio* auditor, and the commissioners may consolidate offices. The precincts are laid off by the commissioners and each elects a justice of the peace and a constable. Cities are divided into classes (see above) according to population, and are governed by a mayor and a council. In cities of the first class fifteen, and of the second ten, councilmen are elected by wards, while in cities of the third class (all having less than 5000 inhabitants) five councilmen are elected on a general ticket.

Miscellaneous Laws.—Men and women may hold and dispose of property on the same terms, except that a husband cannot devise more than two-thirds of real estate away from his wife without her consent, and that a woman attains her majority at eighteen or when she marries. The property of an intestate leaving a widow or widower, but no issue, goes to the survivor if not over $5000 in value; if over that amount, one-half the excess goes to the survivor and one-half to the father and mother of the deceased or to either of them. If neither father nor mother survives, their share goes to the brothers and sisters of the deceased or to their descendants. If there are no descendants, the whole goes to the surviving husband or wife. If a husband or wife and one child survive, they share the estate equally; if more than one child, the surviving husband or wife takes one-third and the children divide the remainder. If the intestate leaves issue but no husband or wife, the issue takes the whole. Failing all these, the estate goes to the next of kin. An illegitimate child is an heir of its mother and of the person who acknowledges himself to be its father. Estates exceeding $10,000 pay an inheritance tax of 5% on the excess. A homestead not exceeding $1500 for the head of the family and $500 additional for the husband or wife and $250 additional for each other member of the family is not subject to execution except for the purchase price, or mechanic's and labourer's liens, lawful mortgage or taxes. The district courts have exclusive jurisdiction in divorce, which may be granted because of impotency at time of marriage, adultery, wilful desertion for more than one year, wilful neglect to provide the necessities of life, habitual drunkenness, conviction for felony, intolerable cruelty, and permanent insanity which has existed for at least five years. An interlocutory decree is entered which becomes absolute at the end of six months, unless appeal is entered. The guilty party forfeits all rights acquired through marriage. Children over ten years of age may select the parent to whom they will attach themselves. A marriage may be annulled on ground of idiocy, insanity, bigamy, loathsome disease at time of marriage, epilepsy, miscegenation (white and negro or white and Mongolian), or when a male is less than sixteen or a female less than fourteen years of age. A marriage licence is required. No female and no male under fourteen may work in a mine. Eight hours is the limit of a day's work in mines and smelters. A person sentenced to death may choose one of two methods of execution—hanging or shooting.

Education.—Before 1890 some districts in the state under a local option law had established free schools, but the general free school system was founded in 1890 by a law which consolidated all the districts in each city into one large school district and classified Salt Lake City as a city of the first class, and Ogden, Logan and

Provo as cities of the second class for school purposes; in 1908–9 six county school districts of the first class were formed. In 1892–1893 text-books and supplies were first furnished free to pupils in the grades; and in the same year supervisory work was introduced. At the head of the public school system is a state superintendent of public instruction, elected for four years, and a board of education, composed of the state superintendent, the president of the state university, the president of the Agricultural College, and two appointees of the governor serving for four years. There is a county superintendent whose term is two years. And in each district there is a board of three trustees, one retiring each year. Two or more contiguous districts may unite to form a high school district. School attendance is compulsory for twenty weeks each year in rural districts and for thirty weeks each year in cities of the first and second class for all children between eight and sixteen years. In 1900 the percentage of illiterates at least ten years old was 3·1. In 1909 there were 685 public schools in the state; the total number of pupils of school age (six to eighteen years) was 102,050, the number enrolled in the public schools was 84,804, and the average daily attendance was 66,774; the total number of teachers was 2255 (1645 women), and the average monthly salary of men teachers was $88·13 and of women $57·44; and the total expenditure for public education was $2,762,581 for the year, being more than twice as much as was expended by the state ten years before. The laws of the state provide for a commission, in cities and counties, for the retirement of public school teachers on a pension. The university of Utah at Salt Lake City was opened in 1850 as the state university of the "state of Deseret." The State Agricultural College and Experiment Station (1888) is at Logan. At Cedar City, in Iron county, is a branch normal school, connected with the state university. There is a state school for the deaf and the blind (1884) at Ogden. The Art Institute at Salt Lake City has an annual art exhibit, a state art collection, and a course of public lectures on art. There is a state commission which promotes the establishment of free libraries and gymnasiums. The Mormons control Brigham Young University (1876) at Provo, Brigham Young College (1878) at Logan, the Latter-day Saints University (1887) at Salt Lake City, and academies at Ogden, Ephraim, Castle Dale, Beaver and Vernal. Other denominational schools are: St Mary's Academy (1875; Roman Catholic) in Salt Lake City; All Hallows College (1886; Roman Catholic) in Salt Lake City; Westminster College (1897; Presbyterian) in Salt Lake City, and Presbyterian academies at Logan, Springville and Mt. Pleasant; Rowland Hall Academy (1880; Protestant Episcopal) for girls at Salt Lake City; and Gordon Academy (1870; Congregational) at Salt Lake City.

Charitable and Penal Institutions.—The state supports a Mental Hospital (1884, with provision for feeble-minded and non-insane epileptics since 1907) at Provo, a state Industrial School (1889) at Ogden and a state prison (1850) at Salt Lake City. Under a law of 1905, amended in 1907 and 1909, provision is made for separate juvenile courts in all districts in which there are cities of the first (Salt Lake City) or the second class (Ogden, Logan and Provo) with jurisdiction over children under eighteen years of age; and similar jurisdiction is given to district courts elsewhere. In connexion with the juvenile court detention homes have been established, and in certain conditions justices of the peace are empowered to act as judges of the juvenile court in their respective precincts. There are many denominational charities, especially Mormon, the entire state being divided into ecclesiastical units or "stakes" for charity organization.

Finance.—The principal source of public revenue is the property tax. An amendment of 1908 provides for the taxation of mines and mining property. The state assumed the Territorial debt of $700,000, and has added to it a bonded indebtedness of $200,000; the bonds, formerly 5%, have been refunded at 3½ and 3%. There were only private banks until 1872, when Brigham Young organized a national bank. The first savings bank was organized in 1873, and state banks now outnumber national banks. The banking business for many years was largely in the hands of high Mormon officials, and the loyalty of church members built up a remarkable financial confidence, so that no Utah banks failed even in the panic of 1893.

History.—Existing documents seem to indicate that Francisco Vasquez de Coronado, the Spanish explorer, sent out an expedition of twelve men under Captain Garcia Lopez de Cardenas in 1540, which succeeded in reaching the Colorado river at a point now within the state of Utah. But more extended exploration was conducted by two Franciscan friars, Francisco Atanasio Dominguez and Silvestre Velez de Escalante, who, on the 29th of July 1776, left Santa Fé with seven others to discover a direct route to Monterey on the coast of Alta California. This party came in sight of Utah lake on the 23rd of August. Almost half a century later, in the winter of 1824–25, James Bridger, a trapper, discovered the Great Salt Lake while seeking the source of the Bear river. Many trappers in their skin boats followed his lead, notably William H. Ashley, of the Rocky Mountain Fur Company, who, in 1825, at the head of about 120 men and a train of horses, left St Louis and established the fort named for him at Lake Utah. In 1843 General John C. Frémont with Kit Carson and three others explored the Great Salt Lake in a rubber boat. With Brigham Young and his little band of Mormon followers (between 140 and 150 members), who entered the Great Salt Lake Valley in July 1847, begins the story of settlement and civilization (see MORMONS). Before the end of 1848 about 5000 Mormons had settled in the Salt Lake Valley. The treaty of Guadalupe Hidalgo (Feb. 2, 1848) ceded to the United States the vast western territory which included Utah. Early in 1849 the Mormon community was organized as the state of Deseret[1] with Brigham Young as governor. Deseret then comprised not only the present state of Utah, but all Arizona and Nevada, together with parts of New Mexico, Colorado, Wyoming and California. Application was made to Congress to admit it as a state or Territory, and on the 9th of September 1850 the Territory of Utah, then comprising the present state and portions of Nevada, Colorado and Wyoming, was established under an Act, which provided that it should be admitted as a state, with or without slavery, as the constitution adopted at the time of admission prescribed. (See COMPROMISE OF 1850.) The Republican party and (less violently) the Democratic in their national platforms and in Congress attacked and opposed the Mormon institution of polygamy. Statehood, therefore, was not granted until the 4th of January 1896, owing to the apparent hostility of the Mormon authorities to non-Mormon settlers and to repeated clashes between the Mormon Church and the United States government regarding extent of control, polygamous practices, &c. And even after the admission of the state these questions arose in the matter of seating prominent Mormons who were elected to Congress. For a detailed account of these difficulties and of the growth of the "Gentile" or non-Mormon element see the article MORMONS.

Through irrigation experiments agriculture became the industrial foundation of the desert community. The waters of City Creek were at first diverted and a canal was built; and the results were encouraging, though in the summer of 1848 crops were destroyed by a swarm of black crickets; but in turn this pest was devoured by sea-gulls, and the phrase "gulls and crickets" has become one of peculiar historic significance in Utah. After 1849 the gold-fever horde bound for California furnished a source of revenue to the Mormons, as their settlement afforded an admirable post for supplies.

The division of land among the Mormons was singularly equitable. Each city block consisted of 10 acres divided into eight 1¼-acre lots, which were assigned to professional and business men. Then a tier of 5-acre lots was apportioned to mechanics, and 10- and 20-acre parcels of land were given to farmers, according to the size of their families. As Great Salt Lake City grew all landholders benefited, either by the location of their property or because of its size, the smaller lots being closer to the business centre and the larger tracts being in the outlying districts.

In 1847 Brigham Young had succeeded Joseph Smith as president of the Mormons, and he held that position of veritable dictator until his death (1877); John Taylor succeeded him, and Wilford Woodruff in 1890 was chosen head of the organization; then Lorenzo Snow was president in 1898–1901, and Joseph Fielding Smith was elected in 1901.

From time to time the Indians have risen against the Mormons. Between 1857 and 1862 outbreaks were frequent, and on the 29th of January 1863 occurred the battle of Bear river, where some 300 Shoshones and Bannocks and about 200 of Colonel P. E. Connor's command participated in a bloody engagement. In April 1865 an Indian war broke out under the leadership of Blackhawk, which lasted intermittently until the end of 1867. But in June 1865 treaties were concluded with the majority of Utah tribes, whereby they agreed to remove to Uinta Valley, where a reservation had been made for them. One other important reservation, the Uncompahgre, has also been opened for the Indians of the state.

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[1] According to the Book of Mormon, "Deseret" means "land of the working bee."

The state has chosen Republican governors and, except in 1896, when it gave its electoral vote to W. J. Bryan, the Democratic candidate for the presidency, has voted for the Republican nominees in presidential elections.

GOVERNORS

State of Deseret

Brigham Young	1849–1850

Territorial

Brigham Young	1850–1857
Alfred Cumming	1857–1861
John W. Dawson	1861
Frank Fuller (Acting Governor)	1861–1862
Stephen S. Harding	1862–1863
James Duane Doty	1863–1865
Charles Durkee.	1865–1869
Edwin Higgins (Acting Governor)	1869–1870
S. A. Mann (Acting Governor).	1870
J. Wilson Schaffer	1870
Vernon H. Vaughan (Acting Governor)	1870–1871
George L. Woods	1871–1874
S. B. Axtell	1874–1875
George B. Emery	1875–1880
Eli H. Murray	1880–1886
Caleb W. West	1886–1889
Arthur L. Thomas	1889–1893
Caleb W. West	1893–1896

STATE GOVERNORS

Heber M. Wells (Republican)	1896–1905
John C. Cutler (Republican)	1905–1909
William Spry (Republican)	1909–

BIBLIOGRAPHY.—On the physiography of Utah see Henry Gannett, *Gazetteer of Utah* (Washington, 1900), being Bulletin 166 of the U.S. Geological Survey; J. W. Powell, *Geology of the Uinta Mountains* (ibid., 1876), *Exploration of the Colorado River of the West* (ibid., 1875), and *The Lands of Utah* (ibid., 1879); W. M. Davis, "An Excursion to the Plateau Province of Utah and Arizona" and "The Mountain Ranges of the Great Basin," in vol. 42 (1903) of *Bulletin* of the Harvard Museum of Comparative Zoology; S. F. Emmons, "Uinta Mountains," in vol. 18 (1907) of the *Bulletin* of the Geological Society of America; C. E. Dutton, *The High Plateaus of Utah* (Washington, 1880); and G. K. Gilbert, Lake Bonneville (ibid., 1890), Monograph I. of the U.S. Geological Survey. On mineral wealth see Nichols, *Mineral Resources of Utah* (Pittsburg, 1873). For administration see James T. Hammond and Grant H. Smith (edd.), *Compiled Laws of the State* (Salt Lake City, 1908). The important titles for the history of the state are those given in the article MORMONS, especially H. H. Bancroft, *History of Utah* (San Francisco, 1889), and O. F. Whitney, *History of Utah* (4 vols., Salt Lake City, 1892–98).

UTAMARO (1754–1806), one of the best known of the Japanese designers of colour-prints, was born at Kawayoye. His father was a well-known painter of the Kanō School, Toriyama Sekiyen (Toyofusa), a pupil of Kanō Chikanobu; and Utamaro traced his descent from the old feudal clans of the Minamoto, whose war with the Taira family belongs to the romantic period of Japanese history. Utamaro's personal name was Yusuke; and he first worked under the signature Toriyama Toyo-aki; but after a quarrel with his father substituted the name Kitagawa for the former appellation. His distinct style was the outcome of that of his father, tempered with the characteristics of the Kanō school. As a painter, his landscapes and drawings of insects are most highly considered by Japanese critics; but his fame will always rest among Europeans on his designs for colour-prints, the subjects of which are almost entirely women—professional beauties and the like. These were done for the most part while he lived, in a sort of bondage, in the house of a publisher, Tsutaya Shigesaburo. His talents were wasted by an unbroken career of dissipation, culminating in a term of imprisonment for a pictorial libel on the shogun Iyenari, in 1804. From this he never recovered, and died on the third day of the fifth month, 1806. The colour-prints of Utamaro are distinguished by an extreme grace of line and of colour. His composition is superb; and even in his lifetime he achieved such popularity among his contemporaries as to gain the title Ukiyo-ye Chūkō-no-so, "great master of the Popular School." His work has a considerable reputation with the Dutch who visited Nagasaki, and was imported into Europe before the end of the 18th century. His book illustrations are also of great beauty. Three portraits of him are known: two colour-prints by himself, and one painting by Chobunsai Yeishi (in the collection of Mr Arthur Morrison). His prints were frequently copied by his contemporaries, especially by the first Toyokuni and by Shunsen; and many of those bearing his name are really the work of Koikawa Harumachi, who had been a fellow-student, and afterwards married his widow. That artist is known by the name of Utamaro II. Most of these imitations were made between 1808 and 1820. Utamaro II., who afterwards changed his name to Kitagawa Tetsugorō, died between 1830 and 1843.

See E. de Goncourt, *Outamaro* (1891); E. F. Strange, *Japanese Illustration* (1897); and Japanese Colour-Prints (Victoria and Albert Museum *Handbook*, 1904). (E. F. S.)

UTE, or **UTAH**, a tribe of North American Indians of Shoshonean stock. They originally ranged over central and western Colorado and north-eastern Utah. They were divided into five sub-tribes, all acknowledging the authority of one chief. They were a wild warlike people, constantly fighting the Plain Indians and raiding as far south as New Mexico. Their relations with the whites have been generally friendly. The outbreak of the White River Band in 1879 is almost the only exception. They are now on reservations in Utah and Colorado, and number over 2000.

UTICA, a city of ancient Africa on the *sinus Uticensis*, 15½ m. N.W. of Carthage and Tunis, on the route from Carthage to Hippo Diarrhytus (Bizerta) and Hippo Regius (Bona). The modern marabout of Sidi Bu Shater, at the foot of Jebel Menzel el Gul, occupies the site of the ruins of Utica, which in ancient times stood at the mouth of the Bagradas (Mejerda). The mouth of the river is now 12 m. to the north, owing to alluvial deposits, and the level of the ancient town is covered with low-lying meadows, pools of water and marshes. The name *Utica* is of uncertain origin; the coins give the form עתק (*Atag, Ătig*); it is therefore with justification that Movers, Tissot and other scholars have suggested a form עתיקא (*Atiqa*) meaning "the ancient" or "the magnificent," or *Statio nautarum* (Movers, *Die Phönizier*, ii. 2nd part, p. 512; Olshausen in *Rheinisches Museum*, 1853, p. 329; Tissot, *Géogr. comp. de l'anc. prov. d'Afrique*, ii. p. 58). The Greeks transliterated the Punic name as Ἰτύκη, Οὐτίκη, Οὔτικα and the Romans by *Utica*. According to tradition, Utica was one of the oldest Phoenician settlements on the African coast, founded three centuries before Carthage. It soon acquired importance as a commercial centre, and was only partially eclipsed by Carthage itself, of which it was always jealous, though it had to submit to its authority. It is mentioned in the commercial treaty of 348 B.C. between Rome and Carthage (Polyb. iii. 24). Agathocles easily captured it in his expedition to Africa in 310. It remained faithful to Caesar during the First Punic War (Polyb. i. 82), but soon withdrew its support in view of the revolt of the Mercenaries. In the Third Punic War it declared for the Romans (Livy, *Epit.* xlix.; Polyb. xxxvi. 1; Appian viii. 75). After the destruction of Carthage it received the rank of a *civitas libera* with an accession of territory (Appian viii. 135; *C.I.L.* i. 200; Caesar, *De bell. civ.* ii. 36; A. Audollent, *Carthage romaine*, p. 30). Having become the city of an administration of the new Roman province up to the time of the rebuilding of Carthage, it played an important part in the wars at the end of the Republic. After the battle of Thapsus in 46 Cato shut himself up in Utica for the final struggle against Caesar, and there committed suicide. Augustus gave the town the rank of *municipium* with full civic rights (Dio Cass. xlix. 16; Pliny, *Hist. nat.* v. 4, 24); its inhabitants were enrolled in the Quirinal tribe (*municipium Julium Uticense*). Under Hadrian it became a *colonia romana*, with the title *Colonia Julia Aelia Hadriana Augusta Utica* (Aul. Gell. *Noct. Attic.* xiii. 4; *C.I.L.* viii. 1181 and 1183).

Septimius Severus conferred upon it the *Ius Italicum* (*Digest.* 50. 15; 8. 11).

We find evidence of the African Church at Utica as early as at Carthage; it was the seat of a bishop and had its martyrs from the 3rd century onwards. But its harbour was beginning to silt; the *Stadiasmus Maris Magni* (cxxvi.) states that already it was no longer a harbour but merely an anchorage. It was captured by Genseric and the Vandals in 439, reconquered by the Byzantines in 534, and finally, in 698, it fell into the hands of the Arabs and was depopulated. The last inhabitants were driven away by fever after the 8th century.

The ruins of the left bank of the Mejerda are often visited by travellers, but very little is left above the level of the ground. In 1869 A. Daux, the French engineer, explored them and made some important investigations. He was able to distinguish the fortifications, the acropolis, the quays of the commercial harbour and also of the military harbour or Cothon. Conjectural attempts have been made to identify the remains of large buildings with a temple of Apollo, the municipal Curia, the Arsenal and the Palace. The only certain identification, however, is that of the ruins of the amphitheatre, which was capable of holding 20,000 spectators, of the theatre, the baths, the reservoirs and the aqueduct which brought drinking water to the city. Subsequently there was found a Punic cemetery dating from the 5th century B.C. (Delattre, *Comptes-rendus de l'Acad. des Inscrip. et Belles Lettres*, 1906, p. 60). A number of coins have been found with Punic legends with the name Utica and heads of the Dioscuri Castor and Pollux. For the Roman period the coins have Latin legends and heads of Livia and Tiberius; they have also the names of the pro-consuls of the African province and of the local Duumvirs.

AUTHORITIES.—Hérisson, *Relation d'une mission archéologique en Tunisie* (1881); Sainte-Marie, *Mission à Carthage* (1884); *Revue archéologique* (1881 and 1882); A. Daux in *Le Tour du Monde* (1872) (views of the ruins); a mosaic of Utica is in the British Museum: *Graeco-Roman Sculpture*, ii. p. 86; A. Daux, *Recherches sur l'origine et l'emplacement des emporia phéniciens dans le Zeugis et le Byzacium* (1869); Ch. Tissot, *Géographie comparée de la province romaine d'Afrique* (1888), ii. pp. 57 et seq.; Lud. Müller, *Numismatique de l'ancienne Afrique*, ii. p. 159. (E. B.*)

UTICA, a city and the county-seat of Oneida county, New York, U.S.A., on the Mohawk river, about 45 m. E. of Syracuse and about 85 m. W. of Albany. Pop. (1890) 44,007; (1900) 56,383, of whom 13,470 were foreign-born, including 3696 Germans, 2458 Irish, 1661 Italians and 1165 Welsh; (1910, census) 74,419. Utica is served by the New York Central & Hudson River and several lines leased by it, including the Rome, Watertown & Ogdensburg; the Delaware, Lackawanna & Western; the New York, Ontario & Western; and the West Shore railways; by the Erie Canal, and by interurban electric railways. The city is situated on ground rising gradually from the river. There are many fine business and public buildings, especially on Genesee Street, the principal thoroughfare, and Utica is known for the number of its institutions, public and private. Those of an educational character include, in addition to the public schools and the Utica Free Academy, the New School (for girls) and the Utica Catholic Academy. Among the libraries are included the Public Library (1893) with 54,000 volumes in 1909, the library of the Oneida Historical Society (which occupies the Munson-Williams Memorial Building), the Utica Law Library and the Deutscher Leserverein. The city is the seat of a State Hospital for the Insane (1843). Among its many charitable institutions are a Masonic Home and School (1893), a Home for the Homeless (1867), St Elizabeth's Home (1886), St Luke's Home (1869), a Home for Aged Men and Couples (1879), Utica Orphan Asylum (1830), St Joseph's Infant Home (1893) and St John's Female Orphan Asylum (1834), both under the Sisters of Charity; the House of the Good Shepherd (1872; Protestant Episcopal); and the General (1873; City of Utica), Homeopathic (1895), St Luke's (1869; supported by the Protestant Episcopal Churches), St Elizabeth's (1866; Sisters of the Third Order of St Francis) and Faxton (1873) hospitals. Among the public buildings are a Federal building, the city hall, the County Court House, a Y.M.C.A. building, a Masonic Temple, an Odd-Fellows' Temple and a State Armoury and Arsenal. The city has a number of fine parks. In Forest Hill Cemetery are the graves of Horatio Seymour and Roscoe Conkling. On West Canada creek, about 15 m. N. of Utica, are Trenton Falls, which descend 312 ft. in 2 m., through a sandstone chasm, in a series of cataracts, some of them having an 80 ft. fall. From the geological formation here the name Trenton is applied to the upper series of the Ordovician (or Lower Silurian) system, and, particularly, to the lowest stage of this series.

Utica has varied and extensive manufactures. In 1905 the capital invested in manufacturing industries was $21,184,033, and the total value of the factory products was $22,880,317, an increase of 38·8% since 1900. Of this product, hosiery and knit goods, with a total value of $5,261,166, comprised 23% of all, and cotton goods ($4,287,658), 18·7%. The hosiery and knit goods constituted 3·9% of the total value of that product of the entire country. Other important products were: men's clothing ($2,943,214); foundry and machine-shop products ($1,607,258); steam fittings and heating apparatus ($1,010,755); malt liquors ($933,278); and lumber products ($869,000). Among the other manufactures are food preparations, wooden ware, wagons and carriages, stoves and furnaces, boots and shoes, tobacco and cigars, flour, candy, gloves, bricks, tile and pottery, furniture, paper boxes and firearms. Utica is a shipping point for the products of a fertile agricultural region, from which are exported dairy products (especially cheese), nursery products, flowers (especially roses), small fruits and vegetables, honey and hops.

The territory on which Utica was built was part of the 22,000-acre tract granted in 1734 by George II. to William Cosby (*c.* 1695–1736), colonial governor of New York in 1732–36, and to his associates, and it was known as Cosby's Manor. During the Seven Years' War a palisaded fort was erected on the south bank of the Mohawk at the ford where Utica later sprung up. It was named Fort Schuyler, in honour of Colonel Peter Schuyler, an uncle of General Philip Schuyler. A fort subsequently built at Rome also was at first called Fort Schuyler (and afterwards Fort Stanwix), and the fort at Utica was then distinguished from it by the prefix "old" and it was as "Old Fort Schuyler" that Utica was first known. The most used trade route to the western country crossed the Mohawk here. In default of payment of arrears of rent Cosby's Manor was sold at sheriff's sale in 1792 and was bid in by General Philip Schuyler, General John Bradstreet, John Morin Scott and others for £1387, or about 15 cents an acre. Soon after the close of the War of Independence a settlement was begun, most of the newcomers being Palatine Germans from the lower Mohawk. In 1786 the proprietors had the manor surveyed. An inn was erected in 1788, and new settlers, largely New Englanders, began to arrive. Among these, in 1789, was Peter Smith (1768–1837), later a partner of John Jacob Astor, and father of Gerrit Smith, who was born here in 1797. In 1792 a bridge was built across the Mohawk. In 1797 Oneida county was established, and the village was incorporated under the name of Utica. The first newspaper, the *Gazette*, began publication in the same year, and the first church, Trinity (Protestant Episcopal), was built. The Erie Canal, completed in 1825, added to Utica's prosperity. Utica was chartered as a city in 1832.

See Pomroy Jones, *Annals and Recollections of Oneida County* (Rome, N.Y., 1851); M. M. Bagg, *Pioneers of Utica* (Utica, 1877); *Outline History of Utica and Vicinity* (Utica, 1900); and the publications of the Oneida Historical Society (Utica, 1881 sqq.).

UTILITARIANISM (Lat. *utilis*, useful), the form of ethical doctrine which teaches that conduct is morally good according as it promotes the greatest happiness of the greatest number of people. The term "utilitarian" was put into currency by J. S. Mill, who noticed it in a novel of Galt; but it was first suggested by Bentham. The development of the doctrine has been the most characteristic and important contribution of British thinkers to philosophical speculation. While British philosophizing up to a recent date has been notably lacking in width of metaphysical outlook, it has taken a very high place in its handling of the more practical problems of conduct. This is due in part, no doubt, to national character; but in the main, probably, to religious and political freedom, and the habit of discussing philosophical questions with regard to their bearing upon matters of religious and political controversy. The British moralists who wrote with political prepossessions are interesting, not merely as contributors to speculation, but as exponents of spiritual tendencies which were expressed practically in the political agitations of their times.

The history of utilitarianism (if we may use the term for the earlier history of a philosophic tendency which appeared long before the invention of the term) falls into three divisions, which may be termed theological, political and evolutional respectively. Hobbes, when he laid it down that the state of nature is a state of war, and that civil organization is the source of all moral laws, was under the influence of two great aversions, political anarchy and religious domination. It is in a clerical work written to refute Hobbes, Bishop Cumberland's *De Legibus Naturae* (pub. in 1672), that we find the beginnings of utilitarianism. Hobbes's conception of the state of nature antecedent to civil organization as a state of war and moral anarchy was obviously very offensive to churchmen. Their interest was to show that the gospel precept of universal benevolence, which owes nothing to civil enactment, was both agreeable to nature and conducive to happiness. Cumberland, therefore, lays it down that "The greatest possible benevolence of every rational agent towards all the rest constitutes the happiest state of each and all. Accordingly common good will be the supreme law"; and this supreme and all-inclusive law is essentially a law of nature. This important principle was developed by Cumberland with much originality and vigour. But his handling of it is clumsy and confused; and he does not make it sufficiently clear *why* the law of nature should be obeyed. He does, however, lay much stress upon the naturally social character of man; and this points forward to that treatment of morality as a function of the social organism which characterizes modern ethical theory. The further development of theological utilitarianism was conditioned by opposition to the Moral Sense doctrine of Shaftesbury and Hutcheson. Both these writers, more particularly the latter, had postulated in controverting Hobbes the existence of a moral sense to explain the fact that we approve benevolent actions, done either by ourselves or by others, which bring no advantage to ourselves. There was a general feeling that the advocates of the moral sense claimed too much for human nature and that they assumed a degree of unselfishness and a natural inclination towards virtue which by no means corresponded with the hard facts. The fire of human enthusiasm burnt low in the 18th century, and theologians shared the general conviction that self-interest was the ruling principle of men's conduct. Moral sense seemed to them a subjective affair, dangerous to the interests of religion. For, if the ultimate ground of obligation lay in a refined sensitiveness to differences between right and wrong, what should be said to a man who might affirm that, just as he had no ear for music, he was insensitive to ethical differences commonly recognized? Moreover, if mere sense were sufficient to direct our conduct, what need had we for religion? Such considerations prevailed where we might least expect to find them, in the mind of the idealist Berkeley. And it was another clergyman, John Gay, who in a dissertation prefixed to Law's translation of Archbishop King's *Origin of Evil* (pub. in 1731) made the ablest and most concise statement of this form of doctrine. What he says comes to this: that virtue is benevolence, and that benevolence is incumbent upon each individual, because it leads to his individual happiness. Happiness arises from the rewards of virtue. The mundane rewards of virtue are very great, but need to be reinforced by the favour or disfavour of God. Further advances along the same line of thought were made by Abraham Tucker in his *Light of Nature Pursued* (pub. 1768–74). Gay and Tucker supplied nearly all the important ideas of Paley's *Principles of Moral and Political Philosophy* (pub. in 1785), in which theological utilitarianism is summarized and comes to a close. Paley, though an excellent expositor and full of common sense, had the usual defect of common-sense people in philosophy—that of tame acquiescence in the prejudices of his age. His two most famous definitions are that of virtue as "the doing good to mankind, in obedience to the will of God and for the sake of everlasting happiness," and that of obligation as being "urged by a violent motive resulting from the command of another": both of which bring home to us acutely the limitations of 18th-century philosophizing in general and of theological utilitarianism in particular. Before we proceed to the next period of utilitarian theory we ought to go back to notice Hume's *Inquiry concerning the Principles of Morals* (pub. in 1751), which though utilitarian is very far from being theological. Hume, taking for granted that benevolence is the supreme virtue, points out that the essence of benevolence is to increase the happiness of others. Thus he establishes the principle of utility. "Personal merit," he says, "consists entirely in the usefulness or agreeableness of qualities to the person himself possessed of them, or to others, who have any intercourse with him." This is plain enough; what remains doubtful is the reason why we approve of these qualities in another man which are useful or agreeable to others. Hume raises the question explicitly, but answers that here is an ultimate principle beyond which we cannot hope to penetrate. For this reason Hume is sometimes classed as a moral-sense philosopher rather than as a utilitarian. From his point of view, however, the distinction was not important. His purpose was to defend what may be called a humanist position in moral philosophy; that is, to show that morality was not an affair of mysterious innate principles, or abstract relations, or supernatural sanctions, but depended on the familiar conditions of personal and social welfare.

The rise of political utilitarianism illustrates most strikingly the way in which the value and dignity of philosophical principles depends on the purpose to which they are applied. Abstractly considered, Bentham's interpretation of human nature was not more exalted than Paley's. Like Paley, he regards men as moved entirely by pleasure and pain, and omits from the list of pleasures most of those which to well-natured men make life really worth living: and he treats all pleasures as homogeneous in character so that they can be measured into equal and equally desirable lots. But his purpose was the exalted one of effecting reforms in the laws and constitution of his country. He took up the greatest happiness principle not as an attractive philosopheme, but as a criterion to distinguish good laws from bad. Sir John Bowring tells us that when Bentham was casting about for such a criterion "he met with Hume's *Essays* and found in them what he sought. This was the principle of utility, or, as he subsequently expressed it with more precision, the doctrine that the only test of goodness of moral precepts or legislative enactments is their tendency to promote the greatest possible happiness of the greatest possible number." These opinions are developed in his *Principles of Morals and Legislation* (pub. in 1789) and in the *Deontology* (published posthumously in 1834). Philosophically Bentham makes but little advance upon the theological utilitarians. His table of springs of actions shows the same mean-spirited omissions that we notice in his predecessors; he measures the quantity of pleasures by the coarsest and most mechanical tests; and he sets up general pleasure as the criterion of moral goodness. It makes no considerable difference that he looked for the moral sanction not to God but to the state: men, in his scheme, are to be induced to obey the rules of the common good by legally ordained penalties and rewards. He never faced the question how a man is to be induced to act morally in cases where these governmental sanctions could be evaded or did not exist in the particular state in which a man chanced to find himself. These principles of Bentham were the inspiration of that most important school of practical English thinkers, the Philosophic Radicals of the early 19th century; these were the principles on which they relied in those attacks upon legal and political abuses. From Bentham the leadership in utilitarianism passed to James Mill, who made no characteristic addition to its doctrine, and from him to John Stuart Mill. John Mill wrote no elaborate treatise on the subject. But he did something better than this. His essay *Utilitarianism* (pub. in 1863) sums up in brief and perfect form the essential principles of his doctrine, and is a little masterpiece worthy to be set beside Kant's *Metaphysic of Morals* as an authoritative statement of one of the two main forms of modern ethical speculation. Though in its abstract statement John Mill's doctrine may not differ very greatly from that of his predecessors, actually there is a vast change. To say that pleasure is the moral end is a merely formal statement: it makes all the difference what experiences you regard as pleasant and which pleasures you regard as the most important. Mill belonged to a generation in which the most remarkable feature was the growth of sympathy. He puts far greater stress than his predecessors upon the sympathetic pleasures, and thus quite avoids that appearance of mean prudential selfishness that is such a depressing feature in Paley and Bentham. Moreover, it is in sympathy that he finds the obligation and sanction of morality. "Morality," he says, "consists in conscientious shrinking from the violation of moral rules; and the basis of this conscientious sentiment is the social feelings of mankind; the desire to be in unity with our fellow-creatures, which is already a powerful principle in human nature, and happily one of those which tend to become stronger from the influences of advancing civilization." Such passages in Mill have their full significance only when we take them in connexion with that rising tide of humanitarian sentiment which made itself felt in all the literature and in all the practical activity of his time. The other notable feature of John Mill's doctrine is his distinction of value between pleasures: some pleasures, those of the mind, are higher and more valuable than others, those of the body. It is commonly said that in making this distinction Mill has practically given up utilitarianism, because he has applied to pleasure (alleged to be the supreme criterion) a further criterion which is not pleasure. But the validity of this criticism may fairly be questioned. Pleasure is nothing objective and objectively measurable: it is simply feeling pleased. The merest pleasure-lover may consistently say that he prefers a single glass of good champagne to several bottles of cooking-sherry; the slight but delicate experience of the single glass of good wine may fairly be regarded as preferable to the more massive but coarser experience of the large quantity of bad wine. So also Mill is justified in preferring a scene of Shakespeare or an hour's conversation with a friend to a great mass of lower pleasure. The last writer who, though not a political utilitarian, may be regarded as belonging to the school of Mill is Henry Sidgwick, whose elaborate *Methods of Ethics* (1874) may be regarded as closing this line of thought. His theory is a sort of reconciliation of utilitarianism with intuitionism, a position which he reached by studying Mill in combination with Kant and Butler. His reconciliation amounts to this, that the rule of conduct is to aim at universal happiness, but that we recognize the reasonableness of this rule by an intuition which cannot be further explained.

Even before the appearance of Sidgwick's book utilitarianism had entered upon its third or evolutional phase, in which principles borrowed from biological science make their entrance into moral philosophy. The main doctrine of evolutional or biological ethics is stated with admirable clearness in the third chapter of Darwin's *Descent of Man* (pub. in 1871). The novelty of his treatment, as he says, consists in the fact that, unlike any previous moralist, he approached the subject "exclusively from the side of natural history." Theological and political utilitarianism alike had been individualistic. But Darwin shows how the moral sense or conscience may be regarded as derived from the social instincts, which are common to men and animals. To understand the genesis of human morality we must study the ways of sociable animals such as horses and monkeys, which give each other assistance in trouble, feel mutual affection and sympathy, and experience pleasure in doing actions that benefit the society to which they belong. Both in animals and in human societies individuals of this character, being conducive to social welfare, are encouraged by natural selection: they and their society tend to flourish, while unsociable individuals tend to disappear and to destroy the society to which they belong. Thus, in man, do sentiments of love and mutual sympathy become instinctive and, when transmitted by inheritance, innate. When man has advanced so far as to be sensitive to the opinions of his fellow-men, their approbation and disapprobation reinforce the influence of natural selection. When he has reached the stage of reflection there arises what we know as conscience. He will approve or disapprove of himself according as his conduct has fulfilled the conditions of social welfare. "Thus the imperious word *ought* seems merely to imply the consciousness of a persistent instinct, either innate or partly acquired, serving as a guide, though liable to be disobeyed."

The most famous of the systematic exponents of evolutional utilitarianism is, of course, Herbert Spencer, in whose *Data of Ethics* (1879) the facts of morality are viewed in relation with his vast conception of the total process of cosmic evolution. He shows how morality can be viewed *physically*, as evolving from an indefinite incoherent homogeneity to a definite, coherent heterogeneity; *biologically*, as evolving from a less to a more complete performance of vital functions, so that the perfectly moral man is one whose life is physiologically perfect and therefore perfectly pleasant; *psychologically*, as evolving from a state in which sensations are more potent than ideas (so that the future is sacrificed to the present) to a state in which ideas are more potent than sensations (so that a greater but distant pleasure is preferred to a less but present pleasure); *sociologically*, as evolving from approval of war and warlike sentiments to approval of the sentiments appropriate to international peace and to an industrial organization of society. The sentiment of obligation Spencer regards as essentially transitory; when a man reaches a condition of perfect adjustment, he will always do what is right without any sense of being obliged to it. The best feature of the *Data of Ethics* is its anti-ascetic vindication of pleasure as man's natural guide to what is physiologically healthy and morally good. For the rest, Spencer's doctrine is valuable more as stimulating to thought by its originality and width of view than as offering direct solutions of ethical problems. Following up the same line of thought, Leslie Stephen with less brilliance but more attention to scientific method has worked out in his *Science of Ethics* (1882) the conception of morality as a function of the social organism: while Professor S. Alexander in his *Moral Order and Progress* (pub. in 1889) has applied the principles of natural competition and natural selection to explain the struggle of ideals against each other within society: moral evil, says Professor Alexander, is in great part a defeated variety of moral ideal. There is no doubt that much remains still to be done in illustrating human morality by the facts and principles of biology and natural history. A. Sutherland's *Origin and Growth of the Moral Instinct* (pub. in 1898) is a capable piece of work in this direction. Professor L. T. Hobhouse's *Morals in Evolution* and Professor Westermarck's *Origin and Development of the Moral Ideas* (both published in 1906) deal with the matter from the side of anthropology.

See E. Albee's *History of English Utilitarianism* (1902), a complete and painstaking survey. Leslie Stephen's *English Utilitarians* (pub. in 1900) deals elaborately with Bentham and the Mills, but more as social and political reformers than as theoretic moralists. See also ETHICS. (H. St.)

UTMAN KHEL, a Pathan tribe who occupy the hills to the north of Peshawar in the North-West Frontier Province of India. Their country lies between the Mohmands and the Ranizais of Swat, to the west and south-west of the junction of the Swat and Panjkora rivers. They claim to be descendants of Baba Utman, who accompanied Mahmud of Ghazni in his expedition into India in 997. The Utman Khel are a tall, stout and fair race, but in their dress and general customs have assimilated themselves to the neighbouring peoples of Bajour. They have none of the vices of the Yusafzais. Their country is very hilly and difficult, but well cultivated in terraces. They number some 40,000, and their fighting strength is about 8000 men. British expeditions were necessary against them in 1852, 1878 and 1898.

UTOPIA, an ideal commonwealth, or an imaginary country whose inhabitants are supposed to exist under the most perfect conditions possible. Hence the terms *Utopia* and *Utopian* are also used to denote any visionary scheme of reform or social theory, especially those which fail to recognize defects inherent in human nature. The word first occurs in Sir Thomas More's *Utopia*, which was originally published in Latin under the title *De Optimo Reipublicae Statu, deque Nova Insula Utopia* (Louvain, 1516). It was compounded by More (*q.v.*) from the Greek *οὐ*, not, and *τόπος*, a place, meaning therefore a place which has no real existence, an imaginary country.

The idea of a Utopia is, even in literature, far older than More's romance; it appears in the *Timaeus* of Plato and is fully developed in his *Republic*. The idealized description of Sparta in Plutarch's life of Lycurgus belongs to the same class of literary Utopias, though it professes to be historical. A similar idea also occurs in legends of world-wide currency, the best known of these being the Greek, and the medieval Norse, Celtic and Arab legends which describe an earthly Paradise in the Western or Atlantic Ocean (see ATLANTIS). Few of these survived after the exploration of the Atlantic by Columbus, Vasco da Gama and others in the 15th century; but in literature More's *Utopia* set a new fashion. An ideal state of society is described in the writings of Hobbes, Sir Robert Filmer and J. J. Rousseau. In Bacon's *New Atlantis* (1624–29) science is the key to universal happiness; Tommaso Campanella's *Civitas Solis* (1623) portrays a communistic society, and is largely inspired by the *Republic* of Plato; James Harrington's *Oceana* (1656), which had a profound influence upon political thought in America, is a practical treatise rather than a romance, and is founded on the ideas that property, especially in land, is the basis of political power, and that the executive should only be controlled for a short period by the same man or men. Bernard de Mandeville's *Fable of the Bees* is unique in that it describes the downfall of an ideal commonwealth. Other Utopias are the "Voyage en Salente" in Fénelon's *Télémaque* (1699); Étienne Cabet's *Voyage en Icarie* (1840); Bulwer Lytton's *The Coming Race* (1871); Samuel Butler's *Erewhon* (1872) and *Erewhon Revisited* (1901); Edward Bellamy's *Looking Backward* (1888); William Morris's *News from Nowhere* (1890); H. G. Wells's *Anticipations* (1901), *A Modern Utopia* (1905) and *New Worlds for Old* (1908). Many Utopias, such as the *Fable of the Bees* and *Erewhon*, are designed to satirize existing social conditions as well as to depict a more perfect civilization. There are separate articles on all the authors mentioned above. A large number of the more recent Utopias have been inspired by socialistic or communistic ideals; among these may be mentioned *Freiland, ein soziales Zukunftsbild* (1890) and *Reise nach Freiland* (1893), by the Austrian political economist Theodor Hertzka (b. Budapest, 1845), which portray an imaginary communistic colony in Central Africa.

UTRECHT, a town of northern Natal, 30 m. by rail E. by N. of Newcastle. Pop. (1904) 1315. It is the chief place in a district of the same name, originally settled in 1848 by emigrant Boers from Natal. They formed an independent community and in 1854 obtained, in exchange for a hundred head of cattle, formal cession of the territory from Panda, the Zulu king. In 1858 the district was united with the republic of Lydenburg, and in 1860, with Lydenburg, became part of the South African Republic. In 1903 it was, with the neighbouring district of Vryheid, annexed to Natal. The town of Utrecht is built in a hollow among the foothills of the Drakensberg. In the neighbourhood are extensive coal-fields.

UTRECHT, the smallest province of Holland, bounded S. by Gelderland and South Holland, W. by South Holland, N. by North Holland and the Zuider Zee and E. by Gelderland. It has an area of 534 sq. m. and a pop. (1905) of 276,543. It belongs chiefly to the basin of the Rhine; the Lower Rhine, which skirts its southern border, after sending off the Crooked Rhine at Wijk, becomes the Lek, and the Crooked Rhine in its turn, after sending off the Vecht at Utrecht to the Zuider Zee, becomes the Old Rhine. The north-eastern portion of the province is drained by the Eem, which falls into the Zuider Zee. The watershed between the Rhine and the Eem is formed by a plateau of sand and gravel hills which extend from the south-east corner on the Rhine to Zeist near Utrecht, and also northwards to Huizen on the Zuider Zee. On its western side the plateau declines into the clay lands (and in the north-west low fen) which characterize the western half of the province. The region of sand and gravel is covered with bare heaths and patches of woods, and the occupations of the scanty population are chiefly those of buckwheat cultivation and peat-digging, as in Drente. Amersfoort is here the only town of any size, but along the western edge of this tract there is a row of thriving villages, namely, Amerongen, Leersum, Doorn, Driebergen and Zeist. Bunschoten on the Zuider Zee is a fishing village; Venendaal, on the south-eastern border, originally a fen-colony, is now a market for the bee-keeping industry in the east. On account of the picturesqueness of this part of the province, many country houses and villa residences are found scattered about it. The western half of the province is flat and often below sea-level. Cattle-rearing and the making of cheese (of the Gouda description) and butter are here the chief occupations. Agriculture is practised along the Crooked Rhine, wheat, barley, beans and peas being the chief products, and there is considerable fruit-farming in the south-west. The development of towns, however, has here been restricted by the rise of Utrecht, the chief town of the province, as a commercial centre. A number of small old towns are found along the Rhine, the Lek and the Holland Ysel, such as Rhenen (or Reenen), Wyk-by-Duurstede, Yselstein, Montfoort. Rhenen was once the seat of an independent lordship, though afterwards joined to the bishopric of Utrecht. The ancient church has a fine tower (1492–1531). Wyk-by-Duurstede, originally a Roman settlement, was of some commercial importance as early as the 7th and 8th centuries, but decayed owing to Norman raids in the 10th century. The ruined castle of the bishops of Utrecht still remains. The lordship of Yselstein can be traced back to the younger brother of Gysbrecht IV. of Amstel, who bought lands and built a castle here before 1279. In the beginning of the next century it had grown to the size of a small town and was granted civic rights and surrounded with walls; and in the course of the following centuries was frequently attacked and even devastated. About 1377 Ystelstein descended to the house of Egmont, and in 1551 to the house of Orange, and by paying an annual contribution to the United Provinces remained an independent barony till 1795. The remains of the castle are picturesque. Montfoort owes its origin to a castle built by the bishop of Rhenen in 1170, which was frequently besieged in the 14th and 15th centuries. In 1833 it was bought by the government, and now serves as a reformatory for women. Vreeland on the Vecht has a similar origin in the castle built by Bishop Hendrik of Vianen in 1253–59 as a protection to the province against the lords of Amstel. The castle was demolished in 1529 when the province came under Burgundian rule. The province is traversed by the main railway lines, which all converge at Utrecht, and is also amply provided with navigable waterways.

The province represents the bulk of the territories once comprised in the ancient prince-bishopric of the same name, *het Sticht* (the see) of Dutch historians. The see was founded in 722 by St Willibrord, and the diocese thus formed, saving for a short time when it was an archbishopric, was subordinate to the see of Cologne. It covered all the northern Netherlands between the Scheldt and the Ems. The bishops, in fact, as the result of grants of immunities by a succession of German kings, and notably by the Saxon and Franconian emperors, gradually became the temporal rulers of a dominion as great as the neighbouring counties and duchies. Bishop Balderic (918–76) successfully defended the see against the Northmen, and received from the emperor Otto I. the right to coin money and all the land between the Leck and the Zuider Zee. The bishopric was weak, however, as compared with the neighbouring states, Holland, Gelderland and Brabant, from the mere fact of its ecclesiastical character. The bishop had no hereditary or dynastic interest in his land, and, as a temporal ruler, his powers were limited by the necessity of having to secure the goodwill of the higher clergy, of the nobles and of the cities, and also because of his relations to the German king and the pope as an ecclesiastical prince of the empire. The middle ages were marked by constant wars between the bishops of Utrecht and the counts of Holland and Gelderland. The growth of the power of Holland, however, under a succession of strong and capable rulers led to the bishopric becoming, during the 14th century, almost a dependency of the county. The death of every bishop was always the signal for violent disputes among the neighbouring feudal states, each of them intriguing to secure the election of its own candidate; but, as stated above, Brabant and Gelderland had at last to recognize the fact of the supremacy of Holland over the see. In the 15th century this supremacy passed to the dukes of Burgundy, and finally, in 1527, Bishop Henry of Bavaria sold his temporal rights to the emperor Charles V. In 1559 the see of Utrecht was by Pope Paul IV. raised to the dignity of an archbishopric. At the time of the revolt against Spain Utrecht took the Protestant side, and was one of the seven provinces which signed the Union of Utrecht in 1579. Each of these provinces retained in a large measure its sovereign rights and its own laws, privileges and customs. During the republican period the estates of Utrecht consisted of three "members." The chapter of the see was secularized, and out of the members of the five colleges a certain number, known as "the Elected" (*Geëligerden*), were chosen by the other two "members" of the estates. They held office for life, and were reckoned as the "first member" of the estates. The knights formed the "second member," the representatives being chosen by co-option. The city of Utrecht, with the four smaller towns of Amersfoort, Rheenen, Wijk-by-Duurstede and Montfoort, made up the "third member."

(G. E.)

The later history of the see of Utrecht is of considerable ecclesiastical interest. The last archbishop of Utrecht, Frederick van Schenk van Toutenburg, died in 1580, a few months before the suppression of Roman Catholic public worship by William of Orange. Two successors were nominated by Spain, both of whom were unable from political causes to take possession of the see. In 1583 the chapter elected Sasbold Vosmeer, Catholic priest at the Hague, vicar-general; the election was confirmed in 1590 by the papal nuncio at Brussels, and in 1602 Vosmeer was consecrated at Rome archbishop of Philippi *in partibus*. After Vosmeer's death (1612) Philip Rovenius van Ardensul was elected by the chapter and confirmed by the pope. In 1631 he formed the surviving members of the chapters of Utrecht and Haarlem into a collegiate body which became known as the chapter of Utrecht. Rovenius was succeeded as vicar-general in 1651 by Jacob de la Torre, consecrated as archbishop of Ephesus. Under his vicariate trouble with Rome began, the pope insisting on his right as universal bishop to appoint the vicar-general's coadjutor and successor. It was not, however, until the vicariate of Peter Codde, consecrated vicar-general with the title of bishop of Sebaste *in partibus* in 1669, that the quarrel came to a head. Codde was the nominee of the Dutch secular clergy, and these had for years past been at violent odds with the Jesuits, the champions of the ultramontane principle. The publication of an anonymous pamphlet in 1697, entitled "A Short Memoir on the State and Progress of Jansenism in Holland" (*Kort gendenkschrift van den staat en voortgang van het Jansenisme in Holland*), gave the latter their opportunity. Codde was accused of being its author, and though he successfully refuted this charge, he was ultimately deposed for Jansenism (1702), his opponent, Theodor de Kock, being appointed in his place. The result was a schism which was only temporarily checked by the expulsion of de Kock from the country by the states-general. Codde himself died in 1710. The Church of Utrecht was now without a bishop, and it was believed at Rome that the movement of revolt would soon perish for want of priests, especially as, with the constant influx of regulars, the number of Codde's adherents had steadily decreased. As a result of the publication of the bull *Unigenitus* by Pope Clement VII. in 1713, however, many French Jansenist priests took refuge in Holland, and so kept the church alive. In 1723 the chapter of Utrecht, in order to preserve the canonical succession of the Dutch clergy, elected Cornelius Steenoven archbishop. He was consecrated (15th October 1724) by Dominique Varlet, bishop of Babylon *in partibus*, who, having been deposed by the pope for Jansenism, had settled in Amsterdam in 1720. The pope replied to this by excommunicating all those who had taken part in the election and consecration. Undeterred by this, the chapter, on the death of Steenoven, elected as archbishop Cornelis Jan Burchman, who was consecrated by the bishop of Babylon on the 30th of September 1725. From this time onward the Jansenist Church of Holland has continued as an independent body, accepting the authority of the general councils, up to and including that of Trent, but basing itself on the Gallican theory of Episcopacy (*q.v.*) and rejecting the Vatican council, the infallibility of the pope and the papal dogma of the Immaculate Conception. Under Archbishop Peter Jan Meindaerts (d. 1767) two suffragan sees were created, that of Haarlem in 1742, that of Deventer in 1757. The Church had shrunk considerably since the 18th century, but in the first decade of the 20th showed signs of revival as a *point d'appui* for Catholics restive under the yoke of the ultramontanism dominant in the Roman Church. With the Church of Utrecht the Old Catholic movement in Germany at first established close relations, the first German Old Catholic bishop, Dr Reinkens, being consecrated by H. Heykamp, bishop of Deventer, in 1873. The Jansenist Church is, however, intensely conservative, and viewed with extreme disapproval the departures made by the German Old Catholics from Catholic tradition, notably in the matter of clerical celibacy. It refused, moreover, to recognize the validity of Anglican orders, and consequently to follow the example of the other Old Catholics in establishing intercommunion with the Church of England. This attitude towards the English Church was accentuated by the consecration, on the 28th of April 1908, of Mr Arnold Harris Mathew[1] as bishop of the Old Catholics in England by Dr Gerard Gul, Jansenist archbishop of Utrecht. The singular offshoot of the Church of Utrecht thus created established its headquarters in a former Congregational chapel (dedicated significantly to the Englishman St Willibrord, the first bishop of Utrecht) in River Street, London, N., the minister of which had joined the movement with his congregation. In 1910 Bishop Mathew claimed that his community numbered between 500 and 600, with ten priests, and that he had had many inquiries from both Roman Catholic priests, discontented with the Vatican policy, and Anglican clergy, uneasy about the validity of their orders (see an "interview" in the *Daily Graphic*, September 4, 1910). Meanwhile, in Holland itself the Roman Catholic hierarchy had been restored by Pope Pius IX. in 1851, with Utrecht as the archiepiscopal see. (W. A. P.)

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UTRECHT, a city of Holland, capital of the province of Utrecht, on the Crooked Rhine, which here divides into the

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[1] Bishop Mathew (b. 1855) about the year 1892 claimed and for a while assumed the title of earl of Llandaff (*sic*), as grandson of Arnold Nesbit Mathew (d. 1820), who was said to have been the eldest son of the first earl of Llandaff, though neither he nor his eldest son ever claimed the title (see G. E. C(okayne)), *Complete Peerage*; corrigenda to vol. v. in vol. viii. p. 450).

Old Rhine and the Vecht. Pop. (1905) 114,321. It is an important junction station 22 m. by rail S.S.E. of Amsterdam. Tramways connect it with Vreeswyk on the Lek (where are the large locks of the Merwede canal), Amsterdam, and by way of De Bilt with Zeist, and thence with Arnhem. It is a picturesque and interesting old town with more regular streets and shady squares and fewer canals than most Dutch towns. It is an important fortress, forming the principal *point d'appui* of the line of defensive inundations called the "New Holland Water Line," in addition to its position as a railway centre. The defences consist of an inner line of works which preserve the place against surprise, and of an outlying chain of detached forts of fairly modern construction, forming roughly two-thirds of a circle of three miles radius. Of these the works facing the east would in war time cover the assembly of troops destined to operate outside the Water Line, while those of the north and south fronts would be surrounded by inundations and serve chiefly to control the sluices. The line of the ancient ramparts, demolished in 1830, is now only marked by the Singel, or outer canal, which surrounds the oldest part of the city, with pleasant gardens and promenades laid out on the inside. Two canals, the Oude and the Nieuwe Gracht, intersect the town from end to end. On the Oude Gracht the roadway and quay are on different levels, the roadway lying over vaults, which open on the quay wall and are used as cellars and poor dwelling-houses. On the east of the town is the Maliebaan or Mall, consisting of an ancient triple avenue of lime trees, now largely replanted. Utrecht is the seat of a university, and of a Roman Catholic archbishopric. It is also the seat of the archbishop of the Dutch Old Catholics. The Domkerk, dedicated to St Martin, the former cathedral church of the bishops of Utrecht, is a large Gothic building, erected in 1254–1267 on the site of the original church founded by St Willibrord about 720 and completed by Bishop Adelbold about 1015. An open space forming the heart of the square in which the church stands separates the solitary western tower (14th century) from the choir and transept, the nave having been blown down by a violent hurricane in 1674 and never rebuilt. The interior (30 ft. wide and 115 ft. high) has been clumsily fitted up with pews and galleries for Protestant worship, so that the effect of its slender columns is spoilt. It contains the monuments of Admiral van Gent (d. 1672) and of Bishops Guy of Hainaut (d. 1317) and George of Egmont (d. 1559), while in the crypt are preserved the hearts of the German emperors Conrad II. (1039) and Henry V. (1125). The Roman Catholic cathedral of St Catherine dates from 1524 and has been restored in modern times. Other churches of very early foundation in Utrecht are the Pieterskerk and the Janskerk. Attached to the Domkerk by fine old Gothic cloisters is the university, which was founded in 1634 and enlarged in 1894. The students number some 750, and there are five faculties of theology, law, medicine, mathematics and science, and letters. The *aula* (restored in 1879) was originally the chapter-house of the cathedral. Connected with the university are a valuable library, occupying the palace built for Louis Bonaparte, king of Holland, in 1807 and containing upwards of 200,000 volumes and MSS.; a museum of natural history; an ophthalmic institute; physical and chemical laboratories; a veterinary school; a botanic garden; and an observatory. The archiepiscopal museum (1872) contains examples of all branches of sacred art in the Netherlands. In the Museum Kunstliefde is a small picture-gallery, chiefly remarkable for some pictures by Jan Scorel (1495–1562); the museum of antiquities contains a miscellaneous collection. Other buildings of interest are the museum of industrial art; the so-called "Pope's house," built in 1517 by Adrian Floriszoon Boeyens, afterwards Pope Adrian VI., and a native of Utrecht; the royal mint of Holland; the Fleshers' Hall (1637); the home for the aged, occupying a 14th-century mansion; the town hall (1830); and the large hospital prison and barracks. The most important industrial establishments are cigar manufactories, manufactories of chemicals and earthenware, and brass foundries, and there is also an active trade in the agricultural produce of the surrounding country.

The country round about Utrecht is pretty and plentifully studded with country houses, especially on the road to Arnhem. Close by, on the north-east, is the village of De Bilt, the seat of the Dutch Meteorological Institute. In this parish was formerly situated the famous Benedictine convent of Oostbroek, founded in the beginning of the 12th century. The abbey was demolished in 1850. The manor of Zuilen on the Vecht, four miles north-west of Utrecht, was partly held in fief from this abbey and partly from the bishops of Utrecht. The lords of Zuilen grew very powerful and built a castle here at the end of the 13th century. In 1302 this possession passed by marriage to the influential family of van Borsele, lords of Veere and governors of Zeeland. But on the extinction of that house towards the end of the 15th century the castle passed through various hands until it came by marriage in 1665 to the family of Baron van Tuyll van Serooskerke. The castle was carefully restored in 1752, and is still in excellent preservation. Five miles east of Utrecht is the village of Zeist, the seat of a Moravian settlement established here in 1746. There are also a fine castle (1667) and grounds, a sanatorium for children and numerous modern villa residences. At Ryzenburg, close by, is a Roman Catholic seminary, founded in connexion with the establishment of the Roman Catholic hierarchy in 1853 and practically serving as an archiepiscopal palace.

Utrecht (*i.e. Oude Trecht* or Old Ford, rendered in Latin documents *Vetus Trajectum*) is a city of great antiquity and much historic interest, especially as illustrating the growth of civic liberties during the middle ages. The place existed in Roman times and is mentioned in the itinerary of Antoninus. Though the name *Trecht* or *Trajectum* is almost universally found in old documents and on coins, the town was known by another name among the Frisians and Franks. Bede, writing in the 8th century, speaks of *Wiltaburg, id est oppidum Wiltorum, lingua autem Gallica Trajectum vocatur.* That any such people as the Wilten existed there is little evidence, but Wiltaburg (or variants of it) occurs in chronicles as late as the 12th century, and it is still preserved in the name Wildenburg, given to a Roman camp near the city.

The earliest authentic record of the town is that of the building of a chapel—afterwards destroyed by the heathen Frisians—by Dagobert I., king of the Franks, in 636; but the importance of the place began when St Willibrord (*q.v.*), the apostle of the Frisians, established his see there. This fact determined the development of the city. The bishop's seat had to be fortified against the incursions of the heathen Frisians and Northmen, and the security thus afforded attracted population till, after the destruction of its rival Dorestad by the Normans in the 9th century, Utrecht became the chief commercial centre of the northern Netherlands. Bishop Balderic (A.D. 918–976) was the real founder of the prosperity of the town. On his accession to the see Utrecht had just been sacked by the Northmen. He succeeded in driving the raiders away, rebuilt the walls, and during the fifty-eight years of his episcopate the town grew and prospered. Its gradual acquisition of civic rights followed the same line of development as in the German episcopal cities. At first the bishop, holding immediately of the Empire, was supreme. In feudal subordination to him a royal count, who was also *Vogt* (*advocatus*) of the cathedral church of St Martin, had his seat at Utrecht as the chief town of the *Gouw* (*Gau, pagus*) of Ifterlake. In the 11th century a burgrave (châtelain, *castellanus*), who was an episcopal officer, is found exercising jurisdiction in the city as well as the Vogt. Bishop Godebald (1122–1127) granted to the inhabitants of Utrecht and of Muiden, the neighbouring port on the Zuider Zee, their first privileges, which were confirmed on the 22nd of June 1122 by the emperor Henry V., who died at Utrecht in 1125. The extant imperial charter does not specify what were the municipal rights that were conceded, but it is certain that at this time they were very limited. The magistrates, the *Schout* or high bailiff and his assessors, the *Schepenen* (*scabini, échevins*), were nominated by the burgrave from the order of knights. In 1196 we read for the first time of councillors (*consules, consiliarii, adjurati*) as assessors of the magistrates, but these, who a little later were known as the *Raad* or council, were also nominated. The position was simplified when, in 1220, Albert van Cuyck, the last of the hereditary burgraves, sold his rights to the bishop. These ecclesiastical princes were churchmen in little but name, and their desire to be absolute rulers found itself confronted by the determination of the burghers to secure greater independence. As the 13th century advanced, the council, representing the wealthy and powerful gild of merchants, began to take a larger share in the government, and to restrict more and more the direct exercise of the episcopal authority. Of the rise of the craft gilds in Utrecht there is no record. They appear suddenly as fully developed organized corporations, able to impose their will upon bishop and aristocracy. All through the 13th century a continual struggle went on, but at last the gilds were victorious and were able to secure in the *Gildebrief* of 1304, confirmed by the bishop in 1305, a new constitution for the city. According to this, as emended by a later Gildebrief of 1347, the existing board of seven Schepenen were to retain office for life, but the new ones, elected yearly, were in future to be chosen by the Raad either in or outside the gilds. The Raad itself was to be chosen by the aldermen of the gilds. Two aldermen, later styled burgomasters, were to preside, the one over the Schepenen, the other over the Raad, sharing this presidency with two episcopal officials. The Schout was still to be nominated by the bishop from among the knights, but his powers were now comparatively insignificant. The two chief aldermen of the gilds, with the two episcopal official presidents above mentioned, together were to form the supreme government of the city. The victory of the democratic principle was entirely new in the Netherlands, though it had been anticipated in Florence, and was perhaps inspired by Italian example. In all other cities of the Netherlands the craft gilds remained in humble subjection to a council co-opted from a limited number of wealthy patrician families. In Utrecht, however, power was henceforth concentrated in the gilds, which became not only trade but political associations, which together constituted the sovereign community. In this government, though the Schepenen retained a dignified precedence, all power was practically concentrated in the popularly elected Raad, even the estates of the see (*Sticht*) had " nothing to say in the city."

The new liberties, as might be expected, did not tend to improve the relations between the town of Utrecht and its ecclesiastical sovereign; and the feud reached its climax (1481–84) in the " groote vorlag," or great quarrel, between the citizens and Bishop David, the Bastard of Burgundy, who had been foisted upon the unwilling chapter by the combined pressure of Duke Philip of Burgundy, his half-brother, and the pope. With the aid of John, burgrave of Montfoort, who had been called in, after the manner of the Italian podestas, and endowed with supreme power for the defence of the town, the Utrechters defeated all the efforts of their bishop, aided by the Hollanders and an aristocratic faction. They only succumbed when the weight of the archduke Maximilian was thrown into the scale against them (1484). Even then Bishop David was once more expelled in 1491. The last prince-bishop of Utrecht was Henry of Bavaria, who was elected, in May 1524, in succession to Philip of Burgundy. He took the part of the nobles against the burghers, but Duke Charles of Gelderland, jealous of the growing power of the house of Habsburg, intervened, put an end to the strife, and, in 1527, himself occupied the city. In July of the next year Bishop Henry was back again, having gained possession of the city by surprise; and in the following October he sold his temporal rights to the emperor Charles V. Utrecht, thus brought into immediate relations with the Spanish Habsburgs, proved no more tolerant of their rule than of that of its bishops, and took a leading part in the revolt of the Netherlands. The union of the seven northern provinces, proclaimed at Utrecht in 1579, laid the foundation of Dutch independence (see NETHERLANDS). The city proved indeed a refractory member of the new league; and, after the death of William the Silent, the Utrechters, jealous of the influence of their old enemies the Hollanders, refused to recognize the authority of the council of state, and elected a stadtholder of their own. Inside the city the old aristocratic and democratic factions still carried on their traditional struggle, complicated now by religious difficulties. The Roman Catholics, though still in the majority in the bishopric, had little influence on the politics of the city, where the aristocrats inclined to the moderate (libertine) opinions advocated by the preacher Hubrecht Duifhuis, while the democrats were organized in the new church order introduced by the uncompromising Calvinist Petrus Dathenus (d. 1581). The adhesion of Utrecht to the party of revolt was the work of the aristocratic party, and the critical state of affairs made it for a while dominant in the town. The gilds and burgher militia were deprived of all voice in the government, and the town council became an hereditary body. After the advent of the earl of Leicester as governor-general of the Netherlands in 1585, a change took place. The ultra-Calvinistic Adolph, count of Nuenar, who was elected stadtholder, overthrew the aristocratic government and placed the people in power. The Utrechters, under the leadership of Gerard Prouninck, otherwise Deventer, vehemently took the side of Leicester in his quarrel with the estates of Holland, and the English governor-general made the town his headquarters during residence in the Netherlands, and took it under English protection. Though heartily disliked in Holland, Leicester made himself so popular in Utrecht that the burgher guard even presented him with a petition that he would assume the sovereignty. The withdrawal of Leicester from the Netherlands was followed by the defeat of Deventer and the return of the aristocratic party to power. The issue was decided (October 5, 1558) when the democrats were defeated in battle. Deventer was imprisoned and banished, and the former Schout, Nicolas van Zuylen van Sevender, was restored to office. An attempt of the democratic party to regain power was temporarily successful (January 10, 1610); but the estates appealed to the States General and Maurice of Nassau, who had been appointed stadtholder on the death of Nuenar, put down the movement with a strong hand, and the Utrechters found themselves compelled to yield. From this time, until the French Revolution, the ancient democratic institutions of the city remained nothing but a name: the rights of the community were exercised by a municipal aristocracy, who held all power in their own hands. The gilds, once supreme, henceforth ceased to have any political importance. At Utrecht the treaty which closed the War of the Spanish Succession was signed on the 11th of April 1713. (G. E.)

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UTRECHT, TREATY OF, the general name given to the important series of treaties which in 1713 and 1714 concluded the great European war of the Spanish Succession (*q.v.*), and by which *inter alia* England obtained possession of Newfoundland, Nova Scotia and Gibraltar.

Worsted, mainly through the genius of Marlborough, in his efforts to secure the whole of the great Spanish monarchy for his grandson, Philip, duke of Anjou, Louis XIV. made overtures for peace in 1706 and again in 1709. These were rejected, and failure also attended the negotiations between France and the United Provinces which took place at Gertruydenberg in 1710, negotiations only entered upon by the Dutch after they had by a treaty with England (October 1709) secured a guarantee that they would obtain the coveted barrier of fortresses against France. But matters changed greatly during 1710 and 1711. In England in August and September 1710, the Tories, the party of peace, succeeded the Whigs, the party of war and the inheritors of the tradition of William III., in the conduct of affairs. In the Empire in April 1711, the archduke Charles, Philip's rival for the throne of Spain, succeeded his brother Joseph I. as ruler of Austria and became prospective emperor, and England and the United Provinces, having waged a long and costly war to prevent the union of the crowns of France and Spain, were equally averse from seeing Spain and Austria under the same ruler. Moreover, the allies realized at last that it was impossible to dislodge Philip from Spain, and all the peoples were groaning under the expenses and the sufferings of the war. France and England came to terms, and the preliminaries of peace were signed in London in October 1711, their basis being a tacit acquiescence in the partition of the Spanish monarchy.

The congress opened at Utrecht on the 29th of January 1712, the English representatives being John Robinson, bishop of Bristol, and Thomas Wentworth, earl of Strafford. Reluctantly the United Provinces accepted the preliminaries and sent representatives, but the emperor refused to do so until he was assured that these preliminaries were not binding. This assurance was given, and in February the imperial representatives made their appearance. As Philip was not yet recognized, as king, Spain did not at first send plenipotentiaries, but the duke of Savoy sent one, and Portugal was also represented.

One of the first questions discussed was the nature of the guarantees to be given by France and Spain that these crowns would be kept separate, and matters did not make much progress until after the 10th of July 1712, when Philip signed a renunciation. Then, England and France having concluded a truce, the pace was quickened and the main treaties were signed on the 11th of April 1713.

By the treaty between England and France Louis XIV. recognized the Protestant succession in England and undertook to give no further aid to the Stuarts. France ceded to England Newfoundland, Nova Scotia or Acadia, the island of St Kitts or St Christopher, and the Hudson's Bay Territory (" sinum et fretum de Hudson, una cum omnibus terris, maribus, maritimis, fluviis, locisque, in dicto sinu et freto sitis "), and promised to demolish the fortifications of Dunkirk and to fill up its harbour. A commercial treaty signed between the two countries on the same day provided that each should allow the other the most favoured nation treatment, while each gave up the claim to the indiscriminate seizure of shipping which had been practised during the war.

The treaty between France and the United Provinces was mainly concerned with securing the barrier of fortresses. These arrangements were somewhat complicated and to a large extent provisional, as Austria and Bavaria, two countries which were deeply interested in the fate of the Netherlands, had not yet assented to the terms of peace. By a commercial treaty concluded on the same day, France gave to the Dutch commercial privileges similar to those enjoyed by England. Other treaties concluded at the same time were between France and Savoy, France and Prussia, and France and Portugal. By the first the duke of Savoy regained Savoy and Nice, taken from him during the war, and France undertook to obtain for him the island of Sicily and the title of king. By the second Prussia secured some small additions of territory, including part of Gelderland and Neuchâtel; in return France definitely and finally obtained the principality of Orange. It is interesting to note that as a constituent of the Empire Prussia was still fighting against France. The treaty between France and Portugal mainly concerned the Portuguese settlements in Brazil, her claim to these being recognized by France.

Other treaties were signed at Utrecht between Spain and the allies, Philip now concluding these as the recognized and lawful king of Spain. On the 13th of July 1713 a treaty was signed between England and Spain, which embodied certain commercial arrangements previously made between the two countries. Spain ceded to England Gibraltar and Minorca and promised to give up Sicily to Savoy. She gave also to England the monopoly for thirty years of the lucrative slave trade with Spanish America, hitherto enjoyed by France: this was the famous Asiento treaty. Finally, there was an article concerning the inhabitants of Catalonia, who had fought bravely for Charles of Austria, and who had a large claim upon the protection of England. However, the protection granted to them was a mere sham, and the Catalans were soon the victims of the revenge of Philip of Spain. The peace between Spain and the United Provinces was signed on the 26th of June 1714, but the conclusion of the one between Spain and Portugal was delayed until the following February. The former was concerned mainly with commercial matters, Spain giving the United Provinces the treatment of a most favoured nation, except as regards Spanish America. The latter dealt with the frontier between the two countries and with the colony of St Sacrament in Uruguay, which was transferred to Spain.

The treaty of Utrecht also provided some compensation for the emperor Charles VI. as soon as he surrendered his claim to Spain. It was arranged that he should receive Naples and Milan, and also the Spanish Netherlands, henceforward known as the Austrian Netherlands.

But the general pacification was still incomplete, as France and the Empire continued the war, albeit somewhat languidly. It was not long, however, before Charles VI. realized how inadequate were his forces, unsupported by those of England and of Holland, to meet the armies of France, and towards the close of 1713 he was for the first time seriously inclined to consider conditions of peace. Accordingly, his representative, Prince Eugene, met the French marshal Villars at Rastatt in November 1713, and here, after negotiations had been broken off and again resumed, peace was made on the 7th of March 1714, Charles VI. concluding the treaty without waiting for the assent of the different states of the Empire. This consent, however, was necessary, and a little later the representatives of some of the princes of the Empire met those of France at Baden, where, on the 7th of September 1714, the treaty of Baden, the last of the treaties included in the general peace of Utrecht, was signed. This dealt entirely with the question of the frontier between France and the Empire, which was restored as it was before the outbreak of the war except that France gained Landau.

One important matter dealt with at Utrecht remains to be mentioned. A second barrier treaty between England and the United Provinces was signed on the 30th of January 1713, and a third treaty signed at Antwerp on the 15th of November 1715 clinched the matter. Seven fortresses were to be garrisoned by a total of 35,000 men, three-fifths of the cost being borne by the imperial government and the remainder by the United Provinces.

The treaty of Utrecht is second to none in importance in English history. Its provisions were a most potent factor in assisting the expansion of England's colonial empire and also in the building up of the country's commercial greatness. In the domestic politics of the 18th century, too, the peace has a great and recurring importance. Its terms were bitterly assailed by the Whigs, and after the accession of George I. four of its Tory authors, Bolingbroke, Oxford, Ormonde and Strafford, were impeached for concluding it, the charges brought against them being that they had corresponded with the queen's enemies and had betrayed the honour and interest of their own country, while the abandonment of the Catalans was not forgotten.

The text of the treaty of Utrecht is published as the *Actes, mémoires et autres pièces authentiques concernant la paix d'Utrecht* (Utrecht, 1714–1715); and by C. W. von Koch and F. Schöll in the *Histoire abrégée des traités* (1817–1818). As far as it concerns the party politics of England, there is much about the peace in Dean Swift's works. See also C. Giraud, *La Paix d'Utrecht* (Paris, 1847); I. S. Leadam, *Political History of England 1702–1760* (1909); A. W. Ward in the *Cambridge Modern History*, vol. v. (1908), and the *State Trials* for the proceedings against the impeached English ministers. But perhaps the most valuable work on the whole peace is O. Weber's *Der Friede von Utrecht. Verhandlungen zwischen England, Frankreich, dem Kaiser und den Generalstaaten 1710–1713* (Gotha, 1891).
(A. W. H.*)

UTRERA, a town of southern Spain, in the province of Seville; on the Arroyo de la Antigua, a right-hand tributary of the river Guadalquivir, and at the junction of the Seville-Cadiz and Cordova-Utrera railways. Pop. (1900) 15,138. Utrera contains few noteworthy buildings, although it is an ancient town, still partly surrounded by medieval fortifications. The principal church, Santa Maria, is Gothic in style, dates from the 15th century, and contains some interesting tombs; but it was to a great extent restored in the 17th century. Agriculture and especially stock-farming are foremost among the local industries, which also include manufactures of leather, soap, oil and spirits. Large numbers of horses, sheep and fighting bulls are bred in the moorlands and marshes which extend eastward towards the Gaudalquivir, and a fair is held yearly in September for the sale of live stock and farm produce. Utrera was occupied by the Moors in the 8th century, and, though retaken by St Ferdinand (1230–52), was not finally incorporated in the kingdom of Castile until 1340. In the middle ages it was notorious as a favourite refuge of brigands and outlaws.

UTTARPARA, a town of British India, in the Hugli district of Bengal, on the river Hugli. Pop. (1901) 7036. It is famous for the public library founded and endowed by Jai Krishna Mukharji, which is specially rich in books on local topography. There is an aided college, and a girls' school supported by a native association.

UTTOXETER, a market town in the Burton parliamentary division of Staffordshire, England, 15 m. N.E. by E. of Stafford by a branch of the Great Northern railway. Pop. of urban district (1901) 5133. It is also served by the North Staffordshire railway. The town lies pleasantly on high ground near the river Dove, a western tributary of the Trent, here the boundary with Derbyshire. There are large works for the manufacture of agricultural implements, and brewing and brick-making are carried on. Several agricultural fairs are held annually. The church of St Mary has a fine decorated tower and spire; the rest of the fabric dates from 1828. Alleyn's grammar-school was founded in 1558. In the market-place here Dr Johnson stood hatless in the rain doing voluntary penance for disobedience to his father. A bas-relief commemorates the incident. The name of the town is locally Uxeter, or an approximate pronunciation. At Denstone, 5 m. N. of Uttoxeter, is St Chad's College, a large middle-class school for boys, founded in connexion with St Nicholas' College, Lancing.

Uttoxeter (*Wotocheskede, Uttokeshather, Utcester, Uttoxater*) was probably not a Roman site, although the termination of the name suggests one, and a few remains have been discovered. It formed part of the estates of Algar, earl of Mercia; at the time of the Domesday Survey it was held by the king, later it passed to the Ferrers family and was included in the honour of Tutbury. In the early 12th century Earl Robert de Ferrers constituted Uttoxeter a free borough, and granted to the inhabitants freedom from all tolls, tonnage, poundage and other exactions. These privileges were confirmed and amplified by a charter, dated August 15, 1251, from William de Ferrers, earl of Derby. Uttoxeter, with the rest of the honour of Tutbury, escheated to the Crown in 1266 owing to the complicity of Robert Ferrers in the barons' rebellion; it was regranted to Edmund Crouchback, ancestor of the dukes of Lancaster, under whom it became part of the duchy of Lancaster, from which it was not severed until 1625. The Wednesday market, which is still held, was granted by Henry III. to William Ferrers, earl of Derby, together with a fair to be held on the feast of the Nativity of the Blessed Virgin (September 8), which was kept up in the 18th century. In 1308 Thomas, earl of Lancaster, obtained the grant of a fair on the vigil, day and morrow of St Mary Magdalene. In Leland's time "the men of the town used grazing" in the "wonderful pastures upon Dove," and in the 17th and 18th centuries the market was the greatest in that part of England for cattle and provisions; in the 18th century it furnished cheeses to many London cheesemongers. In 1648, on the defeat of the invading Scottish army under the marquis of Hamilton by Cromwell, its leader was captured here by Lambert.

UXBRIDGE, a market town in the Uxbridge parliamentary division of Middlesex, England, 18 m. W. by N. of St Paul's Cathedral, London, on the river Colne, and on branches of the Great Western and Metropolitan railways. Pop. of urban district (1901), 8585. There are breweries, foundries and engineering works, and a considerable traffic is carried on by means of the Grand Junction Canal. The town, which is connected by electric tramway with Hammersmith, London, has extended considerably in modern times as a residential centre. The church of St Margaret is Perpendicular, and retains a fine font in that style, and several ancient monuments.

Uxbridge is an ancient borough, stated to have been one of those originated by Alfred the Great, but it is not mentioned in Domesday. Here negotiations were begun, on the 30th of January 1645, between the commissioners of Charles I. and the parliament, but were broken off on the 22nd of February. A part of the "Treaty House," in which they were carried on, remains. In 1647 the parliamentary forces had for some time their headquarters in the town. It remained a garrison town until 1689. It obtained the grant of a market from Henry II.

UXMAL, a deserted city of the Mayas in the state of Yucatán, Mexico, 20 m. W. of Tikul, a station on the railway between Merida and Valladolid. The ruins stand on a wooded plain, and cover an area of a little more than half a mile square, although fragments are found over a much larger space. Uxmal is the largest and most important of the deserted cities of Yucatán, and shows some of the finest specimens of Maya architecture. The climate is much drier than that of Chiapas, and the structures are in a better state of preservation than those of Palenque, but the rank vegetation and the decay of the wooden lintels over the doorways have broken down many of the walls. Uxmal was inhabited for some time after the Spanish conquest, but perhaps only by a remnant of a population once much larger. The neighbourhood is now very unhealthy, and it may be presumed that the process of depopulation, caused by increasingly unhealthy conditions and diminishing sources of food supply, was gradual. There are no streams near the ruins, and the water-supply was derived from cisterns and from a few pools now filled with soil and vegetation. A rather soft limestone was used in the buildings, but the locality of the quarries has not been discovered. The walls are commonly about 3 ft. thick, in some cases much thicker, and the stones were set in a whitish mortar. Stone implements were used. The outer surfaces of the walls are usually divided by a horizontal moulding into two unequal zones, the lower one plain with a band of sculptured ornaments at the base, and the upper elaborately sculptured. The interior walls were generally plastered and rarely ornamented. There are no windows, but large doorways. The jambs were of dressed stone, usually plain, and the longer lintels were of zapote wood; some of them, where protected from the weather, are still to be seen, sometimes covered with inscriptions. The buildings are rectangular in shape, long and narrow, divided usually into two ranges of rooms. They are generally arranged in groups of four, enclosing a quadrangular court, and sometimes singly on massive eminences. The interiors are cut up into numerous small rooms by transverse partitions, while numerous beam-holes and dumb-sheaves indicate other divisions. The rooms are covered by acutely pointed vaults, the stones forming the sides of the vault being bevelled to the angle, and the apex being covered by capstones covering spaces of one to two feet. The spaces between the vaults are filled with solid masonry, and above all is the roof covering, also of masonry, which is sometimes surmounted with an ornamental roof-comb. The buildings stand upon raised terraces, or upon truncated pyramids, approached by broad stairways, usually of cut stone.

There are five principal buildings or groups—the Temple of the Magician, Nunnery Quadrangle, House of the Turtles, House of the Pigeons and Governor's Palace. There are other structures and groups, smaller and more dilapidated. One of them, standing immediately S. of the Nunnery, consists of two parallel walls only; it is usually described as the ball-court, or gymnasium, a structure common to most Maya cities. The Temple of the Magician crowns an unusually steep pyramid 240×180 ft. at the base and 80 ft. high. It has three rooms, and a smaller temple is built against the upper western side of the pyramid. A broad steep stairway ascends to the summit platform on the E., and a narrower stairway to the lower temple on the W. The west front is filled with remarkable figures and designs, including the lattice work common in Uxmal. The Nunnery Quadrangle consists of four large rectangular independent buildings, enclosing a quadrangular court, the whole occupying a terrace over 300 ft. square at the base and upwards of 15 ft. above the level of the plain. The buildings resemble each other in the arrangement of their rooms, and their elaborately ornamented façades face inwards upon the court. The division of the buildings into numerous small rooms is understood to signify that they were used as communal habitations, possibly of priestly orders. The Governor's Palace, standing upon a triple terrace S. of the Nunnery, is, according to W. H. Holmes, "the most important single structure of its class in Yucatán, and for that matter in America." It is 320 ft. long, 40 ft. wide and 25 or 26 ft. high, divided into a long central and two end sections, separated by recesses and two transverse archways about 25 ft. long, 10 ft. wide and 20 ft. high. These archways were subsequently blocked, and may have been intended originally as portals to a quadrangle which was never built. The upper zone of the exterior walls is about 10 ft. wide, exclusive of the mouldings and ornamental frieze, and its total length of 720 ft. is crowded with sculptures, in which there are three principal motives—the mask, the fret and the lattice. The projecting snouts in the line of masks forming the upper part of this zone are a peculiar feature of Uxmal ornamentation. The House of the Turtles is a comparatively small structure near the N.W. corner of the Governor's Palace. It has the same features found in the other structures except for a line of sculptured turtles on the mouldings of the frieze. Immediately S.W. of the Governor's Palace is a huge truncated pyramid, 200×300 ft. at the base and 60 to 70 ft. high. Beyond this is another large quadrangular group known as the House of the Pigeons. It resembles the Nunnery Quadrangle, except that the northern building carries a peculiar roof-comb of colossal size, running its entire length and rising to a height of about 16 ft. The base of this comb is 4 ft. high, capped by a moulding and perforated by over 50 openings. Above this the comb is divided into nine sections rising by large steps to the apex, each pierced by 30 or more openings, like an immense dovecote. Projecting stones suggest that they were built to carry statues or figures like the roof-combs of Palenque.

UZ, JOHANN PETER (1720–1796), German poet, was born at Ansbach on the 3rd of October 1720. He studied law, 1739–43, at the university of Halle, where he associated with the poets Johann Ludwig Gleim (*q.v.*) and Johann Nikolaus Götz (*q.v.*), and in conjunction with the latter translated the odes of Anacreon (1746). In 1748 Uz was appointed unpaid secretary to the *Justiscollegium*, an office he held for twelve years; in 1763 he became assessor to the imperial court of justice at Nuremberg, in 1790 was made a judge and, on the annexation of

Ansbach to Prussia (2nd of December 1791), entered the Prussian judicial service, and died, shortly after his appointment as *Landrichter*, at Ansbach on the 12th of May 1796. Uz wrote a number of graceful lyrics in Gleim's style, and some patriotic odes; he is the typical representative of the rococo period in German poetry. In 1749 the first collection of his *Lyrische Gedichte* was anonymously published. He also wrote, in alexandrines, *Der Sieg des Liebesgottes* (1753), a close imitation of Alexander Pope's *Rape of the Lock* and a didactic poem, *Versuch über die Kunst stets fröhlich zu sein* (1760).

A complete edition of Uz's works—*Sämtliche Poetische Werke*—was published at Leipzig, 1768; a new edition (Vienna, 1804), which has been often reprinted. A critical edition was published by A. Sauer in 1890. See Henriette Feuerbach, *Uz und Cronegk* (1866), *Briefe von Uz an einen Freund aus den Jahren 1753–82* (published by A. Henneberger (1866) and E. Petzet, *Johann Peter Uz* (Ansbach, 1896).

UZ. The "land of Uz" (ארץ עוץ) is best known as the scene of the story of Job. Its precise location is a matter of uncertainty, opinion being divided between a position N. of Palestine ("Aram Naharaim") and one to the S.E., in the neighbourhood of Edom. In favour of the former are the references in Gen. x. 23, xxii. 21, the inclusion of Job among "the children of the East," the possibility that Bildad the Shuhite (cf. Gen. xxv. 2, 6) belonged to the Sûhu, a people living on the right bank of the Euphrates, and the description of Elihu as a Buzite (xxxii. 2). Whether the name Uz is found or not in the cuneiform inscriptions is disputed. In favour of the S.E. position we have the description of Elihu as of the family of Ram[1] which (1 Chron. ii.) was a distinctly southern people, the fact that Eliphaz was a Temanite (*i.e.* he came from Edom, cf. Gen. xxxvi. 4) and the references in Gen. xxxvi. 28 and Lam. iv. 21. The mention of Uz in Jer. xxv. 20 is probably a gloss. While Edom and Uz are not to be identified, the traditional association of "wisdom" with Edom may incline us to place the Uz of Job in its neighbourhood rather than in that of the Euphrates. The tradition which places Job's home in Hauran has no value. It is worth noting that the Septuagint forms from Uz the adjective Αὐσῖτις, which points to a pronunciation *Auṣ*=Arabic *Aud*, the name of a god whose worship was widely spread and might therefore be readily borne by tribes or attached to districts in several regions.

UZÈS, a town of southern France, capital of an arrondissement in the department of Gard, finely situated on an eminence above the Alzon, 16 m. N. by E. of Nîmes by road. Pop. (1906) 4008. Uzès, the seat of an episcopal see from the 5th century to 1790, has a cathedral almost destroyed by the Protestants during the religious wars and rebuilt in the 17th and 18th centuries, but still flanked by a round tower of five storeys lighted by arched openings and dating from the 12th century. The Duché, a château of powerful lords, at first viscounts, and in 1565 dukes, of Uzès, preserves a donjon originally of the 12th century; the main building, flanked by a Gothic chapel, is Renaissance in style. The most ancient structure in the town is a crypt beneath a private house, attributed to the early centuries of the Christian era. The sub-prefecture and the tribunal of first instance occupy the old bishop's palace (17th century). There is a statue of Admiral Brueys (1753–1798), a native of the town. Uzès has a communal college for boys, and carries on the manufacture of silk, bricks and fireproof earthenware, and liquorice, and trade in the truffles for which the district is noted.

UZHITSE (also written Užice and Ushitsa), the capital of the Uzhitse department of Servia. As implied by its name, which may be translated "the narrow places," Uzhitse is built in a narrow and lonely glen amongst the south-western mountains, 1385 ft. above the sea. The surrounding heights, though rugged and barren, produce some of the finest Servian tobacco. Weaving is taught in the girls' school, and fairs are held for the sale of farm produce; but the absence of a railway and the badness of the roads retard commerce. Uzhitse possesses a court of first instance and a prefecture. Despite the prevailing poverty, it has also a real-school with good buildings, founded in 1865, and attended by about 300 pupils in 1900. The houses in Uzhitse are quite unlike those of more prosperous Servian towns, being tall, narrow structures of timber, frequently blackened by the damp. Pop. (1900) about 7000.

Early in the 13th century Uzhitse was the seat of St Sava, the first archbishop, and the patron saint of Servia. The archbishopric was soon removed to Ipek, in Old Servia; but after the Turkish garrison had been expelled in 1862 the city became once more the head of a diocese. At Arilye, 13 m. E.S.E., there is a 13th-century church, dedicated to St Aril, who, according to tradition, was martyred in the 9th century by unconverted Serbs. On the Bosnian frontier, 15 m. W. by N., are the mineral springs of Bayina Bashta (*i.e.* "the Garden Bath"), with Racha monastery close by; and in the neighbourhood is Dobrinye, the home of the Obrenovich family, with a church built by Milosh Obrenovich, called "the Liberator of Servia" (1818–1839).

UZZIAH (Heb. for "Yah[weh] is [my] strength"), more correctly Azariah (Hebrew for "Yah[weh] helps"); son of Amaziah, grandson of Joash I., and king of Judah (2 Kings xiv. 22, xv. 1–7). Of his long reign of fifty-two years little is recorded. He recovered Elath at the head of the Aelanitic Gulf, evidently in the course of a successful campaign against Edom (a possible reference in Isa. xvi. 1); we read further in 2 Chron. xxvi. of great wars against Philistines, Arabians and Meunim, of building operations in Jerusalem (probably after the attack by Joash), and of political and social reforms. The prosperity which Judah enjoyed during this period (middle of 8th century) is illustrated by the writings of Amos and by the earliest prophecies of Isaiah (*e.g.* ii. 6 sqq.). In his old age Uzziah was a leper (2 Kings xv. 5), and the later history (2 Chron. xxvi. 16 sqq.) regarded this as a punishment for a ritual fault of which the king was guilty; whilst Josephus (*Ant.* ix. 10. 4) records the tradition that on the occasion of his transgression the land was shaken by the terrible earthquake to which Amos i. 1 and Zech. xiv. 5 refer. During Uzziah's seclusion his son Jotham acted as regent. The growing power of Judah, however, aroused the jealousy of Israel, which, after the death of Jeroboam (2), had fallen on evil days (see Menahem). Jotham's victory over Ammon (2 Chron. xxvii. 5) could only increase the hostility, and preparations were made by Israel for an alliance with Damascus which culminated in an attack upon Judah in the time of Jotham's son, Ahaz (*q.v.*).

The identification (Schrader, McCurdy, &c.) of Azariah with Azriyau of Ja'udi, the head of a North Syrian confederation at Hamath (Hamah) overcome by Tiglath-Pileser IV. (738 B.C.), conflicts with the chronological evidence, with what is known of Uzziah's life and policy, and with the historical situations represented in the Biblical narratives (see Winckler, *Alttest. Forschungen* [1893], i. 1–23; S. A. Cook, *Ency. Bib.* col. 5244; Whitehouse, *Dict. Bib.* iv. p. 844 seq.; id. *Isaiah*, p. 9 seq.; Skinner, *Kings*, p. 359). On the other hand, the interrelation of events in Palestine and Syria during this period combine with the sudden prominence of Judah (under Uzziah) and the subsequent anti-Judaean and anti-Assyrian coalition (against Ahaz) to suggest that Uzziah had been supported by Assyria (cf. Winckler, *Keilinschr. u. d. Alte Test.*, 3rd. ed., p. 262). In fact, since the Biblical evidence is admittedly incomplete, and to a certain extent insecure, the question of the identification of Azariah of Judah and Azriyau of Ja'udi may be reopened. See H. M. Haydn, *Journ. of Bibl. Lit.*, xxviii. (1909), pp. 182–199, and artt. Jews, §§ 13 (beginning), 15; Palestine, *Old Test. Hist.* (S. A. C.)

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[1] Perhaps a mistake or an abbreviation for Aram.

V This letter was originally, like Y, only one of the earlier forms of the letter U. According to Florio (1611) V is "sometimes a vowel, and sometimes a consonant." In modern times attempts have been made to assign to it the consonantal value of U, but in English another symbol W is used for this, while V has received the value of the voiced form of F, which itself had originally a sound resembling the English W (see under F). V is therefore a voiced labio-dental spirant, the breath escaping through a very narrow slit between the lower lip and the upper teeth. In German, however, V is used with the same value as F, while W takes the value that V has in English. Apart from some southern dialect forms which have found their way into the literary language, as *vat* (for *fat* or *wine-fat* which still survives in the English Bible) and *vixen* the feminine of *fox*, all the words in English which begin with V are of foreign, and most of Latin origin. In the middle of words between vowels *f* was originally regularly voiced: *life, lives*; *wife, wives*, &c. The Latin V, however, was not a labio-dental spirant like the English *v*, but a bi-labial semivowel like the English *w*, as is clear from the testimony of Quintilian and of later grammarians. This quality has remained to it in southern Italy, in Spain and Gascony. In Northern French and in Italian it has become the labio-dental *v*, and from French English has adopted this value for it. Early borrowings like *wine* (Latin *vinum*), *wall* (Latin *vallum*), retain the *w* sound and are therefore spelt with *w*. In the English dialects of Kent, Essex and Norfolk there is a common change of *v* to *w*, but Ellis says (*English Pronunciation*, V, pp. 132, 229) that though he has made diligent search he has never been able to hear the *v* for *w* which is so characteristic of Sam and Tony Weller in the *Pickwick Papers*. It is, however, illustrated in Pegge's *Anecdotes of the English Language* (1803) and confirmed by the editor of the 3rd edition (1844), pp. 65–66. The history of V as the Latin numeral for 5 is uncertain. An old theory is that it represents the hand, while X = 10 is the two hands with the finger tips touching. This was adopted by Mommsen (*Hermes*, xxii. 598). The Etruscan used the same *v*-symbol inverted. V with a horizontal line above it was used for 5000. (P. Gi.)

VAAL, a river of South Africa, chief affluent of the Orange (*q.v.*). It rises at an elevation of over 5000 ft. above the sea on the slopes of the Klipstapel, in the Drakensberg mountains, Ermelo district of the Transvaal, and about 170 m. in a direct line west of Delagoa Bay. It flows in a general S.W. direction, with a markedly winding course, across the plateau of inner South Africa, joining the Orange in 29° 3′ S., 23° 36′ E. The river valley is about 500 m. long, the length of the river being some 750 m.

The first considerable tributary is the Klip (80 m. long), which rises in the Draken's Berg (the hill which gives its name to the range) and flows N.W., its junction with the Vaal being in 27° S., 29° 6′ E., 12 m. S.W. of Standerton. From this point to the eastern frontier of the Cape the Vaal forms the boundary between the Orange Free State and the Transvaal. The river is usually shallow and is fordable at many places, known as *drifts*. But after the heavy summer rains the stream attains a depth of 30 or more feet. At such times the banks, which are lined with willows and in places very steep, are inundated. As a rule little water is added to the Vaal by its tributaries. Of these, the Wilge (190 m.), which also rises on the inner slopes of the Drakensberg, flows first S.W., then N.W. across the eastern part of Orange Free State and joins the Vaal 60 m. below the Klip confluence. Lower down the river receives from the south the Rhenoster, Valsch, Vet and other streams which drain the northern part of the Orange Free State. On the north the basin of the Vaal is contracted by the Witwatersrand and Magaliesberg range, and its tributaries are few and, save in the case of the Harts river, short. The Klip, not to be confounded with the southern Klip already described, rises on the south side of the Witwatersrand about 15 m. W. of Johannesburg, is joined by several small streams, and after a S.E. course of 70 m. reaches the Vaal 2 m. E. of Vereeniging. The Klip is of importance in the supply of water to many of the Black Reef gold mines. The Mooi rises in the Witwatersrand west of the Klip and, after running almost due S. 75 m., unites with the main stream about 90 m. below Vereeniging. It gets its name Mooi (Beautiful) on account of the picturesqueness of its banks. Some of its sources are at Wonderfontein, where they issue from stalactite caves. The Harts river (200 m.) rises on the S.W. slopes of the Witwatersrand and flowing S. by W. unites with the Vaal about 65 m. above the confluence of that stream with the Orange. The volume of water in the Harts is often very slight, but that part of the country, the eastern division of Griqualand West, in which the Vaal receives its last tributaries and itself joins the Orange, is the best watered of any of the inland districts of the Cape. The Vaal here flows in a wide rocky channel, with banks 30 ft. high, through an alluvial plain rendered famous in 1867–70 by the discovery of diamonds in the bed of the river and along its banks. The diamonds are washed out by the water and found amid debris of all kinds, frequently embedded in immense boulders. The last affluent of the Vaal, the Riet river, rises in the Beyers Bergen S.E. of Reddersburg and flows N.W. 200 m. through Orange Free State, being joined, a mile or two within the Cape frontier, by the Modder river (175 m.), which rises in the same district as the Riet but takes a more northerly course. The united Riet-Modder joins the Vaal 18 m. above the Orange confluence.

The name Vaal is a partial translation by the Dutch settlers of the Hottentot name of the river—Kai Gariep, properly Garib (yellow water), in reference to the clayey colour of the stream. The Transvaal is so named because the first white immigrants reached the country from the south by crossing the Vaal.

VAALPENS (dusty-bellies), a little-known nomadic people of South Africa, who survive in small groups in the Zoutpansberg and Waterberg districts of the Transvaal, especially along the Magalakwane river. They are akin to the Bushmen (*q.v.*). In 1905 their total number was estimated by the Transvaal military authorities at "a few hundreds." The Vaalpens were so called by the Boers from the dusty look of their bodies, due, it is said, to their habit of crawling along the ground when stalking game. But their true colour is black. In height the men average about 4 ft., *i.e.* somewhat less than the shortest Bushmen. Socially the Vaalpens occupy nearly as low a position as even the Fuegians or the extinct Tasmanians. They were nearly exterminated by the Aman'debele, a tribe of Zulu stock which entered the Transvaal about the beginning of the 19th century. The Vaalpens, who live entirely by hunting and trapping game, dwell in holes, caves or rock-shelters. They wear capes of skins, and procure the few implements they need in exchange for skins, ivory or ostrich feathers. They form family groups of thirty or forty under a chief or patriarch, whose functions are purely domestic, as must be the case where there are no arts or industries, nothing but a knowledge of hunting and of fire with which to cook their meals. Their speech appears to be so full of clicks as to be incapable of expression by any clear phonetic system. Hence it is impossible to say whether the Vaalpens possess any folklore or other oral literature analogous to that of the Bushmen.

VACARESCU, the name, according to tradition, of one of the oldest noble families in Walachia. Its mythical founder is said to have been a certain Kukenus, of Spanish origin, settled in Transylvania as lord over Fogaras. Others connect the family with Ugrin, count of Fogaras. The first member of historical importance was Ianache (b. 1654), the grand treasurer of Walachia, who was killed with his master, Prince Brancovan, in Constantinople, 1714. His grandson through his son Stephan, also called Ianache (or "Enakitza the Ban," 1730–1796), starts a line of Rumanian scholars and poets; he was the author of the first known Rumanian grammar in the vernacular, printed in 1787. While in exile in Nicopolis he wrote the contemporary history of the Turkish empire in two volumes (1740–1799). He was also the first to attempt Rumanian versification. Greater as a poet is his son Alecu (Alexander), who died as a prisoner in Constantinople in 1798. In 1796 a collection of his poems appeared in Rumania. His brother Nikolaes (d. 1830) also wrote some poems, but they remained in MS. until 1860, when they were published. By far the greatest member of the Vacarescu family in the male line was Iancu (1786–1863), the son of Alexander. He received an excellent education not only in Greek but also in German and French, and was well versed in the literature of the West. An ardent patriot, he sided with the national movement in 1821, and assisted in establishing the Rumanian theatre, translating many books and plays from German and French into Rumanian, notably the *Britannicus* of Corneille, a literary event of no small importance at the time. He inaugurated modern Rumanian poetry. In 1830 appeared his first volume of verse. He died in 1863. A niece of Alexander is the gifted writer Elena Vacarescu (Hélène Vacaresco), who inherited the poetical talent of her family and has enriched Rumanian literature with her *Bard of the Dimbovitza*, and other poems and novels in Rumanian and in French. (M. G.)

VACARIUS (1120–1200?), Italian civilian and canonist, the first known teacher of Roman law in England, was doubtless of the school of Bologna, though of a later generation than the hearers of Irnerius. He was brought to Canterbury, possibly by Becket, together with a supply of books upon the civil law, to act as counsel (*causidicus*) to Archbishop Theobald in his struggle, which ended successfully in 1146, to obtain the transfer of the legateship from the bishop of Winchester to himself. We next hear of Vacarius as lecturing at Oxford, in 1149, to "crowds of rich and poor," and as preparing, for the use of the latter, a compendium, in nine books, of the Digest and Code of Justinian, "sufficient," it was said, "if thoroughly mastered, to solve all legal questions commonly debated in the schools." It became a leading text-book in the nascent university, and its popular description as the *Liber pauperum* gave rise to the nickname *pauperistae* applied to Oxford students of law. Nearly complete MSS. of this work are still in existence, notably in the cathedral libraries at Worcester and Prague and in the town library at Bruges. Fragments of it are also preserved in the Bodleian and in several college libraries at Oxford.

The new learning was not destined to make its way without opposition. King Stephen silenced Vacarius, and ordered the destruction of the books of civil and canon law which had been imported by Theobald. The edict to this effect seems, however, not to have been in force after the death of its royal author in 1154 ("eo magis virtus legis invaluit quo eam amplius nitebatur impietas infirmare," Joh. Sarisburiensis). There is ample evidence that the civil law was soon once more a favourite study at Oxford, where we learn that, in 1190, two students from Friesland were wont to divide between them the hours of the night for the purpose of making a copy of the *Liber pauperum*. Whether or no Vacarius ever resumed his Oxford lectures after their interruption by Stephen we are not informed. In any case he was soon called off to practical work, as legal adviser and ecclesiastical judge in the northern province, by his old friend and colleague at Canterbury, Roger de Pont l'Évêque, after the promotion of the latter, in the year of Stephen's death, to the archbishopric of York. Thenceforth the name of "magister Vacarius" is of very frequent occurrence, in papal letters and the chronicles of the period, as acting in these capacities. He was rewarded with a prebend in the collegiate church of secular canons at Southwell, half of which he was allowed in 1191 to cede to his "nephew" Reginald. He is last heard of in 1198, as commissioned, together with the prior of Thurgarton, by Pope Innocent III. to carry into execution, in the north of England, a letter with reference to the crusade. It is doubtless to the second half of the life of Vacarius that the composition must be attributed of two works the MS. of which, formerly the property of the Cistercian Abbey of Biddleston, is now in the Cambridge University library. One of these, *Summa de assumpto homine*, is of a theological character, dealing with the humanity of Christ; the other, *Summa de matrimonio*, is a legal argument, to the effect that the essential fact in marriage is neither, as Gratian maintains, the *copula*, nor, as Peter Lombard, consent by *verba de praesenti*, but mutual *traditio*.

AUTHORITIES.—Most of the original authorities are textually set out and annotated by Prof. T. E. Holland in vol. ii. of the *Oxford Historical Society's Collectanea* (1890). Wenck, in his *Magister Vacarius* (1820), prints the prologue, and a table of contents, of the *Liber pauperum*, from a MS. now lost. He returns to the subject in Stieber's *Opuscula academica* (1834). F. Maitland in the *Law Quarterly Review*, xiii. pp. 133, 270 (1897), gives a full account of the Cambridge MSS., printing *in extenso* the *Summa de matrimonio* See also Muhlenbruch, *Obs. juris Rom.* i. 36; Hänel, in the *Leips. Lit. Zeitung* (1828), No. 42, "Intelligenzblatt," p. 334; Savigny, *Geschichte*, iv. 423; Stolzel, *Lehre von der operis novi denunt.* (1865), pp. 592–620, and in the *Zeitschrift für Rechtsgeschichte*, vi. p. 234; *Catalogue général des MSS. des bibliothèques publiques de France: Départements*, t. x. Lieberman, in the *English Historical Review*, xi. (1906), pp. 305, 514, identified Vacarius with one "Vac." of Mantua, the author of *Contraria legum Longobardorum*, but withdrew this antecedently improbable suggestion (ib. vol. xiii.) after T. Patella had shown, in the *Atti della R. Academia di Torino*, xxxii., that "Vac. Mantuanus," the author of the *Contraria*, must have been "Vacella," who, in 1189, was a judge at Mantua. (T. E. H.)

VACCINATION (from Lat. *vacca*, a cow), the term originally devised for a method of protective inoculation against small-pox, consisting in the intentional transference to the human being of the eruptive disease of cattle called cow-pox (*vaccinia*). The discovery of vaccination is due to Dr Edward Jenner (*q.v.*), at the time a country medical practitioner of Berkeley, in the vale of Gloucester, whose investigations were first published in 1798 in the form of a pamphlet entitled *An Inquiry into the Causes and Effects of the Variolae Vaccinae, &c.* Many years previously, while he was an apprentice to a medical man at Sodbury, near Bristol, his attention was directed to a belief, widely prevalent in Gloucestershire during the latter half of the 18th century, that those persons who in the course of their employment on dairy farms happened to contract cow-pox were thereby protected from a subsequent attack of small-pox. In particular, his interest was aroused by a casual remark made by a young countrywoman who happened to come to the surgery one day for advice, and who, on hearing mention made of small-pox, immediately volunteered the statement that she could not take the disease, as she had had cow-pox. On coming up to London in 1770, to finish his medical education, Jenner became a pupil of John Hunter, with whom he frequently discussed the question of the possibility of obtaining protection against small-pox. On his return to his native village of Berkeley in 1773, to practise as a medical man, he took every opportunity of talking over and investigating the matter, but it was not until May 1796 that he actually began to make experiments. His first case of vaccination was that of a boy eight years of age, named James Phipps, whom he inoculated in the arm with cow-pox matter taken from a sore on the hand of Sarah Nelmes, a dairymaid, who had become infected with the disease by milking cows suffering from cow-pox. It was apparently not until 1798 that he made his first attempt to carry on a strain of lymph from arm to arm. In the spring of that year he inoculated a child with matter taken directly from the nipple of a cow, and from the resulting vesicle on the arm of the child first operated upon, he inoculated, or, as it may now be more correctly termed, "vaccinated," another. From this child several others were vaccinated. From one of these a fourth remove was successfully carried out, and finally a fifth. Four of these children were subsequently inoculated with small-pox—the "variolous test"—without result. The success of many such experiments, in his own hands and in those of his contemporaries, led Jenner to express his belief—a mistaken one, as events have proved—that the protective influence of vaccination would be found to last throughout the lifetime of the person operated on. Obviously he did not realize the fact that the data at his disposal were insufficient for the formation of an accurate judgment on this point, since time alone could prove the exact duration of the protection originally obtained. Subsequent experience has demonstrated that, as has been well said by a writer in the *Edinburgh Review*, "even after efficient vaccination a slow progress away from safety and towards danger is inevitable, and re-vaccination at least once after childhood is necessary if protection is to be maintained."

Relationship of small-pox and cow-pox.

In applying to cow-pox the term "variolae vaccinae," Jenner gave expression to his belief that this disease was in reality nothing more nor less than small-pox of the cow. But soon it was discovered that if there were such a malady as "small-pox of the cow," there was also, as Dr Loy first satisfactorily demonstrated, a small-pox of the horse, which, under the name of "grease," was resorted to from time to time as a source of vaccine lymph. Jenner had, indeed, put forward the suggestion that "grease" was a necessary antecedent to cow-pox; but even taking this term to have been used by him in the sense of horse-pox, he was, in all probability, mistaken in his assumption. At the same time, however, there can be little doubt that these two diseases are very closely allied, if indeed they be not identical. As evidence of a definite relationship between human small-pox and cow-pox, it may be mentioned that whereas, prior to the introduction of vaccination, epidemics of these disorders frequently arose concurrently, the so-called "natural" cow-pox has now in great measure disappeared. There is, moreover, no appreciable difference in the minute anatomical appearances characteristic of the eruption following on inoculation of one or other of these two affections in the human subject. But of far greater importance in this connexion are the results obtained by numerous observers who, in various parts of the world, and almost from the time of Jenner onwards, have set themselves the task of attempting, by experimental methods, to solve the problem of the true relationship of variola to vaccinia. As the outcome of this work it may now be definitely stated that small-pox lymph, more especially, as the present writer has shown, if obtained from the primary vesicle of a case of the inoculated form of the disease, by passage through the system of the calf can be so altered in character as to become deprived of its power of causing a generalized eruption, while inducing at the site of inoculation a vesicle indistinguishable from a typical vaccine vesicle; and, more important still, that when transferred again to man, it has by such treatment completely lost its former infectious character. Such being the case, it may fairly be asserted that cow-pox, or rather that artificially inoculated form of the disease which we term *vaccinia*, is nothing more nor less than *variola* modified by transmission through the bovine animal. An outbreak of small-pox, indeed, may be turned to account for raising, by appropriate experimental methods, a fresh stock of vaccine lymph.

Bacteriology.

There is much evidence to prove that the results following on vaccination are due to a specific contagium, and, moreover, that the particular micro-organism concerned is capable of existing, during one period of its life-cycle, in a resting or spore form, in which condition it is more resistant to the germicidal effects of glycerine than is the case with non-sporing microbes. Advantage is taken of this fact, in the method devised by the present writer, and now employed officially in England, as also on the Continent and in America, for ensuring the bacteriological purity of vaccine lymph. Up to the present, unfortunately, no satisfactory method has been discovered by which the micro-organism of vaccinia can be unfailingly cultivated on artificial media while still retaining its specific properties.

Vaccination Commission, 1889-96.

The publication in 1896 of the final report of the English Royal Commission on Vaccination, in which the various phases of the vaccination question are discussed on the basis of evidence obtained from witnesses of all shades of opinion during a period extending over no less than six years, considerably simplifies the task of dealing with this subject. The Royal Commission, originally numbering fifteen members,[1] with Lord Herschell as president, was appointed in May 1889, the terms of reference being as follows: "To inquire and report as to—(1) The effect of vaccination in reducing the prevalence of, and mortality from, small-pox. (2) What means, other than vaccination, can be used for diminishing the prevalence of small-pox; and how far such means could be relied on in place of vaccination. (3) The objections made to vaccination on the ground of injurious effects alleged to result therefrom; and the nature and extent of any injurious effects which do, in fact, so result. (4) Whether any, and, if so, what means should be adopted for preventing or lessening the ill effects, if any, resulting from vaccination; and whether, and, if so, by what means, vaccination with animal vaccine should be further facilitated as a part of public vaccination. (5) Whether any alterations should be made in the arrangements and proceedings for securing the performance of vaccination, and, in particular, in the provisions of the Vaccination Acts with respect to prosecutions for non-compliance with the law."

The evidence given before the Royal Commission was published at intervals in a series of Blue-books, but, as stated, it was not until August 1896 that the final report made its appearance. As regards the effect of vaccination in reducing the prevalence of, and mortality from, small-pox, the following conclusions were arrived at, Dr Collins and Mr Picton alone dissenting: "(1) That it diminishes the liability to be attacked by the disease. (2) That it modifies the character of the disease and renders it (*a*) less fatal, and (*b*) of a milder or less severe type. (3) That the protection it affords against attacks of the disease is greatest during the years immediately succeeding the operation of vaccination. It is impossible to fix with precision the length of this period of highest protection. Though not in all cases the same, if a period is to be fixed, it might, we think, fairly be said to cover in general a period of nine or ten years. (4) That after the lapse of the period of highest protective potency, the efficacy of vaccination to protect against attack rapidly diminishes, but that it is still considerable in the next quinquennium, and possibly never altogether ceases. (5) That its power to modify the character of the disease is also greatest in the period in which its power to protect from attack is greatest, but that its power thus to modify the disease does not diminish as rapidly as its protective influence against attacks, and its efficacy, during the later periods of life, to modify the disease is still very considerable. (6) That re-vaccination restores the protection which lapse of time has diminished, but the evidence shows that this protection again diminishes, and that, to ensure the highest degree of protection which vaccination can give, the operation should be at intervals repeated. (7) That the beneficial effects of vaccination are most experienced by those in whose case it has been most thorough. We think it may fairly be concluded that where the vaccine matter is inserted in three or four places, it is more effectual than when introduced into one or two places only, and that if the vaccination marks are of an area of half a square inch, they indicate a better state of protection than if their area be at all considerably below this."

For the evidence, statistical or otherwise, on which these conclusions are based, the Reports of the Royal Commission should be consulted. But reference may here be made to two facts of which proof is overwhelming. (1) Small-pox, in pre-vaccination days a disease of infancy and childhood—like measles at the present day—has in the United Kingdom become a disease mainly of adults. The shifting of age-incidence can only be accounted for by the custom of vaccination in infancy. To this day, when small-pox attacks young unvaccinated children, it is found to be as virulent as, or even more virulent than, small-pox in the unvaccinated at higher ages. On the other hand, small-pox is practically unknown among well-vaccinated children. When, quite exceptionally, such children have been attacked, the disease has been so trivial in character as to be liable to escape recognition altogether. (2) Medical men, nurses and other persons exposed to the disease habitually protect themselves by efficient re-vaccination, and when this precaution has been taken, never contract small-pox.

Efficient vaccination.

The clinical activity and bacteriological purity of the lymph employed for vaccination; the skilful performance of the operation itself; the making an adequate number of insertions of lymph over a sufficient area; the observance of precautions needful for ensuring strict asepsis, both at the time of vaccination and subsequently until the vaccination wounds are soundly healed—all these are matters to be regarded as essential to "efficient vaccination." Certain principles in respect of them are generally recognized, and in the case of public vaccinators, whose work comes under government inspection, a series of instructions on these several points are prescribed by the Local Government Board. First in regard to lymph. That which is now almost universally employed in Great Britain is glycerinated calf lymph, the use of which has entirely superseded, in public vaccinations, the arm-to-arm method which for many years previously had been employed as the best means then attainable of ensuring the activity and comparative purity of the lymph. Glycerinated lymph, under proper conditions, usually retains its potency for many weeks or months; but nevertheless, in certain circumstances at present imperfectly understood, is liable to become gradually weakened, and even eventually to become altogether inert. Possibly the condition of the calves from which the lymph is obtained, especially as regards their general health and the suppleness or the reverse of their skins, or exposure of the lymph to the action of light or to a high temperature, are of special importance. Consequently, in order to ensure the best results from its use, it is not only necessary that great care should be exercised in its manufacture, but it is also advisable that the lymph should be employed for vaccination as soon as possible after bacteriological examination has demonstrated its freedom from suppurative and other extraneous micro-organisms. As regards the carrying out of the operation itself, it is somewhat unfortunate that there exists no official definition of what constitutes a "successful vaccination," and in consequence it is open to any practitioner to give a certificate of successful vaccination in cases where but one minute vesicle may have been produced. It is to be feared that such certificates are too frequently given, and it cannot be too strongly urged that vaccination of this sort involves incomplete protection. The standard laid down by the Local Government Board—the production, namely, of a total area of vesiculation of not less than half a square inch, divided among four separate vesicles or groups of vesicles, not less than half an inch from one another—has for the most part proved easily attainable in practice, and it is much to be desired that in private as in public work the attainment of this standard should be aimed at in every instance.

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[1] The original Commissioners were—Lord Herschell, C. Bradlaugh, Dr Bristowe, Dr Collins, Sir C. Dalrymple, J. S. Dugdale, Q.C., Prof. M. Foster, Sir E. H. Galsworthy, Sir Guyer Hunter, J. Hutchinson, Sir James Paget, J. A. Picton, Sir William Savory, S. Whitbread, F. Meadows White, Q.C. Mr Bradlaugh, Dr Bristowe and Sir William Savory died during the progress of the inquiry. Only one of the vacancies thus caused was filled up, Mr J. A. Bright having been appointed on the death of Mr Bradlaugh.

The protection afforded by a primary vaccination tends gradually to diminish, and eventually to disappear more or less completely, with the lapse of time. In consequence, it is desirable that the operation should be repeated at the age of from seven to ten years, and thereafter, if it be possible, at intervals during later life. The final report of the Royal Commission thus summarizes the evidence as to the value of such additional procedure:—

> "Where re-vaccinated persons were attacked by, or died from, small-pox, the re-vaccination had for the most part been performed a considerable number of years before the attack. There were very few cases where a short period only had elapsed between the re-vaccination and the attack of small-pox. This seems to show that it is of importance, in the case of any persons specially exposed to the risk of contagion, that they should be re-vaccinated, and that in the case even of those who have been twice re-vaccinated with success, if a long interval since the last operation has elapsed, the operation should be repeated for a third, and even a fourth time."

It not unfrequently happens that in the case of a re-vaccination the process runs a somewhat different course from that witnessed in a typical primary vaccination. In a successful re-vaccination, the site of the operation may be distinctly reddened and somewhat irritable by the second day, while papules will probably make their appearance about the third to the fifth day. The papules may or may not develop further into vesicles and pustules. Occasionally a re-vaccination appears to fail altogether; but, as pointed out by the Royal Commission, it is advisable, as in the case of a primary vaccination, to make further attempts with lymph of known potency before concluding that the individual is really insusceptible.

Alleged injurious effects.

In a certain small proportion of cases the operation of vaccination has been followed, after a longer or shorter interval, by various complications, of which by far the most important are those of an inflammatory nature, such as erysipelas, which are not peculiar to vaccination, but which constitute the danger of any local lesion of the skin, however caused. During the many decades in which vaccination from arm to arm was practised, in many millions of children, a few authenticated cases were recorded in which there was reason to believe that syphilis could have been invaccinated. Such an occurrence could at no time have happened if proper care had been taken by the vaccinator; and now that the use of calf lymph has become practically universal, the possibility of such occurrence in the future may be disregarded, since the calf is not capable of contracting this disease. Tubercle in its various forms and leprosy have also been included in the list of possible complications of vaccination, though without any sufficient proof. The employment of calf lymph, treated with glycerine after the manner first advocated by S. Monckton Copeman, will obviate any such danger, for even if tubercle bacilli or the streptococcus of erysipelas were by chance present in the lymph material when collected, it has been found experimentally that they are quite unable to survive prolonged exposure to the action of a 50% solution of glycerine in water. Leprosy is not communicable to the calf. In view of the frequency of various skin eruptions in infancy, it is to be expected that in a proportion of cases they will appear during the weeks following vaccination. Eczema and impetigo in particular have, *post hoc*, been attributed to vaccination, but no direct connexion has been proved to exist between the operation and the occurrence of these disorders. In section 434 of the final report of the Royal Commission on Vaccination the extent to which other inoculable diseases are liable to complicate vaccination is thus summed up:—

> "A careful examination of the facts which have been brought under our notice has enabled us to arrive at the conclusion that although some of the dangers said to attend vaccination are undoubtedly real, and not inconsiderable in gross amount, yet when considered in relation to the extent of vaccination work done, they are insignificant. There is reason, further, to believe that they are diminishing under the better precautions of the present day, and with the additions of the future precautions which experience suggests, will do so still more in the future." (S. M. C.)

Compulsory vaccination.

Legislation making vaccination *compulsory* was first introduced in Bavaria (1807), Denmark (1810), Sweden (1814), Württemburg, Hesse and other German states (1818), Prussia (1835), the United Kingdom (1853), German empire (1874), Rumania (1874), Hungary (1876), Servia (1881), Austria (1886). But in many cases there had been earlier provisions indirectly making it necessary. In the same way, though there is no federal compulsory law in Switzerland, most of the cantons enforce it; and though there is no statutory compulsion in France, Italy, Spain, Portugal, Belgium, Norway, Russia or Turkey, there are government facilities and indirect pressure, apart from the early popularity of vaccination which made it the usual practice. In the United States there is no federal law, but many of the separate states make their own compulsion either directly or indirectly, Massachusetts starting in 1809.

English legislation.

The benefit of vaccination proved itself in the eyes of the world by its apparent success in stamping out small-pox; but there continued to be people, even of the highest competence, who regarded this as a fallacious argument—*post hoc, ergo propter hoc*. The cause of "anti-vaccination" has had many followers in England, and their persistence has had important effect in English legislation. Under the provisions of the Vaccination Act 1898, and of the Vaccination Order (1898) of the Local Government Board, with some minor changes in succeeding acts, numerous changes in connexion with vaccination administration and with the performance of the operation were introduced, in addition to the supersession of arm-to-arm vaccination, by the use of glycerinated calf lymph. Thus, whereas by the Vaccination Acts of 1867 and 1871 the parent or person having the custody of any child was required to procure its vaccination within three months of birth, this period by the act of 1898 was extended to six months. Again, parents were relieved of any penalty under the compulsory clauses of the Vaccination Acts who afforded proof that they had, within four months of the birth of a child, satisfied a stipendiary magistrate, or two justices in petty sessions, that they conscientiously believed that vaccination would be prejudicial to the health of the child. Moreover, proceedings were not to be taken more than twice against a defaulting parent, namely, once under section 29 of the act of 1867, and once under section 31 of the same act, provided that the child had reached the age of four years. Finally, the public vaccinator was now required to visit the homes of children for the purpose of offering vaccination with glycerinated calf lymph, "or such other lymph as may be issued by the Local Government Board." The operative procedure in public vaccinations was formerly based on the necessity of carrying on a weekly series of transferences of vaccine lymph from arm to arm; and for the purposes of such arm-to-arm vaccination the provision of stations, to which children were brought first for the performance of the operation, and again, after a week's interval, for inspection of the results, was an essential. The occasional hardships to the mothers, and a somewhat remote possibility of danger to the children, involved in being taken long journeys to a vaccination station in bad weather, or arising from the collecting together in one room of a number of children and adults, one or more of whom might happen to be suffering at the time from some infectious disorder, are a few of the reasons which appeared to render a change in this regulation desirable; as a matter of fact, it would appear that nothing but good has arisen from the substitution of domiciliary for stational vaccination. There have naturally been some curious discussions before the magistrates as to what is "conscientious" or not, but the working of the so-called "conscience clause" by no means justified the somewhat gloomy forebodings expressed, both in Parliament and elsewhere, at the time of its incorporation in the act of 1898. On the contrary, its operation appeared to tend to the more harmonious working of the Vaccination Acts, by affording a legal method of relief to such parents and guardians as were prepared to affirm that they had a conscientious belief that the performance of the operation might, in any particular instance, be prejudicial to the health of the child.

Authorities.—Acland, "Vaccinia," Allbutt and Rolleston, *System of Medicine* (1906); Baron, *Life of Jenner*; Henry Colburn (London, 1838); Copeman, *Vaccination: Its Natural History and Pathology* (Milroy Lectures) (Macmillan, London, 1899); "Modern Methods of Vaccination and their Scientific Basis," *Trans. Royal Med. and Chir. Society* (1901–2); M'Vail, "Criticism of the Dissentient Commissioners' Report," *Trans. Epidemiological Society* (1897); Reports of the Royal Commission on Vaccination (1889–1896); "The History and Effects of Vaccination," *Edinburgh Review*, No. 388 (1899); *Vaccination Law of German Empire* (Berlin, 1904).

VACHEROT, ÉTIENNE (1809–1897), French philosophical writer, was born of peasant parentage at Torcenay, near Langres, on the 29th of July 1809. He was educated at the École Normale, and returned thither as director of studies in 1838, after some years spent in provincial schoolmasterships. In 1839 he succeeded his master Cousin as professor of philosophy at the Sorbonne. His *Histoire critique de l'école d'Alexandrie* (3 vols. 1846–51), his first and best-known work, drew on him attacks from the Clerical party which led to his suspension in 1851. Shortly afterwards he refused to swear allegiance to the new imperial government, and was dismissed the service. His work *Démocratie* (1859) led to a political prosecution and imprisonment. In 1868 he was elected to the French Academy. On the fall of the Empire he took an active part in politics, was *maire* of a district of Paris during the siege, and in 1871 was in the National Assembly, voting as a Moderate Liberal. In 1873 he drew nearer the Conservatives, after which he was never again successful as a parliamentary candidate, though he maintained his principles vigorously in the press. He died on the 28th of July 1897. Vacherot was a man of high character and adhered strictly to his principles, which were generally opposed to those of the party in power. His chief philosophical importance consists in the fact that he was a leader in the attempt to revivify French philosophy by the new thought of Germany, to which he had been introduced by Cousin, but of which he never had more than a second-hand knowledge. Metaphysics he held to be based on psychology. He maintains the unity and freedom of the soul, and the absolute obligation of the moral law. In religion, which was his main interest, he was much influenced by Hegel, and appears somewhat in the ambiguous position of a sceptic anxious to believe. He sees insoluble contradictions in every mode of conceiving God as real, yet he advocates religious belief, though the object of that belief have but an abstract or imaginary existence.

His other works are: *La Métaphysique et la science* (1858), *Essais de philosophie critique* (1864), *La Religion* (1869), *La Science et la conscience* (1870), *Le Nouveau Spiritualisme* (1884), *La Démocratie libérale* (1892).

See Ollé Laprune, *Étienne Vacherot* (Paris, 1898).

VACQUERIE, AUGUSTE (1819–1895), French journalist and man of letters, was born at Villequier (Seine Inférieure) on the 19th of November 1819. He was from his earliest days an admirer of Victor Hugo, with whom he was connected by the marriage of his brother Charles with Léopoldine Hugo. His earlier romantic productions include a volume of poems, *Enfer de l'esprit* (1840); a translation of the *Antigone* (1844) in collaboration with Paul Meurice; and *Tragaldabas* (1848), a melodrama. He was one of the principal contributors to the *Événement* and followed Hugo into his exile in Jersey. In 1869 he returned to Paris, and with Paul Meurice and others founded the anti-imperial *Rappel*. His articles in this paper were more than once the occasion of legal proceedings. After 1870 he became editor. Other of his works are *Souvent homme varie* (1859), a comedy in verse; *Jean Baudry* (1863), the most successful of his plays; *Aujourd'hui et demain* (1875); *Futura* (1900), poems on philosophical and humanitarian subjects. Vacquerie died in Paris on the 19th of February 1895. He published a collected edition of his plays in 1879.

VACUUM-CLEANER, an appliance for removing dust from carpets, curtains, &c., by suction, and consisting essentially of some form of air-pump drawing air through a nozzle which is passed over the material that has to be cleaned. The dust is carried away with the air-stream and is separated by filtration through screens of muslin or other suitable fabric, sometimes with the aid of a series of baffle-plates which cause the heavier particles to fall to the bottom of the collecting receptacle by gravity. In the last decade of the 19th century compressed air came into use for the purpose of removing dust from railway carriages, but it was found difficult to arrange for the collection of the dust that was blown out by the jets of air, and in consequence recourse was had to working by suction. From this beginning several types of vacuum cleaner have developed.

In the first instance the plants were portable, consisting of a pump driven by a petrol engine or electric motor. and were periodically taken round to houses, offices &c., when cleaning was required. The second stage was represented by the permanent installation of central plants in large buildings, with a system of pipes running to all floors, like gas or water pipes, and provided at convenient points with valves to which could be attached flexible hose terminating in the actual cleaning tools. The vacuum thus rendered available is in some cases utilized for washing the floors in combination with another system of piping connected to a tank containing soap and water, which having been sprayed over the floor by compressed air is removed with the dirt it contains and discharged into the sewers; or in a simpler arrangement the soap and water is contained in a portable tank from which it is distributed, to be sucked up by means of the vacuum as before. In their third stage vacuum cleaners have become ordinary household implements, in substitution for, or in addition to the broom and duster, and small machines are now made in a variety of forms, driven by hand, by foot, or by an electric motor attached to the lighting circuit. In addition to their domestic uses, other applications have been found for them, as for instance in removing dust from printers' type-cases.

VACUUM TUBE. The phenomena associated with the passage of electricity through gases at low pressures have attracted the attention of physicists ever since the invention of the frictional electrical machine first placed at their disposal a means of producing a more or less continuous flow of electricity through vessels from which the air had been partially exhausted. In recent years the importance of the subject in connexion with the theory of electricity has been fully realized; indeed, the modern theory of electricity is based upon ideas which have been obtained from the study of the electric discharge through gases. Most of the important principles deduced from these investigations are given in the article Conduction, Electric (*Through Gases*); here we shall confine ourselves to the consideration of the more striking features of the luminous phenomena observed when electricity passes through a luminous gas.

Methods of producing the Discharge.—To send the current through the gas it is necessary to produce between electrodes in the gas a large difference of potential. Unless the electrodes are of the very special type known as Wehnelt electrodes, this difference of potential is never less than 200 or 300 volts and may rise to almost any value, as it depends on the pressure of the gas and the size of the tube. In very many cases by far the most convenient method of producing this difference of potential is by means of an induction coil; there are some cases, however, when the induction coil is not suitable, the discharge from a coil being intermittent, so that at some times there is a large current going through the tube, while at others there is none at all, and certain kinds of measurement cannot be made under these conditions. Not only is the current intermittent, but it is apt with the coil to be sometimes in one direction and sometimes in the opposite; there is a tendency to send a discharge through the tube not only when the current through the primary is started but also when it is stopped. These discharges are in opposite directions, and though that produced by stopping the current is more intense than that due to starting it, the latter may be quite appreciable. The reversal of the current may be remedied by inserting in series with the discharge tube a piece of apparatus known as a "rectifier" which allows a current to pass through it in one direction but not in the opposite. A common type of rectifier is another tube containing gas at a low pressure and having one of its electrodes very large and the other very small; a current passes much more easily through such a tube from the small to the large electrode than in the opposite direction. Sometimes an air-break inserted in the circuit with a point for one electrode and a disk for the other is sufficient to prevent the reversal of the current without the aid of any other rectifier.

There are cases, however, when the inevitable intermittence of the discharge produced by an induction coil is a fatal objection. When this is so, the potential difference may be produced by a battery of a large number of voltaic cells, of which the most convenient type, where more than a few milli-ampères of current are required, are small storage cells. As each of these cells only produces a potential difference of two volts, a very large number of cells are required when potential differences of thousands of volts have to be produced, and the expense of this method becomes prohibitive. When continuous currents at these high potential differences are rquired, electrostatic induction machines are most generally used. By means of Wimshurst machines, with many plates, or the more recent Wehrsen machines, considerable currents can be produced and maintained at a very constant value.

The exhaustion of the tubes can, by the aid of modern mercury pumps, such as the Töpler pump or the very convenient automatic Gaede pump, be carried to such a point that the pressure of the residual gas is less than a millionth of the atmospheric pressure. For very high exhaustions, however, the best and quickest method is that introduced by Sir James Dewar. In this method a tube containing small pieces of dense charcoal (that made from the shells of coco-nuts does very well) is fused on to the tube to be exhausted. The preliminary exhaustion is done by means of a water-pump which reduces the pressure to that due to a few millimetres of mercury and the charcoal strongly heated at this low pressure to drive off any gases it may have absorbed. The tube is then disconnected from the water-pump and the charcoal tube surrounded by liquid air; the cold charcoal greedily absorbs most gases and removes them from the tube. In this way much higher exhaustions can be obtained than is possible by means of mercury pumps; it has the advantage, too, of getting rid of the mercury vapour which is always present when the exhaustion is produced by mercury pumps. Charcoal does not absorb much helium even when cooled to the temperature of liquid air, so that the method fails in the case of this gas; the absorption of hydrogen, too, is slower than that of other gases. Both helium and hydrogen are vigorously absorbed when the charcoal is cooled to the temperature of liquid hydrogen.

When first the discharge is sent through an exhausted tube, a considerable amount of gas (chiefly hydrogen and carbon monoxide) is liberated from the electrodes and the walls of the tube, so that to obtain permanent high vacua the exhaustion must be continued until the discharge has been going through the tube for a considerable time. One of the greatest difficulties experienced in getting these high vacua is that even when all the joints are carefully made there may be very small holes in the tube through which the air is continually leaking from outside, and when the hole is very small it is sometimes very difficult to locate the leak. The writer has found that a method due to Goldstein is of the greatest service for this purpose. In this method one of the electrodes in the tube and one of the terminals of the induction coil are put to earth, and the pressure of the gas in the tube is reduced so that a discharge would pass through the tube with a small potential difference. The point of an insulated wire attached to the other terminal of the induction coil is then passed over the *outside* of the tube. When it comes to the hole, a very bright white spark may be seen passing through the glass, and in this way the leak located. The appearance of the discharge when the exhaustion is going on is a very good indication as to whether there is any leakage in the tube or not. If the colour of the discharge remains persistently red in spite of continued pumping, there is pretty surely a leak in the tube, as the red colour is probably due to the continued influx of air into the tube. Platinum is the only metal which can be fused through the glass with any certainty that the contact between the glass and the metal will be close enough to prevent air leaking into the tube. Platinum, however, when used as a cathode at low pressures "sputters," and the walls of the tube get covered with a thin deposit of the metal: to avoid this, the platinum is often fastened to a piece of aluminium, which does not sputter nearly so much. Tantalum is also said to possess this property, and it has the advantage of being much less fusible than aluminium. This sputtering depends to some extent on the kind of gases present in the tube, as in monatomic gases, such as mercury vapour, even aluminium sputters badly.

Electrodeless Tubes.—As some gases, such as chlorine and bromine, attack all metals, it is impossible to use metallic electrodes when the discharge through these gases has to be investigated. In these cases "electrodeless" tubes are sometimes used. These are of two kinds. The more usual one is when tin-foil is placed at the ends of the tube on the outside, and the terminals of the induction coil connected with these pieces of foil; the glass under the foil virtually acts as an electrode. A more interesting form of the electrodeless discharge is what is known as the "ring" discharge. The tube in this case is placed inside a wire solenoid which forms a part of a circuit connecting the outside coatings of two Leyden jars, the inside coatings of these jars being connected with the terminals of an induction coil or electrical machine; the jars are charged up by the machine, and are discharged when sparks pass between its terminals. As the discharge of the jars is oscillatory (see ELECTRIC WAVES), electric currents surge through the solenoid surrounding the discharge tube, and these currents reverse their direction hundreds of thousands of times per second. We may compare the solenoid with the primary coil of an induction coil, and the exhausted bulb with the secondary; the rapidly alternating currents in the primary induce currents in the secondary which show themselves as a luminous ring inside the tube. Very bright discharges may be obtained in this way, and the method is especially suitable for spectroscopic purposes (see *Phil. Mag.* [5], 32, pp. 321, 445).

Appearance of the Discharge in Vacuum Tubes.—Fig. 15 b of the article CONDUCTION, ELECTRIC (*Through Gases*) represents the appearance of the discharge when the pressure in the tube is comparable with that due to a millimetre of mercury and for a particular intensity of current. With variations in the pressure or the current some of these features may disappear or be modified. Beginning at the negative electrode *k*, we meet with the following phenomena: A velvety glow runs, often in irregular patches, over the surface of the cathode; this glow is often called the first negative layer. The spectrum of this layer is a bright line spectrum, and Stark has shown that it shows the Döppler effect due to the rapid motion of the luminous particles towards the cathode. Next to this there is a comparatively dark region known as the "Crookes' dark space," or the second negative layer. The luminous boundary of this dark space is approximately such as would be got by tracing the locus of the extremities of normals of constant length drawn from the negative electrode; thus if the electrode is a disk, the luminous boundary of the dark sphere is nearly plain over a part of its surface as in fig. 1, while if the electrode is a ring of wire (fig. 2) the luminous boundary resembles that shown in fig. 17 of the article **Conduction, Electric** (*Through Gases*). The length of the dark space depends on the pressure of the gas and on the intensity of the current passing through it. The width of the dark space increases as the pressure diminishes, and may, according to the experiments of Aston (*Pro. Roy. Soc.* 79, p. 81), be represented with considerable accuracy by the expression $a+b/p$ or $a+c\lambda$, where a, b, c are constants, p the pressure and λ the mean free path of a corpuscle through the gas. The thickness of the dark space is larger than this free path; for hydrogen, for example, the value of c is about 4.

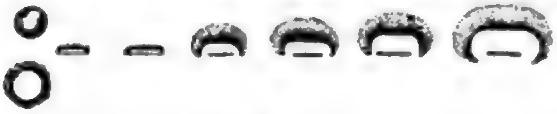

Fig. 1.

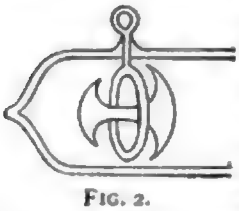

Fig. 2.

When the current is so large that the whole of the cathode is covered with glow the width of the dark space depends upon the current decreasing as the current increases. In helium and hydrogen Aston (*Pro. Roy. Soc.* 80 A., p. 45) has detected the existence of another thin dark space quite close to the cathode whose thickness is independent of the pressure. The farther boundary of the Crookes' dark space is luminous and is known as the negative glow or the third negative layer. Until the current gets so large that the glow next the cathode covers the whole of its surface the potential difference between the cathode and the negative glow is independent of the pressure of the gas and the current passing through it; it depends only on the kind of gas and the metal of which the cathode is made. This difference of potential is known as the cathode fall of potential; the values of it in volts for some gases and electrodes as determined by Mey (*Verh. deuts. Phys. Ges.*, 1903, v. p. 72) are given in the table.

Cathode Fall

Gas	Electrode										
	Pt	Hg	Ag	Cu	Fe	Zn	Al	Mg	Na	Na-K	K
O_2	369	..	..	..	..	..	..	..	..	..	—
H_2	300	..	295	280	230	213	190	168	185	169	172
N_2	232	226	..	.	.	..	..	207	178	125	170
He	226	..	..	..	..	..	..	..	80	78·5	69
Arg	167	.	..	..	..	..	100	..	..	..	—

The cathode fall of potential measures the smallest difference of potential which can produce a spark through the gas. Thus, for example, it is not possible to produce a spark through nitrogen with platinum electrodes with a potential difference of less than 232 volts, except when the electrodes are placed so close together that with a smaller potential difference the electric force between the terminals amounts to more than a million volts per centimetre; for this to be the case the distance between the electrodes must be comparable with the wave-length of sodium light.

When the current is small the glow next the cathode does not cover the whole of the surface, and when this occurs an increase in the current causes the glow to cover a greater area, but does not increase the current density nor the cathode fall. When the current is so much increased that the glow covers the whole of the cathode an increase in current must result in an increase of the current density over the cathode, and this is accomplished by a rapid increase in the cathode fall of potential. The cathode fall in this case has been investigated by Stark (*Phys. Zeit.* 111, p. 274), who finds that its value K can be represented by the equation

$$K=K_n+k(C-xpf)^{\frac{1}{2}}/pf^{\frac{1}{2}},$$

where K_n is the normal cathode fall, f the area of the cathode, C the current through the tube, p the pressure of the gas and k and x constants.

The increase in the potential fall is much more marked in small tubes than in large ones, as with small tubes the formation of the negative glow is restricted; this gives rise to a greater concentration of the current at the cathode and an increase in the cathode fall. The intensity of the electric field in the dark space has been measured by many observers. Aston used very large plain cathodes and measured the electric force by observing the deflection of a small pencil of cathode rays sent across the dark space at different distances from the cathode. He found that the magnitude of the force at a point in the dark space was proportional to the distance of the point from the junction of the negative glow and the dark space. This law of force shows that positive electricity must be in excess in the dark space, and that the density of the electrification must be constant throughout that space. The force inside the negative glow if not absolutely zero is so small that no one has as yet succeeded in measuring it; thus the surface of this glow must be very approximately an equi-potential surface. In the dark space there is a stream of positively electrified particles moving towards the cathode and of negatively electrified corpuscles moving away from it, these streams being mutually dependent; the impact of the positive particles against the cathode gives rise to the emission of corpuscles from the cathode; these, after acquiring kinetic energy in the dark space, ionize the gas and produce the positive ions which are attracted by the cathode and give rise to a fresh supply of corpuscles. The corpuscles which carry the negative electricity are very different from the carriers of the positive; the former have a mass of only $\frac{1}{1700}$ of the atom of hydrogen, while the mass of the latter is never less than that of this atom.

The stream of positive particles towards the cathode is often called the *Canalstrahlen*, and may be investigated by allowing the stream to flow through a hole in the cathode and then measuring, by the methods described in **Conduction, Electric** (*Through Gases*), the velocity and the value of e/m when e is the charge on a carrier and m its mass. It has been found that this stream is somewhat complex and consists of—

α. A stream of neutral particles.

β. A stream of positively electrified particles moving with a constant velocity of 2×10^8 cm./sec., and having $e/m=10^4$. This is a secondary stream produced by the passage of α through the gas, and it is very small when the pressure of the gas is low.

γ. Streams of positively electrified atoms and perhaps molecules of the gases in the tube. The velocity of these depends upon the cathode fall of potential.

The streams of negative corpuscles and positive particles produce different kinds of phosphorescence when they strike against a solid obstacle. The difference is especially marked when they strike against lithium chloride. The corpuscles make it phosphoresce with a steely blue light giving a continuous spectrum; the positive particles, on the other hand, make it shine with a bright red light giving in the spectroscope the red lithium line. This affords a convenient method of investigating the rays; for example, the distribution of the positive stream over the cathode is readily studied by covering the cathode with fused lithium chloride and observing the distribution of the red glow. Goldstein has observed that the film of metal which is deposited on the sides of the tube through the sputtering of the cathode is quickly dissipated when the positive stream impinges on it. This suggests that the sputtering of the cathode is caused by the impact against it of the positive stream. This view is supported by the fact that the sputtering is not very copious until the increase in the current produces a large increase in the cathode fall of potential. The magnitude of the potential fall and the length of the dark space are determined by the condition that the positive particles when they strike against the cathode must give to it sufficient energy to liberate the number of cathode particles which produce, when they ionize the gas, sufficient positive particles to carry this amount of energy. Thus the cathode fall may be regarded as existing to make the cathode emit negative corpuscles. If the cathode can be made to emit corpuscles by other means, the cathode fall of potential is not required and may disappear. Now Wehnelt (*Ann. Phys.*, 1904, 14, p. 425), found that when lime or barium oxide is heated to redness large quantities of negative corpuscles are emitted; hence if a cathode is covered with one of these substances and made red hot it can emit corpuscles without the assistance of an electric field, and we find that in this case the cathode fall of potential disappears, and current can be sent through the gas with very much smaller differences of potential than with cold cathodes. With these hot cathodes a luminous current can under favourable circumstances be sent through a gas with a potential difference as small as 18 volts.

The dimensions of the parts of the discharge we have been considering—the dark space and the negative glow—depend essentially upon the pressure of the gas and the shape of the cathode, and do not increase when the distance between the anode and cathode is increased. The dimensions of the other part of the discharge which reaches to the anode and is called the positive column depends upon the length of the tube, and in long tubes constitutes by far the greater part of the discharge. This positive column is separated from the negative glow by a dark interval generally known as the Faraday dark space; the dimensions of this dark interval are very variable—it is sometimes altogether absent.

The positive column assumes a considerable variety of forms as the current through the gas and the pressure are varied: sometimes it is a column of uniform luminosity, at others it breaks up into a series of bright and dark patches known as striations. Some examples of these are given in fig. 17 of Conduction, Electric (*Through Gases*) The distance between the striations varies with the pressure of the gas and the diameter of the tube, the bright parts being more widely separated when the pressure is low and the diameter of the tube large, than when the pressure is high and the tube small. The striations are especially brilliant and steady when a Wehnelt cathode covered with hot lime is used and the discharge produced by a number of storage cells, by this means large currents can be sent through the tube, resulting in very brilliant striations. When the current is increased the positive column shortens, retreating backwards towards the anode, and may, by using very low currents, be reduced to a glow over the surface of the anode. The electric force in the positive column has been measured by many observers. It is small compared with the forces which exist in the dark space: when the luminosity in the positive column is uniform, the force there is uniform; when the positive column is striated there are periodic variations in the electric force, the force being greater in the bright parts of the striation than in the dark.

Anode Drop of Potential.—Skinner (*Wied. Ann.* 68, p. 752; *Phil. Mag.* [6], 8, p. 387) has shown that there is a sudden change in potential between the anode itself and a point in the gas close to the anode. This change amounts to about 20 volts in air; it is thus much smaller than the cathode fall of potential, and it is also much more abrupt. There does not seem to be any region at the anode comparable in dimensions with the Crookes' dark space in which the drop of potential occurs.

The highly differentiated structure we have described is not the only way in which the current can pass through the tube. If a large Leyden jar is suddenly discharged through the tube the discharge passes as a uniform, continuous column stretching without interruption from anode to cathode; Goldstein has shown (*Verh. deutsch. phys. Ges.* 9, p. 321) that the spectrum of this discharge shows very interesting characteristics. (J. J. T.)

VÁCZ (Ger. *Waitzen*), a town of Hungary, in the county of Pest-Pilis-Solt-Kis-Kun, 20 m. N. of Budapest by rail. Pop. (1900) 16,563. It is situated on the left bank of the Danube, at the point where this river takes its southern course, and at the foot of the Nagyszál (Ger. *Waitzenberg*), on the outskirts of the Carpathians. It is the seat of a Roman Catholic bishopric, founded in the 11th century, and contains a beautiful cathedral, built in 1761–1777, after the model of St Peter's at Rome. Amongst other buildings are the episcopal palace, with a museum of Roman and medieval antiquities, several convents, and the principal deaf and dumb institute in the country. There are large vineyards in the neighbouring hilly district, and the exportation of grapes is extensively carried on. Vácz was the scene of two victories gained by the Austrians against the Turks, one in 1597 and the other in 1684.

VADE-MECUM, a Latin phrase meaning literally "come with me" (*vade*, imperative of *vadere*, to go or come; *cum*, with; *me*, abl. of *ego*, I), and used in French, Spanish and English for something that a person is in the habit of constantly taking about with him, especially a book of the nature of a handy guide or work of reference.

VAGRANCY (formed from "vagrant," wandering, unsettled; this word appears in Anglo-Fr. as *wakerant* and O.Fr. as *wancrant*, and is probably of Teut. origin, cf. M.L.G. *welkern*, to walk about; it is allied to Eng. "walk," and is not to be directly referred to Lat. *vagari*), the state of wandering without any settled home; in a wider sense the term is applied in England and the United States to a great number of offences against the good order of society. An English statute of 1547 contains the first mention of the word "vagrant," using it synonymously with "vagabond" or "loiterer." Ancient statutes quoted by Blackstone define vagrants to be "such as wake on the night and sleep on the day and haunt customable taverns and alehouses and routs about; and no man wot from whence they come ne whither they go." The word vagrant now usually includes idle and disorderly persons, rogues, vagabonds, tramps, unlicensed pedlars, beggars, &c.

The social problem of vagrancy is one that in 1910 had not yet been satisfactorily dealt with, so far as the United Kingdom is concerned. Indeed, the legislation of the early 19th century remained still in force in England and Wales. In early times, legislation affecting the deserving poor and vagrants was blended. It was only very gradually that the former were allowed to run a freer course, but provisions as to vagrancy and mendicity, including stringent laws in relation to constructive "sturdy beggars," "rogues" and "vagabonds," formed, until well on in the 19th century, a prominent feature of Poor Law legislation. In 1713 an act was passed for reducing the laws relating to rogues, vagabonds, sturdy beggars and vagrants into one act, and for more effectually punishing them and sending them to their homes, the manner of conveying them including whipping in every county through which they passed. This act was in turn repealed in 1740; the substituted consolidation act (13 Geo. II. c. 24), embracing a variety of provisions, made a distinction between idle and disorderly persons, rogues and vagabonds and incorrigible rogues. Four years later was passed another statute which continued the rough classification already mentioned. The laws relating to idle and disorderly persons, rogues and vagabonds, incorrigible rogues and other vagrants in England were again consolidated and amended in 1822, but the act was superseded two years later by the Vagrancy Act (5 Geo. IV. c. 83), which in 1910 was the operative statute.

The offences dealt with under the act of 1824 may be classified as follows: (1) offences committed by persons of a disreputable mode of life, such as begging, trading as a pedlar without a licence, telling fortunes, or sleeping in outhouses, unoccupied buildings, &c., without visible means of subsistence; (2) offences against the poor law, such as leaving a wife and family chargeable to the poor rate, returning to and becoming chargeable to a parish after being removed therefrom by an order of the justices, refusing or neglecting to perform the task of work in a workhouse, or damaging clothes or other property belonging to the guardians; (3) offences committed by professional criminals, such as being found in possession of house-breaking implements or a gun or other offensive weapon with a felonious intent, or being found on any enclosed premises for an unlawful purpose, or frequenting public places for the purpose of felony.

Offences specially characteristic of vagrancy are begging, sleeping out, and certain offences in casual wards, such as refusal to perform a task of work and destroying clothes. Persons committing these last-mentioned offences are classed as "idle and disorderly persons" and are liable on summary conviction to imprisonment with hard labour for fourteen days or on conviction by a petty sessional court to a fine of £5 or a month's imprisonment with or without hard labour. A second conviction makes a person a "rogue and vagabond" liable on summary conviction to imprisonment for fourteen days or on conviction by a petty sessional court to a fine of £25 or imprisonment for three months with or without hard labour. Any person sleeping out without visible means of subsistence is a rogue and vagabond, or on second conviction an incorrigible rogue, while an ordinary beggar is an idle and disorderly person. Under the poor law as reformed in 1834 the primary duty of boards of guardians was to relieve destitute persons within their district, but legislation and administration gradually widened that duty, so that eventually they came to administer relief to vagrants also, or casual paupers, as they are officially termed.

Casual Wards.

Within the limits prescribed by the local government board the treatment in English casual wards varies in a striking degree. Before admission to a casual ward a vagrant requires an order, obtained either from a relieving officer or his assistant. In cases of sudden or urgent necessity, however, the master of the workhouse has power to admit without an order. Generally speaking, vagrants are not admitted to the casual wards before 4 p.m. in winter or 6 p.m. in summer. On admission, they are supposed to be searched, but this is not usually done with much thoroughness; broken food found on them is sometimes allowed to be eaten in the ward; money, pipe, tobacco, &c., are restored to them on discharge. As soon as practicable after admission vagrants are required to be cleansed in a bath with water of suitable temperature. Their clothes are taken away and disinfected and a nightshirt provided. Sleeping accommodation is provided either on the cellular system or in associated wards, the proportion of workhouses providing the former being 2 to 1. Vagrants are, as a general rule, supposed to be detained two nights and are required to perform a task of work. This consists of stone-breaking, wood-sawing, wood-chopping, pumping, digging or oakum picking, and should represent nine hours' work.

The supervising authority has endeavoured, in prescribing the work to which vagrants are put, to make it as deterrent as possible, but in practice the work presents little difficulty to the habitual vagrant, and very few workhouses enforce the two nights' detention rule. The fare provided for vagrants is a welcome relief, too, from their usual scanty fare, and in many of the modern workhouses the wards are almost luxurious in their style and equipment.

Reform movement.

The consequence of this generous treatment of those who are "work-shy" is that instead of being repelled or reformed by their treatment, the class is continually on the increase. This increase has received the serious attention of social reformers, and in 1904 the president of the local government board appointed a departmental committee to inquire into the subject of vagrancy. The committee presented its report in 1906, which with the evidence of witnesses is a most valuable exposition of the subject. Among the various recommendations of the committee the most important were the transference of casual wards to the control of police authorities; the issue of way-tickets, as used on the continent of Europe and a very few English counties, by the police to *bona fide* work-seekers, and more especially the detention of habitual vagrants in labour colonies. This last recommendation was also that of the Royal Commission on the Poor Laws which reported in 1909, to which those interested are also referred for valuable information.

The system of way-tickets has been found useful in Germany and Switzerland in assisting the genuine work-seeker on his way and in discriminating between him and the idle vagrant. In Germany those leaving their districts must carry certain papers of identification in addition to a *Wanderschein* or way-ticket. For the relief of the destitute wayfarer there is the *Herberge* or lodging-house, maintained by a voluntary society, and the *Verpflegungs-station*, or relief station, maintained by the local authorities. In each, those in search of work can obtain lodging and food either for a small payment or by the performance of three hours' work, such as wood-chopping or stone-breaking. In Switzerland way-tickets are issued by a society named the Inter-Cantonal Union to those who can prove that they have worked for an employer within the three preceding months, and that at least five days have elapsed since that employment ceased. The Vagrancy Committee recommended that the English way-ticket in book form should give the man's personal description, his usual trade, his reason for wanting to travel and his proposed destination, and should contain his signature and, possibly, his finger-prints for the purpose of testing identity The name of each casual ward visited should be stamped on the ticket. The duration of the ticket should be limited to a certain period, possibly a month. With such a ticket, a man should be entitled at the casual ward to a night's lodging, supper and breakfast, and after performing two hours' work to help to pay for his food and lodging he should be free to leave whenever he liked. The name of the next ward on the direct line of his route, which he could reach that night, should be entered on the ticket, and on his arrival at that place he should be treated in the same manner. The ticket would thus form a record of his journey and show whether he was genuinely in search of work.

Labour colonies.

The remedy which has been considered as most likely to be effective for the cure of habitual vagrancy in England is that of labour colonies, which have been tried on the continent of Europe with a substantial measure of success. These European labour colonies are described in detail in the appendices to the Report and Evidence of the Vagrancy Committee and in the books mentioned at the end of this article, but a *résumé* of the more important colonies may here be given.

Holland.—There are two classes of colonies, both originally established by the *Maatschaapij van Weldadigheid* (Society of Beneficence), a society founded by General van den Bosch (1780–1844) in 1818. The *Free Colonies* were designed for the reception of indigent persons, for the purpose of teaching them agriculture, and so enabling them eventually to earn their own living independently. There are three of these free colonies, viz. Frederiksoord, Willemsoord and Wilhelminasoord, forming practically one colony, with a population of about 1500. The expenses of the colonies are met by voluntary subscriptions, but it has been found that the persons who enter the free colonies remain there and few fresh cases are received. The number of inmates has been steadily decreasing. The society also maintained *Beggar Colonies* for the compulsory detention of persons committing the offence of begging. They were more penal than reformatory institutions, and the inmates were taught certain occupations by which they might support themselves on leaving. They did not prove self-supporting and were eventually taken over by the state. The chief institution is that at Veenhuizen, which occupies some 3000 acres of land, and where some 4000 men of the vagrant class are detained for periods varying from not less than six months to not more than three years. There is a similar institution for women at Leiden.

Belgium.—In Belgium the institutions for the repression of vagrancy are maintained by the state under a law of November 27th, 1891. They are of three kinds:—(1) *Dépôts de mendicité* (beggars' depots); (2) *maisons de refuge* (houses of refuge); and (3) *écoles de bienfaisance* (reformatory schools). The beggars' depots are "exclusively devoted to the confinement of persons whom the judicial authority shall place at the disposal of the government" for that purpose, and these are classified as (*a*) able-bodied persons who, instead of working for their living, depend upon charity as professional beggars; (*b*) persons, who, owing to idleness, drunkenness or immorality, live in a state of vagrancy; and (*c*) *souteneurs.* There are two of these depots: one for men at Merxplas, and another for women at Bruges. Persons are committed to the depots on summary conviction for a period of not less than two years or more than seven years. The population of Merxplas is over 5000; the colonists are employed in land reclamation, farming and various industries. Small daily wages, varying from 1d. to 3d., are paid, but these may be withheld for disciplinary purposes. One half of the wages is retained by the management and paid out to the colonist on leaving, the other half being given monthly in the shape of tokens to spend at the canteen in articles of food, tobacco, &c.

The houses of refuge are for men who from age or infirmity are unable to work, or who have been driven to begging or vagrancy by the want of work or misfortune. The chief house of refuge is at Hoogstraeten, where the helpless and sick are received, that at Wortel being reserved for the able-bodied. The colonists earn wages ranging from 1d. to 7d. a day, one-third of this being given to them to spend, and they may take their discharge when they have saved 12s. from their earnings or can show that they have work to go to. The maximum period of detention is one year.

Germany.—In Germany there are between thirty and forty labour colonies, under the management of a charitable association, the Labour Colony Central Board. There is however, no compulsory detention. The institutions which deal with vagrants and persons who neglect to maintain themselves are termed "workhouses" (*Arbeitshäuser*), but they correspond to the compulsory colonies of Belgium and Holland. Under the penal code of 1900, any one (*a*) who wanders about as a vagabond; (*b*) who begs, or causes or allows his children to beg; (*c*) who through gambling, drunkenness or idleness is forced to apply for relief for himself, or those for whose maintenance he is responsible; (*d*) who while in receipt of public relief refuses to do work given him by the authorities; (*e*) who after losing his lodging fails to procure another within a certain time, is liable to detention in a workhouse for a period not exceeding two years. The workhouses are under strict military discipline, the inmates being termed prisoners. They are taught domestic, agricultural and industrial occupations.

Switzerland.—Labour colonies are of two kinds, voluntary and compulsory. The voluntary colonies, of which there are three in Switzerland, are managed by philanthropic societies. Entry and discharge are voluntary, but those seeking admission must agree to stay a stated time, usually one or two months. Compulsory colonies are established in every canton, under the management of the cantonal council. Beggars can be arrested, and, if habitual offenders, can be sent to a labour colony for a period varying from six months to two years. If the man is found to have refused work, he can be sent to a labour colony as a "work-shy" for from three months to two years. Owing in great measure to the success of these labour colonies, vagrancy has considerably diminished in Switzerland, and the colonies everywhere are small; that at Witzwyl, the largest, having less than 200 inmates. Punishment is generally inflicted by reduction of food; the inmates receive no wages, but by industry may earn a remission of their period of detention

AUTHORITIES.—For a history of vagrancy see C. J. Ribton-Turner, *History of Vagrants and Vagrancy* (1887); see also *Reports, Evidence and Appendices of Departmental Committee on Vagrancy, 1906*—a most valuable publication—as well as *The Vagrancy Problem* (1910), by W. H. Dawson, who was a witness before the committee, and whose work quoted is full of first-hand information. Two Board of Trade Reports on "Agencies and Methods for dealing with the Unemployed," 1893 and 1904, will be found useful, as also Rev. W. Carlile and V. W. Carlile's *The Continental Outcast* (1906).

(T. A. I.)

VAISON, a town of south-eastern France, in the department of Vaucluse, 26 m. N.N.E. of Avignon by road. Pop. (1906) 2148. The Ouvèze, a tributary of the Rhone, divides Vaison into two quarters—the Roman and early medieval town on the right bank, and the town of the later middle ages on the left bank,—the two communicating by an ancient Roman bridge consisting of a single arch. On the right bank is the church (once the cathedral) of Ste Marie, the choir of which is thought to date in parts from the 9th century, while the nave belongs to the 12th century. A Romanesque cloister containing a collection of old sculpture flanks the church on the north. Remains of a Roman amphitheatre and the chapel of St Quenin (dedicated to a bishop of the 6th century), with a curious apse of the end of the 11th century, are also to be seen in the old town. On the left bank are the parish church (15th and 16th centuries), remains of the medieval fortifications, and the keep of a castle of the counts of Toulouse. The industries of the town include the manufacture of wooden shoes, bellows and agricultural implements. Vaison, under the name of *Vasio*, was one of the principal towns of the *Voconlii*, and was a place of great importance under the Romans, as is shown by an abundance of objects unearthed by excavation, amongst which may be mentioned a fine statue of an athlete (the Diadumenos) in the British Museum. The bishopric established in the 3rd century was suppressed in 1791. Its holders, towards the end of the 12th century, were despoiled of the temporal power in the town by the counts of Toulouse. Subsequently Vaison came, together with the rest of Comtat-Venaissin, under the power of the popes.

VALAIS (Ger. *Wallis*, Ital. *Vallese*), one of the cantons of southern Switzerland. Its name has been explained as meaning the "Wälsch" (*i.e.* non-Teutonic) land. But it is pretty certainly derived from *vallis* or *vallensis pagus*, for the region is simply the old *Vallis Poenina*, or upper valley of the Rhone from its source in the Rhone glacier to the gorge of St Maurice, together with the left bank of the Rhone from that gorge to the Lake of Geneva. The spelling "Vallais" prevailed till the end of the 18th century, and was officially superseded early in the 19th century by "Valais," a form that is very rarely found previously.

The total area of the canton is 2016·6 sq. m. (exceeded only by that of the Grisons and of Bern), of which, however, only 1107 is reckoned as "productive" (forests covering 297·4 sq. m. and vineyards 10·7 sq. m.), while of the rest no fewer than 375 sq. m. (the most considerable stretch in Switzerland) is occupied by glaciers, and 41¾ sq. m. by the cantonal share of the Lake of Geneva. It is therefore naturally one of the poorest cantons in the confederation. It would be still poorer were it not for its excellent wines, and for the fact that in summer-time it is visited by many thousands of travellers, for whom inns have been built in nearly every glen and on many high pastures (Zermatt, Saas, Riffel Alp, Evolena, Arolla, Zinal, Champéry, in the Val de Bagnes, in the Lötschen valley, the Bel Alp, the Rieder Alp, the Eggishorn, Binn, and near the Rhone glacier). It consists of a deep and long trench, which becomes a mere gorge between Niederwald and Brieg, the general direction being south-west, till at Martigny the valley makes a sharp bend to the north-west. The loftiest point in the canton is the culminating summit or Dufourspitze (15,217 ft.) of Monte Rosa, which rises on a short spur projecting from the watershed, but the highest mountain which is wholly situated in the canton is the Dom (14,942 ft.), the culminating point of the Mischabel range.

A railway line runs through the canton from Le Bouveret, on the Lake of Geneva, to (73 m.) Brieg, at the N. mouth of the magnificent Simplon tunnel (12¼ m., opened in 1906), the line from St Maurice (about 14 m. from Bouveret) onwards forming the through line from Lausanne towards Milan. There are also mountain railways from Visp up to Zermatt (thence a branch up to the Gornergrat), and from Vernayaz (near Martigny) past Salvan towards Chamonix, while the new tunnel, begun in 1906, beneath the Lötschen Pass or Lötschberg, connects Kandersteg, in the Bernese Oberland, with Brieg, and thus opens up a new direct route from London and Paris to Italy As the canton is shut in almost throughout its entire length by high mountain ranges it is as a rule only accessible by foot paths or mule paths across this lofty Alpine barrier. But there are excellent carriage roads over the Great St Bernard Pass (8111 ft.), as well as over the Simplon Pass (6592 ft.), both leading to Italy. At the very head of the Rhone valley two other finely engineered carriage roads give access to Uri over the Furka Pass (7992 ft.) and to the canton of Bern over the Grimsel Pass (7100 ft.). Being thus shut in it was almost impossible for the canton to extend its boundaries, save in 1536, when it won the left bank of the Rhone below the gorge of St Maurice. But at early though unknown dates it acquired and still holds the upper bit of the southern slope of the Simplon Pass, as well as the Alpine pastures on the northern slope of the Gemmi. The mineral waters of Leukerbad, and, to a lesser degree, those of Saxon, attract some summer visitors, the vast majority of whom, however, prefer the glorious scenery of the various high Alpine glens.

The canton forms the diocese of Sion (founded in the 4th century), and has St Théodule (or Theodore) as its patron saint. Till 1513 the diocese was in the ecclesiastical province of Moûtiers in the Tarentaise (Savoy), but since then has been immediately dependent on the pope. Within its limits are the three famous religious houses (all now held by Austin Canons) of St Maurice (6th century), of the Great St Bernard, and of the Simplon. Since 1840 the abbot of St Maurice has borne the title of bishop of Bethlehem "in partibus infidelium." Ecclesiastical affairs are managed without any control or interference on the part of the state, though the cantonal legislature presents to the pope as bishop one of four candidates presented by the chapter of Sion.

In 1900 the population was 114,438, of whom 74,562 were French-speaking, 34,339 German-speaking, and 5469 Italian-speaking, while 112,584 were Romanists, 1610 Protestants, and 25 Jews. The linguistic frontier has varied in the course of ages. Nowadays from Sierre (10 m. above Sion) upwards a dialect of German is generally spoken (though it is said that the opening of the Simplon through route has given a considerable impetus to the extension of French among the railway officials), while below Sierre a French dialect (really a Savoyard patois) is the prevailing tongue. To a considerable degree the history of the Valais is a struggle between the German element (predominant politically till 1798) and the French element. Good wines are produced in the district, especially Muscat and Vin du Glacier. Otherwise the inhabitants of the main valley (at least from Brieg onwards) are engaged in agriculture, though suffering much from the inundations of the Rhone, against which great embankments have been constructed, while many swampy tracts have been drained, and so the plague of malarial fever abated to a certain extent.

In the higher valleys the inhabitants are employed in pastoral occupations. The number of "alps" or mountain pastures is 547 (319 in the Lower Valais and 228 in the Upper Valais, the line of division being drawn a little above Sierre), capable of supporting 50,735 cows (33,192 and 17,543 respectively) and of an estimated capital value of 10,873,900 fr. (7,969,500 and 2,904,400 respectively), so that, as might be expected for other reasons, the lower portion of the valley where the climate is less rigorous is richer and more prosperous than the upper portion where other conditions prevail. The capital is Sion (*q.v.*). Next in point of population came (in 1900) Naters (3953), on account of the numbers of Italian workmen engaged in piercing the Simplon tunnel. The neighbouring town of Brieg had then 2182 inhabitants, and the wide commune of Monthey 3392.

The canton is divided into 13 administrative districts, which comprise 166 communes. The cantonal constitution was little advanced till 1907 when it was entirely remodelled. The legislature (*Grand Conseil* or *Gross Rath*) is composed of members elected in the proportion of one for every 1000 (or fraction over 500) citizens, and holds office for four years. The executive (*Conseil d'État* or *Staatsrath*) is composed of five members, named by the Grand Conseil, and holds office for four years. The "obligatory referendum" prevails, while 4000 citizens (6000 in the case of a revision of the cantonal constitution) have the right of "initiative" as to legislative projects. The two members of the Federal *Ständerath* are named by the Grand Conseil, but the six members of the Federal *Nationalrath* are elected by a popular vote. The 1907 cantonal constitution has a curious provision (art. 84) that while members of the cantonal legislature are ordinarily elected by all the voters of a *Bezirk* or district, yet if one or several communes (numbering over 500 inhabitants) demand it, this commune or these communes form a *kreis* or *cercle* and elect a member or members.

The Vallis Poenina was won by the Romans after a great fight at Octodurus (Martigny) in 57 B.C., and was so thoroughly Romanized that the Celtic aboriginal inhabitants and the Teutonic Burgundian invaders (5th century) became Romance-speaking peoples. According to a tradition which can be traced back to the middle of the 8th century, the "Theban legion" was martyred at St Maurice about 285 or 302. Valais formed part of the kingdom of Transjurane Burgundy (888), which fell to the empire in 1032, and later of the duchy of Burgundia Minor, which was held from the emperors by the house of Zähringen (extinct 1218). In 999 Rudolph III. of Burgundy gave all temporal rights and privileges to the bishop of Sion, who was later styled "praefect and count of the Valais," and is still a prince of the Holy Roman Empire; the pretended donation of Charlemagne is not genuine. The bishops had much to do in keeping back the Zähringen, and later the counts of Savoy. The latter, however, succeeded in winning most of the land west of Sion, while in the upper part of the valley there were many feudal lords (such as the lords of Raron, those of La Tour-Châtillon, and the counts of Visp). About the middle of the 13th century we find independent communities or "tithings" (*dizains* or *Zehnten*) growing up, these, though seven in number, taking their name most probably from a very ancient division of the bishop's manors for administrative and judicial purposes. In the same century the upper part of the valley was colonized by Germans from Hasli (Bern), who thoroughly Teutonized it, though many Romance local names still remain. In 1354 the liberties of several of the seven "tithings" (Sion, Sierre, Leuk, Raron, Visp, Brieg and Conches) were confirmed by the Emperor Charles IV. A little later the influence of Savoy became predominant, and the count secured to his family the bishopric of Sion, of which he was already the suzerain. His progress was resisted by the tithings, which in 1375–76 crushed the power of the house of La Tour-Châtillon, and in 1388 utterly defeated the forces of the bishop, the count and the nobles at Visp, this being a victory of the Teutonic over the Romance element in the land. From 1384 the Morge stream (a little below Sion) was recognized as the boundary between Savoyard or Lower Valais and episcopal or Upper Valais. In 1416–17 the *Zehnten* of the upper bit of the valley made an alliance with Lucerne, Uri and Unterwalden, with a view partly to the conquest of the Val d'Ossola, which was finally lost in 1422, and partly to the successful crushing of the power of the lords of Raron (1420). By the election of Walther von Supersax of Conches as bishop in 1457 the Teutonic element finally won the supremacy. On the outbreak of the Burgundian War the bishop of Sion and the tithings made a treaty with Bern. In November of the same year (1475) they seized all Lower or Savoyard Valais up to Martigny, and in 1476 (March), after the victory of Grandson, won St Maurice, Evian, Thonon and Monthey. The last three districts were given up in 1477, but won again in 1536, though finally by the treaty of Thonon in 1569 Monthey, Val d'Illiez and Bouveret alone were permanently annexed to the Valais, these conquests being maintained with the help of their old allies, Uri, Schwyz and Unterwalden. These conquered districts (or Lower Valais) were always ruled as subject lands by the bishop and tithings of Upper Valais. The Valais took part in the Milanese war of 1512–16, and henceforth was reckoned as an "ally" of the Swiss Confederation. In 1533 a close alliance was made with the Romanist cantons; but by 1551 the Protestants had won so much ground that toleration was proclaimed by the local assembly. In 1586 Upper Valais became a member of the Golden League, and finally in 1603–04 the four tithings of Conches, Brieg, Visp and Raron carried the day in favour of the old faith against those of Leuk, Sierre and Sion. In 1790–91 Lower Valais rose in revolt; but it was not finally freed till 1798, when the whole of Valais became one of the cantons of the Helvetic Republic. Such prolonged and fierce resistance was, however, offered to French rule by the inhabitants that in 1802 Bonaparte declared Valais an independent state under the name of the "Rhodanic Republic," yet in 1810, for strategic reasons, he incorporated it with France as the "department of the Simplon," and it was not freed till the Austrians came in 1813. In 1815 a local assembly was created, in which each of the seven tithings of Upper and each of the six of Lower Valais (though the latter had nearly double the population of the former) elected four members, the bishop being given four votes. This constitution was approved by the Federal Swiss Diet, which thereupon (1815) received the Valais as a full member of the Swiss Confederation. In 1832 the Valais joined the League of Sarnen to maintain the Federal Pact of 1815. In 1839–40 it was convulsed by a struggle between the Conservative and Radical parties, the split into two half cantons being only prevented by the arrival of Federal troops. The constitution was revised in 1839, the local assembly was to be elected according to population (1 member for every 1000 inhabitants), and the bishop was given a seat instead of his four votes, while the clergy elected one deputy. In 1844 civil war raged, many Liberals being slain at the bridge of Trient (May 1844), and the Valais becoming a member of the Sonderbund. By the 1844 constitution the clergy elected a second deputy. The introduction of the Jesuits embittered matters, and the Valais was the last canton to submit in the Sonderbund War (1847); it contented itself, however, with voting steadily against the acceptance of the Federal constitutions of 1848 and 1874. By the constitution of 1848 all ecclesiastical exemptions from taxation were swept away, and the bishop lost his seat in the assembly. New constitutions were framed in 1852, in 1875 and in 1907.

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VALDEMAR I., king of Denmark (1131–1182), the son of the chivalrous and popular Canute Lavard and the Russian princess Ingeborg, was born a week after his father's murder, and was carefully brought up in the religious and relatively enlightened household of Asser Rig, whose sons Absalon and Esbjörn Snare, or "the Swift," were his playmates. On the death of King Eric Lam in 1147 Valdemar came forward as one of the three pretenders to the Danish crown, Jutland falling to his portion (compact of Roskilde, 9th of August 1157). Narrowly escaping assassination, at a banquet a few days later, at the hands of his rival, King Sweyn III., he succeeded only with the utmost difficulty in escaping to Jutland, but on the 23rd of October utterly routed Sweyn at the great battle of Grathe Heath, near Viborg, Sweyn perishing in his flight from the field. Valdemar had no longer a competitor. He was the sole male survivor of the ancient royal line; his valour and ability were universally recognized, and in Absalon, elected bishop of Roskilde in 1158, he possessed a minister of equal genius and patriotism. The first efforts of the new monarch were directed against the Wendish pirates who infested the Baltic and made not merely the political but even the commercial development of the Danish state impossible. What the Northmen were to the Western powers in the 8th and 9th the Wends were to the Scandinavian lands in the 11th and 12th centuries. But the Wendish pirates were more mischievous because less amenable to civilization than the Vikings. They lived simply for plunder, and had neither the ambition nor the ability to found colonies like Normandy or Northumbria. We may form some idea of the extent and the severity of their incursions from the fact that at the beginning of the reign of Valdemar the whole of the Danish eastern coast lay wasted and depopulated. Indeed, according to Saxo, one-third of the realm was a wilderness. The stronghold of the Wends was the isle of Rügen. Here lay Arkona their chief sanctuary and Garz their political capital. Both places were captured in 1169 by a great expedition under the command of Valdemar and Absalon; the hideous colossal idol of Rügievit was chopped into firewood for the Danish caldrons, and the Wends were christened at the point of the sword and placed beneath the jurisdiction of the see of Roskilde. This triumph was only obtained, however, after a fierce struggle of ten years, in which the Danes were much hampered by the uncertain and selfish co-operation of their German allies, chief among whom was Henry the Lion, duke of Saxony and Bavaria, who appropriated the lion's share of the spoil. For at the beginning of his reign Valdemar leaned largely upon the Germans and even went the length, against the advice of Absalon, of acknowledging the over-lordship of the Emperor Frederick Barbarossa at the reichstag of Dôle, 1162. Very different was Valdemar's second conference with Barbarossa, on the banks of the Eider, in 1182, when the two monarchs met as equals in the presence of their respective armies, and a double marriage was arranged between two of Valdemar's daughters and two of the emperor's sons. The only serious domestic trouble during Valdemar's reign was the rebellion of the Scanian provinces, which objected to the establishment of a strong monarchy inimical to local pretensions and disturbances, and especially to the heavy taxes and tithes necessary to support the new reign of law and order. The rising was ultimately suppressed by Absalon at the battle of Dysiaa, 1181. In the following year died King Valdemar. His services to his country are aptly epitomized in the epitaph on his ancient monument at Ringsted church which describes him as "Sclavorum dominator, patriae liberator et pacis conservator." His fame has been somewhat obscured by that of his great minister Absalon, whom their common chronicler Saxo constantly magnifies at the expense of his master. Valdemar's worst faults were a certain aloofness and taciturnity. He is the only one of Saxo's heroes in whose mouth the chronicler never puts a speech. But his long reign is unstained by a single ignoble deed, and he devoted himself heart and soul to the promotion of the material and spiritual welfare of Denmark.

See *Danmarks Riges Historie*, vol. i. pp. 570–670 (Copenhagen, 1897–1905); Saxo, *Gesta Danorum*, books 10–16 (Strassburg, 1886). (R. N. B.)

VALDEMAR II., king of Denmark (1170–1241), was the second son of Valdemar I. and brother of Canute VI., whom he succeeded on the 12th of November 1202. Already during his brother's lifetime, as duke of Schleswig, Valdemar had successfully defended Denmark against German aggression. In 1201 he assumed the offensive, conquered Holstein, together with Hamburg, and compelled Count Henry of Schwerin to acknowledge the over-lordship of the Danish crown. Immediately after his coronation, he hastened to his newly won territories, accompanied by the principal civil and ecclesiastical dignitaries of Denmark, and was solemnly acknowledged lord of Northalbingia (the district lying between the Eider and the Elbe) at Lübeck, Otto IV., then in difficulties, voluntarily relinquishing all German territory north of the Elbe to Valdemar, who in return recognized Otto as German emperor. Thus the three bishoprics of Lübeck, Ratzeburg and Schwerin, which hitherto had been fief of the *Reich*, now passed under Danish suzerainty. Lübeck was a peculiarly valuable possession. The city had been founded in 1158 with the express object of controlling the Baltic trade. Only through Lübeck, moreover, could supplies and reinforcements be poured into the German military colonies in Livonia. By closing Lübeck Valdemar had German trade and the German over-seas settlements entirely at his mercy. This state of things was clearly recognized by German statesmen, and in 1208, when the Emperor Otto felt more secure upon his unstable throne, he became overtly hostile to Denmark and would have attempted the recovery of the lost German territory but for the interposition of Pope Innocent III., who threatened to excommunicate any German prince who should attack Valdemar, the equally pious and astute Danish king having undertaken, at the bidding of the holy see, to lead a crusade against the heathen Esthonians. Valdemar's position was still further strengthened when Frederick II., the successful rival of Otto IV., was, in 1215, crowned at Aix-la-Chapelle. Valdemar at once cultivated the friendship of the new emperor; and Frederick, by an imperial brief, issued in December 1214 and subsequently confirmed by Innocent III. and Honorius III., formally renounced all the German lands north of the Elbe and Elde, as well as the Wendish lands on the Baltic, in favour of Valdemar.

An attempt by Otto in 1215 to recover Northalbingia was easily frustrated by Valdemar, who henceforth devoted himself to the extension of the Danish empire over the eastern Baltic shores. Here, however, he had already been forestalled. At the end of the 12th century the whole of the Baltic littoral from semi-Christian Pomerania to orthodox Pleskow was fiercely and obstinately pagan. The connecting link between the western and the eastern Baltic was the isle of Gotland, where German merchants from Lübeck had established a depot (the later Visby). The fur-trade with the Esthonians and Livonians proved so lucrative that a German colony was planted in Livonia itself at what was afterwards Riga, and in 1201 for its better security the colony was converted into a bishopric. A still firmer footing was gained by the Germans on Livonian soil when Abbot Theoderick of Riga founded the order of the Sword (a foundation confirmed by the pope in 1204), whose duty it was to convert the heathen Esths and Livs and appropriate as much of their land in the process as possible. Two years later Valdemar, urged by Archbishop Anders Sunesön, also appeared off the Esthonian coast and occupied the isle of Oesel. In 1210 Valdemar led a second expedition eastwards, this time directed against heathen Prussia and Samland, the chief result of which was the subjection of Mestwin, duke of Pomerania, the leading chieftain in those parts.

Now was to be seen the determining influence of sea-power even in those days. Despite its superior weapons and mode of warfare, the German east Baltic colony was constantly in danger of being overborne by the endless assaults of the dogged aborigines, whose hatred of the religion of the Cross as preached by the knights is very intelligible; and in 1218 Bishop Albert of Riga was driven to appeal for assistance to King Valdemar. Valdemar cheerfully undertook a new crusade "for the honour of the Blessed Virgin and the remission of my own sins." In 1218 he set sail for Esthonia with one of the largest fleets ever seen in northern waters, including a Wendish contingent led by Prince Vitslav. Landing at Lyndantse (the modern Reval) in north Esthonia, Valdemar at once received the submission of the inhabitants, but three days later was treacherously attacked in his camp and only saved from utter destruction by his own personal valour and the descent from heaven, at the critical moment, of a red banner with a white cross on it, the Dannebrog (Danes' Cloth), of which we now hear for the first time, and which henceforth was to precede the Danish armies to victory till its capture by the Ditmarshers, three hundred years later. This victory was followed by the foundation of Reval and the occupation of Harrien and Wirland, the northern districts of Esthonia, by the Danes.

Valdemar was now, after the king of England, the most powerful potentate in the north of Europe. The south-western Baltic was a Danish Mediterranean, and Danish territory extended from the Elbe to lake Peipus. But this scattered and heterogeneous empire required a large standing army and a strong central government to hold it together. It is doubtful whether even the genius of Valdemar would have proved equal to such a stupendous task. He never had the opportunity of attempting it. In May 1223 he was seized at midnight in his tent on the isle of Lyö, whither he had come to hunt, by his vassal and guest Count Henry of Schwerin, and conveyed with his son and many other valuable hostages to the inaccessible castle of Dannenberg-on-Elbe. In this dungeon he languished for two and a half years, and, despite all the efforts of Pope Honorius III. on his behalf, was ultimately forced to pay a heavy ransom, and surrender Northalbingia and all his Wendish conquests except Rügen. On his release Valdemar attempted to retrieve his position by force of arms, but was utterly defeated at the battle of Bornhöved (22nd of July 1227), which deserves a place among the decisive battles of history, for it destroyed at once and for ever the Danish dominion of the Baltic and established the independence of Lübeck, to the immense detriment in the future of all the Scandinavian states. On the other hand Valdemar, by prudent diplomacy, contrived to retain the greater portion of Danish Esthonia (compact of Stensby, 1238). With rare resignation Valdemar devoted the remainder of his life to the great work of domestic reform. His noblest achievement in this respect is the codification of the Danish laws known as the *Jydske Lov* (Jutland Code), which he lived to see completed a few days before his death at Vordingborg on the 28th of March 1241. Valdemar was twice married, his first consort being Dragomir (Dagmar) of Bohemia, his second Berengaria of Portugal. All his four sons, Valdemar, Eric, Abel and Christopher became kings of Denmark.

See *Danmarks Riges Historie*, vol. i. pp. 736–849 (Copenhagen, 1897–1905). (R. N. B.)

VALDEMAR IV., king of Denmark (*c.* 1320–1375), was the youngest son of Christopher II. of Denmark. Valdemar was brought up at the court of the German emperor, Louis of Bavaria, during those miserable years when the realm of Denmark was partitioned among Holstein counts and German *Ritter*, while Scania, "the bread-basket" of the monarchy, sought deliverance from anarchy under the protection of Magnus of Sweden. Even the Hanse Towns, the hereditary enemies of Denmark, regarded the situation with disquietude. "One would gladly have seen a single king in Denmark if only for peace sake," says the contemporary Lübeck chronicle, "for peace was not to be had either at sea or on land." The assassination at Randers of the detested Holstein tyrant Count Gerhard III. (1340), who for nine years had held Jutland and Funen and dominated the rest of Denmark, first opened Valdemar's way to the throne, and on midsummer day 1340 he was elected king at a *Landsting* held at Viborg, after consenting to espouse Helveg, the sister of his most important confederate, Valdemar, duke of Schleswig.

Neither the time nor the place of Valdemar's birth is known, but he could not have been more than twenty when he became the nominal king of Denmark, though, as a matter of fact, his territory was limited to the northernmost county of Jutland. His precocious maturity is strikingly evident from the first. An energy which never slackened, a doggedness which no adversity could crush, a fiery ambition coupled with the coolest calculation, and a diplomatic unscrupulousness which looked always to the end and never to the means, these were the salient qualities of the reconstructor of the dismembered Danish state. First Valdemar aimed at the recovery of Zealand, which was actually partitioned among a score of Holstein mortgagees who ruled their portions despotically from their strong castles, and sucked the people dry. The oppressed clergy and peasantry regarded Valdemar as their natural deliverer; but so poor and friendless was he that the work of redemption proved painfully slow. In November 1343 he obtained the town and castle of Copenhagen from King Magnus Smek of Sweden, by reconfirming in still more stringent terms the previous surrender of the rich Scanian provinces, and by the end of the following year he had recovered the whole of North Zealand. In 1347 the remainder of Zealand was redeemed, and the southern isles, Laaland, Falster and Mön, also fell into the king's strenuous hands. By this time, too, the whole of Jutland (except the province of Ribe) had fallen to him, county by county, as their respective holders were paid off. In 1349, at the *Landsting* of Ringsted, Valdemar proudly rendered an account of his stewardship to the Estates of Zealand, and the bishop of Roskilde congratulated him on having so miraculously delivered his people from foreign thraldom. In August 1346, he prudently rid himself of the distant and useless province of Esthonia by selling it very advantageously to the Livonian Order.

Valdemar now gave full play to his endless energy. In north German politics he interfered vigorously to protect his brother-in-law the Margrave Louis of Brandenburg against the lords of Mecklenburg and the dukes of Pomerania, with such success that the emperor, Charles IV., at the conference of Bautzen, was reconciled to the Brandenburger and allowed Valdemar an annual charge of 16,000 silver marks on the city of Lübeck (1349). Some years later Valdemar seriously thought of reviving the ancient claims of Denmark upon England, and entered into negotiations with the French king, John, who in his distress looked to this descendant of the ancient Vikings for help. A matrimonial alliance between the two crowns was even discussed, and Valdemar offered, for the huge sum of 600,000 gulden, to transport 12,000 men to England. But the chronic state of rebellion in western Denmark, which, fomented by the discontented Jutish magnates, lasted with short intervals from 1350 to 1360, compelled Valdemar to renounce these far-reaching and fantastic designs. On the other hand, he proved more than a match for his domestic rebels, especially after his great victory at Brobjaerg in Funen (1357). Finally, the compact of Kalundborg restored peace to the kingdom.

Valdemar now turned his eyes from the west to the east, where lay the "kingdom of Scania." Valdemar had indeed pledged it solemnly and irrevocably to King Magnus of Sweden, who had held it for twenty years; but profiting by the difficulties of Magnus with his Norwegian subjects, after skilfully securing his own position by negotiations with Albert of Mecklenburg and the Hanseatic League, Valdemar suddenly and irresistibly invaded Scania, and by the end of 1361 all the old Danish lands, except North Holland, were recovered.

By the recovery of Scania Valdemar had become the lord of the great herring-fishery market held every autumn from St Bartholomew's day (24th of August) to St Denis's day (9th of October) on the hammer-shaped peninsula projecting from the S.W. corner of Scania containing the towns of Skanör and Falsterbo. This flourishing industry, which fully occupied 40,000 boats and 300,000 fishers assembled from all parts of Europe to catch and salt the favourite Lenten fare of the whole continent, was the property of the Danish crown, and the innumerable tolls and taxes imposed by the king on the frequenters of the market was one of his most certain and lucrative sources of revenue. Foreign chapmen eagerly competed for special privileges of Skanör and Falsterbo, and the Hanseatic merchants in particular aimed at obtaining a monopoly there. But Valdemar was by no means disposed to submit to their dictation, and political conjunctures now brought about actual hostilities between Valdemar and the Hansa, or at least that portion of it known as the Wendish Towns,[1] whose commercial interests lay principally in the Baltic.

From time immemorial the isle of Gotland had been the staple of the Baltic trade, and its capital, Visby, whose burgesses were more than half German, the commercial intermediary between east and west, was the wealthiest city in northern Europe. In July 1361 Valdemar set sail from Denmark at the head of a great fleet, defeated a peasant army before Visby, and a few days later the burgesses of Visby made a breach in their walls through which the Danish monarch passed in triumph. The conquest of Gotland at once led to a war between Valdemar and Sweden allied with the Hanseatic towns; but in the spring of 1362 Valdemar repulsed from the fortress of Helsingborg a large Hanseatic fleet provided with "shooting engines" (cannon) and commanded by Johan Wittenburg, the burgomaster of Lübeck. In Sweden proper he was equally successful, and the general pacification which ensued in April 1365, very greatly in his favour, was cemented by the marriage of his daughter Margaret with Hakon VI. of Norway, the son of King Magnus.

Valdemar was now at the height of his power. Every political rival had been quelled. With the papal see, since his visit to Avignon in 1364, he had been on the best of terms. His ecclesiastic patronage was immense, and throughout the land he had planted strong castles surely held by the royal bailiffs. But in the winter of 1367–68 a hostile league against him of all his neighbours threatened to destroy the fruits of a long and strenuous lifetime. The impulse came from the Hansa. At a *Hansetag* held at Cologne on the 11th of November 1367, three groups of the towns, seventy in number, concerted to attack Denmark, and in January 1368 Valdemar's numerous domestic enemies, especially the Jutlanders and the Holstein counts, acceded to the league, with the object of partitioning the realm among them. And now an astounding and still inexplicable thing happened. At Easter-tide 1368, on the very eve of this general attack, Valdemar departed for three years to Germany, leaving his realm in the capable hands of the earl-marshal Henning Podbusk. Valdemar's skilful diplomacy, reinforced by golden arguments, did indeed induce the dukes of Brunswick, Brandenburg and Pomerania to attack the confederates in the rear; but fortune was persistently unfriendly to the Danish king, and peace was finally concluded with the towns by Podbusk and the Danish Council of State at the congress of Stralsund, 1370. The conditions of peace were naturally humiliating for Valdemar,[1] though, ultimately, he contrived to render illusory many of the inordinate privileges he was obliged to concede. He was also able, shortly before his death on the 24th of October 1375, to recover the greater part of Holstein from the rebels.

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[1] Rostock, Greifswald, Wismar and Stralsund.

We know astonishingly little of him personally. A few caustically witty sayings of his, and St Bridget's famous comparison of him to a fowler who could entice the shyest birds with his fluting, are almost all his *personalia*. It would be a mistake to regard him as a patriot. He was too unscrupulous and self-centred to play for anything but his own hand. Yet no other Danish king did so much for his country. His statesmanship, as judged from his acts, was all but flawless, and he was certainly one of the greatest of the medieval diplomatists. His character peeps forth most clearly perhaps in the saying which has become his epithet, *Atterdag* ("There will be a to-morrow"), which is an indication of that invincible doggedness to which he owed most of his successes.

See *Danmarks Riges Historie*, vol. ii. pp. 275–356 (Copenhagen, 1897–1905). (R. N. B.)

VALDEPEÑAS, a town of Spain, in the province of Ciudad Real; near the right bank of the river Jabalon, a tributary of the Guadiana, and on the Madrid-Cordova and Valdepeñas-La Calzada railways. Pop. (1900) 21,015. Valdepeñas is the largest town in the Campo de Calatrava, an extensive plain north of the Sierra Morena. Its commerce developed rapidly in the last quarter of the 19th century, largely as a result of improvements in its communications by road and rail, the population in the same period increased by more than one-third. Valdepeñas contains large distilleries, tanneries, flour mills, cooperages, and other factories; but its trade is chiefly in the red wines for which the district is famous throughout Spain. There are hot mineral springs near the town.

VALDES, JUAN DE (*c.* 1500–1541), Spanish religious writer, younger of twin sons of Fernando de Valdes, hereditary regidor of Cuenca in Castile, was born about 1500 at Cuenca. He has been confused with his twin-brother Alphonso (in the suite of Charles V. at his coronation in Aix-la-Chapelle, 1520; Latin secretary of state from 1524, died in 1532 at Vienna). Juan, who probably studied at the university of Alcala, first appears as the anonymous author of a politico-religious *Diálogo de Mercurio y Caron*, written and published about 1528. A passage in this work may have suggested Don Quixote's advice to Sancho Panza on appointment to his governorship. The *Diálogo* attacked the corruptions of the Roman Church; hence Valdes, in fear of the Spanish Inquisition, left Spain for Naples in 1530. In 1531 he removed to Rome, where his criticisms of papal policy were condoned, since in his *Diálogo* he had upheld the validity of Henry VIII.'s marriage with Catherine of Aragon. On the 12th of January 1533 he writes from Bologna, in attendance upon Pope Clement VII. From the autumn of 1533 he made Naples his permanent residence, his name being Italianized as Valdesso and Val d'Esso. Confusion with his brother may account for the statement (without evidence) of his appointment by Charles V. as secretary to the viceroy at Naples, Don Pedro de Toledo; there is no proof of his holding any official position, though Curione (in 1544) writes of him as "cavalliere di Cesare." His house on the Chiaja was the centre of a literary and religious circle; his conversations and writings (circulated in manuscript) stimulated the desire for a spiritual reformation of the church. His first production at Naples was a philological treatise, *Diálogo de la Lengua* (1533). His works entitle him to a foremost place among Spanish prose writers. His friends urged him to seek distinction as a humanist, but his bent was towards problems of Biblical interpretation in their bearing on the devout life. Vermigli (Peter Martyr) and Marcantonio Flaminio were leading spirits in his coterie, which included Vittoria Colonna and her sister-in-law, Giulia Gonzaga. On Ochino, for whose sermons he furnished themes, his influence was great. Carnesecchi, who had known Valdes at Rome as "a modest and well-bred courtier," found him at Naples (1540) "wholly intent upon the study of Holy Scripture," translating portions into Spanish from Hebrew and Greek, with comments and introductions. To him Carnesecchi ascribes his own adoption of the Evangelical doctrine of justification by faith, and at the same time his rejection of the policy of the Lutheran schism. Valdes died at Naples in May 1541.

His death scattered his band of associates. Abandoning the hope of a regenerated Catholicism, Ochino and Vermigli left Italy. Some of Valdes's writings were by degrees published, in Italian translations. Showing much originality and penetration, they combine a delicate vein of semi-mystical spirituality with the personal charm attributed to their author in all contemporary notices. Llorente traces in Valdes the influence of Tauler; any such influence must have been at second hand. The *Aviso* on the interpretation of Scripture, based on Tauler, was probably the work of Alphonso. Valdes was in relations with Fra Benedetto of Mantua, the anonymous author of *Del Benefizio di Gesù Cristo Crocefisso*, revised by Flaminio (reprinted by Dr Babington, Cambridge, 1855). The suggestion that Valdes was unsound on the Trinity was first made in 1567 by the Transylvanian bishop, Francis Dávid (see article Socinus); it has been adopted by Sand (1684), Wallace (1850) and other anti-Trinitarian writers, and is countenanced by Bayle. To this view some colour is given by isolated expressions in his writings, and by the subsequent course of Ochino (whose heterodox repute rests, however, on the insight with which he presented objections). Valdes never treats of the Trinity (even when commenting on Matt. xxviii. 19), reserving it (in his *Latte Spirituale*) as a topic for advanced Christians; yet he explicitly affirms the consubstantiality of the Son, whom he unites in doxologies with the Father and the Holy Spirit (*Opusc.* p. 145). Practical theology interested him more than speculative; his aim being the promotion of a healthy and personal piety.

The following is a list of his writings:—

(1) *Diálogo de Mercurio y Caron* (no date or place; 1528?). An Italian translation by Nicolo Franco, Venice (no date); reprinted, Venice, 1545. Bound with the original (and with the translation) will usually be found a *Diálogo* by Alphonso de Valdes on the sack of Rome in 1527; this is also ascribed to Juan in the reprint, *Dos Diálogos* (1850).

(2) *Diálogo de la Lengua* (written, 1533; first printed, Madrid, 1737; reprinted, 1860, 1873).

(3) *Qual Maniera si devrebbe tenere a informare . . . gli figliuoli de Christiani delle Cose della Religione* (no date or place; before 1545, as it was used by the Italian translator of Calvin's catechism, 1545). No Spanish original is known. Reproduced as *Latte Spirituale*, Basel, 1549; Paris, 1550; in Latin, by Pierpaolo Vergerio, 1554; 1557; in Spanish, by Ed. Boehmer, 1882; in English, by J. T. Betts, 1882; also in German (twice) and in Polish.

(4) *Trataditos*, Bonn, 1881, from a manuscript in the Palatine Library, Vienna; in Italian, *I Cinque Tratatelli Evangelici*, Rome, 1545; reprinted, 1869; in English, by J. T. Betts, in *XVII Opuscules*, 1882.

(5) *Alfabeto Christiano* (written about 1537), in Italian, Venice, 1545; in English, by B. B. Wiffen, 1861; no Spanish original is known.

(6) *Ciento i Diez Conçideraçiones*; all copies of the original edition suppressed by the Spanish Inquisition; thirty-nine of the *Conçideraçiones*, published with the *Trataditos*, from a Vienna manuscript, in Italian, by Celio Secondo Curione, *Le Cento et Dieci Divine Consideratione*, Basel, 1550; in French, by Claude de Kerquifinen, Lyons, 1563; Paris, 1565; in English, by Nicholas Ferrar (at the instance of George Herbert), Oxford, 1638; Cambridge, 1646; another version by J. T. Betts, 1865; in Spanish, by Luis Usóz i Rio, 1855.

(7) *Seven Doctrinal Letters* (original published with the *Trataditos* from Vienna manuscript), in English, by J. T. Betts, with the *Opuscules*.

(8) *Comentario Breve . . . sobre la Epistola de San Pablo a los Romanos*, Venice, 1556 (with text; edited by Juan Perez de Pineda); reprinted, 1856; in English, by J. T. Betts, 1883.

(9) *Comentario Breve . . . sobre la Primera Epistola de san Pablo a los Corintios*, Venice, 1557 (edited, reprinted and translated as No. 8)

(10) *El Evangelio de San Mateo* (text and commentary), 1881, from Vienna manuscript; in English, by J. T. Betts, 1883.

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[1] They even gave the Hansa a vote in the future election of the Danish kings.

(11) *El Salterio* (the Psalms from Hebrew into Spanish), published with the *Tratadítos* from Vienna manuscript.

(12) At Vienna is an unpublished commentary in Spanish on Psalms i.-xli.

(13) Sand mentions a commentary on St John's Gospel, not known to exist.

Notices of Valdes in Sand (*Biblioth. Antitrinitar.* 1684), Bayle and Wallace (*Antitrin. Biog.*, 1850) are inadequate. Revival of interest in him is due to McCrie (*Hist. Ref. in Italy*, 1827; *Hist. Ref. in Spain*, 1829). Fuller knowledge of his career was opened up by Benjamin B. Wiffen, whose *Life* of Valdes is prefixed to Betts's translation of the *Considerations*, 1865. Discoveries have since been made in the Aulic Library, Vienna, by Dr Edward Boehmer; cf. his *Span. Reformers of Two Centuries* (1874), his *Lives of J. and A. de Valdes* (1882), and his article in *Realencyklopädie für prot. Theol. und Kirche* (1885). See also M. Young, *Aonio Paleario* (1860); K. Benrath, *Bernardino Ochino* (1875;) Menendez Pelayo, *Los Heterodoxos Españoles* (1880); G. Bonet-Maury, *Early Sources of Eng. Unit. Christ.* (trans. E. P. Hall, 1884). (A. Go.*)

VALDIVIA, a southern province of Chile, bounded N. by Cautin, E. by Argentina, S. by Llanquihue and W. by the Pacific. Area, 8649 sq. m. Pop. (1895) 60,687; (1902, estimated) 76,000. The province is roughly mountainous in the E., is heavily forested and is traversed by numerous rivers. There is a chain of lakes across its eastern side near the Andes, the largest of which are Villarica, Rinihue and Ranco. The rivers are the Tolten on the northern boundary, the Valdivia, or Calle-Calle, with its large tributaries in the central part of the province, and the Bueno on the southern frontier. The Valdivia (about 100 m. long) has its sources in the Andes and flows W. to the Pacific. Its largest tributary on the N. is the Rio Cruces. The Valdivia is the outlet for Lake Rinihue and is navigable for a long distance. Valdivia is one of the most recently settled provinces and has a large immigrant element, chiefly German. Its most important industry is that of clearing away the heavy forests and marketing the timber. Stock-raising is an important industry, and wheat is grown on the cleared lands. Lumber, cattle, leather, flour and beer are exported. The capital is Valdivia, a flourishing city on the Valdivia river, 12 m. above its port, Corral, near the mouth of the river. Pop. (1895) 8062; (1902, estimated) 9704. It is a roughly built pioneer town, in which wood is the principal building material. The mean annual temperature is 59·9° and its annual rainfall is 115 in. A government railway runs to Osorno on the S., and in 1909 was being connected with the central line running S. through Bio-Bio and Cautin. The port of Corral, at the mouth of the Valdivia river, in lat. 39° 49′ S., long. 73° 19′ W., is situated on the S. side of a broad, lagoon-like sheet of water, forming one of the best natural harbours on the coast. It is a port of call for several lines of steamers, including those of the Pacific Mail running between Liverpool and Valparaiso.

VALDOSTA, a city and the county-seat of Lowndes county, Georgia, U.S.A., about 155 m. S.W. of Savannah. Pop. (1890) 2845; (1900) 5613 (2958 negroes); (1910) 7656. Valdosta is served by the Atlantic Coast Line, the Georgia Southern & Florida, and the Georgia & Florida railways. The city has a public library; the principal public buildings are the County Court House and the Federal building. Valdosta is in a rich farming and forest country; among its manufactures are cotton products, lumber, &c. The city owns and operates the water works. Valdosta was first settled in 1859, was incorporated as a town in 1860, and was chartered as a city in 1901.

VALENCE, a town of south-eastern France, capital of the department of Drôme, situated on the left bank of the Rhone, 65 m. S. of Lyons on the railway to Marseilles. Pop. (1906), town, 22,950; commune, 28,112. The river is here crossed by a fine suspension bridge. The cathedral of St Apollinaris, which has an interesting apse, was rebuilt in the 11th century in the Romanesque style of Auvergne and consecrated in 1095 by Urban II. It was greatly injured in the wars of religion, but restored in the first decade of the 17th century. The porch and the stone tower above it were rebuilt in 1861. The church contains the monument of Pius VI., who died at Valence in 1799. A curious house (Maison des Têtes) of the 16th century has a sculptured front with heads of Homer, Hippocrates, Aristotle, Pythagoras, &c. The Maison Dupré-Latour with a beautifully carved doorway and the sepulchral monument known as the Pendentif date from the same century. The library and the museum containing Roman antiquities, sculptures and a picture gallery, are housed in the old ecclesiastical seminary. The most notable of the monuments erected by Valence to its natives are those to Emile Augier the dramatist by the duchess of Uzès (1897) and to General Championnet (1762–1800).

Valence is the seat of a bishop, a prefect and a court of assizes, and has a tribunal of first instance, a board of trade arbitration, a chamber of commerce, a branch of the Bank of France, training colleges for both sexes, and a communal college. Among the industries are flour-milling, cooperage and the manufacture of furniture, liquorice, whitewash, and tapioca and similar foods. Trade, in which the port on the Rhone shares, is in fruit, cattle and live-stock, wine, early vegetables and farm produce, &c.

Valentia was the capital of the Segalauni, and the seat of a celebrated school prior to the Roman conquest, a colony under Augustus, and an important town of *Viennensis Prima* under Valentinian. Its bishopric dates probably from the 4th century. It was ravaged by the Alani and other barbarians, and fell successively under the power of the Burgundians, the Franks, the sovereigns of Arles, the emperors of Germany, the dukes of Valentinois, the counts of Toulouse, and its own bishops. The bishops were often in conflict with the citizens and the dukes of Valentinois, and to strengthen their hands against the latter the pope in 1275 united their bishopric with that of Die. The citizens put themselves under the protection of the dauphin, and in 1456 had their rights and privileges confirmed by Louis XI. and put on an equal footing with those of the rest of Dauphiné, the bishops consenting to recognize the suzerainty of the dauphin. In the 16th century Protestantism spread freely under Bishop Jean de Montluc, and Valence became the capital of the Protestants of the province in 1563. The town was fortified by Francis I. It had become the seat of a celebrated university in the middle of the 15th century; but the revocation of the edict of Nantes struck a fatal blow at its industry, commerce and population.

VALENCIA, or VALENTIA, an island off the south-western coast of Ireland, county Kerry, forming the southern horn of Dingle Bay. It is about 7 m. long and 3 broad at its widest part. The strait between the island and the mainland forms a fine natural harbour, land-locked with narrow entrances, and a depth of about 40 ft. at low tide, and thus capable of accommodating large vessels. At its north end is the Valencia Harbour station on a branch of the Great Southern & Western railway, with a ferry across the strait to Knightstown, the town on the island. The harbour is sometimes visited by warships, and is extensively used by fishing vessels, for which it is the headquarters of a district. At Knightstown are the buildings of the Anglo-American Telegraph Company, for it was from Valencia, after several unsuccessful attempts from 1857 onward, that the steamer "Great Eastern" first succeeded in laying the cable to Newfoundland in 1866. There are four cables across the Atlantic and one to Emden in Germany. On the island are Protestant and Roman Catholic churches, constabulary barracks and a coastguard station. The meteorological reports received by the central office in London from Valencia are of high importance as giving the first indication from any station in the United Kingdom of weather influences from the Atlantic. Valencia formerly exported slate of fine quality. Its cliff scenery is magnificent, and its luxuriant semi-tropical vegetation remarkable. Its name is of Spanish origin; the Irish originally called it Dairbhre, or Darrery, the oak forest.

VALENCIA, the name of a maritime province of eastern Spain, and of the kingdom in which this province was formerly included. The province is bounded on the N. by Teruel and Castellon de la Plana, E. by the Mediterranean, S. by Alicante and W. by Albacete and Cuença. Pop. (1900) 806,556; area, 4150 sq. m. Along the coast the surface is for the most part low and level, the fertile *vegas*, or cultivated plains, of Valencia, Játiva and Gandia in many places rising very little above sea-level. To the west of these is a series of tablelands with a mean elevation of about 1000 ft., which in turn rise into the mountains that form the eastern boundary of the tableland of New Castile, and attain within the province a maximum elevation of nearly 4000 ft. The coast is skirted by considerable stretches of sand-dune, and by a series of these the lagoon called the Albufera (*q.v.*) de Valencia is separated from the Mediterranean. The principal rivers are the Guadalaviar or Turia and the Jucar (*q.v.*). The Guadalaviar enters the province in the extreme north-west, flows south-east, and falls into the sea below the city of Valencia; it receives numerous tributaries of little importance, and it dispenses fertility by numerous aqueducts, mostly of Moorish origin, throughout the lower part of its course. Both the Jucar and its right-hand tributary the Albaida supply water for an extensive system of irrigation canals.

In the lowlands, especially towards the coast, very little rain falls; but heavy rain and melting snow among the highlands in which the principal rivers rise occasionally cause sudden and disastrous floods. The *vegas* have an exceptionally fine, almost sub-tropical climate. In their low-lying portions rice is the favourite crop; elsewhere wheat, maize and all kinds of fruit are abundantly grown; the mulberry is cultivated for silk; and wine and oil are produced. Esparto grass is grown in the less fertile areas. The tablelands produce, according to their elevation and exposure, figs, almonds, olives or vines. The pastures of the higher grounds sustain numerous sheep and goats; but cattle and horses are relatively few. The hillsides are somewhat bare of timber. The mineral resources of the province are little developed. The fishing industry on the coast is considerable, and there are manufactures of silk, carpets and tapestry, woollen, hemp and linen fabrics, glass, pottery and leather; there are also iron foundries, distilleries, cooperages and oil refineries. These industries are important, although the silk manufactures declined after three decades of prosperity (from 1850 to 1880). The coast railway from Barcelona traverses the province, passing through the city of Valencia on the way south to Alicante and Murcia. From Játiva another important line diverges westward to Albacete, and there are branch lines from Valencia to Liria and to Utiel, from Silla to Cullera, from Carcagénte to Gandía, and thence to Dénia and Alcóy in the province of Alicante. Valencia, the capital and principal seaport, and the towns of Alcira, Requena, Sueca, Játiva, Carcagénte, Cullera, Utiel, Onteniente and Gandía, are described in separate articles. Other towns of more than 7000 inhabitants are Algemesí, Catarroja, Liria, Sagunto, Tabernas de Valldigna and Torrente.

When the ancient kingdom of Valencia was incorporated into Aragon in 1238, it included the provinces of Castellon de la Plana (*q.v.*) and Alicante (*q.v.*). It was bounded inland on the N. by Catalonia, W. by Aragon and New Castile, and S. by Murcia. This region has an area of 8830 sq. m.; its present population is about 1,600,000. For its history see VALENCIA (city). The inhabitants are of very mixed race, owing to the successive occupation of the country by Iberians, Greeks, Carthaginians, Romans, Visigoths and Moors. Their dialect resembles Catalan but is softer, and contains a larger percentage of Arabic words. On the physique of the people, as on their customs and the architecture of their houses, Moorish rule left a durable imprint. The elaborate irrigation-works and the system of intensive agriculture which have rendered the *huertas* or gardens of Valencia celebrated were initiated by the Moors; the fame of the Elche date-groves, the Alicante vineyards and the Valencia orange plantations, was also originally due to them. With the decline of the caliphate of Cordova early in the 11th century, Valencia became an independent kingdom, which passed successively into the power of the Almoravides and Almohades. When James I. of Aragon captured the city of Valencia in 1238, he found so large a number of Mozarabic Christians who had adopted the Arabic language and many of the customs of their rulers, that it was found necessary to translate the Bible into Arabic for their use. In 1609, 200,000 Moriscoes, or Moors who outwardly professed Christianity, were banished from the country. In 1833 Valencia was divided into the three provinces already named.

VALENCIA, the capital of the Spanish province of Valencia, on the right bank of the river Guadalaviar or Turia, 3 m. from the Mediterranean Sea, and 304 m. by rail E.S.E. of Madrid. Pop. (1877) 143,856; (1900) 213,550. Valencia is connected by numerous railways with all parts of Spain, and has one of the most secure and capacious harbours on the east coast. It is the seat of an archbishop, a court of appeal, a university, a captain-general and an army corps. All round it stretches the beautiful and closely cultivated Huerta de Valencia, an alluvial plain planted with groves of oranges, lemons and mulberries. The climate is mild and very dry; rain hardly ever falls except when the east wind blows from the sea. The white houses of the city, often Moorish in many details of their architecture, and the multitude of domes and towers overlaid with blue, white and gold tiles, give to Valencia an oriental appearance which is remarkable even in south-eastern Spain. Until 1871 it was enclosed by a wall founded by the Romans and rebuilt in 1356 by Pedro IV.; two picturesque gateways with machicolated towers still remain, but few other remnants are left of the old fortifications, the site of which is now occupied by fine boulevards. The river, reduced, except in time of flood, to a scanty stream by the demands made upon it for irrigation, is crossed by several bridges, of which the longest has thirteen arches. The streets are for the most part narrow, crooked and somewhat gloomy, but in the more modern quarters there are some broad and handsome thoroughfares. Towards the close of the 19th century Valencia was lighted by gas and electricity; electric tramways were laid down and a good water-supply and drainage system secured.

The cathedral (La Seo), begun in 1262, was in 1459 lengthened in its original Gothic style, but in such a way as to spoil its proportions, and in the 18th century it was further injured by pseudo-Classic additions. It possesses some fine examples of the sculpture and metal-work of the 15th century, as well as of the Valencian school of painting. The campanile (el Miguelete), an isolated octagonal Gothic tower, 152 ft. in height, commands an extensive view of the town and surrounding country. Near the cathedral is the episcopal palace; its large and valuable library, rich in medals and other antiquities, suffered greatly during the French occupation in 1812. Besides the cathedral, Valencia has numerous parish churches and other ecclesiastical buildings, none of them of great architectural beauty or interest; the church of St Nicholas (of Moorish origin) has, however, good specimens of paintings by Vicente Juanes as well as frescoes by Dionis Vidal; and Ribalta can be studied in the chapel of the Colegio de Corpus or del Patriarcha.

Valencia University was formed about 1500 by the fusion of an episcopal school of theology with a municipal school of arts, medicine and law, both dating from the middle of the 14th century. New colleges were soon added, and up to 1600 the university attained much prosperity and a high reputation. It then began to decline, but was reorganized after 1848, and resumed its place as one of the leading universities. The average number of students is 1750; law, philosophy, natural science and medicine are the subjects taught. The large but uninteresting university buildings date from the 16th century. The library, containing about 60,000 volumes, was robbed of its chief treasures by the French in 1812. There is a rich provincial museum, with paintings by Velazquez, Ribera, Dürer, Juanes, Bosco, Goya and many modern artists. Among other public buildings may be mentioned the court-house, a Doric edifice, dating from the time of Ferdinand the Catholic, and having curious frescoes (1592) in its main hall; the custom-house (1758), now a cigar manufactory, employing some 3500 women; and the silk exchange, a large and elegant Gothic hall (1482). The citadel, on the north-east of the town, was built by Charles V. as a protection against Khair-ed-Din Barbarossa, the sea-rover; in the south-west of the town is the former College of Saint Augustine, now used as a model prison, adjoining which is a large hospital. Beyond the old line of the walls there are a botanic garden, a large bull-ring, and various shady promenades, including the beautiful "Glorieta," and, on the north side of the river, the alameda, leading to the port (El Grao). The principal manufacture is silk, and the town is also celebrated for its coloured tiles or "azulejos," and its oranges. Linen, woollen and esparto fabrics, hats, fans, leather, paper, cigars, glass and pottery are also manufactured, and there are foundries and printing-works. Corn, rice, silk, saffron, oranges, raisins, almonds, figs and other fruits are extensively exported, and iron, hardware, timber, manure, grain and colonial produce are imported.

The port and the village of Villanueva del Grao are 3 m. E. by N. of Valencia, and are connected with it by two railways and two tramways. The harbour works, begun in 1792 at local expense, have been steadily improved, and now provide many facilities for loading or discharging on the moles and wharves. During the five years, 1901–5, about 2600 ships of 1,500,000 tons entered at the port every year. About 2000 of these were Spanish, including a large number of small coasters. The majority of the foreign ocean-going ships were British. The fishing fleet of El Grao comprises about 600 boats with 2800 hands. About 1 m. N. is the town of Pueblo Nuevo del Mar or El Cabañal, to which large numbers of the Valencians migrate in summer for sea-bathing.

The earliest historical mention of Valencia (*Valentia*) is by Livy (*Epit.* lv.), according to whom Junius Brutus settled the soldiers of Viriathus here in 138 B.C., and invested the town with the *jus Latinum*. It sided with Sertorius (*c.* 77 B.C.), and was accordingly taken and partially destroyed by Pompey in 75 B.C.; but it must have recovered speedily, as it is mentioned by Pliny (iii. 4) as a colony in the region of the Edetani, and by Mela as an important place. It was taken by the Visigoths in A.D. 413, and by the Moors in 714. After the downfall of the caliphate of Cordova, an independent Moorish kingdom of Valencia was established in 1021, and extended along the coast from Almeria to the Ebro estuary. The Almoravides occupied the city in 1094, but it was retaken within a few months by the Christians under the Cid (*q.v.*), from whom it is sometimes called Valencia del Cid. The Moors recovered possession in 1101 and the kingdom was re-established in 1146. After 1172 it became tributary to Aragon, and in 1238 James I. of Aragon added it to his dominions. The first Spanish printing-press is said to have been set up here in 1474. Towards the close of the 15th century Valencia was annexed to Castile and placed under the rule of a viceroy. In the 16th and 17th centuries it became the seat of a considerable school of painting, of which Vicente Juanes (1523–1579) may be regarded as the founder, and to which belonged also Francisco de Ribalta (1550–1628), Juan de Ribalta (1597–1628), José Ribera (1588–1656), Pedro Orrente (1560–1644) and J. G. Espinosa (1600–1680). In the beginning of the 17th century Valencia and its surrounding district suffered greatly from the expulsion of the Moriscos, its most industrious and enterprising cultivators. In the War of Succession Valencia sided emphatically with the house of Austria, for which it was punished by being deprived of many of its ancient privileges. In 1808 an abortive attempt to capture it was made by the French; they succeeded, however, in 1812, and held it till June 1813. Queen Christina signed her abdication at Valencia in 1840.

VALENCIA, a city of Venezuela and capital of the state of Carabobo, 111 m. by rail W.S.W. of Caracas, and 24 m. direct (33½ m. by rail) S. by E. of Puerto Cabello. Pop. (1894) 38,654. There is railway connexion with Caracas by the Great Venezuela line (German) and with Puerto Cabello by the Puerto Cabello and Valencia line (English), which crosses the N. range of the Maritime Andes. There is also a steamboat service on Lake Valencia. The city is situated on the N.W. border of a lacustrine plain occupied in great part by Lake Tacarigua, or Valencia,[1] and nearly 2 m. from its western margin. It is beautifully situated in a large fertile valley between parallel ranges of the Maritime Andes, about 1625 ft. above sea-level, and in the midst of rich plantations and luxuriant tropical vegetation. The climate is mild and pleasant, the temperature ranging from 66° to 87° F. with an annual mean of 76°, and the rainfall being about the same as that of Caracas, or 23 to 30 in. Near Valencia on the Puerto Cabello railway are the Las Trincheras thermal springs. Among Valencia's public edifices and institutions are some good churches, the government palace, a university, a national college for women, a normal school for men and a public library.

Valencia was founded in 1555 and is older than Caracas. It was occupied for a time in 1561 by Aguirre and his band of outlaws. At the beginning of the War of Independence it was made the capital of Venezuela, and the patriot congress was in session there in 1812 when Caracas was destroyed by an earthquake. It changed masters several times during the war, its most famous events being two successful defences in 1814 against Spanish besieging forces. The town suffered much in the war and from subsequent revolutions, but the remarkable productiveness of the surrounding districts and its advantageous commercial position ensured a prompt recovery from all reverses.

VALENCIA DE ALCÁNTARA, a town of western Spain, in the province of Cáceres; on the Madrid-Cáceres-Lisbon railway, near the right bank of the Sever, a small stream which here divides Spain from Portugal. Pop. (1900) 9417. Valencia de Alcántara is the most important custom-house for direct traffic between the Peninsular kingdoms except Badajoz, and has a flourishing trade in farm produce of all kinds, and in phosphates from the neighbouring mines. The town is occupied by a garrison, and retains its old-fashioned loopholed walls and dismantled citadel. A Roman aqueduct still brings water to the main street, and there are other Roman remains in the district; the courtyards and windows of many houses are Moorish in style. The interesting church of Roqueamador dates from the 14th century, the church of Encarnacion, the town hall and a fine convent, from the 16th. From the 16th century to the 18th Valencia was a celebrated border fortress; it was captured by the Portuguese in 1664 and 1698.

VALENCIENNES, a town of northern France in the department of Nord on the Scheldt, at its confluence with the Rhônelle, 30 m. S.E. of Lille by rail. Pop. (1906), town, 25,977; commune, 31,759. The Scheldt here divides into two branches, one of which flows through the town, while the other, canalized and forming a port, skirts it on the west. Of the fortifications, dismantled in 1892, and replaced by boulevards, the Tour de la Dodenne (13th and 15th centuries) and the citadel (17th century) are the chief remains. Valenciennes is the centre of a rich coal-field, to which Anzin (*q.v.*), an industrial town a little over a mile to the north-west, has given its name. To this fact is due the existence of the important foundries, forges, rolling-mills, wire-works and machine shops which line the bank of the Scheldt. There is also an extensive beetroot cultivation, with attendant sugar-works and distilleries, and glass, starch, chemicals and soap are produced. Hosiery, trimmings and handkerchiefs are manufactured and cotton weaving and printing are carried on, though little of the famous lace is now made. Other industries are brewing and malting. There are a sub-prefecture, courts of first instance and of commerce, a chamber of commerce, a board of trade arbitration, and a branch of the Bank of France, a lycée, a school of music and a school of fine art (founded in 1782). The town hall is a fine building of the early 17th century, but its façade was rebuilt in 1867 and 1868. The museum contains galleries of painting and sculpture, with works by Antoine, Louis and François Watteau, Carpeaux, all of whom were natives of the town, and by Rubens and other Flemish artists. Opposite the museum there is a monument commemorating the defence of the town in 1793. The principal church is that of Notre-Dame du Cordon, a fine modern building in the Gothic style surmounted by a tower 272 ft. in height. The church of St Géry preserves a few pillars dating from the 13th century. Near it stands the statue of Antoine Watteau, and there is also a statue of Jean Froissart, born at Valenciennes.

Valenciennes is said to owe its name and foundation to one of the three Roman emperors named Valentinian. In the middle ages it was the seat of a countship which in the 11th century was united to that of Hainaut. In the 16th century Valenciennes became the stronghold of Protestantism in Hainaut, but was conquered by the Spaniards, who committed all sorts of excesses. In 1656 the Spaniards under Condé made a successful defence against the French under Turenne; but in 1677 Louis XIV. took the town after an eight days' siege, and Vauban constructed the citadel. Valenciennes, which then became the capital of Hainaut, has since always belonged to France. In 1793, after forty-three days' bombardment, the garrison, reduced to 3000 men, surrendered to the allied forces numbering some 140,000 or 150,000 men, with 400 cannon. In 1815 it defended itself successfully.

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[1] Lake Valencia occupies one of the so-called Aragua valleys, enclosed between the parallel ranges of the Maritime Andes. It is 1348 ft. above the sea, is about 30 m. long, has an area of 216 sq. m., and a catchment basin of 1782 sq. m., and lies partly in the state of Aragua. It includes a number of small islands, some inhabited, and receives the waters of a score of small streams from the surrounding mountains.

VALENCY. The doctrine of valency, in chemistry, may be defined as the doctrine of the combining power of the atoms or elementary radicles of which compound molecules consist. The conception that each elementary atom has a definite atom-fixing power, enunciated by Frankland in 1852, is the foundation of the system of rational or structural formulae which now plays so great a part in chemical science. Frankland dealt more particularly with the valency of the metallic elements, in which he was specially interested at the time; but in conjunction with his co-worker Kolbe, he subsequently applied it to compounds of carbon. At that time (1852–56), the application of Avogadro's theorem to the determination of atomic weights was not yet recognized; it was only when Cannizzaro[1] made this clear that it became possible to develop the doctrine of valency upon a consistent basis. Kekulé, whose services in this field rank with those of Frankland, was the first to develop the consequences of the conception that carbon is a quadrivalent element and to apply it in a logical manner to the explanation of the structure of carbon compounds generally; his paper published in 1858, "On the Constitution and Metamorphoses of Chemical Compounds and on the Chemical Nature of Carbon," is admittedly the foundation of the modern theory of the structure of these compounds.

An admirable though brief summary of the historical development of the doctrine of valency is to be found in the lecture delivered in 1898 by Professor Japp in memory of Kekulé (*Journ. Chem. Soc.* 73, p. 97). Several discoveries have since been made which have an important bearing on the doctrine.

Frankland held that each element has a certain maximum valency but may manifest one or more subordinate valencies, the affinities in abeyance in cases in which only the lower valency is manifest satisfying each other mutually. By a logical extension of this view, elements have been divided into those of odd and those of even valency; apart from a few exceptional compounds, elements are to be reckoned as belonging either to the one or to the other of these two classes.

Kekulé always maintained that valency could not vary and in discussing this question Professor Japp goes so far as to say: "Of all the doctrines which we owe to Kekulé, that of fixed valency is probably the one that has met with least acceptance even among chemists of his own school. At the present day it is, so far as I am aware, without supporters." But he adds, "Yet Kekulé held it to the last." And such a fact cannot be overlooked: that Kekulé went too far in asserting that valency could not vary is probably true; the essential feature in his objection—that in many cases valency was overestimated by the Frankland school—cannot be so easily disposed of.

He saw clearly that structure is the determining factor to be taken into account in all such discussions; he also considered that it was necessary always to make use of univalent or monad elements in determining valency; moreover, that the only compounds on which valid arguments could be based were those which could be volatilized without undergoing decomposition—a condition that must be fulfilled if the molecular weight of a compound is to be placed beyond question. He therefore objected to the use of compounds such as ammonium chloride and phosphorus pentachloride as criteria of valency, as they undergo decomposition when volatilized. This objection has been somewhat robbed of its force by Brereton Baker's observation that decomposition can be prevented if the utmost care be taken to exclude moisture. In objecting to the use of such compounds, however, Kekulé took the further important step of dividing compounds into two classes—that of atomic compounds, such as ammonia and hydrogen chloride, in which the components are held together by atomic affinities; and that of molecular compounds, such as ammonium chloride, containing atomic compounds held together by molecular affinities: but Kekulé never gave any very clear explanation of the difference. Notwithstanding Brereton Baker's observations, the question remains with us to-day, the only difference being that we have substituted the more precise term "residual affinity" for Kekulé's term "molecular affinity."

Hydrogen is the one element which at present can be affirmed to be of unvarying valency: as no compound of determinable molecular weight is known in which a single atom of this element can be supposed to be present in the molecule in association with more than a single atom of another element, the hydrogen atom may be regarded as a consistent univalent or monad radicle. As the element of unit valency, hydrogen is, therefore, the one fit atomic measure to be used in ascertaining valency; unfortunately, it cannot always be applied, as so few elements form volatile hydrides. Hydrocarbon radicles such as methyl, CH_3, however, are so entirely comparable with the hydrogen radicle that they form equally efficient standards; as many elements form volatile methides, some assistance may be obtained by the use of such radicles. But in all other cases the difficulty becomes very great; indeed, it is doubtful if a trustworthy standard can then be found—we are still forced, in fact, to recognize the wisdom of Kekulé's contentions. The greatest difficulty of all that we have to meet is due to the fact that valency is a dependent variable in the case of many if not of most elements, the degree in which it is manifest depending on the reciprocal affinities of the associating elements, as well as on environmental conditions.

Among univalent elements, carbon is the only one that appears to have a determinate maximum valency; this is manifest in methane, CH_4, the simplest hydride the element forms, the first parent of the mighty host of compounds numbering thousands upon thousands which are the subject-matter of organic chemistry. Carbon, it is well known, is distinguished from all other elements by forming a great variety of compounds with hydrogen—the hydrocarbons; from these, in turn, other series of compounds are formed by the displacement of hydrogen atoms in the hydrocarbons by various radicles. The chemistry of the carbon compounds is, in fact, the chemistry of substitution compounds; no other element can be said to give rise to substitution compounds. It is because of this fact—because of the simple relationship obtaining between the various series of hydrocarbons and between these and their substitution compounds—that we are able to deduce structural formulae for carbon compounds with a degree of certainty not attainable in the case of any other element; and we are consequently able to infer the valency of carbon with a degree of definiteness that cannot be approached in any other case. Several of the simpler derivatives of carbon exhibit peculiarities which may be referred to as of particular interest, as showing how difficult it is to arrive at any understanding of the manner in which valency is exercised. Apparently the compound represented by the symbol CH_2 cannot exist, all attempts to isolate it having failed, the hydrocarbon ethylene, formed by the union of two such groups, being obtained in its place. This would be in no way surprising were it not that the corresponding oxygenated compound, carbon monoxide, CO, has no tendency whatever to undergo polymerization under ordinary conditions and is, in fact, speaking generally, a remarkably inert substance, although in certain cases it forms compounds without difficulty—yet always in a very quiet manner. A single atom of oxygen apparently has the power, if not of satisfying, at least of stilling the needs of the carbon atom. One other case which makes the behaviour of carbon monoxide still more exceptional may be referred to, that of the analogous sulphur compound carbon monsulphide, CS, recently discovered by Sir James Dewar and Mr H. O.

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[1] Stanislao Cannizzaro, *A Course of Chemical Philosophy* (1858). Alembic Club Reprints, No. 18. [1910.]

Jones. This compound is so unstable, so active, that it polymerizes with explosive violence at temperatures slightly above that at which liquid air boils. Such illustrations afford clear proof that, as before mentioned, valency is a reciprocal function—that it is impossible to regard the units of affinity of the atoms of different elements as of equivalent value and capable of satisfying each other mutually.

There is no reason to suppose that an uneven number of affinities can be active in the carbon atom; in devising structural formulae, it is therefore always considered necessary to account for the disposition of the four units of affinity, the four valencies, of the carbon atom. In 1900 some excitement was aroused by the discovery by Gomberg of a remarkable hydrocarbon formed by the withdrawal of the chlorine atom from chlorotriphenylmethane, $C(C_6H_5)_3Cl$: at first it was contended that this was a compound of triad carbon, *triphenylmethyl*; it is now generally admitted, however, that such cannot well be the case and that one of the phenyl groups becomes altered in structure and converted into a dyad radicle (see TRIPHENYLMETHANE).

The homologues of methane—the hydrocarbons of the paraffin or C_nH_{2n+2} series, in which the carbon atoms are associated by single affinities, their remaining affinities being engaged by hydrogen atoms—behave chemically as saturated compounds and are apparently incapable of entering into combination with other molecules. But it is important to guard against the assumption that they are actually saturated in any absolute sense. Even gases such as helium and argon, destitute as they appear to be of all chemical activity, must be credited with the possession of some measure of affinity—as they can be liquefied; moreover, as Sir James Dewar has shown, when helium is liquefied in contact with charcoal a not inconsiderable amount of heat is liberated beyond that given out in the mere liquefaction of the gas. The argument may be extended to hydrogen and the paraffins and it may even be supposed that the amount of residual affinity increases gradually as the series is ascended—this would account for the fact that their activity, the readiness with which they are attacked, increases slightly as the series is ascended. In any case, it cannot well be supposed that carbon and hydrogen mutually satisfy each other even in the paraffins.

The manner in which the valencies of the carbon atom are disposed of in the case of unsaturated hydrocarbons—that is to say, those containing a lower proportion of hydrogen than is indicated by the formula C_nH_{2n+2}—has given rise to much discussion, the subject being one which affords an opportunity for great difference of opinion. In ethylene, C_2H_4, each carbon atom is attached to only two hydrogen atoms, as two affinities of each atom are therefore free to enter reciprocally into combination. These atoms certainly do not combine twice over in the way in which the two atoms of carbon in ethane, $H_3C{\cdot}CH_3$, enter into combination—if they did, ethylene should be a saturated compound, whereas actually it behaves as an eminently unsaturated substance. It was contended by Julius Thomsen, on the basis of determinations of the heat of combustion of the hydrocarbons, that the two carbon atoms in ethylene are less firmly united in ethylene than are those in ethane; moreover, that in acetylene, C_2H_2, in which there are three affinities at the disposal of each of the two carbon atoms, the union is even less firm than in ethylene. The argument on which these conclusions are founded has been called in question and the data are clearly insufficient to justify their acceptance; moreover, the stability of acetylene at high temperatures, also the readiness with which ethylene is often formed and with which ethenoid compounds revert to the paraffin type may be cited as arguments against them.

In dealing with such a problem, it is necessary to take into account the evidence we have that valency is a directed function. The tetrahedron is now accepted as the most suitable model of the carbon atom to be visualized whenever carbon is thought of; moreover, it is held that the directions in which valency acts are appropriately pictured if they are regarded as proceeding from the centre of mass to the four solid angles of the tetrahedron. In such a case, two affinities proceeding from each of two carbon atoms do not meet and overlap but cross, each pair at a considerable angle through which they must be deflected to bring them into contact. Von Baeyer has suggested that this angle, ½(109° 28′), is the measure of the strain imposed upon the affinities and that the existence of this strain affords an explanation of the readiness with which ethylene lapses into a derivative of ethane when suitable opportunity is given to combine with some other substance. Another way of looking at the matter is to suppose that the affinities do not, as it were, overlap but merely cross each other and that the angle of approach referred to is a direct measure of the degree of unsaturatedness: such a view is more in accordance with Thomsen's contention. In any case, the ethenoid condition of unsaturatedness at the junction of two carbon atoms is a centre at which altogether peculiar properties, chemical and physical, are developed—the most noteworthy being the enhanced refractive power. The ethenoid symbol $C{=}C$ is therefore of peculiar significance. It is a remarkable fact that the properties of ring systems generally are in accordance with the above hypothesis—the degree of unsaturatedness diminishing as "the angle of approach" is diminished, the more nearly the affinities can be pictured as overlapping.

The most stable arrangement of the carbon affinities would appear to be that in benzene and compounds of the benzene type—whatever that may be. The determination of the "structure" of this hydrocarbon has given rise to a large amount of paper warfare. Two tendencies may be said to have been brought together in the course of this discussion: on the one hand, the desire to arrive at a determination of the actual structure; on the other, the desire to devise formulae which shall be faithful expressions of functional behaviour and broadly indicative of the structural relationship of the constituent elements. The latter is perhaps the tendency which is now in the ascendant: we are beginning to realise, particularly in the case of carbon compounds, that formulae are primarily expressive of behaviour—being based on the observation of behaviour. Thus in the case of all paraffinoid compounds, the symbol $C{-}C$ has a distinctive meaning, as indicating saturation; in the case of ethenoid compounds, the symbol $C{=}C$ has an equally distinctive meaning, indicating a particular degree of unsaturatedness.

From this point of view, therefore, the benzene symbol originally proposed by Kekulé is misleading, inasmuch as it indicates that the hydrocarbon contains three ethenoid junctions; it should therefore be an eminently unsaturated compound, which is not the case. On this account the centric formula is to be preferred as an expression of the properties of the compound.

The non-metallic elements other than carbon all form volatile hydrides and methides from which their fundamental valencies can be deduced without difficulty. Chlorine, oxygen, nitrogen and silicon may be regarded as typical of the four classes into which the non-metals fall. But the number of hydrogen and methyl radicles which the atom carries cannot be taken as the measure of absolute valency in the case of elements of the chlorine, oxygen and nitrogen classes. The hydrides of the elements of these classes must all be regarded as more or less unsaturated compounds, the fact that gases such as hydrogen chloride and ammonia are intensely soluble in water being clearly a proof that their molecules are greatly attracted by and have great attraction for water molecules; it is remarkable, however, that although hydrogen chloride and ammonia are easily soluble in water and also combine readily with one another, they are gases which are by no means easily condensed—in other words, the molecules in each gas have little tendency to associate among themselves. It may also be pointed out that, to account for the properties of liquid water, it is necessary to suppose that the simple molecules represented by the symbol H_2O have a very considerable mutual affinity and that water consists largely of complex molecules.[1] Taking into account the estimate we are able to form, on the one hand, of the functions of hydrogen, on the other of those of elements such as chlorine, oxygen and nitrogen, it seems probable that in the hydrides of these elements the extra attractive power is exercised entirely by the element which enters into combination with the hydrogen—in other words, that chlorine in hydrogen chloride, oxygen in hydrone and nitrogen in ammonia are each possessed of considerable residual affinity. The great question at issue has been and still is—What is the nature of this residual affinity and how is it exercised? This is the question raised by Kekulé and left by him as a legacy to be decided upon. When hydrogen chloride and ammonia enter into combination to form ammonium chloride, for example, do they combine in some special manner, molecularly, so that each molecule retains its individuality as a radicle in the new compound; or is a redistribution effected, so that the several atoms become arranged around the one which exercises the dominant influence much as they are in the parent compound ammonia? In the former case, two orders of affinity would come into operation; in the latter, only one The general opinion has always been in favour of the latter view.

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[1] On this account it is desirable to confine the term water to the liquid and to distinguish the simple molecule represented by the symbol H_2O by a separate name—that proposed is *Hydrone*. Liquid water is probably a mixture of several polyhydrones together with more or less hydrone.

The discovery that compounds of sulphur containing four different monad radicles together with a single sulphur atom, such as the chloride, $S(CH_3)(C_2H_5)(CH_2 \cdot CO_2H)Cl$, are optically active may be said to have set the question at rest, as optical activity is only to be expected in the case of a compound of asymmetric structure having the four radicles separately associated with and arranged around the sulphur atom. If it be granted that sulphur can thus function as a tetrad, it may equally be admitted that nitrogen can function as a pentad element in the ammonium compounds.

The discussion has entered on another stage, however, now that Barlow and Pope have been successful in subjecting the problem to geometric treatment by correlating crystalline form with chemical constitution. The fundamental conception upon which the relationship is based is that each atom present in a compound occupies a distinct portion of space by virtue of an influence which it exerts uniformly in every direction. A crystalline structure is regarded as a close-packed, homogeneous assemblage of the spheres of influence of the component atoms. According to this view, valency acquires volume significance. For example, the hydrogen atom being represented by a sphere of unit volume, that of the tetrad carbon atom is represented by one of four times this unit volume; the monad elements—chlorine, bromine and iodine—are supposed, in like manner, to occupy approximately unit spheres of influence. Whilst they are prepared to admit that the spheres of atomic influence of the univalent elements, for example, are not quite the same—moreover, that the volume ratios of the spheres of influence of various elements may alter slightly under changes of condition—Barlow and Pope contend that the relative magnitudes are only slightly affected in passing from compound to compound. In their view, however, the absolute magnitudes of the spheres of influence often change considerably.

For example, taking the spheres of atomic influence of carbon as of volume 4 and those of hydrogen, chlorine and bromine as of volume 1, they find that benzene, C_6H_6, hexachlorobenzene, C_6Cl_6, and hexabromobenzene, C_6Br_6, present an almost identical spatial arrangement of the spheres of atomic influence. This could not be the case if the atoms of carbon, hydrogen, chlorine and bromine appropriated respectively the volumes 11·0, 5·5, 22·8 and 27·8—the so-called atomic volumes deduced by Kopp. Barlow and Pope therefore consider that, both in benzene of molecular volume 77·4 and in a derivative such as tetrabromobenzene of molecular volume 130·2, the sphere of influence of the carbon atom is about four times as large as that of either hydrogen or bromine; on displacing the hydrogen atoms by bromine atoms, however, the volumes of the carbon atoms in the benzene molecule and of the remaining hydrogen atoms expand proportionally in the ratio of 77·4 : 130·2. This remarkable conclusion is a most helpful addition to the doctrine of valency. The relative fundamental valency volume, according to Barlow and Pope, is a constant—when compounds of a "higher type" are produced, greater number of atoms become arranged about the centralizing atom but the relative valency volumes do not change. They have shown that if an atom of valency 1 be inserted into the space already occupied by an atom of valency m, a gap is produced which must be filled up by another atom of valency 1 if the close packing is to be restored without remarshalling, thus accounting for the progression of valency by two units. Ammonium chloride, for example, is to be regarded as formed by the insertion into the ammonia assemblage of a chlorine atom of volume 1 and of an atom of hydrogen of volume 1, the nitrogen atom retaining its fundamental valency 3. This geometric conception affords a justification of Kekulé's conception of fixed valency; at the same time it gives expression to the view he advocated that a distinction was to be drawn between atomic and molecular compounds; but it also supports the contention of Kekulé's opponents that in the two classes of compound the atoms must be regarded equally as arranged about a centralizing atom. The two points of view are therefore brought into harmony. But the problem is by no means solved—other modes of arrangement than those pictured must also be possible. To take the case of a solution of ammonia, for example: it is generally admitted that only a very small proportion is present as the hydroxide $NH_4 \cdot OH$; far the greater part must be held in solution in some other form, either as $H_3N = OH_2$ or in the form of more complex molecules of the polymethylene type. These may be regarded as Kekulé's molecular compounds and as the forerunners of the "more organized" compounds in which the atoms are centralized in the crystal structure. It has not been found necessary hitherto to attribute spheres of atomic influence of different relative volumes to the same element under different conditions—that is to say, elements such as sulphur and nitrogen always exhibit the fundamental valencies 2 and 3 respectively; moreover, in the case of per- and proto-metallic salts all known facts accord with the assumption of one and only one fundamental valency of the metal. One other conclusion of interest which Barlow and Pope are inclined to draw may be referred to, namely, that although silicon apparently functions as a tetrad element, its relative valency volume is probably only 2; they even question whether any element other than carbon has a valency volume four times that of hydrogen. It may well be that the peculiar stability of carbon compounds is to be sought in this peculiarity.

The Barlow-Pope hypothesis, however, affords a purely static representation of the facts: we are still unable to apply dynamic considerations to the explanation of valency. From the time of Faraday onwards, chemists have been willing to regard chemical affinity as electrical in its origin; on this account, the atomic-charge hypothesis advocated by Helmholtz has been most favourably received: but this hypothesis does not in any way enable us to understand the many qualitative peculiarities which are apparent when the reciprocal affinities of various elements are taken into account; moreover, it affords no explanation of the apparent variations in valency which are so frequently manifest; and it affords no satisfactory explanation of the fact that many compounds of like radicles, such as the elementary gases hydrogen, nitrogen and chlorine, for example, are among the most stable compounds known—more stable than many compounds consisting of elements of opposite polarity. Attempts have been made of late to apply the electronic hypothesis—these attempts, however, have involved little more than a paraphrase of current static views and they are in no way helpful in the directions in which help is most needed. It is no way surprising, however, that we should know so little of the origin of a property that may be said to be the fundamental property of matter—if we could explain it, we could explain most things; what we have reason to be surprised at is that it should have been possible to develop so consistent a doctrine as that now at our disposal.

It is scarcely necessary to point out that the sketch above given is but a bare outline of the subject, one in which attention is drawn to certain points of importance in the hope that it may be clear that the problems cannot be discussed usefully in the formal manner which is too frequently adopted. Our knowledge of valency cannot be expressed in a few symbols or in a few formal statements. (H. E. A.)

VALENS, East Roman emperor from 364 to 378, owed his elevation in the thirty-sixth year of his age to his brother Valentinian, who chose him to be his associate in the empire, of which a formal division into East and West was now once for all definitively arranged (see VALENTINIAN I.). Valens had been attached to Julian's bodyguard, but he did not inherit the military ability of his father, Gratian of Pannonia, who had risen from the ranks to a high position. A revolt headed by Procopius in the second year of his reign, and backed up by the public opinion of Constantinople and the sympathy of the Gothic princes and chiefs on the Danube, seemed so alarming to him that he thought of negotiation; but in the following year the revolt collapsed before the firmness of his ministers and generals. In the year 366 Valens at one stroke reduced the taxes of the empire by one-fourth, a very popular measure, though one of questionable policy in the face of the threatening attitude of the Goths on the lower Danube. Before venturing on a campaign against them, Valens received baptism from Eudoxus, the bishop of Constantinople and the leader of the Arian party. After some small successes over the Goths, won by his generals (367–9), Valens concluded a peace with them, which lasted six years, on a general understanding that the Danube was to be the boundary between Goths and Romans. On his return to Constantinople in 369–70 Valens began to persecute his orthodox and Catholic subjects, but he lacked the energy to carry out his edicts rigorously.

In the years 371 to 377 Valens was in Asia Minor, most of the time at the Syrian Antioch. Though anxious to avoid an Eastern war, because of danger nearer home from the restlessness of the Goths, he was compelled to take the field against Shapur II. who had invaded and occupied Armenia. It seems that Valens[1] crossed the Euphrates in 373, and in Mesopotamia his troops drove back the king of Persia to the farther bank of the Tigris. But the Roman success was by no means decisive, and no definite understanding as to boundaries was come to with Persia. Valens returned to Antioch, where in the winter of 373–4 he instituted a persecution of magicians and other people whom he foolishly believed to imperil his life. Between 374 and 377 we read of grievous complaints of injustice and extortion perpetrated under legal forms, the result probably of the recent panic, and pointing to an increasing weakness and timidity at headquarters. Although preparations were made for following up the war with Persia and securing the frontier, a truce was patched up, rather to the disadvantage of the empire, Armenia and the adjacent country being half conquered and annexed by Shapur. The armies of Rome, in fact, were wanted in another quarter. The Huns, of whom we now hear for the first time, were beginning in 376 to press the Goths from the north, and the latter asked leave of the emperor to cross the Danube into Roman territory. This they were allowed to do, on the condition that they came unarmed, and their children were transported to Asia as hostages. The conditions, however, were not observed by the imperial generals, who for their own profit forced the new settlers to buy food at famine prices. Accordingly, the enraged Goths, under their chief Fritigern, streamed across the Balkans into Thrace and the country round Adrianople, plundering, burning and slaughtering as they went. They were driven back for a time, but returned in the spring of 378 in greater force, with a contingent of Huns and Alans; and again, after some repulses, they penetrated to the neighbourhood of Adrianople. Valens, who had now returned to Constantinople, left the capital in May 378 with a strong and well-officered army. Without awaiting the arrival of his nephew Gratian, emperor of the West, who had just won a great victory over one of the barbarous tribes of Germany in Alsace, Valens attacked the enemy at once, although his troops had to go into action heated and fatigued by a long march on a sultry August day. The battle, which was fought on confined ground in a valley, was decided by a cavalry charge of the Alans and Sarmatians, which threw the Roman infantry into confusion and hemmed it in so closely that the men could scarcely draw their swords. The slaughter, which continued till the complete destruction of the Roman army, was one of the greatest recorded in antiquity. Valens either perished on the field, or, as some said, in a cottage fired by the enemy. From the battle of Adrianople the Goths permanently established themselves south of the Danube.

See Ammianus Marcellinus, bks. 26–31, E. Gibbon, *The Decline and Fall of the Roman Empire* (ed. Bury, London, 1896), chs. 25–26; W. Judeich in *Deutsche Zeitschrift für Geschichtswissenschaft* (1891), pp. 1–21.

VALENTIA, SIR FRANCIS ANNESLEY, VISCOUNT (1585–1660), Anglo-Irish statesman, son of Robert Annesley of Newport Pagnel in Buckinghamshire, was born in 1585, and settled in Ireland at an early age, acquiring property in various parts of the island. His friendship with the lord deputy, Sir Arthur Chichester, procured for him government employment and the favour of King James I., who conferred on him a grant of the land and fort of Mountnorris, county Armagh, in 1612. He was returned to the Irish parliament by the county Armagh in 1614, and four years later was appointed secretary for Ireland, being created a baronet in 1620. In the following year he received, by an unusual patent, a reversionary grant of the viscountcy of Valencia after the death without male issue of a kinsman (Sir Henry Power, created viscount of Valentia in 1621), the then living viscount. In 1625 Sir Francis Annesley was elected member for the county of Carmarthen in the English parliament; and in the same year he was made vice-treasurer and receiver-general of Ireland. In 1628 he was created Baron Mountnorris in the peerage of Ireland. He strongly opposed the policy of Lord Falkland, who became lord deputy in 1622, and procured his recall in 1629. When Sir Thomas Wentworth, afterwards the famous earl of Strafford, went to Ireland in 1633, he took action against Mountnorris, whom he accused of corruption and malversation of public money. The two men became violent opponents, and at a dinner at the lord chancellor's house in April 1635 Mountnorris used insulting and threatening language in reference to the lord deputy. Wentworth brought him before a court-martial on a charge of insubordination as an officer in the army, and by this tribunal Mountnorris was condemned to death. The sentence was not carried out, but he was imprisoned and deprived of all his offices on the report of a committee appointed by the privy council to inquire into the charges of corruption. The vindictiveness of the proceedings against Mountnorris, which afterwards constituted one of the counts in the impeachment of Strafford, has been strongly condemned by some historians and extenuated by others; that the trial by court-martial and the sentence were at all events not illegal, has been shown by S. R. Gardiner. Mountnorris was not long detained in prison, and in 1640 his relations with Strafford were examined by a committee of the Long Parliament, which pronounced the sentence passed on him unjust and illegal. In 1642 he succeeded, under the above-mentioned reversion, to the title of viscount of Valentia. During the Commonwealth he again held the post of secretary in Ireland to the lord deputy, Henry Cromwell, with whom he was on friendly terms. Valentia died in 1660. His wife was Dorothy, daughter of Sir John Phillipps of Picton, Pembrokeshire, by whom he was the father of Arthur Annesley, earl of Anglesey (*q.v.* for later history).

See S. R Gardiner, *History of England*, vol. viii. (London, 1883–84); Strafford's *Letters and Dispatches*, edited by W. Knowler (2 vols., Dublin, 1740); G. E. C., *Complete Peerage*, vol. v. (London, 1893).

VALENTINE, or VALENTINUS, the name of a considerable number of saints. The most celebrated are the two martyrs whose festivals fall on the 14th of February—the one, a Roman priest, the other, bishop of Terni (Interamna). The *Passion* of the former is part of the legend of SS. Marius and Martha and their companions; that of the latter has no better historical foundation: so that no argument can be drawn from either account to establish the differentiation of the two saints. It would appear from the two accounts that both belonged to the same period, *i.e.* to the reign of the emperor Claudius (Gothicus); that both died on the same day; and that both were buried on the Via Flaminia, but at different distances from Rome. The *Martyrologium Hieronymianum* mentions only one Valentinus: "Interamnae miliario LXIIII. via Flaminia natale Valentini." It is probable that the basilica situated at the second milestone on the Via Flaminia was also dedicated to him. It is impossible to fix the date of his death. The St Valentinus who is spoken of as the apostle of Rhaetia, and venerated in Passau as its first bishop, flourished in the 5th century. Although the name of St Valentine is very popular in England, apparently no church has been dedicated to him. For the peculiar observances that used to be commonly connected with St Valentine's Eve and Day, to which allusion is frequently made by English writers, such works as John Brand's *Popular Antiquities* (edited by W. C. Hazlitt, vol. ii. pp. 606–11, London, 1905), W. Hone's *Every-Day Book*, and Chambers's *Book of Days* may be consulted. Their appropriateness to the spring season is, in a general way perhaps, obvious enough, but the association of the lovers' festival with St Valentine seems to be purely accidental.[1]

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[1] Amm. Marc. xxix. 1: the narrative is brief and not very clear.

See *Acta Sanctorum*, February, ii. 753, 756, and January, i. 1094; G. B. de Rossi, *Bullettino di archeologia cristiana* (1871), p. 101 and (1878) p. 59. (H. De.)

VALENTINE AND ORSON, a romance which has been attached to the Carolingian cycle. It is the story of twin brothers, abandoned in the woods in infancy. Valentine is brought up as a knight at the court of Pippin, while Orson grows up in a bear's den to be a wild man of the woods, until he is overcome and tamed by Valentine, whose servant and comrade he becomes. The two eventually rescue their mother Bellisant, sister of Pippin and wife of the emperor of Greece, by whom she had been unjustly repudiated, from the power of a giant. There are versions of the tale, which appears to rest on a lost French original, in French, English, German, Icelandic, Dutch and Italian. In the older versions Orson is described as the "nameless" one. The kernel of the story lies in Orson's upbringing and wildness, and is evidently a folk-tale the connexion of which with the Carolingian cycle is purely artificial. The story of the wife unjustly accused with which it is bound up is sufficiently common, and was told of the wives both of Pippin and Charlemagne.

The French prose romance was printed at Lyons in 1489 and often subsequently. *The Historye of the two Valyannte Brethren: Valentyne and Orson* . . . by Henry Watson, printed by William Copland about 1550, is the earliest known of a long series of English versions. A ballad on the subject was printed in Bishop Percy's *Reliques of English Poetry*, and the tale adapted for the nursery was illustrated by Walter Crane in the *Three Bears' Picture Book* (1876). For a detailed bibliography of the English, French, German, Dutch and Italian forms of the tale, see W. Seelman, "Valentin und Namelos" (Norden and Leipzig, 1884), in vol. iv. of *Niederdeutsche Denkmäler*, edited by the Verein für niederdeutsche Sprachforschung.

VALENTINIAN I., Roman emperor of the West from A.D. 364 to 375, was born at Cibalis, in Pannonia. He had been an officer of the guard under Julian and Jovian, and had risen high in the imperial service. Of robust frame and distinguished appearance, he possessed great courage and military capacity. He was chosen emperor in his forty-third year by the officers of the army at Nicaea in Bithynia in 364, and shortly afterwards named his brother Valens (*q.v.*) colleague with him in the empire. The two brothers, after passing through the chief cities of the neighbouring district, arranged the partition of the empire at Naissus (Nissa) in Upper Moesia. As emperor of the West, Valentinian took Italy, Illyricum, Spain, the Gauls, Britain and Africa, leaving to Valens the eastern half of the Balkan Peninsula, Greece, Egypt, Syria and Asia Minor as far as Persia. During the short reign of Valentinian there were wars in Africa, in Germany and in Britain, and Rome came into collision with barbarian peoples of whom we now hear for the first time—Burgundians, Saxons, Alamanni. The emperor's chief work was guarding the frontiers and establishing military positions. Milan was at first his headquarters for settling the affairs of northern Italy; next year (365) he was at Paris, and then at Reims, to direct the operations of his generals against the Alamanni. This people, defeated at Scarpona (Charpeigne) and Catelauni (Châlons-sur-Marne) by Jovinus, were driven back to the German bank of the Rhine, and checked for a while by a chain of military posts and fortresses. At the close of 367, however, they suddenly crossed the Rhine, attacked Moguntiacum (Mainz) and plundered the city. Valentinian attacked them at Solicinium (Sulz in the Neckar valley or Schwetzingen) with a large army, and defeated them with great slaughter, but his own losses were so considerable that he abandoned the idea of following up his success. Later in 374, he made peace with their king, Macrianus, who from that time remained a true friend of the Romans. The next three years he spent at Trier, which he chiefly made his headquarters, organizing the defence of the Rhine frontier, and personally superintending the construction of numerous forts. During his reign the coasts of Gaul were harassed by the Saxon pirates, with whom the Picts and Scots of northern Britain joined hands, and ravaged the island from the wall of Antoninus to the shores of Kent. In 368 Theodosius was sent to drive back the invaders; in this he was completely successful, and established a new British province, called Valentia, in honour of the emperor. In Africa the Moorish prince, Firmus, raised the standard of revolt, being joined by the provincials, who had been rendered desperate by the cruelty and extortions of Count Romanus, the military governor. The services of Theodosius were again requisitioned. He landed in Africa with a small band of veterans, and Firmus, to avoid being taken prisoner, committed suicide. In 374 the Quadi, a German tribe in what is now Moravia and Hungary, resenting the erection of Roman forts to the north of the Danube in what they considered to be their own territory, and further exasperated by the treacherous murder of their king, Gabinius, crossed the river and laid waste the province of Pannonia. The emperor in April of the following year entered Illyricum with a powerful army, but during an audience to an embassy from the Quadi at Brigetio on the Danube (near Pressburg) died in a fit of apoplexy. His general administration seems to have been thoroughly honest and able, in some respects beneficent. If he was hard and exacting in the matter of taxes, he spent them in the defence and improvement of his dominions, not in idle show or luxury. Though himself a plain and almost illiterate soldier, he was a founder of schools, and he also provided medical attendance for the poor of Rome, by appointing a physician for each of the fourteen districts of the city. He was an orthodox Catholic, but he permitted absolute religious freedom to all his subjects. Against all abuses, both civil and ecclesiastical, he steadily set his face, even against the increasing wealth and worldliness of the clergy. The great blot on his memory is his cruelty, which at times was frightful, and showed itself in its full fierceness in the punishment of persons accused of witchcraft, soothsaying or magical practices.

See Ammianus Marcellinus xxv.–xxx.; Gibbon, *Decline and Fall*, chap. 25; T. Hodgkin, *Italy and her Invaders*, bk. i. chap. 3; H. Schiller, *Geschichte der römischen Kaiserzeit* (Gotha, 1883–87), bk. iii. chap. iv. 27–30; H. Richter, *Das weströmische Reich* (Berlin, 1865), pp. 240–68.

After his death, his son, VALENTINIAN II., an infant of four years of age, with his half-brother Gratian (*q.v.*) a lad of about seventeen, became the emperors of the West. They made Milan their home; and the empire was nominally divided between them, Gratian taking the trans-Alpine provinces, whilst Italy, Illyricum in part, and Africa were to be under the rule of Valentinian, or rather of his mother, Justina. Justina was an Arian, and the imperial court at Milan pitted itself against the Catholics, under the famous Ambrose, bishop of that city. But so great was his popularity that the court was decidedly worsted in the contest, and the emperor's authority materially shaken. In 387 Magnus Maximus (*q.v.*), who had commanded a Roman army in Britain, and had in 383 (the year of Gratian's death) made himself master of the northern provinces, crossed the Alps into the valley of the Po and threatened Milan. The emperor and his mother fled to Theodosius, the emperor of the East and husband of Galla, Valentinian's sister. Valentinian was restored in 388 by Theodosius, through whose influence he was converted to Orthodox Catholicism. Four years later he was murdered at Vienne in Gaul, probably at the instigation of his Frankish general Arbogast, with whom he had quarrelled.

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[1] Until nearly the close of the 19th century the custom of sending "valentines"—*i.e.* anonymous love-tokens, written or otherwise—on St Valentine's day was fairly general. They gradually lost their original significance, and the custom, where it survives, has become completely vulgarized.

See Gibbon, *Decline and Fall*, chap. 27; Schiller, *Geschichte der römischen Kaiserzeit*, bk. iii. vol. iv. pp. 32, 33; L. Ranke, *Weltgeschichte*, bk. iv. vol. i. chap. 6; and especially H. Richter, *Das weströmische Reich unter den Kaisern Gratian, Valentinian II. und Maximus* (Berlin, 1865), pp. 577–650, where full references to authorities are given.

VALENTINIAN III., emperor of the West from 425 to 455, the son of Constantius and Placidia, daughter of the great Theodosius. He was only six years of age when he received the title of Augustus, and during his minority the conduct of affairs was in the hands of his mother, who purposely neglected his education. His reign is marked by the dismemberment of the Western Empire; the conquest of the province of Africa by the Vandals in 439; the final abandonment of Britain in 446; the loss of great portions of Spain and Gaul, in which the barbarians had established themselves; and the ravaging of Sicily and of the western coasts of the Mediterranean by the fleets of Genseric. As a set-off against these calamities there was the great victory of Aëtius over Attila in 451 near Châlons, and his successful campaigns against the Visigoths in southern Gaul (426, 429, 436), and against various invaders on the Rhine and Danube (428–31). The burden of taxation became more and more intolerable as the power of Rome decreased, and the loyalty of her remaining provinces was seriously impaired in consequence. Ravenna was Valentinian's usual residence; but he fled to Rome on the approach of Attila, who, after ravaging the north of Italy, died in the following year (453). In 454 Aëtius, between whose son and a daughter of the emperor a marriage had been arranged, was treacherously murdered by Valentinian. Next year, however, the emperor himself was assassinated by two of the barbarian followers of Aëtius. He not merely lacked the ability to govern the empire in a time of crisis, but aggravated its dangers by his self-indulgence and vindictiveness.

Our chief original sources for the reign of Valentinian III. are Jordanes, Prosper's *Chronicles*, written in the 6th century, and the poet Apollinaris Sidonius. See also Gibbon, *Decline and Fall*, chaps. 33–35; J. B. Bury, *Later Roman Empire*, bk. ii. chaps. 6–8; E. A. Freeman, "Tyrants of Britain, Gaul and Spain" (*Eng. Hist. Review*, January 1886), and "Aëtius and Boniface" (*ibid.*, July 1887).

VALENTINOIS, the name of a countship in France, the chief town of which was Valence (Drôme). From the 12th to the 15th century Valentinois belonged to a family of Poitiers, which must not be confused with that of the counts of Poitiers. To the detriment of his kinsmen, the lords of St Vallier, Count Louis II. (d. 1419) bequeathed his counties of Valentinois and Diois to the Dauphin Charles, afterwards King Charles VII.; and in 1498 Louis XII. erected the countship of Valentinois into a duchy, and gave it to Caesar Borgia, son of Pope Alexander VI. A few years later Borgia was deprived of the duchy, which, in 1548, was given by Henry II. to his mistress, Diane de Poitiers, a descendant of the counts of Valentinois. Having again reverted to the Crown, the duchy was given by Louis XIII. to Honoré Grimaldi, prince of Monaco, whose descendants retained it until the French Revolution. The new duchy of Valentinois, however, did not consist of the lands attached to the former one, but was made up of several scattered lordships in Dauphiné. The title of duke of Valentinois is still borne by the prince of Monaco.

See J. Chevalier, *Mémoires pour servir à l'histoire des comtés de Valentinois et de Diois* (Paris, 1897–1906).

VALENTINUS, pope for thirty or forty days in 827, in succession to Eugenius II. (824–27). He was a Roman by birth, and, according to the *Liber Pontificalis*, was first made a deacon by Paschal I. (817–24). Nothing further is known of his history. His successor was Gregory IV. (827–44).

VALENTINUS and **THE VALENTINIANS.** I. Valentinus, the most prominent leader of the Gnostic movement, was born, according to Epiphanius (*Haer.* 31, 2), near the coast in Lower Egypt, and was brought up and educated in Alexandria. He then went to Rome, as we learn from Irenaeus, *Adv. haer.* iii. 4, 3; Valentinus came to Rome during the episcopate of Hyginus, flourished under Pius and stayed till the time of Anicetus. The duration of the episcopates of the Roman bishops at this period is not absolutely established, but we can hardly go altogether wrong if, with Harnack (*Chronologie der altchristlichen Literatur*, i. 291), we fix the period 135–60 for Valentinus's residence in Rome. This is confirmed by the fact that Justin Martyr in his *Apology*, i. 26, begun about 150, mentions that in his earlier work against heresy, the *Syntagma*, he attacked, among others, Valentinus; so that his heresy must have begun to appear at least as early as 140. According to Irenaeus iii. 3, 4, Polycarp, during his sojourn in Rome under the episcopate of Anicetus, converted a few adherents of the Valentinian sect. Tertullian (*Adv. Valentin.* cap. 4) declares that Valentinus came to Rome as an adherent of the orthodox Church, and was a candidate for the bishopric of Rome, but he abandoned the Church because a confessor was preferred to him for this office. The credibility of this statement may be questioned. There is nothing impossible in it, but it has rather the appearance of a piece of the usual church gossip. Great uncertainty attaches to the residence of Valentinus in Cyprus, recorded by Epiphanius (*loc. cit.*), who places it after his stay in Rome, adding that it was here that he definitely accomplished his secession from the Church. Scholars are divided as to whether this stay in Cyprus was before or after that in Rome. But on the whole it seems to be clear from the various notices that Valentinus did not, *e.g.* like Marcion, break with the Church from the very beginning, but endeavoured as long as possible to maintain his standing within it.

II. The authorities which we have to consider deal for the most part with Valentinianism in its fully developed form, and not with the original teaching of the master. Justin's *Syntagma* (*v.s.*), which treats of Valentinus, is unfortunately lost. Irenaeus in his section i. 11, 1–3, has preserved what is obviously an older document, possibly from Justin, dealing with Valentinus's own teaching and that of two of his disciples. The sketch which he gives is the best guide for the original form of Valentinianism. For Valentinus himself we have also to consider the fragments of his writings preserved by Clemens Alexandrinus. The best edition of and commentary on them is Hilgenfeld's *Ketzergeschichte des Urchristentums* (pp. 293–307). Irenaeus in his treatise *Adv. haer.* gives a detailed account of the two chief schools following Valentinus, the school of Ptolemaeus (i. 1–10), and Marcus and the Marcosians (i. 13–21). For his account of the Ptolemaeans, Irenaeus seems to have used various writings and expositions of the school, especially prominent being a collection of Scripture proofs which may have once had a separate literary existence (i. 1, 3; 3, 1–5 (6); 8, 2–4). To this work is appended in a somewhat disconnected fashion a commentary on the prologue to the fourth Gospel (i. 8, 5). Irenaeus himself twice prefaces his remarks by saying he is indebted to other authorities for his exposition (i. 2, 3–4; 7, 2–5). Section 6, 2–4, interrupts and disturbs the continuity, and section 5, 1–3, is a duplicate of 5, 4. We see how the account of Irenaeus is built up from small fragments. In his account of Marcus and the Marcosians the chapters on the sacraments (i. 13 and 20) seem originally to have formed part of the same whole. Very valuable too are the *Excerpta ex Theodoto* which are to be found in the works of Clemens Alexandrinus, and may be looked upon as a collection made by the author with a view to the eighth book of his *Stromateis*, which was never finished. Of these excerpts paragraphs 4, 5, 8–15, 17b–20, 27, should be distinguished as Clemens's own observations; the remaining parts are extracted from Gnostic writings (cf. Zahn, *Geschichte des Kanons*, ii. pp. 260 seq.). Yet the *Excerpta*, as their contents show, are not homogeneous, and cannot have been borrowed from one writing. The question as to whether Clemens' method of quotations, which mentions sometimes Theodotus, sometimes the Valentinians as his sources for these excerpts, is of any use as a guide to an estimate between these sources, must be left undecided. The most important sections are paragraphs 29–68, in which an attempt is made at a continuous exposition of the system (though here again from various sources), and section 69–86, which deals with the Gnostic doctrine of the sacraments and that of the liberation of the *Heimarmene*. The lost *Syntagma* of Hippolytus, which, as we know, is preserved in the works of Philastrius and the pseudo-Tertullian, seems to furnish us with valuable information as to the earlier doctrines of the sect, and in his second treatise against heretics, the so-called *Philosophumena* (6, 29 seq.). Hippolytus gives a homogeneous and continuous exposition of a later Valentinian system, possibly connected with the school of Ptolemaeus. Important, too, are Hippolytus' references to an Italic and an Anatolian branch of the Valentinian sect (6, 35). Tertullian gives at the beginning of his treatise against the Valentinians a few separate notices of the life and disciples of Valentinus, but his further argument is closely dependent upon Irenaeus' exposition of the Ptolemaean system, which he embellishes in his usual fashion with bitterly sarcastic comments. Epiphanius deals with Valentinus and his school in sections 31–36 of his work. In cap. 31, 1–8, he gives an account of the Valentinians, which seems to be based on his own observation. Thus in 31, 5–6, we find yet another verbal extract from a Valentinian doctrinal work. For the rest he copies the text of Irenaeus word for word, which has the advantage of preserving for us Irenaeus' Greek phraseology, which we otherwise should only know in a Latin translation. In his section on Ptolemaeus, cap. 33, Epiphanius has preserved for us a valuable letter of Ptolemaeus to Flora, which is a document of the highest importance for the understanding of Gnosticism.

III. Valentinus is the only one of the Gnostics who had a whole series of disciples who are known by name—indeed, in the accounts of the Church Fathers his own system and views are almost entirely obscured by the accounts of those of his disciples. His fundamental ideas can be with difficulty reconstructed from Irenaeus i. 11, from the fragments contained in Clemens, and to a certain extent from the *Syntagma* of Hippolytus, with the aid of later systems connected with his. Two early disciples of Valentinus are enumerated in Irenaeus ii. 2–3, one of whom is named Secundus; according to Irenaeus we have to trace back to him the division of the Valentinian Sophia into the double form of an aeon abiding in heaven, and her daughter, Sophia Achamoth. The second disciple is not named by Irenaeus; it is conjectured that he may have been Colorbases, the teacher of Marcus (i. 14, 1). The most important disciples of Valentinus, then, are the two dealt with at length by Irenaeus, Ptolemaeus and Marcus, who both seem to have had a numerous following. Besides these we should also mention Herakleon, of whose commentary on the gospel of St John extensive fragments are preserved by Origen. Ptolemaeus and Herakleon are counted by Hippolytus (6, 35) among the Italic branch of Valentinianism. There was also the Anatolian branch, as representative of which Hippolytus mentions Axionicus, who is also referred to by Tertullian as having actually been taught in Antioch. The *Excerpta ex Theodoto* in Clemens are also, according to the superscription, fragments from the Anatolian Gnosticism. It is, however, an error when Hippolytus speaks of Bardesanes as representative of this branch, for he had an entirely distinct position.

IV. In the important section of Irenaeus (i. 11) devoted to Valentinus, his teaching is definitely connected with the so-called "falsely reputed Gnostics." It will be useful, in trying to ascertain the teaching and view of life of Valentinus, to keep closely before us that of the "Gnostics" in the narrower sense of the word, as preserved in the expositions of Irenaeus (i. 29, 30) and Epiphanius (*passim*). The Gnostics were *par excellence* worshippers of the supreme Mother-goddess, the Μήτηρ, in whom we have no difficulty in recognizing the characteristics of the goddess of heaven of anterior Asia. This "Meter" is, in the system of these Gnostics, also at one time the stern, austere goddess, the Mother, who dwells in heaven, at other times the licentious goddess of love, the great courtesan (*Prunikos*), who, *e.g.* in the Simonian system, takes the form of the prostitute Helena, in whose worship all kinds of obscene rites were celebrated. She dwells in the eighth or highest heaven, whence her name Ogdoas. Next to her stands the supreme and shadowy form of the unknown and nameless Father, below her in the seven lower heavens reign the seven planetary, world-creating angelic powers, headed by Jaldabaoth, who was later to be identified with the God of the Old Testament. The Gnostics are children of the supreme Mother; from her the heavenly seed, the divine spark, descended in some way to this lower world, and thus the children of heaven still exist in this gross material world, subject to the Heimarmene and in the power of hostile spirits and powers; and all their sacraments and mysteries, their formulae and symbols, must be part of her worship, in order to find the way upwards, back to the highest heaven, "where the Mother dwells." This idea that the Gnostics know themselves to be in a hostile and evil world reacted in the same direction upon the conception of the Mother of heaven. She became likewise a fallen goddess, who has sunk down into the material world and seeks to free herself from it, receiving her liberation at the hands of a heavenly Redeemer, exactly like the Gnostics. Various myths have contributed towards this; one of these is the widespread naïve pagan myth of a goddess who disappears, carried off by the powers of evil, to be set free and taken back to her home by a divine liberator, a brother or betrothed. The moon-goddess with her disappearance may have been the prototype of this mythical figure (there are, indeed, certain analogies to be remarked between the Simonian Helena and Selene). With this myth are connected certain Jewish Theologumena; the goddess who sinks down into the material may readily be identified with Ruach (Rucha), the Spirit of God, who broods over Chaos, or even with the later Sophia (Chokma Achamoth), who was generally conceived of as a world-creating agent. Thirdly, the chief influence at work here seems to have been the oriental myth of the Primal Man sunk in the material world, which appears in its simple form in individual Gnostic systems, *e.g.* in Poimandres (in the *Corpus hermeticum*) and in Manichaeism. In the Gnostic systems of Irenaeus i. 29, 30, the Anthropos (*i.e.* the Primal Man) no longer appears as the world-creative power sinking down into the material world, but as a celestial aeon of the upper world (or even as the supreme god), who stands in a clearly defined relationship to the fallen goddess; it is possible that the rôle of the Anthropos is here transferred to Sophia Achamoth. The fallen Sophia next becomes, in like manner, a world creative power. And now the highest of the world-creating angels, Jaldabaoth, appears as her son, and with this whole conception are then linked up the ideas of liberation and redemption. Next to the Sophia stands a male redeeming divinity. In all the Gnostic systems known to us Christ already appears as the Saviour, and so in this respect a Christianizing of Gnosticism has been carried out; but originally this Saviour-divinity had nothing in common with the figure of the Christian Redeemer. This is clear from Irenaeus's account of the Gnostics (i. 30). For here the redemption is actually and essentially effected through the uniting in marriage of the fallen goddess with her higher celestial brother, and they are expressly described as the bride and bridegroom. That is to say, we have here the purely mythical idea of the deliverance of a goddess by a god, and of the celestial marriage of a divine pair. This myth can only with difficulty be connected with the historic redemption through Jesus of Nazareth, by further relating that Christ, having been united to the Sophia, descends into the earthly Jesus.

V. This primitive "Gnosticism" was very closely followed by Valentinus, who may have come to know these doctrines in Egypt. This can be seen from the fact that in Valentinianism the Mother-goddess always stands absolutely at the centre of the system. Irenaeus (i. 6, 1) is very instructive on this point, characterizing the Gnostics as the *pneumatici* who have a perfect knowledge of God, and have been initiated into the mysteries of Achamoth. A mighty system is certainly erected here out of the modest elements of Gnosticism.

(1) More especially, the superstructure of the celestial system, the celestial world of aeons, which exists above the fallen goddess, is

here developed in the most complicated way. Valentinus has a system of thirty aeons, but we can with but little trouble recognize the simple system underlying this great superstructure. The quite shadowy plurality of ten and twelve aeons (the Dekas and the Dodekas) of the Valentinian system we may at once set aside as mere fantastical accretions. We have left only a group of eight celestial beings, the so-called Ogdoas, and of these eight figures four again are peculiar to the Valentinian system, and are probably artificial interpolations. For instance, when for the third pair of aeons we find the Logos and Zoë, figures which occur only here, and perceive, moreover, that the place of this pair of aeons is not firmly established, but that in this Valentinian tradition they occur sometimes before and sometimes after the fourth pair of aeons, the Anthropos and the Ekklesia, we cannot be far wrong in suspecting that here already we find Valentinus to have been influenced by the prologue of the fourth Gospel (we also find the probably Johannine names Monogenes and Parakletos in the series of aeons).

(2) The first pair of aeons, Bythos and Sige, is likewise an original innovation of the Valentinian school, and clearly betrays a monistic tendency. According to Irenaeus's account of the "Gnostics" (i. 29), their theory was that Sophia casts herself into the primal substratum of matter to be found outside the celestial world of aeons. In the Valentinian system, primal matter (Bythos), the original Chaos, is brought into connexion with the celestial world of aeons. And thus it is effected that matter is here not found originally and irretrievably separated from the higher celestial world, but that the latter originally exists for itself alone; the fall or disturbance is accomplished within the celestial world, and the material world first comes into existence through the fall. When we subtract from the Ogdoas the two pairs of aeons whose later introduction into the Valentinian system has been demonstrated, we are left actually with a double pair of aeons, the Father and Truth, the Anthropos and the Ekklesia. These strongly recall the Gnostic systems set forth in Irenaeus i. 29 and 30 (cf. i. 29, 3). And thus the *Anthropos* (man), a leading figure of primitive Gnosticism, now half-forgotten, moves back into the centre of the system and the direct vicinity of the fallen goddess. It is also clear why the Ekklesia appears together with the Anthropos. With the celestial Primal Man—of whom the myth originally relates that he has sunk into matter and then raised himself up from it again—is associated the community of the faithful and the redeemed, who are to share the same fate with him. Similarly among the Gnostics of Irenaeus i. 29, 3, perfect Gnosis (and thus the whole body of Gnostics) is connected with the Anthropos.

(3) The fallen goddess, mentioned above, occurs in the Valentinian system, as in the Gnostic systems described by Irenaeus, and in the older systems it is again the celestial aeon himself who falls, and whose fate outside the Pleroma is related (cf. the exposition in Irenaeus i. 11, *Excerpta ex Theodoto*, § 31 seq., and Hippolytus, *Syntagma*, in the pseudo-Tertullian). In the later Valentinian systems, probably from Secundus onwards (see above), the figure appears in double guise. The higher Sophia still remains within the upper world after creating a disturbance, and after her expiation and repentance; but her premature offspring, Sophia Achamoth, is removed from the Pleroma, and becomes the heroine of the rest of the drama (we have dealt in the preceding section with the other conception of the fall of Sophia).

(4) In the true Valentinian system the so-called Christos is the son of the fallen Aeon, who is thus conceived as an individual. Sophia, who in a frenzy of love had sought to draw near to the unattainable Bythos, brings forth, through her longing for that higher being, an aeon who is higher and purer than herself, and at once rises into the celestial worlds. Among the Gnostics of Irenaeus we find a kindred conception, but with a slight difference. Here Christos and Sophia appear as brother and sister, Christos representing the higher and Sophia the lower element. In the enigmatic figure of Christos we again find hidden the original conception of the Primal-Man, who sinks down into matter but rises again. (In the later Valentinian systems this origin of the Christos is entirely obscured, and Christ, together with the Holy Spirit, becomes a later offspring of the celestial world of aeons; this may be looked upon as an approximation to the Christian dogma).

(5) A figure entirely peculiar to Valentinian Gnosticism is that of Horos (the Limiter). The name is perhaps an echo of the Egyptian Horus. The peculiar task of Horos is to separate the fallen aeons from the upper world of aeons. At the same time he becomes (first, perhaps, in the later Valentinian systems) a kind of world-creative power, who in this capacity helps to construct an ordered world out of Sophia and her passions. He is also called, curiously enough, Stauros (cross), and we frequently meet with references to the figure of Stauros. But we must not be in too great a hurry to conjecture that this is a Christian figure. Speculations about the Stauros are older than Christianity, and a Platonic conception may have been at work here. Plato had already stated that the world-soul revealed itself in the form of the letter Chi (X); by which he meant that figure described in the heavens by the intersecting orbits of the sun and the planetary ecliptic. Since through this double orbit all the movements of the heavenly powers are determined, so all "becoming" and all life depend on it, and thus we can understand the statement that the world-soul appears in the form of an X, or a cross. The cross can also stand for the wondrous aeon on whom depends the ordering and life of the world, and thus Horos-Stauros appears here as the first redeemer of Sophia from her passions, and as the orderer of the creation of the world which now begins. This explanation of Horos, moreover, is not a mere conjecture, but one branch of the Valentinian school, the Marcosians, have expressly so explained this figure (Irenaeus i. 17, 1). Naturally, then, the figure of Horos-Stauros was often in later days assimilated to that of the Christian Redeemer.

(6) Peculiarly Valentinian is the above-mentioned derivation of the material world from the passions of Sophia. Whether this already formed part of the original system of Valentinus is, indeed, questionable, but at any rate it plays a prominent part in the Valentinian school, and consequently appears with the most diverse variations in the account given by Irenaeus. By it is effected the comparative monism of the Valentinian system. The dualism of the conception of two separate worlds of light and darkness is overcome by the derivation of the material world from the passions of Sophia. Older myths may here have served as a model; for instance, we may recall the myth of the derivation of the world from the body and limbs of the Primal Man (Bousset, *Hauptprobleme der Gnosis*, p. 211).

(7) This derivation of the material world from the passions of the fallen Sophia is next affected by an older theory, which probably occupied an important place in the true Valentinian system. According to this theory the son of Sophia, whom she forms on the model of the Christos who has disappeared in the Pleroma, becomes the Demiourgos, and this Demiourgos with his angels now appears as the real world-creative power. These two conceptions had now to be combined at all costs. And it is interesting to observe here what efforts were made to give the Demiourgos a better position. According to the older conception, he was an imperfect, ignorant, half-evil and malicious offspring of his mother, who has already been deprived of any particle of light (Irenaeus i. 29, 30). In the Valentinian systems he appears as the fruit of Sophia's repentance and conversion. Even his name has been changed from that of the older Gnosticism. He is no longer called Jaldabaoth, but has been assigned the better name, drawn from the philosophy of Plato, of Demiourgos. We must not forget here that the Demiourgos of the Gnostic is known to have corresponded to the God of the Old Testament, who was the God of the Christian Church, and that we can thus lay our finger here on a compromise with the faith of the great Christian community.

(8) With the doctrine of the creation of the world is connected the subject of the creation of man. We fortunately know, from a fragment preserved by Clemens, that Valentinus here preserved the old Gnostic myth practically unaltered in his system. According to it, the world-creating angels—not one, but many—create man, but the seed of the spirit comes into their creature without their knowledge, by the agency of a higher celestial aeon, and they are then terrified by the faculty of speech by which their creature rises above them, and try to destroy him. In the Valentinian system known to us this myth has practically lost its original freshness and colour, and can only be arrived at from allusions. On the other hand, the speculations of the Valentinians delight in accounts of the artificial and complicated putting together of the first man out of the various elements. And a specifically Valentinian idea is here added in that of the threefold nature of man, who is represented as at once spiritual, psychical and material. In accordance with this there also arise three classes of men, the *pneumatici*, the *psychici* and the *hylici* (ὕλη, matter). It is significant that Valentinus himself is credited with having written a treatise upon the three natures (Schwartz, *Aporien*, i. 292). Here we have another instance of the theological compromise of the Valentinians. All the other Gnostic systems recognize only a dual division, the children of light and the children of darkness. That the Valentinians should have placed the *psychici* between the *pneumatici* and *hylici* signifies a certain recognition of the Christian Church and its adherents. They are not numbered simply among the outcasts, but considered as an intermediate class, to whom is left the choice between the higher celestial nature and the lower and earthly.

(9) At the centre of the whole Valentinian system naturally stands the idea of redemption, and so we find here developed particularly clearly the myth of the heavenly marriage already known from Irenaeus i. 30 to be Gnostic. Redemption is essentially accomplished through the union of the heavenly Soter with the fallen goddess. There is great uncertainty in the Valentinian system as to who this celestial Soter is. In the Gnostic systems of Irenaeus i. 30 he is the Christos, the celestial brother who turns back to the fallen sister. In the Valentinian system the redeemer is likewise sometimes brought into relation with the Christos, sometimes, in a significant way, with the Anthropos, and sometimes again with Horos-Stauros. In the fully developed Ptolemaean system he appears as the common offspring of the whole Pleroma, upon whom all the aeons confer their best and most wonderful qualities (we may compare here the Marduk myth, in which it is related that all the gods transfer their qualities and powers to the young god Marduk, who is recognized as their leader). And this celestial redeemer-aeon now enters into a marriage with the fallen goddess; they are the "bride and bridegroom." It is boldly stated in the exposition in Hippolytus's *Philosophumena* that

they produce between them 70 celestial sons (angels). (In the other accounts these angels no longer appear as the sons of the celestial pair, but as the heavenly attendants accompanied by whom the Soter approaches Sophia.) It is obvious from the number 70 that we have here a marriage between a celestial and divine pair. This marriage relation between the Soter and Sophia is expounded in quite a material way even in Irenaeus iii. 3, 4, where the Old Testament phrase πᾶν ἄρρεν διανοῖγον μήτραν is translated, "the Pan (the all, a name for the Soter), the masculinity which opens the mother's womb." This myth of the redeemer, as we shall see more fully below, and as may be mentioned here, is of great significance for the practical piety of the Valentinian Gnostics. It is the chief idea of their pious practices mystically to repeat the experience of this celestial union of the Soter with Sophia. In this respect, consequently, the myth underwent yet wider development. Just as the Soter is the bridegroom of Sophia, so the heavenly angels, who sometimes appear as the sons of the Soter and Sophia, sometimes as the escort of the Soter, are the males betrothed to the souls of the Gnostics, which are looked upon as feminine. Thus every Gnostic had his angel standing in the presence of God, and the object of a pious life was to bring about and experience this inner union with the celestial abstract personage. This leads us straight to the sacramental ideas of this branch of Gnosticism (see below). And it also explains the expression used of the Gnostics in Irenaeus i. 6, 4, that they always meditate upon the secret of the heavenly union (the Syzygia).

(10) With this celestial Soter of the Valentinians and the redemption of Sophia through him is connected, in a way which is now not quite intelligible to us, the figure of Jesus of Nazareth and the historical redemption connected with his name. The Soter, the bridegroom of Sophia, and the earthly Jesus answer to each other as in some way identical. Here again we recognize the entirely artificial compromise between Gnosticism and Christianity. It is characteristic of this that in one passage in the account of Irenaeus it is directly stated that the redeemer came specially on account of the *psychici*, for the *pneumatici* (the Gnostics) already belong by nature to the celestial world, and no longer require any historical redemption, while the *hylici* have fallen beforehand into damnation, so that with the *psychici* only is there any question as to whether they will turn to redemption or damnation, and for them the historical redeemer is of efficacy (Irenaeus i. 6, 1). This assertion is in thorough agreement with the fundamental tendency of Gnostic piety; for the Gnostics individual redemption has actually been accomplished in the union between the Soter and Sophia, and is effected for the individual Gnostics in repeating the experience of this union. So that in effect they no longer require the historical redemption through Jesus.

(11) Among the manifold confusion of opinions as to the nature and characteristics of the Redeemer Jesus of Nazareth, certain explanations stand out as characteristically Valentinian, especially those in which it is laid down that even the redeemer has a threefold nature; from his mother, Sophia, he derived his nature as a *pneumaticos*, in the world of the Demiourgos he was united with the Christos, and finally a wonderful bodily nature was formed for him from celestial elements, which was yet not of earthly material. As such he was miraculously born of the Virgin, as through a canal (διὰ σωλῆνος). The compromises with the Catholic Church are here obvious. According to this theory Jesus, having an element of the psychical nature, can appear in virtue of this as the son of the Demiourgos, *i.e.* of the Old Testament God, and as the Redeemer of the *psychici*; and when we read of this miraculous bodily nature, which is not composed of earthly material, there is an obvious compromise between the fundamental heresy of Gnosticism, Docetism and the dogma of the Christian Church as to the true bodily nature of the Redeemer. Into this already complicated Christology is now introduced by an obscure combination, in the systems known to us, the idea that upon this Jesus, so constituted, yet another celestial nature, the Christos or the Soter, has descended at his baptism. This is the older and peculiar Gnostic conception of Irenaeus i. 30, which appears to have been introduced into Valentinianism at a late stage of its development. The express statement in Hippolytus 6, 35, that this doctrine was shared only by the Italic branch of the Valentinians, but disclaimed by the Anatolian branch, also bears on the point.

(12) The close of the drama and the final accomplishment of the redemption is also depicted by the Valentinian writings in accordance with the old Gnosticism. A general ascent takes place, the Soter returns with the liberated Sophia into the Pleroma, and likewise the Gnostics with the angels with whom they are connected. But it is characteristic of the Valentinian system that the Demiourgos and the *psychici* who are connected with him also ascend to the eighth or highest heaven of Achamoth, while the remaining material world sinks into flames.

VI. The first survey of these confused speculations, these myths gathered together and preserved from the ancient world, this marshalling together of the most varied traditions, and above all, these artificial attempts at compromise dictated by practical prudence, makes us inclined to doubt whether it was possible for any true piety to coexist with all this. Yet such piety existed, indeed we have here a set of regular mystics. It is not, indeed, a purely spiritual and mystical piety, but a mysticism much distorted and over-grown with sacramental additions and a mysterious cult. But all this is not without an inner value and an attractive atmosphere. Our information, it is true, is scant; most of it is to be found in the fragments of the letters and homilies of the master of the school preserved for us by Clemens. The central point of the piety of Valentinus seems to have been the mystical contemplation of God; in a letter preserved in Clemens ii. 20, 114, he sets forth that the soul of man is like an inn, which is inhabited by many evil spirits. "But when the Father, who alone is good, looks down and around him, then the soul is hallowed and lies in full light, and so he who has such a heart as this is to be called happy, for he shall behold God." But this contemplation of God, as Valentinus, closely and deliberately following the doctrines of the Church, and with him the compiler of the Gospel of John declares, is accomplished through the revelation of the Son. This mystic and visionary also discusses the Psalm which is preserved in the *Philosophumena* of Hippolytus (6, 37). With celestial enthusiasm Valentinus here surveys and depicts the heavenly world of aeons, and its connexion with the lower world.[1] Exalted joy of battle and a valiant courage breathe forth in the sermon in which Valentinus addresses the faithful (Clemens iv. 13, 91): "Ye are from the beginning immortal and children of eternal life, and desire to divide death amongst you like a prey, in order to destroy it and utterly to annihilate it, that thus death may die in you and through you, for if ye dissolve the world, and are not yourselves dissolved, then are ye lords over creation and over all that passes away." From Tertullian, *de carne Christi* cap. 17, 20, we learn that Valentinus composed psalms. We may conjecture that these psalms were similar in their kind to the beautiful odes of Solomon which have lately been discovered, though without suggesting that these particular psalms were specifically Gnostic or Valentinian.

VII. But with this mysticism, of which we possess only a few of the beautiful flowers, is connected the mystery and cult of the sacrament. The lofty spirituality of the Gnostic degenerates over and over again into a distinctly material and sensual attitude, in which all kinds of efforts are made actually to assimilate to oneself the divine through external means. Our authorities for the sacramental practices of the Valentinians are preserved especially in the accounts of the Marcosians given in Irenaeus i. 13 and 20, and in the last section of the *Excerpta ex Theodoto*. We must point out once again how the mother aeon stands absolutely at the centre of this cult. There are moreover various figures in the fully developed system of the Valentinians who are in the Gnostic's mind when he calls upon the Mother goddess; sometimes it is the fallen Achamoth, sometimes the higher Sophia abiding in the celestial world, sometimes Aletheia, the consort of the supreme heavenly father, but it is always the same person, the Mother goddess, on whom the fervent faith of the Gnostics is fixed. Thus a baptismal confession of faith of the Gnostics (Irenaeus i. 21, 3) runs, "In the name of the unknown Father of all, by Aletheia, the mother of all, by the name which descended upon Jesus." And in almost all the sacramental prayers of the Gnostics handed down to us by Irenaeus, the mother is the object of the invocation. If the interpretation generally given of the Aramaean baptismal formula by Irenaeus in the same passage is correct, it began with the words: "In the name of Achamoth." Hence we can understand how, according to Irenaeus i. 5, 3, Sophia Achamoth had among the Valentinians the title of *kyrios* (lord), and, a question closely connected with this, why they did not call Jesus *kyrios*, but Soter, as Irenaeus expressly assures us (i. 1, 3) *Kyrios* is the title given to the hero who is the subject of a cult among a given body of people, and the heroine of the cult of the Valentinians, Sophia Achamoth, therefore receives this title.

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[1] Cf. Goethe's *Faust*, I.:—

"Wie Himmelskräfte auf und niedersteigen
Und sich die goldnen Eimer reichen."

The chief sacrament of the Valentinians seems to have been that of the bridal chamber.

We have stated above the relation of this sacrament with the Valentinian speculations. Just as the apostle Paul represented his Christianity as a living, dying and rising again with Christ, so the first concern of the pious Valentinian was the experience of the divine marriage feast of Sophia. As Sophia was united with the Soter, her bridegroom, so the faithful would experience a union with their angel in heaven (*i.e.* their "double," *Doppelgänger*). The ritual of this sacrament is briefly indicated by Irenaeus i. 21, 3: "A few of them prepare a bridal chamber and in it go through a form of consecration, employing certain fixed formulae, which are repeated over the person to be initiated, and stating that a spiritual marriage is to be performed after the pattern of the higher Syzygia." Through a fortunate chance, a liturgical formula which was used at this sacrament appears to be preserved, though in a garbled form and in an entirely different connexion, the author seeming to have been uncertain as to its original meaning. It runs: "I will confer my favour upon thee, for the father of all sees thine angel ever before his face we must now become as one; receive now this grace from me and through me; deck thyself as a bride who awaits her bridegroom, that thou mayest become as I am, and I as thou art. Let the seed of light descend into thy bridal chamber; receive the bridegroom and give place to him, and open thine arms to embrace him. Behold, grace has descended upon thee."

Besides this the Gnostics already practised baptism, using the same form in all essentials as that of the Christian Church. The name given to baptism, at least among certain bodies, was *apolytrosis* (liberation); the baptismal formulae have been mentioned above. Great importance attaches in the Gnostic sacramental speculations to invocation (of the name). The Gnostics are baptized in the mysterious name which also descended upon Jesus at his baptism. The angels of the Gnostics have also had to be baptized in this name, in order to bring about redemption for themselves and the souls belonging to them (*excerpta ex Theodoto*, 22). In this connexion we also find the formula λύτρωσιν ἀγγελικήν (for the angelic redemption, Irenaeus i. 21, 3). In the baptismal formulae the sacred name of the Redeemer is mentioned over and over again. In one of the formulae occur the words: "I would enjoy thy name, Saviour of Truth." The concluding formula of the baptismal ceremony is: "Peace over all upon whom the Name rests" (Irenaeus i. 21, 3). This name pronounced at baptism over the faithful has above all the significance that the name will protect the soul in its ascent through the heavens, conduct it safely through all hostile powers to the lower heavens, and procure it access to Horos, who frightens back the lower souls by his magic word (*exc. ex Theodoto*, 22). And for this life also baptism, in consequence of the pronouncing of the protecting name over the baptized person, accomplishes his liberation from the lower daemonic powers. Before baptism the Heirmarmene is supreme, but after baptism the soul is free from her (*exc. ex Theod.* 77).

With baptism was also connected the anointing with oil, and hence we can also understand the death sacrament occurring among the Valentinians consisting in an anointing with a mixture of oil and water (Irenaeus i. 21, 4). This death sacrament has naturally the express object of assuring the soul the way to the highest heaven "so that the soul may be intangible and invisible to the higher mights and powers" (Irenaeus, *loc. cit.*). In this connexion we also find a few formulae which are entrusted to the faithful, so that their souls may pronounce them on their journey upwards. One of these formulae runs: "I am a son of the Father, the Father who was before the whole world—I came to see everything, that which is strange and that which is my own; and deep down there is nothing strange, but only that which belongs to Achamoth. For she is the feminine aeon, and she has made all things. I draw my sex from that which was before the world, and take back to it the property from which I came" (Irenaeus i. 21, 5). Another formula is appended, in which there is a distinction in the invocation between the higher and lower Sophia. Another prayer of the same style is to be found in Irenaeus i. 13, and it is expressly stated that after prayer is pronounced the Mother throws the Homeric helmet (cf. the *Tarnkappe*) over the faithful soul, and so makes him invisible to the mights and powers which surround and attack him.

On the other hand, we see how here and there a reaction took place against the absurdity of this sacramental superstition. Thus Irenaeus (i. 21, 4) tells us of certain Gnostics who would admit no external holy practices as efficacious: "The completed *apolytrosis* is the actual knowledge of the inexpressible majesty (of God), for through ignorance arose all faultiness and suffering, and through knowledge will be removed all the conditions which arose from ignorance; and therefore knowledge (*gnosis*) is the perfecting of the inner man." A pure piety, rising above mere sacramentalism, breathes in the words of the Gnostics preserved in *excerpta ex Theodoto*, 78, 2: "But not baptism alone sets us free, but knowledge (*gnosis*): who we were, what we have become, where we were, whither we have sunk, whither we hasten, whence we are redeemed, what is birth and what rebirth."

VIII. It has already been seen clearly that Valentinian Gnosticism affected the nearest approach of all the Gnostic sects to the Catholic Church. Valentinus's own life indicates that he for a long time sought to remain within the official Church, and had at first no idea of founding a community of his own. Many compromises in his theories point the same way. The Johannine tendencies of his doctrine of the aeons (Logos, Zoë, Aletheia, Parakletos); the attempt to modify the sharp dualism of Gnosticism in a monistic direction, the derivation of the world from the fallen Sophia; the favourable judgment of the Demiourgos, and his origin in the repentance and conversion of Sophia, which are peculiar to the Valentinian system; the triple division of mankind into *pneumatici*, *psychici* and *hylici*, which is obviously contrived for the benefit of the *psychici*; the inclusion of an element of the *psychici* in the composition of the Redeemer; the theory that Jesus possessed a miraculous body formed in the upper world; the emphasis on the fact that the redemption of Jesus was primarily for the *psychici*; the doctrine that by the final redemption the Demiourgos and the *psychici* find a place in the Ogdoas; the adoption of Christian baptism—all this, and perhaps more, indicates a definite and deliberate approach towards the doctrine of the Church.

These Gnostics, as in the case of most of the other Gnostic sects, possessed their own peculiar holy writings and books, but they also made a great use in their own circle of the canon of the Christian Church, especially the canon of the New Testament and—though with a few reservations—of the Old Testament. Irenaeus in his account of the Ptolemaean sects has used a source which contained a detailed scriptural exposition of the Valentinian doctrines based on the New Testament. We can even—and this is of great interest and significance for the history of the canon—establish the contents of the Gnostic canon. It included the three first gospels and the apostle Paul. The proofs are constantly drawn firstly from the utterances of the Saviour, and then from the Epistles of Paul. The Gospel of John does not seem to have yet found a place in this canon, for the very good reason that it was not yet widely known and circulated. Later Valentinian Gnosticism delighted in making use of the Johannine Gospel as a crowning testimony. Thus to the older and ancient scriptural evidences which we mentioned above, Irenaeus (i. 8, 5) directly appends a commentary on the Gospel of John, which is ascribed to Ptolemaeus himself. And in the *excerpta ex Theodoto*, 6 seq., we also find a commentary on the prologue to this Gospel. And we know that the later Valentinian Herakleon wrote a detailed exposition of the whole Gospel. But the Old Testament too was a sacred book of these Gnostics, and its statements were used as evidence and proofs. This was done with some diffidence and caution. The attitude, at least of the later Valentinians, is best indicated by the letter of Ptolemaeus to Flora, which is preserved in Epiphanius 33, 3–7. Ptolemaeus here openly attacks the doctrine that the Old Testament is the work of the devil, or that it cannot at least be ascribed unconditionally to the Supreme God. The Old Testament he considers to contain a system of laws given by God himself, a system of laws given by Moses according to his own ideas, and precepts interpolated by the elders of the people. The laws of God himself fall then into three classes: the true law, which is not interwoven with evil; the law permeated with unrighteousness, which the Redeemer has dissolved; and the typical and symbolical law, which the Redeemer has translated from the material into the spiritual. Thus there is a gradual approach to the Christian Church's conception of the Old Testament. (It should indeed be remarked that Ptolemaeus in the above-mentioned letter has purposely expounded the exoteric doctrine in special approximation with the Catholic Church, while for the actual difficult questions as to the nature of the Demiourgos and his relation with the unity of the Divine nature he consoles Flora with a further and more intimate instruction.)

And yet this reconciliation of Gnosticism was a fruitless and henceforward a purposeless undertaking. Oriental dualism and wildly intemperate Oriental mythology had grown into so radical and essential a part of Gnosticism that they could not be separated from it to make way for a purer and more spiritual view of religion. And at a time when the prevailing tendency of Christianity was a struggle out of the darkness of Oriental mythology and eschatology into clearness, and an effort towards union with the lucid simplicity of the Hellenic spirit, these Gnostics, for all their efforts, and even the most noble of them, had come too late. They are not the men of a forward movement, but they are, and remain, in spite of all clearer insight, the rear-guard in the history of piety, who have gone under and disappeared in a struggle with the impossible. None the less we cannot omit the observation that the Christian Church in later centuries to a certain extent travelled again over Gnostic ground in its sacramental theories and fully developed Christological speculations.

See Bibliography to article GNOSTICISM. Also A. Harnack, *Dogmengeschichte*, vol. i. (4th ed., 1909); W. Bousset, *Hauptprobleme der Gnosis* (1907). See also Pauly-Wissowa, *Realencyklopädie des klassischen Altertums*, s.v. *Gnosticismus, Gnostiker*. More particularly devoted to Valentinianism are: G. Heinrici, *Die Valentinianische Gnosis und die heiligen Schriften* (1871); E. Schwartz, "Aporien im 4 Evangelium" in *Nachrichten der Gött. Gesellsch. der Wissensch.* (1908), ii. 127–41; A. Harnack, *Brief des Ptolemaeus an die Flora, Sitzungsber. der Berl. Akademie* (1909). (W. Bo.)

VALENZUELA, FERNANDO DE (1630–1692), Spanish royal favourite and minister, was born at Naples on the 19th of January 1630. His father, Don Francisco de Valenzuela, a gentleman of Ronda, had been compelled to flee from Spain in consequence of a brawl, and had enlisted as a soldier in Naples, where he married Doña Leonora de Encisa. Francisco de Valenzuela having died young, his son was placed by his mother as a page in the household of the duke of Infantado. He lost his place owing to a reduction of the duke's establishment, and for several years he lived obscurely; but by good fortune he succeeded in persuading Maria de Uceda, one of the ladies-in-waiting of Mariana, second wife of Philip IV., to marry him. By her help Valenzuela obtained a footing in the palace. He was appointed introducer of ambassadors on the 12th of October 1671, and it became notorious that whoever had a petition to present or a place to ask for must apply to him. He became popularly known as the *duende*, the fairy or brownie of the palace, and was believed to be the lover of the queen. In 1675 a court intrigue, conducted by his rivals and supported by the younger Don John of Austria, was so far successful that he was driven from court; but the queen gave him the title of marquis of Villa Sierra, and appointed him ambassador to Venice. Valenzuela succeeded in getting the embassy exchanged for the governorship of Granada. His stay at this post was short, for he was able to organize a counter-intrigue which soon brought him back to court. The queen-regent now openly appointed him prime minister, gave him official quarters in the palace, and conferred a grandeeship on him, to the profound indignation of the other grandees. In January 1678 a palace revolution broke out against the queen-regent, who was driven from Madrid, and Valenzuela fled for refuge to the monastery of the Escorial. He was, however, taken out by force, and his house was pillaged. His property was confiscated—his jewels, furniture and ready money were estimated to amount to £120,000—he was degraded from the grandeeship and exiled to the Philippines. At a later period he was released from close confinement and allowed to settle in Mexico, where a pension was given him. He died in Mexico, from the kick of a horse he was breaking in, on the 7th of February 1692. Part of his property, and the title of Villa Sierra, but not the grandeeship, were restored to his wife and children. The career of Valenzuela probably helped to suggest the subject of *Ruy Blas* to Victor Hugo.

See *Documentos Inéditos para la Historia de España*, vol. lxvii. (Madrid, 1842, &c.), which contain an artful and well-written defence of himself addressed to King Charles II. of Spain from Mexico.

VALERA Y ALCALÁ GALIANO, JUAN (1824–1905), Spanish novelist, son of a retired commodore, José Valera, who married Doña Dolores Alcalá Galiano, marquesa de la Paniega, widow of a Swiss general named Freuller, was born on the 18th of October 1824 at Cabra (Cordova). Valera was educated at Malaga and at the university of Granada, where he took a degree in law. Entering diplomacy in 1847, he became unpaid attaché to the Spanish embassy at Naples under the famous Duke de Rivas, the leader of the romantic movement in Spain. Valera witnessed the events of the Revolution, was promoted second secretary to the embassy at Lisbon in 1850, and in 1851 was transferred as first secretary to Rio de Janeiro, where he remained for two years. After a short period passed at Dresden, he was appointed to the permanent staff of the Foreign Office at Madrid, and in 1857 was attached to the special embassy to St Petersburg under the Duke de Osuna. In 1858 he resigned his post, was elected deputy for Archidona, in the province of Malaga, took his seat with the advanced Liberal Opposition, and joined with Albareda and Fabié in founding *El Contemporáneo*, a very influential journal. An expert in the art of covering an opponent with polite ridicule, his writings in the press attracted general attention. He was elected a member of the Spanish Academy in 1861, and remained in Opposition till 1865, when O'Donnell appointed him minister at Frankfort; on the flight of Isabella II. in 1868 he was elected deputy for Montilla in the province of Cordova, became under-secretary of state for foreign affairs, and was one of the deputation who offered the crown to Amadeus of Savoy in the Pitti Palace at Florence. Though he always called himself a Moderate Liberal, Valera invariably voted for what are considered Radical measures in Spain, and a speech delivered by him in February 1863 against the temporal power of the pope created a profound sensation. However, though a member of the revolutionary party, he steadily opposed organic constitutional changes, and therefore he retired from public life during the period of republican government. After the Bourbon restoration he acted as minister at Lisbon (1881–1883), at Washington (1885), at Brussels (1886) and as ambassador at Vienna (1893–1895), retiring from the diplomatic service on the 5th of March 1896. During the last ten years of his life he took no active part in politics. He died on the 18th of April 1905.

Valera's first publication, *Canciones, Romances y Poemas*, was published in 1856. His verses are melodious, finished and various in subject; but they are rather the imitative exercises of a scholarly man of the world than the inspirations of an original poet. That they failed to attract notice is not altogether to be regretted, for, as Valera himself confessed later in his half-ironical, half-ingenuous preface to the second edition (1885), "In spite of my idleness, I should have shown a most deplorable fecundity had I been received with favour and applause." However, if he published little more in the shape of verse, he wrote incessantly in prose. More than two-thirds of his work is still uncollected, buried in reviews and newspapers; but we may take it that he rescued what he thought most valuable. His criticism may be read in the *Estudios criticos sobre literatura* (1864), in the *Disertaciones y juicios literarios* (1878) and in the *Nuevos estudios criticos* (1888); yet, with all his penetration and taste, Valera laboured under one disadvantage not frequent in critics. He suffered from an excessive amiability. He said a hundred incisive, wise, witty, subtle and suggestive things concerning the mysticism of St Theresa, the art of novel-writing, *Faust*, the Inquisition, *Don Quixote*, Shakespeare, the psychology of love in literature; but, to do himself justice, it was an almost indispensable condition that he should deal with the past. In the presence of a living author Valera was disarmed. Unless the writer were an incurable pessimist, Valera would find something in his work to praise, exhausting the vocabulary of compliment and graceful tribute; but, except in the *Cartas americanas* (1889), where the laudation was manifestly so exaggerated that no harm could come of it, this trick of eulogy became perplexing and misleading. Valera, in effect, refused to criticize contemporary literature; as a rival author it seemed to him an indelicacy to censure his competitors, and he was either laudatory or silent. It is regrettable, for criticism was and is greatly needed in Spain.

Valera, then, excelled neither as a poet nor as an impartial critic; he had the vocation of the novelist, though he was slow in discovering it, since he was in his fiftieth year before he published the novel which was to make him famous. *Pepita*

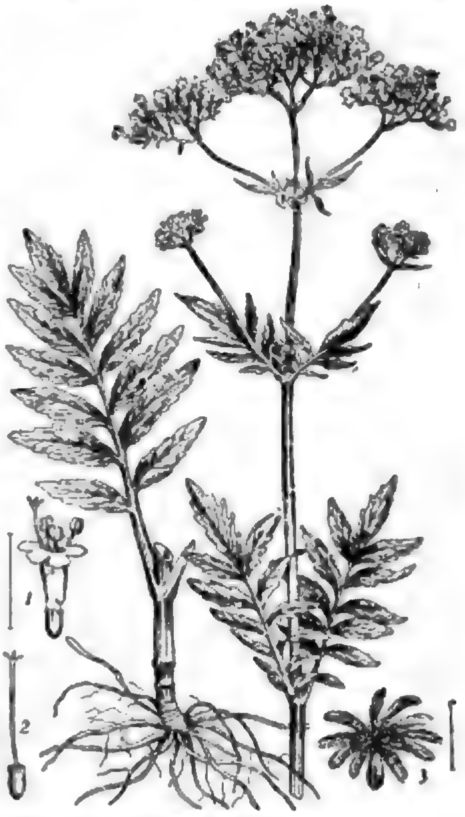
Jiménez (1874) is a recital of the fall of Luis de Vargas, a seminarist who conceived himself to be a mystic and a potential saint, and whose aspirations dissolve at the first contact with reality. It is easy to point out blemishes: the story is not well constructed, and it has pauses during which the writer's fantasy plays at pleasure over a hundred subjects not very germane to the matter; but its characters are as real as any in fiction, the love story is told with the most refined subtlety and malicious truth, while page upon page is written in such Spanish as would do credit to the best writers of the 16th and 17th centuries. Unquestionably *Pepita Jiménez* is a very remarkable achievement—so remarkable, that contemporaries were reluctant to admit the superiority of its successors. It is certain that Valera's second novel, *Las ilusiones del Doctor Faustino* (1875), was received with marked disfavour, and that it has the faults of over-refinement and of cruelty; yet in keen analysis and in humour it surpasses *Pepita Jiménez*. The *Comendador Mendoza* (1877) is more pathetic and of a profounder significance; and if *Doña Luz* (1879) repeats the situation and the general idea already used in *Pepita Jiménez*, it strikes a deeper and more tragic note, which came as a surprise to those familiar only with the lighter side of Valera's genius. Besides these elaborate psychological studies, Valera issued a volume of *Cuentos* (1887), some of these short tales and dialogues being marvels of art and of insight. Thenceforward he was silent for eight years, but after his retirement from politics he published several good books—*El hechicero* (1895), *Juanita la larga* (1896), *Genio y figura* (1897), *De varios colores* (1898) and *Morsamor* (1899). These are not all of equal excellence, but they are characteristic of their author, and abound in understanding, humorous comment and sympathetic creation.

At the close of the 19th century Valera was recognized as the most eminent man of letters in Spain. He had not Pereda's force nor his energetic realism; he had not the copious invention nor the reforming purpose of Pérez Galdós; yet he was as realistic as the former and as innovating as the latter. And, for all his cosmopolitan spirit, he fortunately remained intensely and incorrigibly Spanish. His aristocratic scepticism, his strange elusiveness, his incomparable charm are his own: his humour, his flashing irony, his urbanity are eminently the gifts of his land and race. He is by no means an impersonal artist; in almost every story there is at least one character who talks and thinks and subtilizes and refines as Valera himself wrote in his most brilliant essays. This may be a fault in art; but, if so, it is a fault which many great artists have committed, from Cervantes to Thackeray. It is dangerous to attempt a forecast of Valera's final place in literary history, yet it seems safe to say that, though his poems and essays will be forgotten, *Pepita Jiménez* and *Doña Luz* will survive changes of fashion and of taste, and that their author's name will be inseparably connected with the renaissance of the modern Spanish novel. (J. F.-K.)

VALERIA, VIA, an ancient highroad of Italy, the continuation north-eastwards of the Via Tiburtina (*q.v.*). It probably owed its origin to M. Valerius Messalla, censor in 154 B.C. It ran first up the Anio valley past Varia (*q.v.*), and then, abandoning it at the 36th mile, where the Via Sublacensis diverged, ascended to Carseoli (*q.v.*), and then again to the lofty pass of Monte Bove (4003 ft.), whence it descended again to the valley occupied by the Lago di Fucino (*q.v.*). It is doubtful whether it ran farther than the eastern point of the territory of the Marsi at Cerfennia, to the N.E. of the Lacus Fucinus, before the time of Claudius. Strabo states that in his day it went as far as Corfinium, and this important place must have been in some way accessible from Rome, but probably, beyond Cerfennia, only by a track. The difficult route from Cerfennia to the valley of the Aternus—a drop of nearly 1000 ft., involving too the crossing of the main ridge of the Apennines (3675 ft.) by the Mons Imeus (mod. Forca Caruso)—was, however, probably not made into a highroad until Claudius's reign: one of his milestones (*Corp. Inscr. Lat.* ix. 5973) states that he in A.D. 48–49 made the Via Claudia Valeria from Cerfennia to the mouth of the Aternus (mod. Pescara). He also constructed a road, the Via Claudia Nova, connecting the Via Salaria, which it left at Foruli (mod. Civitatomassa, near Amiternum) with the Via Valeria near the modern Popoli. This road was continued south (we do not know by whom or when) to Aesernia. From Popoli the road followed the valley of the Aternus to its mouth, and there joined the coast-road at Pescara. The modern railway from Rome to Castellammare Adriatico follows closely the line of the Via Valeria.

See E. Albertini in *Mélanges de l'École française de Rome* (1907), 463 sqq. (T. As.)

VALERIAN, a genus of herbaceous perennial plants of the natural order Valerianaceae. Two species—*Valeriana officinalis* and *V. dioica*—are indigenous in Britain, while a third, *V. pyrenaica*, is naturalized in some parts. The valerians have opposite leaves and small flowers, usually of a white or reddish tint, and arranged in terminal cymes. The limb of the calyx is remarkable for being at first inrolled and afterwards expanding in the form of a feathery pappus which aids in the dissemination of the fruit. The genus comprises about 150 species, which are widely distributed in the temperate parts of the world. In medicine the root of *V officinalis* is intended when valerian is mentioned. The plant grows throughout Europe from Spain to the Crimea, and from Iceland through northern Europe and Asia to the coasts of Manchuria. Several varieties of the plant are known, those growing in hilly situations being considered the most valuable for medicinal purposes.



Habit after Curtis, *Flora Londinensis.*

FIG. 1.—Valerian (*Valeriana officinalis*), one-third natural size. 1, flower; 2, flower after removal of corolla; 3, fruit crowned by the feathery pappus. 1, 2, 3 enlarged.

Valerian is cultivated in England (in several villages near Chesterfield in Derbyshire), but to a much greater extent in Prussian Saxony (in the neighbourhood of Cölleda, north of Weimar), in Holland and in the United States (Vermont, New Hampshire and New York). The dried root or rhizome consists of a short central erect portion, about the thickness of the little finger, surrounded by numerous rootlets about $\frac{1}{12}$ of an inch in diameter, the whole being of a dull brown colour. When first taken from the ground it has no distinctive smell; but on drying it acquires a powerful odour of valerianic acid. This odour, now regarded as intolerable, was in the 16th century considered to be fragrant, the root being placed among clothes as a perfume (Turner, *Herbal*, 1568, part iii. p. 76), just as *V. celtica* and some Himalayan species of the genus are still used in the East. By the poorer classes in the north of England it was esteemed of such medicinal value that "no broth, pottage or physical meat" was considered of any value without it (Gerard, *Herball*, 1633, p. 1078).

The red valerian of gardens is *Centranthus ruber*, also belonging to the Valerianaceae, but Greek valerian is *Polemonium coeruleum*, belonging to the natural order Polemoniaceae. Cats are nearly as fond of the smell of this plant as of the true valerian, and will frequently roll on the plant and injure it.

The chief constituent of valerian is a volatile oil, which is present in the dried root to the extent of 1–2%, plants growing on dry or stony soil being said to yield the largest quantity. The oil is of complex composition, containing valerianic (valeric), formic and acetic acids combined with a terpene, $C_{10}H_{16}$; the alcohol known as borneol; and pinene. The valerianic acid present in the oil is not the normal acid, but isovalerianic acid. It occurs in many plants and in cod-liver oil. It is strongly acid, burning to the palate, and with the odour of the plant. The oil is soluble in thirty parts of water and readily in alcohol and ether. The British Pharmacopeia contains the tinctura valerianae ammoniata, containing valerian, oil of nutmeg, oil of lemon and ammonia. It is an extremely nauseous and offensive preparation. The valerianate of zinc is also official in Great Britain, but, like valerianic acid itself, it is pharmacologically inert and therapeutically useless.

Valerian acts medicinally entirely in virtue of its volatile oil, which exerts the actions typical of its class. The special use of this drug, like that of others which contain an offensive volatile oil—such as asafoetida—is in hysteria or, as it is more properly styled, neuromimesis. It is generally believed that the drug acts in virtue of its unpleasant odour and taste, which cause the patient to display so much volition as shall enable him or her to control the symptoms and thereby obtain the discontinuance of the drug. Good results are sometimes obtained, however, when the drug is given in capsules or in some other form which puts this mode of action out of the question. Binz of Bonn has shown that the volatile oils act as sedatives of the motor cells in the anterior horns of grey matter in the spinal cord, and it is probable that this action may account for the good results often obtained by the use of valerian in neuromimesis; though there is little doubt that the *modus operandi* above described may also come into play. The valerianates of iron, quinine, guaiacol and sodium share with that of zinc the disability of exerting no action attributable to their acid radicle, but have frequently been employed. Valerianic diethylamide, or valyl has also been employed as a substitute for the preparations in ordinary use

VALERIANUS, PUBLIUS LICINIUS, Roman emperor from A.D. 253 to 260. He was of noble family, and in 238 was *princeps senatus*. In 251, when Decius revived the censorship with legislative and executive powers so extensive that it practically embraced the civil authority of the emperor, Valerian was chosen censor by the senate. After the death of Decius Valerian retained the confidence of his successor, Trebonianus Gallus, who sent him to fetch troops to quell the rebellion of Aemilianus, governor of Moesia and Pannonia. The soldiers in Raetia, however, proclaimed Valerian emperor; and marching slowly towards Rome he found both his rivals dead, slain by their own soldiers. Valerian was about sixty-three years of age, and had scarcely the vigour to deal with the enemies that threatened every frontier of the empire. Taking his son Gallienus as colleague, he left the wars in Europe to his direction, under which matters went from bad to worse and the whole West fell into disorder. Valerian chose for his own part the war in the East, where Antioch had fallen into the hands of a Persian vassal and Armenia was occupied by Shapur (Sapor) I., while in 258 the Goths ravaged Asia Minor. Valerian recovered Antioch, fought in Mesopotamia with mixed success and finally was taken captive. It is said that he was subjected to the greatest insults by his captors, and that after his death his skin was stuffed with straw and preserved as a trophy in the chief Persian temple. Owing to imperfect and contradictory authorities, the chronology and details of this reign are very uncertain.

See Trebellius Pollio, *Life of Valerian* (frags.); Aurelius Victor, *Caesares*, 32; Eutropius ix. 6; Ammianus Marcellinus xxiii. 5; Zosimus i. 27; Gibbon, *Decline and Fall*, chap. 10; H. Schiller, *Geschichte der römischen Kaiserzeit*, i. pt. 2.

VALERIC ACID, or VALERIANIC ACID, $C_4H_9{\cdot}CO_2H$, an organic acid belonging to the fatty acid series, which exists in four isomeric forms, one of which contains an asymmetric carbon atom and consequently occurs in two optically active modifications and one optically inactive modification. Ordinary valeric acid (baldrianic acid) is a mixture of isovaleric acid or isopropylacetic acid, $(CH_3)_2CH{\cdot}CH_2{\cdot}CO_2H$, and optically active methylethylacetic acid, $(CH_3)(C_2H_5)CH{\cdot}CO_2H$, which occur free or as esters in the vegetable and animal kingdoms, chiefly in the roots of *Angelica archangelica* and *Valeriana officinalis*. It may be extracted by boiling with water or soda. A similar product is obtained by oxidizing fermentation amyl alcohol with chromic acid. Isovaleric acid is an oily liquid having the odour of stale cheese and boiling at 174°; the salts are usually greasy to the touch. Potassium permanganate oxidizes it to β-oxyisovaleric acid $(CH_3)_2{\cdot}C(OH){\cdot}CH_2{\cdot}CO_2H$, whilst nitric acid gives, among other products, dinitropropane, $(CH_3)_2C(NO_2)_2$. The acid has been synthesized, as has also the inactive form of methylethylacetic acid; this modification is split into its optical antipodes by crystallization of its brucine salt. Normal valeric acid or propylacetic acid, $CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H$, is a liquid boiling at 186°. The remaining isomer, pivalic or trimethylacetic acid, $(CH_3)_3C{\cdot}CO_2H$, melts at 35° and boils at 163°. Both these acids are synthetic products.

VALERIUS, PUBLIUS, surnamed PUBLICOLA (or POPLICOLA), "friend of the people," the colleague of Brutus in the consulship in the first year of the Roman republic (509 B.C.). According to Livy and Plutarch, his family, whose ancestor Volusus had settled in Rome at the time of King Tatius, was of Sabine origin. He took a prominent part in the expulsion of the Tarquins, and though not originally chosen as the colleague of Brutus he soon took the place of Tarquinius Collatinus. On the death of Brutus, which left him sole consul, the people began to fear that he was aiming at kingly power. To calm their apprehensions he discontinued the building of his house on the top of the Velian Hill, and also gave orders that the fasces should be lowered whenever he appeared before the people. He further introduced two laws to protect the liberties of the citizens, one enacting that whosoever should attempt to make himself a king might be slain by any man at any time, while another provided an appeal to the people on behalf of any citizen condemned by a magistrate (*lex Valeria de provocatione*: see ROME, *History*, II. "The Republic"). He died in 503, and was buried at the public expense, the matrons mourning him for ten months.

Livy ii. 6–8; Dion. Halic. iv. 67, v. 12–40; *Life* by Plutarch.

VALERIUS FLACCUS, GAIUS, Roman poet, flourished under Vespasian and Titus. He has been identified on insufficient grounds with a poet friend of Martial (i. 61. 76), a native of Padua, and in needy circumstances; but as he was a member of the College of Fifteen, who had charge of the Sibylline books (i. 5), he must have been well off. The subscription of the Vatican MS., which adds the name Setinus Balbus, points to his having been a native of Setia in Latium. The only ancient writer who mentions him is Quintilian (*Instit. Orat.* x. 1. 90), who laments his recent death as a great loss, although it does not follow that he died young; as Quintilian's work was finished about A.D. 90, this gives a limit for the death of Flaccus. His work, the *Argonautica*, dedicated to Vespasian on his setting out for Britain, was written during the siege, or shortly after the capture, of Jerusalem by Titus (70). As the eruption of Vesuvius (79) is alluded to, it must have occupied him a long time. The *Argonautica* is an epic in eight books on the Quest of the Golden Fleece. The poem is in a very corrupt state, and ends abruptly with the request of Medea to accompany Jason on his homeward voyage. It is a disputed question whether part has been lost or whether it was ever finished. It is a free imitation and in parts a translation of the work of Apollonius of Rhodes (*q.v.*), already familiar to the Romans in the popular version of Varro Atacinus. The object of the work has been described as the glorification of Vespasian's achievements in securing Roman rule in Britain and opening up the ocean to navigation (as the Euxine was opened up by the Argo). Various estimates have been formed of the genius of Flaccus, and some critics have ranked him above his original, to whom he certainly is superior in liveliness of description and delineation of character. His diction is pure, his style correct, his versification smooth though monotonous. On the other hand, he is wholly without originality, and his poetry, though free from glaring defects, is artificial and elaborately dull. His model in language was Virgil, to whom he is far inferior in taste and lucidity. His tiresome display of learning, rhetorical exaggeration and ornamentations make him difficult to read, which no doubt accounts for his unpopularity in ancient times.

The *Argonautica* was unknown till the first four and a half books were discovered by Poggio at St Gall in 1417. The *editio princeps* was published at Bologna (1474). Recent editions by G. Thilo (1863), with critical notes; C. Schenkl (1871), with bibliography; E. Bährens (1875), with critical introduction; P. Langen (1896), with Latin notes, and short introductions on the style and language, Caesar Giarratano (1904); see also J. Peters, *De V. F. Vita et Carmine* (1890); W. C. Summers, *Study of the Argonautica* (1894).

VALERIUS MAXIMUS, Latin writer, author of a collection of historical anecdotes, flourished in the reign of Tiberius. Nothing is known of his personal history except that his family was poor and undistinguished, and that he owed everything to Sextus Pompeius (consul A.D. 14), proconsul of Asia, whom he accompanied to the East in 27. This Pompeius was a kind of minor Maecenas, and the centre of a literary circle to which Ovid belonged; he was also the intimate of the most literary prince of the imperial family, Germanicus. The style of Valerius's writings seems to indicate that he was a professional rhetorician. In his preface he intimates that his work is intended as a commonplace book of historical anecdotes for use in the schools of rhetoric, where the pupils were trained in the art of embellishing speeches by references to history. According to the MSS., its title is *Nine Books of Memorable Deeds and Sayings*. The stories are loosely and irregularly arranged, each book being divided into sections, and each section bearing as its title the topic, most commonly some virtue or vice, or some merit or demerit, which the stories in the section are intended to illustrate. Most of the tales are from Roman history, but each section has an appendix consisting of extracts from the annals of other peoples, principally the Greeks. The exposition exhibits strongly the two currents of feeling which are intermingled by almost every Roman writer of the empire—the feeling that the Romans of the writer's own day are degenerate creatures when confronted with their own republican predecessors, and the feeling that, however degenerate, the latter-day Romans still tower above the other peoples of the world, and in particular are morally superior to the Greeks.

The author's chief sources are Cicero, Livy, Sallust and Pompeius Trogus, especially the first two. Valerius's treatment of his material is careless and unintelligent in the extreme; but in spite of his confusions, contradictions and anachronisms, the excerpts are apt illustrations, from the rhetorician's point of view, of the circumstance or quality they were intended to illustrate. And even on the historical side we owe something to Valerius. He often used sources now lost, and where he touches on his own time he affords us some glimpses of the much debated and very imperfectly recorded reign of Tiberius. His attitude towards the imperial household has often been misunderstood, and he has been represented as a mean flatterer of the same type with Martial. But, if the references to the imperial administration be carefully scanned, they will be seen to be extravagant neither in kind nor in number. Few will now grudge Tiberius, when his whole action as a ruler is taken into account, such a title as *salutaris princeps*, which seemed to a former generation a specimen of shameless adulation. The few allusions to Caesar's murderers and to Augustus hardly pass beyond the conventional style of the writer's day. The only passage which can fairly be called fulsome is the violently rhetorical tirade against Sejanus. But it is as a chapter in the history of the Latin language that the work of Valerius chiefly deserves study. Without it our view of the transition from classical to silver Latin would be much more imperfect than it is. In Valerius are presented to us, in a rude and palpable form, all the rhetorical tendencies of the age, unsobered by the sanity of Quintilian and unrefined by the taste and subtlety of Tacitus. Direct and simple statement is eschewed and novelty pursued at any price. The barrier between the diction of poetry and that of prose is broken down, the uses of words are strained; monstrous metaphors are invented; there are startling contrasts, dark innuendoes and highly coloured epithets; the most unnatural variations are played upon the artificial scale of grammatical and rhetorical figures of speech. It is an instructive lesson in the history of Latin to compare minutely a passage of Valerius with its counterpart in Cicero or Livy. In the MSS. of Valerius a tenth book is given, which consists of the so-called *Liber de Praenominibus*, the work of some grammarian of a much later date. The collection of Valerius was much used for school purposes, and its popularity in the middle ages is attested by the large number of MSS. in which it has been preserved. Like other schoolbooks it was epitomated. One complete epitome, probably of the 4th or 5th century, bearing the name of Julius Paris, has come down to us; also a portion of another by Januarius Nepotianus. Editions by C. Halm (1865), C. Kempf (1888), contain the epitomes of Paris and Nepotianus.

VALET (Fr. *valet*, O. Fr *vaslet*), a term now restricted in meaning to that of a gentleman's personal servant. The origin of the word is debated. Du Cange (*Glossarium*, s. *Valeti*) explains it as the diminutive of *vassallus*, a vassal, the sons of *vassalli* being termed *vasseleti* (and so *vasleti*, *valeti*), on the analogy of *domicelli* (*damoiseaux*) for the sons of *domini*. This view is also taken by W. W. Skeat (*Etym. Dict.* s. "Varlet"); but Hatzfeld and Darmesteter (*Dict. gén. de la langue française*), dispute this derivation as phonetically impossible, preferring that from *vassulittus* from a hypothetical *vassulus*, diminutive of *vassus*, from which *vassallus* also is ultimately derived (see VASSAL). Just as *vassus* was in Merovingian times the Gallo-Roman word for "servitor," which the Franks borrowed to designate the domestic soldiers of their kings, so "valet" retained this, its sole surviving sense, throughout the middle ages. Yet the phrase "gentleman's gentleman," commonly used of the modern valet, is more historical than may at first sight appear. For valet, like esquire (*écuyer*), long signified the apprentice stage of knighthood, at first with a certain difference, the esquire being mounted, the valet unmounted, but afterwards with scarce a shade of distinction. Later, "valet" became the usual term for gentlemen who were not knights. In England it was not till the early years of the 14th century that *valletus* in this sense was superseded by *armiger*, and that "valet" (valete, vadlete, verlet, varlet[1]) began to be applied to the class of free men below the rank of esquire. In France the word *valet*, though in Saintonge and Poitou it survived till the close of the 14th century, had elsewhere—like *damoiseau*—much earlier been replaced generally by *écuyer* as the designation of an unknighted gentleman.

At the outset, "valet" had meant no more than "youth" or "boy." Thus Wace in the *Roman de Rou* (III. v. 2903), speaking of William the Conqueror, says: *Guillaume fu vadlet petiz* ("William was a little boy"). The various developments of the word are closely parallel with those of some of its synonyms. Youth suggested both strength and service, the qualifications for nobility in a primitive society, where service in arms was the title to rank. *Puer* (boy) was early used, as a synonym for *vassus*, of the soldiers of the Frankish bodyguard (*pueri ad ministerium*); the Greek *τέκνον* ("child") is etymologically related to O.H. Ger. *degan*, M.H. and Mod. Ger. *degen*, "warrior," A.S. *thegn*, "thane"; "child" itself was applied in the 13th and 14th centuries to young men of gentle birth awaiting knighthood, as a title of dignity, and was perhaps a translation of *valet* (see CHILD), with which may be compared the Spanish *infanzon* and German *junker*. So, too, *cniht* (a "lad" or "servant"), becomes first a warrior and then develops into a title of dignity as "knight," while in Germany the parallel word *knecht* remains as "servant." But valet has also shared with other synonyms a downward development. Just as "knave" (*cnafa*) meant originally a boy (cf. Ger. *knabe*) or servant, and has come to mean a rogue, so *valet* in its English (15th century) form of "varlet" had decayed, before it became obsolete, from its meaning of "servant" to signify a "scoundrel" or "low fellow."

See Du Cange, *Glossarium* (ed. Niort, 1887); A. Luchaire, *Manuel des institutions françaises* (Paris, 1892), P. Giulhiermoz, *Essai sur l'origine de la noblesse en France au moyen âge* (Paris, 1902); Note on the word "Valet" by Maurice Church, App. xix. to Sir R. Hennell's *Hist. of the Yeomen of the Guard* (Westminster, 1904).

(W. A. P.)

VALHALLA (Old Norse *Valholl*, *i.e.* "hall of the slain"), the name given by the heathen Scandinavians to the abode in which the god Odin received the souls of those who had fallen in battle. There they are represented as spending their time in constant fighting and feasting in his service. See TEUTONIC PEOPLES, *ad fin.*

VALKYRIES (Old Norse *valkyriur*, "choosers of the slain"), figures of Northern mythology, generally represented as divine (less frequently human) maidens who ride through the air on Odin's service. Clad in full armour they are sent forth to determine the course of battles and to select brave warriors for Valhalla (*q.v.*). Beings with the same name (*waelcyrgean*) were known also in England, where we find them associated with witches. The name is used in Anglo-Saxon glossaries to translate various Latin terms for "War-goddess" or "Fury" (Bellona, Erinys, &c.). See Teutonic Peoples, *ad fin.* (H. M. C.)

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[1] The form *valectus* led to the spelling *valect* in transcribing from Latin documents.

VALLA, LORENZO, or Laurentius (*c.* 1406–1457), Italian humanist, was born at Rome, of parents from the neighbourhood of Piacenza, about 1406, his father, Luca delle Vallea, being an advocate. He was educated at Rome, attending the classes of eminent professors, among them Leonardi Bruni and Giovanni Aurispa (*c.* 1369–1459), from whom he learned Latin and Greek. In 1431 he became a priest, and after trying vainly to secure a position as apostolic secretary in Rome he went to Piacenza, whence he proceeded to Pavia, where he obtained a professorship of eloquence. Valla wandered from one university to another, accepting short engagements and lecturing in many cities. During this period he made the acquaintance of Alphonso V. of Aragon, whose service he entered about 1435. Alphonso made Valla his private secretary, defended him against the attacks of his numerous enemies, and at a later date encouraged him to open a school in Naples.

By this time Valla had won a high reputation by his dialogue *De Voluptate*, and by his treatise *De Elegantiis Latinae Linguae*. In the former work he contrasted the principles of the Stoics with the tenets of Epicurus, openly proclaiming his sympathy with those who claimed the right of free indulgence for man's natural appetites. It was a remarkable utterance. Here for the first time the paganism of the Renaissance found deliberate expression in a work of scholarly and philosophical value. *De Elegantiis* was no less original, although in a different sphere of thought. This work subjected the forms of Latin grammar and the rules of Latin style and rhetoric to a critical examination, and placed the practice of composition upon a foundation of analysis and inductive reasoning. The same originality and critical acumen were displayed in his treatise on the Donation of Constantine (*De falso credita et ementita Constantini donatione declamatio*), written in 1439 during the pontificate of Eugenius IV., in which the nature of the forged document known as the *Constitutum Constantini* was for the first time exposed (see Donation of Constantine). From Naples Valla continued his war against the Church. He showed that the supposed letter of Christ to Abgarus was a forgery, and by throwing doubt upon the authenticity of other spurious documents, and by questioning the utility of monastic life, he aroused the anger of the faithful. He was compelled to appear before an inquisitory tribunal composed of his enemies, and he only escaped by the special intervention of Alphonso. He was not, however, silenced; he ridiculed the Latin of the Vulgate and accused St Augustine of heresy. In 1444 he visited Rome, but in this city also his enemies were numerous and powerful, and he only saved his life by flying in disguise to Barcelona, whence he returned to Naples. But a better fortune attended him after the death of Eugenius IV. in February 1447. Again he journeyed to Rome, where he was welcomed by the new pope, Nicholas V., who made him an apostolic secretary, and this entrance of Valla into the Roman Curia has been justly called "the triumph of humanism over orthodoxy and tradition." Valla also enjoyed the favour of Pope Calixtus III. He died in Rome on the 1st of August 1457.

All the older biographical notices of Valla are loaded with long accounts of his many literary and theological disputes, the most famous of which was the one with Poggio (*q.v.*), which took place after his settlement in Rome. It is almost impossible to form a just estimate of Valla's private life and character owing to the clouds of dust which were stirred up by this and other controversies, in which the most virulent and obscene language was employed. He appears, however, as a vain, jealous and quarrelsome man, but he combined the qualities of an elegant humanist, an acute critic and a venomous writer, who had committed himself to a violent polemic against the temporal power of Rome. In him posterity honours not so much the scholar and the stylist as the man who initiated a bold method of criticism, which he applied alike to language, to historical documents and to ethical opinions. Luther had a very high opinion of Valla and of his writings, and Cardinal Bellarmine calls him *praecursor Lutheri*, while Sir Richard Jebb says that his *De Elegantiis* "marked the highest level that had yet been reached in the critical study of Latin."

Collected, but not quite complete, editions of Valla's works were published at Basel in 1540 and at Venice in 1592 fol., and *De Elegantiis* was reprinted nearly sixty times between 1471 and 1536. For detailed accounts of Valla's life and work see G. Voigt, *Die Wiederbelebung des classischen Alterthums* (1880–81); J. A. Symonds, *Renaissance in Italy* (1897–99); G. Mancini, *Vita di Lorenzo Valla* (Florence, 1891); M. von Wolff, *Lorenzo Valla* (Leipzig, 1893); J. Burckhardt, *Kultur der Renaissance* (1860); J. Vahlen, *Laurentius Valla* (Berlin, 1870); L. Pastor, *Geschichte der Päpste*, Band ii. English trans. by F. I. Antrobus (1892); the article in Herzog-Hauck's *Realencyklopädie*, Band xx. (Leipzig, 1908); and J. E. Sandys, *Hist. of Class. Schol.* ii. (1908), pp. 66–70.

VALLADOLID, an inland province of Spain, one of the eight into which Old Castile was divided in 1833; bounded on the N. by Leon and Palencia, E. by Burgos, S. by Segovia, Ávila and Salamanca, and W. by Zamora. Pop. (1900) 278,561; area, 2922 sq. m. The province belongs entirely to the basin of the Duero (Douro), which traverses it from E. to W., and within its limits receives the Pisuerga (with the Esgueva) on the right, and the Duraton, the Cega, the united Adaja and Eresma, the Zapardiel and the Trabancos on the left. The country watered by these rivers is for the most part flat and exceedingly fertile, the only part that can be called in any sense hilly being in the north-west, where the low Montes de Torozos occur. For the excellence and abundance of its grain crops Valladolid shares with the Tierra de Campos in Palencia the title of granary of the Peninsula.

Besides wheat, maize, barley and oats, the province produces hemp, flax, various fruits, red and white wine, oil and madder. The Montes de Torozos are thinly covered with oaks and other timber, and there are forests in the S.E. The pastures are extensive and large numbers of asses, mules and sheep, as well as some horses and cattle, are reared. Honey, wax and silk are also produced. The woollen fabrics of Valladolid were once highly esteemed, but this industry has now greatly declined, although in the larger towns there are still linen and cloth factories, besides iron foundries, tanneries, saw-mills and flour-mills. But agriculture is by far the foremost industry of the province. Trade is facilitated by the Canal de Castilla, which connects Valladolid, on the Pisuerga, with Alar del Rey, in Palencia, also on that river. See Palencia (province). Valladolid is traversed by the national highways from Madrid to Santander, Leon and Corunna, and by the Calatayud and Salamanca roads. It is also traversed from N. to S. by the northern railway from Madrid to France via Irun, which has branches from Valladolid to Medina del Rioseco, and from Medina del Campo to Salamanca and Zamora. Apart from the capital Valladolid, Nava del Rey (6148), Medina del Campo (5971) and Medina del Rioseco (5007) are the only towns with more than 5000 inhabitants. For an account of the people and history of the province, see Castile.

VALLADOLID, a town of Mexico, in the state of Yucatan, 90 m. S.E. of Merida, with which it is connected by rail. Pop. about 5000. It is situated in a healthy and fertile part of Yucatan, and is a resort for invalids. It has a number of old churches, a Jesuits' college, town hall, hospital and aqueduct, and the better class of residences are of the usual type, low, large-roomed structures in the midst of gardens. It was founded in 1544, soon after the conquest, and was planned to be a great ecclesiastical centre, but these plans were not realized and its churches and other fine buildings have fallen into decay. Its manufactures include cotton goods and tobacco. The inhabitants, chiefly descendants of the ancient Mayas, have frequently revolted against their rulers. In 1910 they were in a state of insurrection, assisted by the wild tribesmen of the neighbouring territory of Quintana Roo, on which occasion Valladolid was captured by them and many of its officials and prominent white residents were massacred.

VALLADOLID, the capital of the Spanish province of Valladolid, situated 2228 ft. above sea-level, at the confluence of the river Pisuerga with the Esgueva. Pop. (1900) 68,789. Valladolid is an archbishopric, and the seat of an army corps, a court of appeal and a university. It is connected by numerous railways with every province of Spain. Its site is a small valley, enclosed by steep and rugged but not very high hills, which merge into the vast upland plain of Castile. The city was formerly surrounded by walls and entered by four principal gates, but it has been to a great extent modernized, and possesses many fine streets and squares. There are broad avenues and public gardens beside the rivers. Among the chief open spaces are the arcaded Plaza Mayor, the Campo Grande, a wooded park and the Paseo de la Avenida, a wide boulevard in which is the statue of the poet José Zorilla (1817–1893). The granite cathedral was begun in 1585 by Juan de Herrera in the Renaissance style. Herrera's original model is preserved in the muniment-room, but only the nave and one tower (out of four) were completed after his design, and the tower fell in 1841. The building was continued by Churriguera (d. 1725). The interior contains some pictures by Luca Giordana (1623–1705) and the celebrated silver monstrance wrought by Juan de Arphe (b. 1523), which is 6½ ft. high; it is in the form of a temple, decorated with figures of Adam and Eve in the garden of Eden. The tower and nave of the church of Santa Maria la Antigua date from about 1200. The church of San Pablo is later (1286); its chief feature of interest is a beautiful Flamboyant portal, and formerly it had exquisite cloisters. Adjoining is San Gregorio (15th century) with a fine Plateresque façade. San Benito, dating from the end of the 14th century, is a Gothic building with a lofty roof finely groined. The Plateresque college of Santa Cruz, built by Enrique de Egas in 1479–92, contains an interesting collection of pictures and sculptures, including three pictures by Rubens, which have been somewhat damaged, and some remarkable wooden statues by Alonso Berruguete (d. 1581) and others. The college of San Gregorio, dating from the same period, was wrecked by the French in 1808, but has a magnificent late Gothic façade. This building has been converted into municipal offices. The university is attended by about 1200 students, and has faculties of law, medicine, natural science, philosophy and literature. Originally founded at Palencia early in the 13th century, it was transferred to Valladolid before 1250 and attained its greatest prosperity from the 16th century to the 18th. The library contains many rare MSS. The university buildings date from the 17th century and are extravagantly ornate. Among other public buildings of Valladolid may be mentioned the royal palace, built in the beginning of the 17th century, the court-house, the town hall, several convents used as barracks, the provincial institute, training schools for teachers and primary schools, royal academy for cavalry cadets, provincial lunatic asylum, hospitals, seminary (raised in 1897 by Pope Leo XIII. to the rank of a pontifical university), archaeological museum, picture gallery and public library. The house in which Cervantes lived (1603–1606) is owned by the state. The principal industries are the manufacture of linen, silk and woollen fabrics, pottery, gold and silver work, flour, wine, beer, chocolate, leather, ironware and paper. There is also a large agricultural trade.

Valladolid is sometimes identified with the ancient Pintia of Ptolemy, described as a town of the Vaccaei on the road from Asturica to Caesaraugusta. Its Roman origin is uncertain. The present name is undoubtedly Moorish, but its meaning is obscure. Valladolid was recovered from the Moors in the 10th century, but is first named in a public document by Sancho II. of Leon in 1072. The cortes of Castile frequently met here in the following centuries, and in the beginning of the 15th century John II. made it his principal residence. After the removal of the capital to Madrid by Philip II. in 1560 it began rapidly to decay. In December 1808 it was taken and sacked by the French, who destroyed many fine buildings and works of art. Columbus died (1506) and Philip II. was born (1527) at Valladolid.

VALLANDIGHAM, CLEMENT LAIRD (1820–71), American politician, was born in New Lisbon, Ohio, on the 29th of July 1820. He was educated in the common schools and afterwards studied law and was admitted to the bar in 1842. Elected to the Ohio House of Representatives in 1845, he became one of the extremest of the state rights Democrats of his section, emphasizing his principles in the legislature in the local and national party conventions, and in the columns of a newspaper, the *Western Empire*, which he edited at Dayton, Ohio, in 1847–49. From 1858 to 1863 he was in the lower house of Congress, where he was noted for his strong opposition to the principles and policies of the growing Republican party, his belief that the South had been grievously wronged by the North, his leadership of the Peace Democrats or Copperheads, who were opposed to the prosecution of the war, and his bitter attacks upon the Lincoln administration, which, he said, was destroying the Constitution and would end by destroying civil liberty in the North. Attempts were made to expel him, but without success. In 1863 he made violent speeches in Ohio against the administration, and for these he was arrested by the military authorities, tried by military commission, and sentenced to imprisonment. President Lincoln commuted this sentence to banishment, and Vallandigham was sent into the Confederate lines, whence he made his way to Canada. While in exile he was elected supreme commander of the Knights of the Golden Circle in Ohio and received the Democratic nomination for governor of Ohio, but was defeated. In 1864 he returned to Ohio, took active part in the campaign of that year, wrote part of the National Democratic platform at Chicago, and assisted to nominate McClellan for the presidency. After the war he denounced the Reconstruction policy of the Republicans as unconstitutional and tyrannical, but in 1870, seeing the uselessness of further opposition, he advised his party to accept the situation and adopt new issues. He thus initiated what was known as the "New Departure" Democratic movement. Vallandigham was a good lawyer and a popular politician. He was fanatically devoted to the Constitution as he understood that document, and in his course during the war he was not, as his enemies asserted, trying to aid the Confederates, but merely desirous of restoring "the Union as it was." He died in Lebanon, Ohio, on the 17th of June 1871.

See J. L. Vallandigham, *Life of Clement L. Vallandigham* (Baltimore, 1872); and J. F. Rhodes, *History of the United States from the Compromise of 1850* (New York, 1893–1906).

VALLE, PIETRO DELLA (1586–1652), Italian traveller in the East, came of a noble Roman family, and was born on the 11th of April 1586, in the family palace built by Cardinal Andrea. His early life was divided between the pursuits of literature and arms. He saw active service against the Moors of Barbary, but also became a member of the Roman academy of the Umoristi, and acquired some reputation as a versifier and rhetorician. The idea of travelling in the East was suggested by a disappointment in love, as an alternative to suicide, and was ripened to a fixed purpose by a visit to the learned Mario Schipano, professor of medicine in Naples, to whom the record of Pietro's travels was addressed in the form of very elaborate letters, based on a full diary. Before leaving Naples he took a vow of pilgrimage to the Holy Land, and, sailing from Venice on the 8th of June 1614, reached Constantinople, where he remained for more than a year, and acquired a good knowledge of Turkish and a little Arabic. On the 25th of September 1615 he sailed for Alexandria with a suite of nine persons, for he travelled always as a nobleman of distinction, and with every advantage due to his rank. From Alexandria he went on to Cairo, and, after an excursion to Mount Sinai, left Cairo for the Holy Land on the 8th of March 1616, in time to assist at the Easter celebrations at Jerusalem. Having visited the holy sites, he journeyed by Damascus to Aleppo, and thence to Bagdad, where he married a Syrian Christian named Maani, a native of Mardin, who died in 1621. He now desired to visit Persia; but, as that country was then at war with Turkey, he had to leave Bagdad by stealth on the 4th of January 1617. Accompanied by his wife he proceeded by Hamadan to Isfahan, and joined Shah Abbas in a campaign in northern Persia, in the summer of 1618. Here he was well received at court and treated as the shah's guest. On his return to Isfahan he began to think of returning by India rather than adventure himself again in Turkey; but the state of his health, and the war between Persia and the Portuguese at Ormuz, created difficulties. In October 1621 he started from Isfahan, and, visiting Persepolis and Shiraz, made his way to the coast; but it was not till January 1623 that he found passage for Surat on the English ship "Whale." In India he remained till November 1624, his headquarters being Surat and Goa. He was at Muscat in January 1625, and at Basra in March. In May he started by the desert route for Aleppo, and took ship at Alexandretta on a French vessel. Touching at Cyprus he reached Rome on the 28th of March 1626, and was received with much honour, not only by literary circles, but by Pope Urban VIII., who appointed him a gentleman of his bedchamber. The rest of his life was uneventful; he married as second wife a Georgian orphan of noble family, Mariuccia (Tinatin de Ziba), whom his first wife had adopted as a child, and who had accompanied him in all his journeys. By her he had fourteen sons. He died at Rome on the 21st of April 1652.

In Pietro della Valle's lifetime there were printed—(1) a *Funeral Oration on his Wife Maani*, whose remains he brought with him to Rome and buried there (1627); (2) an *Account of Shah Abbas*, printed at Venice in 1628, but not published; (3) the first part of the letter describing his *Travels* (Turkey, 1650). The *Travels* in Persia (2 parts) were published by his sons in 1658, and the third part (India) in 1663. An English translation appeared in 1665 (fol.). Of the Italian text the editon of Brighton, 1843 (2 vols. 8vo), is more esteemed than the other reprints. It contains a sketch of the author's life by Gio. P. Bellori (1622). Della Valle's story is often prolix, with a tendency to the rhetorical; but he is clear and exact, well informed and very instructive, so that his work still possesses high value.

VALLEJO, a city of Solano county, California, U.S.A., on the San Pablo Bay, at the mouth of the Napa river, about 24 m. N.E. of San Francisco. Pop. (1890) 6343; (1900) 7965 (2033 foreign-born); (1910) 11,340. It is served by a branch of the Southern Pacific railway, by steamboats to San Francisco, and by an interurban electric line. The city is situated at the mouth of the great interior valley of the state, and has a good harbour, the channel of which, since the removal of a shoal by the Federal government in 1902–1906, has a maximum depth at low tide of 24 ft. Directly opposite the city, half a mile distant and connected by ferry, is Mare Island, the headquarters of the Pacific Naval Squadron of the United States, with a large United States Navy Yard, a naval arsenal, two stone dry docks (one 750 ft. long) and a lighthouse. The Navy Yard was established in 1854, and its first commandant was D. G. Farragut. In the city are a Carnegie library, St Vincent's Academy and a Good Templars' Home (1869) for orphans. Vallejo is the outlet of the beautiful Napa Valley, one of the finest fruit-growing regions of the state, and, besides fruit, ships large quantities of wheat. Among its manufactures are flour, leather, dairy products and lumber. The municipality owns and operates its waterworks, the water-supply being obtained from the mountains 25 m. distant. The city takes its name from General Mariano Guadalupe Vallejo, a prominent Mexican leader in the years immediately preceding the annexation of California to the United States. It was a dull and out-of-the-way settlement in 1851, when, through General Vallejo's efforts, it became the state capital. The state legislature met here in 1851, 1852 and 1853. In 1871 Vallejo ranked third in population among the cities of the state, and its position and the excellence of its harbour made it a rival of Oakland in the struggle (1869–72) for the terminus of the Central Pacific railway; but Vallejo was unsuccessful, and after 1872 began to decline in relative importance.

VALLÈS, JULES (1832–1885), French journalist and author, was born at Puys, France, on the 10th of June 1832. Coming to Paris, he joined the staff of the *Figaro*, and became a constant contributor to the other leading journals. In 1866 he republished much of his newspaper work in *Refractaires*, the volume forming a romance of the seamy side of Paris life. He was in Paris during the siege of 1870, and after the capitulation was a member of the Commune and founded *Le Cri du Peuple*. He took a conspicuous part in the fighting in the Paris streets, but finally made his escape to London, whence he contributed anonymously to the French press. In 1878 he began in the *Siècle* the serial publication of his principal work, *Jacques Vingtres*, a long autobiographical romance. He died in Paris on the 14th of February 1885.

VALLETTA, or VALETTA, the capital of Malta (since 1570). Pop. (1901) 24,685; or 40,406, including suburbs. The nucleus of the city is built on a ridge of rock (Mount Sceberras) which runs like a tongue into the middle of a bay, which it thus divides into two harbours, the Grand Harbour to the east and the Marsamuschetto to the west, which are subdivided again by three other peninsulas into creeks. On two of these peninsulas on the east side of the Grand Harbour, and at their base, are built the aggregate of towns called the Three Cities—Vittoriosa, Conspicua and Senglea (see MALTA). On the main promontory, with Valletta, stands the suburb Floriana; Fort St Elmo, with a lighthouse, stands on the extremity of the promontory; the suburb Sliema lies on the point which encloses the Marsamuschetto harbour; Fort Ricasoli on the opposite point enclosing the east, Grand, or Great Harbour. The streets of Valletta, paved with stone, run along and across the ridge, and end on each side towards the water in steep flights of steps. Many of the houses, which are of stone throughout, with flat roofs, are large and luxuriously built; wooden-covered balconies project from the windows and give a peculiar aspect to the streets. There are several fine public buildings, as the governor's palace, the new opera-house, the public library and museum of Maltese antiquities, and the *auberges* or lodges of the Knights of Malta (especially the Auberge de Castile) which are now used for military offices, club-rooms, and other purposes. Roman Catholic churches in Valletta are very numerous; the cathedral of S. Giovanni, dating from 1576, is famous for its rich inlaid marbles, its Brussels tapestries, its roof painted by Matteo Preti (1661–1699), the picture by Michael Angelo da Caravaggio of the beheading of John the Baptist, numerous memorials of the knights and other relics.

The governor's palace was formerly that of the grand master of the Maltese Order, and it also contains relics of the knights, tapestries, armour, &c. Extensive bagnios under the rock, formerly occupied by the slaves of the knights, are now used for stores. The knights strengthened Valletta and its harbour by bastions, curtain-walls, lines and forts, towards the sea, towards the land and on every available point, taking advantage in every particular of the natural rock and of the marvellous advantages of situation, rendering it then almost impregnable. The work of fortifying the place has been carried on by the British government, which possesses here a naval hospital, military prison and other necessary institutions. Since the British occupation Valletta has been a naval and military station of the first importance. The dock and victualling yards occupy together an area of some 100 acres spread over the shores on both sides of those arms of the great harbour known as "Dockyard" and "French" creeks, the dockyard being partly on the former, but principally on the latter creek. In 1880 the graving dock accommodation consisted of one double dock at the extremity of Dockyard creek, known as Nos. 1 and 2 Docks, with a total length of about 525 ft. and with 25 ft. over the sill at average water-level, the tidal range at Malta being but slight; and opening into French creek a dry dock of more modern construction, known as No. 3, or the Somerset Dock, 427 ft. long on floor, and with 34 ft. over the sill. Subsequently to this period the fine range of buildings known as the iron ship repairing shop was erected close to the Somerset Dock, and added greatly to the repairing resources of the yard. Dock No. 4, or the Hamilton Dock, was completed in 1891, having a length on floor of 520 ft., a width of entrance of 94 ft. and with 35 ft. 5 in. depth over the sill at average water-level. Associated with this dock was the construction of adjacent deep-water wharf walls, together with the great 160-ton crane. Among later additions were gun-mounting stores, boiler shop, boat sheds, canteen, coal stores, &c., together with a double dock 750 ft. long over all, and a single dock 550 ft. long. The large transit trade and the local trade of the island centre upon Valletta. The influx of winter visitors adds to the wealth of the city.

VALLEYFIELD, town and port of entry, Beauharnois county, Quebec, Canada, 25 m. S.W. of Montreal, at the foot of Lake St Francis—an expansion of the river St Lawrence—and at the head of the Beauharnois canal. Pop. (1891) 5515; (1901) 11,055. It is a station on the Canada Atlantic and New York Central railways, and a port of call for all steamers plying between Montreal and Lake Ontario ports. It is the see of a Roman Catholic bishop, and contains a college and a convent. It has extensive cotton, flour, canning and paper mills.

VALLEY FORGE, a small village in Chester county, Pennsylvania, U.S.A., on the S. bank of the Schuylkill river, about 20 m. N.W. of Philadelphia. It is served by the Philadelphia & Reading railway. The village lies in part of the tract occupied in the winter of 1777–1778 by the American army (under General Washington), whose sufferings from cold, starvation and sickness made the place historic. On the 19th of December (after the battles of Brandywine and Germantown and the occupation of Philadelphia by the British) the army, numbering about 10,000, went into camp here, the site having been selected by Washington partly because the hilly ground was favourable for defence, and partly because the army was thus placed between the British forces and York, Pennsylvania (about 65 m. W. of Valley Forge), where Congress was in session. The camp was almost unapproachable from the west by reason of the precipitous hillsides and Valley Creek, a small stream flowing northward at their base into the Schuylkill river which afforded a barrier on the north; on the east a series of intrenchments and rifle-pits were built. In this vicinity the army remained encamped until the middle of June. As a result of the mismanagement and general incapacity of the Commissary Department, the army received little food or clothing during the winter months; in the latter part of December nearly 2900 men were unfit for duty on account of sickness or the lack of clothing, and by the 1st of February this number had increased by nearly 1000, a state of affairs which Washington said was due to "an eternal round of the most stupid mismanagement [by which] the public treasure is expended to no kind of purpose, while the men have been left to perish by inches with cold and nakedness." There were many desertions and occasional symptoms of mutiny, but for the most part the soldiers bore their suffering with heroic fortitude. On the 27th of February Baron Steuben (*q.v.*) reached the camp, where he drilled and reorganized the army. In 1893 the state of Pennsylvania created a commission of ten members, which (with $365,000 appropriated up to 1911) bought about 475 acres (in Chester and Montgomery counties) of the original camp ground, now known as the Valley Forge Park, preserved Washington's headquarters (built in about the year 1758) and other historic buildings, and reproduced several bake-ovens and huts of the kind used by the army. The state has also erected (1908) a fine equestrian statue by Henry K. Bush-Brown to General Anthony Wayne, and a number of granite markers which indicate the situation of the camps of the different brigades. The state of Maine erected in 1907 a granite memorial to the soldiers from Maine who camped here, and in 1910 Massachusetts appropriated $5000 for a memorial to her troops. Valley Forge took its name from an iron forge (also called "Mountjoy forge") built on the east side of Valley Creek, near its mouth, in about 1750, and destroyed by the British in 1777.

VALLOMBROSA, a summer resort of Tuscany, Italy, in the province of Florence, reached by a cable railway 5 m. long from the station of S. Ellero (which is 16 m. S.E. of Florence) and 328 ft. above sea-level, on the N.W. slope of the Prato Magno chain. The former monastery, suppressed in 1816, is occupied by the Royal School of Forestry. A number of hotels have been built. Similar summer resorts are situated among the woods above the Casentino or upper valley of the Arno to the east, such as Camaldoli, Badia di Prataglia, &c. Camaldoli was the original headquarters of the Camaldulensian order, now partly occupied by an hotel. Five hours' journey to the S. of the last on foot and 7¼ m. to the E. of Bibbiena by road is the monastery of La Verna, 3660 ft. above sea-level, founded by St Francis in 1215.

VALLOMBROSIANS, an order of monks under the Benedictine rule, founded by St John Gualbert in 1038. He was son of a Florentine nobleman, and became first a Benedictine and then a Camaldulian. Finally, about 1030, he withdrew to Vallombrosa, a shady dale on the side of a mountain in the Apennines, 10 m. from Florence, and for some years led a completely solitary life. Disciples, however, gathered around him, and he formed them into an order in which the cenobitical and the eremitical lives should be combined. The monks lived in a monastery, not in separate huts like the Camaldulians, and the Benedictine rule was the basis of the life; but the contemplative side was strongly emphasized, and every element of Benedictine life was eliminated that could be supposed to interrupt the attention of the mind to God—even manual labour. The Vallombrosians spread in Italy and France, but they never had more than sixty houses. They now have three, with some sixty monks in all. The habit was originally grey, but it became black; and the life also has been assimilated to that of the Benedictines. There were some convents of Vallombrosian nuns.

See Helyot, *Histoire des Ordres religieux* (1718), v. cc. 28, 29; Max Heimbucher, *Orden u. Kongregationen* (1907), I. § 44.

(E. C. B.)

VALLS, a town of north-eastern Spain, in the province of Tarragona; 11 m. N. of Tarragona, on the Picamoixons-Roda railway. Pop. (1900) 12,625. Valls is an old town, and its walls and towers still remain. Wool and cotton spinning and weaving, dyeing, distilling, paper-making and tanning are carried on here with considerable activity.

VALOIS, COUNTS AND DUKES OF. The French countship of Valois (*pagus Vadensis*) takes its name from Vez (Latin *Vadum*), its early capital, a town in the department of the Oise. From the 10th to the 12th century it was owned by the counts of Vermandois and of Vexin; but on the death of Eleanor, sister and heiress of Count Raoul V. (d. 1167), it was united to the crown by King Philip Augustus. Soon detached from the royal domain, Valois was the property of Blanche of Castile, widow of Louis VIII., from 1240 to 1252, and of Jean Tristan, a younger son of Louis IX., from 1268 to 1270. In 1285 Philip III. gave the county to his son Charles (d. 1325), whose son and successor, Philip, count of Valois, became king of France as Philip VI. in 1328. Sixteen years later Valois was granted to Philip's son, Philip, duke of Orleans; then passing with the duchy of Orleans in 1392 to Louis (d. 1407), a son of Charles V., it was erected into a duchy in 1406, and remained the property of the dukes of Orleans until Duke Louis became king of France as Louis XII. in 1498, when it was again united with the royal domain.

After this event the duchy of Valois was granted to several ladies of the royal house. Held by Jeanne, countess of Taillebourg (d. 1520), from 1516 to 1517, and by Marie, countess of Vendôme, from 1530 until her death in 1546, it was given to Catherine de Medici, the widow of Henry II., in 1562, and in 1582 to her daughter, Margaret of Valois, the wife of Henry of Navarre. In 1630 Louis XIII. granted Valois to his brother Gaston, duke of Orleans, and the duchy formed part of the lands and titles of the dukes of Orleans from this time until the Revolution.

The house of Valois, a branch of the great Capetian family, is thus descended from Charles, a son of Philip III., and has been divided into several lines, three of which have reigned in France. These are: (1) the direct line, beginning with Philip VI., which reigned from 1328 to 1498; (2) the Orleans branch, descended from Louis, duke of Orleans, a son of Charles V., from 1498 to 1515; (3) the Angoulême branch, descendants of John, another son of the same duke, from 1515 to 1589. Excluding the royal house, the most illustrious of the Valois branches are: the dukes of Alençon, descendants of Charles, a younger son of Charles I., count of Valois; the dukes of Anjou descendants of Louis, the second son of King John II.; and the dukes of Burgundy, descendants of Philip, the fourth son of the same king.

VALOIS, HENRI DE [Valesius] (1603–1676), French scholar, was born at Paris on the 10th of September 1603. He was a pupil of the Jesuits at the college of Clermont, then studied law at Bourges. He was called to the bar in 1623, but before long devoted himself entirely to literature. He had an extraordinary memory and a thorough knowledge of the classics, and to him we owe editions of several of the Greek historians, with excellent Latin translations, the only fault found with which is that they are too elegant: *Polybii, Diodori Siculi, Nicolai Damasceni, Dionysii Halicarnassii, Appiani et Joannis Antiocheni excerpta* (1634; Henri de Valois used for this edition a manuscript coming from Cyprus, which had been acquired by Peiresc); *Ammiani Marcellini rerum gestarum libri 18* (1636); *Eusebii ecclesiastica historia, et vita imperatoris Constantini, graece et latine* (1659); *Socratis, Sozomeni, Theodoreti et Evagrii Historia ecclesiastica* (1668–1673). When almost sixty years of age, and nearly blind, he married Marguerite Chesneau (1664), and had by her four sons and three daughters He died in Paris on the 7th of May 1676.

His brother, Adrien de Valois (1607–1692), was also a well-known scholar. He made the acquaintance of Father Petau, Father Sirmond and the brothers Dupuy, who turned his attention towards medieval studies. He was appointed historiographer in 1660. He undertook the task of writing a critical history of France, but did not get further than the deposition of Childeric III. (752). He devoted, however, to this period three folio volumes (*Gesta Francorum seu rerum francicarum tomi tres*, 1646–1658), which form a critical commentary of much value, and in many points new, on the chroniclers of the Merovingian age. His study on the palaces constructed by the Merovingian kings (*De basilicis quas primi Francorum reges condiderunt*, 1658–1660) is noteworthy in this connexion. In 1675 appeared his *Notitia Galliarum ordine litterarum digesta*, a work of the highest merit, which laid the foundations of the scientific study of historical geography in France; but, like all the scholars of his age, he had no solid knowledge of philology. His last work was a life of his elder brother (*De Vita Henrici Valesii*, 1677).

Adrien's son, Charles de Valois (1671–1747), was a distinguished numismatist, and formed a fine collection of medals, chiefly Roman. He entered at an early age the *Académie des Inscriptions et Belles Lettres*, where he became first a pupil (1705), then an associate (1714) and finally a *pensionnaire* (1722). He published little; we know, however, an *Histoire des Amphictyons* by him. His best work, the *Valesiana* (1694), was inspired by filial affection; in it he collected a number of historical and critical observations, anecdotes and Latin poems of his father. His *Éloge*, by Fréret, is in the *Mémoires de l'Académie des Inscriptions*, vol. xxi. p. 234 (1747).

VALPARAISO, a province of Chile on the Pacific coast, bounded N. by Aconcagua, E. and S. by Santiago and W. by the ocean. Area, 1953 sq. m. Pop. (1895) 220,756; (1902, estimated) 249,885. Its surface is chiefly mountainous, and in great part barren. The river and mountain valleys, however, are fertile, and where irrigation is possible yield large crops, especially cereals. The valley of the Aconcagua, which flows across the N. end of the province, is celebrated for its fertility, especially in the vicinity of Quillota, sometimes called the "garden of Chile." The capital is Valparaiso, and the principal town outside the capital is Quillota.

VALPARAISO, a city and seaport of Chile, capital of the province of Valparaiso, on a broad open bay of the Pacific in lat. 33° 0′ 2″ S., long. 71° 41′ 15″ W., about 70 m. N.W. of Santiago. Pop. (1902) 142,282; (1907, estimated) 180,600. The almost semicircular Bay of Valparaiso is slightly over 3 m. across from Punta Angeles to Punta Gruesa, and the city stands on the south side, on the slopes of a spur of barren hills projecting into the Pacific and forming a rocky peninsula terminating in Punta Angeles. This point affords good shelter from southerly and westerly storms, but the bay is open to those from the north. The city occupies a narrow strip of beach extending around the head of the bay, and extends up the steep slopes and valleys of the enclosing hills, which have an altitude of 1000 to 1400 ft. The extreme outer points of the bay are strongly fortified. Valparaiso is pre-eminently a commercial city. The foreign trade is largely in the hands of foreign merchants. Among industrial establishments are the government railway shops, large foundry and machine shops, coach-building works, a large sugar refinery, breweries, distilleries, bottling works and numerous small factories. The trade of the port, which is the largest and most important on the Pacific coast of South America, makes it a terminal and port of call for several regular lines of steamers, which afford frequent communication with Europe and the United States. The transcontinental railway line between Valparaiso and Buenos Aires (the Andean tunnel was opened in April 1910) adds to the traffic of the port, through the transhipment of passengers and freight to escape the long and dangerous voyage by way of the Straits of Magellan. Two cable lines give telegraphic communication with Europe and the United States—a West Coast line running N. to Panama, and a land line across the Andes to Buenos Aires in connexion with the cable to Europe from that port. There is but one railway out of Valparaiso—the government line to Santiago, with a branch running to Los Andes and the international tunnel through the Andes. There are a wireless telegraph station in regular communication with the islands of Juan Fernandez, state telegraph lines communicating with all parts of the republic, and an efficient telephone service. Valparaiso has an attractive suburb, Viña-del-Mar, immediately E. of Punta Gruesa, only 15 minutes by rail from the city.

Valparaiso was founded in 1536 by Juan de Saavedra, who named it after his birthplace near Cuenca, Spain. It was an ill-chosen name, however, for there is nothing in it descriptive of the barren hills, dirty streets and foul-smelling shores of Valparaiso (Paradise Valley). The port and town were of but little note during the colonial period, for free commercial intercourse with the colony was forbidden. In 1819, near the end of the war with Spain, its population barely reached 5000. In 1578 it was captured by Sir Francis Drake, and in 1596 by Sir John Hawkins. In 1600 it was sacked by the Dutch under Van Noort. On the 31st of March 1866, it was bombarded by a Spanish fleet under the command of Admiral Nunez, when a large part of the town was laid in ruins, and on the 28th of August 1891, after the victory of the congressional troops over Balmaceda's forces in the vicinity, it was partially sacked by the Chileans themselves. Valparaiso has suffered much from earthquakes—in 1730, 1822, 1839, 1873 and 1908. The last-mentioned caused the destruction of a large part of the city, including public edifices, private residences, the water mains, public lighting service and transportation facilities. A large part of the population was deprived of shelter and had to take refuge on the plateau above. Aid was promptly given by the national government, and assistance was sent from foreign countries; and the national government made a grant for the rebuilding of the city.

VALPARAISO, a city and the county-seat of Porter county, Indiana, U.S.A., about 40 m. S.E. of Chicago. Pop. (1890) 5090; (1900) 6280, including 660 foreign-born; (1910) 6987. It is served by the Grand Trunk, the New York, Chicago & St Louis, and the Pennsylvania railways. The city has a public library (1905), and is the seat of an Institute of Telegraphy (founded in 1874; chartered in 1900) and of Valparaiso University (1873; formerly known as the Valparaiso Normal Training School). This university was founded to furnish a practical education at a low cost, and in 1910 had 187 instructors and a total enrolment of 5367 students. Valparaiso was settled about 1835, incorporated in 1856 as a village and chartered as a city in 1865.

VALPY, RICHARD (1754–1836), English schoolmaster, was born in Jersey on the 7th of December 1754. He was sent to schools in Normady and Southampton, and completed his education at Pembroke College, Oxford. In 1777 he took orders, and in 1781 became head master of Reading grammar school, a post which he held for fifty years. He was the author of Greek and Latin grammars which enjoyed a large circulation. He died in London on the 28th of March 1836.

His second son, Abraham John Valpy (1787–1854), printer and publisher, is remembered in connexion with two great undertakings in the department of classical literature. These were reissues of (1) Stephanus's Greek *Thesaurus*, for which E. H. Barker was chiefly responsible; (2) the Delphin Classics in 143 volumes with *variorum* notes, under the editorial superintendence of George Dyer. He also founded the *Classical Journal* in 1810.

VALS (Vals-les-Bains), a village of south-western France, in the department of Ardèche, 3 m. N.N.W. of Aubenas, with which it communicates by tramway. Pop. (1906) town, 2694; commune, 4352. Vals is situated on the Volane amongst volcanic mountains. It is celebrated for its numerous cold mineral springs impregnated in most cases with bicarbonate of soda. They are used chiefly for drinking but also as baths, and are efficacious in maladies of the digestion, liver and kidneys, and for gravel and gout. Seven or eight million bottles annually are exported. Wood-turning and silk-milling are carried on.

VALTELLINA (Ger. *Veltlin*; the name comes from the former capital, Teglio, near Tresenda), properly the name of the upper valley of Adda, in north Italy. Historically and officially, it also comprises the Italian Liro or San Giacomo valley, which extends from the Splügen Pass past Chiavenna (where the Liro is absorbed by the Mera, flowing from the Swiss Val Bregaglia) to the Lake of Como, the Mera entering this lake slightly to the north of the Adda. These two valleys (but not Colico, which is in the province of Como) form together the province of Sondrio. Pop. 145,265 (exclusive of Colico) or 122,466 (omitting Chiavenna). Politically the whole valley belongs to the kingdom of Italy, except the side valley of Poschiavo (Puschlav), which belongs to the Swiss canton of the Grisons (Graubünden). The chief town is Sondrio (7172), other important places being Tirano (5870), Chiavenna (4592) and Morbegno (3603). Near Bormio (Ger. *Worms*) there are some frequented mineral springs (sulphur and lime), known in Pliny's time, and efficacious in diseases of the skin. There are several other baths in the side valleys, such as Santa Caterina (chalybeate), Masino and Le Prese (sulphur).

The highest points in the ranges enclosing the valley are the Piz Zupo (13,131 ft.) in the Bernina group and the Konigsspitze (12,655 ft.) in the Ortler district; the Monte della Disgrazia (12,067 ft.) is the highest peak comprised entirely within the water-basin of the valley. Four well-marked Alpine passes are traversed by good carriage-roads—the Stelvio Pass or Stilfserjoch (9055 ft., the highest carriage-road in Europe) from Bormio to Meran in the Adige valley, the Bernina Pass (7645 ft.) from Tirano to Samaden in the Upper Engadine, and the Aprica Pass (3875 ft.) from Tirano to the Val Camonica and the Lake of Iseo, while from near the top of the Stelvio a fourth road leads over the Umbrail Pass (8242 ft., the highest in Switzerland) to the Swiss valley of Münster, which is reached at the village of Santa Maria. The main valley is traversed from end to end by a magnificent carriage-road constructed by the Austrian Government in 1820–1825. A railway runs from Colico, on the Lake of Como, past Sondrio to Tirano, a distance of 42 m., while there is another from Colico to Chiavenna (16½ m.).

The population is wholly Italian-speaking and Roman Catholic, the valley being in the diocese of Como. The shrine of the Madonna of Tirano (founded 1520) annually attracts a large number of pilgrims. The valley, particularly in its lower portion, is extremely fertile; and of late years vigorous measures have been taken to prevent the damage caused by the frequent inundations of the Adda. Chestnuts, vines, mulberry trees and fig trees abound; and there are many picturesquely situated churches, castles and villages. The chief articles exported are wine and honey. The wine is largely consumed in north Italy and Switzerland, the best varieties being Grumello, Sassella and Montagna. Large quantities of honey are annually sent abroad.

History.—The political history of Valtellina is made up of the histories of three districts—(1) the "free community" of Poschiavo (first mentioned as such in 1200–1201); (2) the county of Bormio (first mentioned as a county in 1347); and (3) Valtellina proper, extending from the defile of the Serra di Morignone on the east to the Lake of Como on the west. After the defeat of the Lombards (774) these three districts were given (775) by Charlemagne to the abbey of St Denis near Paris, which never seems to have exercised its rights. In 824 Lothair I., confirming an earlier donation (803) made by Charlemagne, gave the churches of Poschiavo and Bormio to the bishop of Como. Bormio was in 1205 won by the men of Como, who in 1006 had received one-half of Valtellina from the emperor, and by 1114 they were masters of the entire valley. They retained Bormio till 1300, when it freed itself; but in 1336 it belonged to the bishop of Chur. In 1335 the Visconti, lords (later dukes) of Milan, became lords of Como, and therefore of Valtellina. In 1350 they seized on Bormio and Poschiavo, the latter being won back by the bishop of Chur in 1394 and again lost to the Visconti in 1470. As early as 1360 the men of Rhaetia made incursions into Valtellina under the pretext that it had formed part of ancient Rhaetia. This idea was confirmed in 1404, when, in return for kind treatment received during his exile, Mastino Visconti (son of Barnabò) gave to the bishop of Chur his share of the Milanese, including Poschiavo, Bormio and Valtellina. Relying on this donation, the men of the Three Leagues of Rhaetia (best known by the name of one, Graubünden) invaded the valley in 1486–1487, Poschiavo becoming in 1486 permanently a member (not a subject land) of the *Gotteshausbund*. This donation served too as the excuse for seizing, in 1512, on Chiavenna, Bormio and Valtellina, which were harshly ruled as "subject bailiwicks." Under the governor at Sondrio there were four "podestas" for the three divisions of Valtellina (Morbegno and Traona, Sondrio and Tirano), besides one at Teglio and one at Bormio. Mastino Visconti's donation was solemnly confirmed in 1516 by the emperor Maximilian I. In 1530 the bishop of Chur was forced to sell to the Three Leagues for a small sum his title to these two districts. At the time of the Reformation Poschiavo became Protestant. The other two districts clung to the old faith and came under the influence of Carlo Borromeo, who, when founding in 1579 his "Collegium Helveticum" at Milan for Swiss students for the priesthood, reserved for Valtellina six out of the forty-two places. Valtellina was extremely important to the Habsburgs as affording the direct route between their possessions of the Milanese and Tirol. Hence a great struggle, into which religious questions and bribery largely entered, took place between Austria and Spain on one side and France and Venice on the other. In 1603 Fuentes, the Spanish governor of the Milanese, built a fortress (of which traces still remain) close to the Lake of Como, and at the entrance to the valley, in order to overawe it. The religious conflicts in Graubünden led to reprisals in the "subject land" of Valtellina. In 1620 (19th July–4th August) the Spanish and Romanist faction (headed by the Planta family) massacred a great number of Protestants in the valley, 350 to 600 according to different accounts (*Veltliner Mord*). For the next twenty years the valley was the scene of great strife, being held by the Spaniards (1621–23, 1629–31, 1637–39), by the French (1624–27, 1635–37), and by the pope (1623, 1627). At length George Jenatsch, a former pastor, who had been the active and unscrupulous leader of the Protestant party, became a Romanist (1635) in order to free the land from the French by aid of the Spaniards (1637), who finally (1639) gave it back to its old masters on condition that the Protestants were excluded from the valley. In this way the local struggles of Valtellina came to be mixed up with the Thirty Years' War. In 1797 Bormio and Valtellina were annexed to the Cisalpine republic, in 1805 to the kingdom of Italy (of which Napoleon was king), and in 1815 (despite the remonstrances of the Raetian leagues) to the kingdom of Lombardo-Venetia, held by the emperor of Austria. In 1859 they became, like the rest of Lombardy, part of the kingdom of united Italy Poschiavo followed the fortunes of the "Gotteshausbund." It became (after 1798) part of the canton Raetia of the Helvetic republic, and in 1803 of the canton of the Graubünden or Grisons, which was then first received a full member of the Swiss Confederation.

See G. Leonhardi, *Das Veltlin* (1859) and *Das Poschiavinothal* (1860); Romegialli, *Storia della Valtellina* (1834–39, 5 vols.); C. von Moor, *Geschichte von Currätien* (1870–74); P. C. von Planta, *Die currätischen Herrschaften in der Feudalzeit* (1881); W. Coxe, *Travels in Switzerland*, &c. (4th ed., 1801; Letters 74–78); G. B. Crollalanza, *Storia del Contado di Chiavenna* (Milan, 1870), D. W. Freshfield, *Italian Alps* (London, 1875); Edmondo Brusoni, *Guida della Valtellina* (Sondrio, 1906); A. Giussani, *Il Forte di Fuentes*

(Como, 1905); P. A. Lavizari, *Storia della Valtellina* (2 vols., Capolago (Tessin), 1838); A. Lorria and E. A. Martel, *Le Massif de la Bernina* (Zürich, 1894); E. Rott, *Henri IV., les Suisses, et la Haute Italie—la Lutte pour les Alpes, 1508–1610* (Paris, 1882); E. Rott, *Histoire de la représentation diplomatique de la France auprès des cantons Suisses* (Bern; vols. iii. (1906) and iv. relate to the French in the Valtellina from 1620 sqq.); E. Haffter, *Georg Jenatsch* (Davos, 1894); F. Pieth, *Die Feldzüge des Herzogs Rohan im Veltlin und in Graubünden* (Bern, 1905); F. Fossati, *Codice Diplomatico della Rezia* (originally published in the *Periodico* of the *Società Storica a Comense* at Como; separate reprint, Como, 1901); L. von Ranke, *History of the Popes*, bk. vii.; and H. Reinhardt, "Das Veltliner Mord," in *Geschichtsfreund* (vol. xl., 1885).

VALUATION AND VALUERS. A valuation of property may be required in view of a proposed sale or purchase, or in order to ascertain the amount for which it will constitute a sufficient security if mortgaged, or which should be paid by way of compensation where it is compulsorily taken or wrongfully damaged. It may also be necessary with a view to the assessment of property for rating, or for fiscal or other purposes. Where it is desired to ascertain the amount which may properly be invested in the purchase of land or buildings, the valuer will consider their character and situation, and the greater or less degree of risk incidental to their nature, in order to determine the rate of interest which they ought to yield. The valuation will proceed upon the basis that the property should return to the purchaser the capital which he invests together with interest at the rate so settled, or afford him security for such interest while he keeps the property and the return of the capital when he desires to realize it. Accordingly, the net rent which it may be expected to yield must be ascertained by deducting the known and estimated outgoings and any other allowances which have to be taken into consideration from the gross amount which a knowledge of the local circumstances indicates as the probable return. Where the property is leasehold held for a term of fixed duration, the number of years' purchase will depend upon the length of the unexpired portion of the term, and can be ascertained without special calculation by reference to a table in common use. If the duration of the term or other interest in the property is uncertain, as, for example, in the case of a lease for lives, the number of years' purchase which may fairly be taken will be found in some other of the tables (*e.g.* Inwood's or Willich's), which have been prepared to meet the different classes of cases with which valuers have to deal. If the property is freehold the number of years' purchase can be found by dividing one hundred by the rate of the interest required.

A valuation or appraisement, under English law, need not be stamped where it is made (1) for, and for the information of, one party only, and is not obligatory as between parties; (2) in pursuance of the order of a court of admiralty or on appeal therefrom; (3) of property of a deceased person for the information of an executor, or other person required to deliver an affidavit of the estate of such deceased person; or (4) of any property for the purpose of ascertaining the legacy or succession or account duty payable in respect thereof. Any other valuation or appraisement, whether of property or any interest therein or of the annual value thereof, or of any dilapidations or of any repairs wanted or of the materials and labour used, or to be used, in any building or of any artificer's work, must be stamped. An appraiser who makes an appraisement or valuation chargeable with stamp duty must, within fourteen days after making it, write it out in words and figures showing the full amount thereof upon duly stamped material. If he omits to do so, or in any other manner discloses the amount, he becomes liable to a fine of £50. Any person who receives from an appraiser, or pays for the making of, any such appraisement or valuation not so written out and stamped, becomes liable to a fine of £20.

Where a contract has been made for the sale of property at a valuation, a valuation made in accordance with its terms will be conclusive as between the parties, in the absence of fraud, collusion or mistake. Where there has been an agreement to sell goods on the terms that the price is to be fixed by the valuation of a third party and such third party cannot or does not make such valuation, the agreement is avoided; but if the goods or any part thereof have been delivered to and appropriated by the buyer he must pay a reasonable price therefor. Where the third party is prevented from making the valuation by the fault of the seller or buyer, the party not in fault may maintain an action for damages against the party in fault. Where the fixing of a value by valuers is not of the essence of an agreement, but is wholly subsidiary to it, the courts will, if justice require it, ascertain the value in order to carry the agreement into effect. Where an agreement had been entered into for the sale of a house at a fixed price and of the fixtures and furniture therein at a valuation by a person named by both parties, and he undertook the valuation but was refused permission by the vendor to enter the premises for that purpose, the vendor was ordered to allow the entry so that the valuation might proceed.

A person who exercises the calling of an appraiser or who, for or in expectation of any fee or reward makes any valuation or appraisement chargeable with stamp duty, must (unless he is licensed as an auctioneer or house agent) have an appraiser's licence, upon which a duty of £2 is charged and which continues in force from the day of its date until the following 5th of July. By default in this respect a liability to a penalty of £50 is incurred. Moreover, an unlicensed appraiser cannot recover remuneration. A valuer is liable to the person who has employed him for the consequences of negligence or want of due care and skill on his part. If his services are thereby rendered worthless he will not be able to recover anything by way of remuneration. A valuation of a house taken by a railway company made by a surveyor who did not enter the house was held not to be a proper valuation. Although a valuer cannot be expected to possess a minute and accurate knowledge of the law, he ought to be acquainted with the general principles applicable to the valuations which he undertakes so far as is necessary in order to enable him to make them properly. The valuer, however, will be liable for the consequences of his negligence only towards the person who employed him, and not to any one else who may happen in fact to have been prejudiced thereby. (H. Ha.)

VALUE (O. Fr. *value*, from *valoir*, to be worth, Lat. *valere*), in general usage a term signifying worth. It has, however, a special meaning in economics, which is the subject of this article.

In some departments of economic theory it is still convenient to use as the basis of the exposition the opinions of J. S. Mill, because he embodied in his treatise on Political Economy in a remarkable manner nearly everything of importance from the theoretical standpoint in the work of his predecessors, and to a considerable extent subsequent advances in economic science have been made by way of criticism or development of his version. This observation is especially true of the theory of value. In this subject Mill had digested the mass of previous learning with such effect that he commences his treatment with the remark: "Happily there is nothing in the laws of value which remains for the present or any future writer to clear up; the theory of the subject is complete. The only difficulty to be overcome is that of so stating it as to solve by anticipation the chief perplexities which occur in applying it." Curiously enough this part of economic theory was the first to receive at the hands of Jevons and others serious modification, the nature and need for which can, however, only be properly understood after a preliminary examination of the old orthodox position.

As regards the question of definition, Mill starts with the distinction somewhat loosely drawn by Adam Smith between value in use and value in exchange. When we say that a thing possesses a certain value in use, we say in more words than are necessary that it is useful: that is to say, value in use is an awkward phrase for utility. The conception of utility (see WEALTH) is the most fundamental in economics. It is held by Mill to mean the capacity to satisfy a desire or serve a purpose, and thus "useful," the corresponding adjective, is as fitly applied to ices as to steam-engines. It has always seemed rather paradoxical to apply the term utility (with its adjective useful) to things which the common sense of mankind (or of any representative section) considers to be deleterious or trivial. Accordingly V. Pareto has proposed the term *ophélimité* (Gr. ὠφέλιμος) for this wider interpretation of "utility." But utility in this sense is obviously much wider than value, and Mill proceeds to say that by value in political economy we should always understand exchange value. This language seems familiar and definite, but on analysis it is clear that exchange implies two terms at least. If we say that a thing can be exchanged, we imply that it can be exchanged for something else, and when we speak of the exchange value of a thing we must directly or indirectly refer to the value of some other thing or things. In practice in modern societies this other thing is standard money: an Englishman who talks of the exchange value of anything means the number of pounds sterling (or parts thereof) which it will fetch in the market or be appraised at by a fair arbitrator. On this view then the value of a thing is its price; but a very little experience in the theory or history of economics will show that it is often desirable, and sometimes necessary, to contrast value with price. "At the same time and place," says Adam Smith, "money is the exact measure of the real exchangeable value of all commodities. It is so, however, at the same time and place only." If, however, the exchange value of a thing is not its price, what is it? According to Mill, "The value of a thing is its general power of purchasing, the command which its possession gives over purchasable commodities in general." But what, we may well ask with Mill, is meant by command over commodities in general? Are we to understand the complete national inventory of wealth, or the total of things consumed in a given time by a nation? Obviously such conceptions are extremely vague and possibly unworkable. If, however, we make a selection on any representative principle, this selection will be more or less arbitrary.

The elaborate work of C. M. Walsh on the *Measurement of General Exchange Value* (1901) gives a critical analysis of the views of the chief writers on the subject and indicates the advances made since Mill. Mill is to some extent aware of the difficulties, although he never subjected them to a rigorous analysis; and he points to the obvious fact that a coat, for example, may exchange for less bread this year than last, but for more glass or iron, and so on through the whole range of commodities it may obtain more of some and less of others. But in this case are we to say that the value of the coat has risen or fallen? On what principles are we to strike an average? The attempt to answer these questions in a satisfactory manner is at present engaging the attention of economists more than any other problem in the pure theory. Mill, however, instead of attempting to solve the problem, frankly assumed that it is impossible to say except in one simple case. If, owing to some improvement in manufacture, the coat exchanges for less of all other things, we should certainly say that its value had fallen. This line of argument leads to the position: "The idea of general exchange value originates in the fact that there really are causes which tend to alter the value of a thing in exchange for things generally, that is, for all things that are not themselves acted upon by causes of similar tendency." There can be no doubt as to the truth of the latter part of this statement, especially if we substitute for one commodity groups of commodities. But it is doubtful if the idea of general exchange value arises from a consideration of the causes of value; and later writers have constantly emphasized the distinction between any change and the causes of the change. Following out the idea in the last sentence quoted, Mill goes on to say that any change in the value of one thing compared with things in general may be due either to causes affecting the one thing or the large group of all other things, and that in order to investigate the former it is convenient to assume that all commodities but the one in question remain invariable in their relative values. On this assumption any one of them may be taken as representing all the rest, and thus the money value of the thing will represent its general purchasing power. That is to say, if for the sake of simplicity we assume that the prices of all other things remain constant, but that one thing falls or rises in price, the fall or rise in price in this thing will indicate the extent of the change in its value compared with things in general. There can be no doubt that, in discussing any practical problem as to the changes in the relative value of any particular thing, it is desirable to take the changes in price as the basis, and much confusion and cumbrousness of expression would have been avoided in the theory of the subject if, to adapt a phrase of Cournot's, money had by Mill and others been used to oil the wheels of thought, just as in practice it is used to oil the wheels of trade.

Requisites for value.

By this method of abstraction the treatment of the theory of value becomes essentially an examination of the causes which determine the values of particular commodities relatively to a standard which is assumed to be fixed. Cournot compares this hypothetical point of the standard of value to the "mean sun" of astronomers. In order that anything may possess value in this sense, that it may exchange for any portion of standard money or its representatives, it is evident on the first analysis that two conditions must be satisfied. First, the thing must have some utility; and secondly, there must be some difficulty in its attainment. As regards utility, Mill apparently regards it simply as a kind of entrance examination which every commodity must pass to enter the list of valuables, whilst the place in the list is determined by variations in the degree of the difficulty of attainment. Later writers, however, have given much more prominence to utility, and have drawn a careful distinction between final or marginal and total utility. Following Jevons, most economists have adopted this distinction, and the writers of the Austrian school in particular have made it of vital importance, and by attempting to introduce it when the conception is inappropriate have often caused much unnecessary complexity. The distinction is certainly useful in throwing light on the advantages of, and motives for, exchanging commodities. Suppose that on a desert island A possesses all the food, so many measures—(say) pecks—of corn, and B all the drinking water, so many measures—(say) pints. Then A, taking into account present and future needs, might ascribe to the possession of each portion of his stock so much utility. The utility of the first few pecks of corn might be regarded as practically infinite; but, if his stock were abundant, and a speedy rescue probable, the utility ascribed to successive portions would be less and less. In the same way B might make an estimate of the utility of successive measures of the drinking water. Now, if we regard only *total* utilities from the point of view of each, both are infinite. If an exchange were made of the total stocks of both men, the position of neither would be improved. But, if A sets aside (say) half his stock, then it may well happen that he could advantageously exchange the rest against part of B's drinking water. In precisely the same way B might set aside so much of his stock for his own consumption, and then the utility of the remaining portion would be much less than the utility he would gain if he obtained in exchange A's surplus. Thus, if the two men exchange their remainders, both will gain in utility; in the case supposed they will make an enormous gain. For simplicity we have supposed each stock to be divided into two portions, but nothing has been said of the principles of the division. It is, however, clear that A can advantageously go on exchanging a measure of corn for a measure of water so long as by doing so he makes a gain of utility. Conversely B can advantageously offer water so long as he gains greater utility from the corn received in exchange. The utility of the last portion of corn retained by A (or of water by B) is the *final* or marginal utility of the stock retained, and similarly the utility of the last measure obtained in exchange may be called the final utility of the stock purchased. A will have done his best if these utilities are just equal. For at this point, if he were to offer (at the same rate of exchange) more corn, it is clear that he would lose more utility than he would gain. *Mutatis mutandis*, the same reasoning applies to B; and thus the rate of exchange will be so adjusted as to bring about this equality of marginal utilities on both sides. It follows that, if A gains on the last portion received just as much utility as he loses on the portion parted with, on all the other portions received he will have gained more than he lost. The total of these gains over successive portions has been called by Professor Marshall *consumer's rent* or surplus.

Final or marginal and total utility.

Difficulty of attainment.

However useful this theory of marginal utility may be in throwing light on the fundamental nature of value, and on the advantages of exchange, it is obviously too abstract to be applied to the explanation of the relative values of the endless series of commodities and services which constitute a nation's stock of valuables at any time. For this purpose we must resort to the law of supply and demand, which requires a very careful statement owing to the ambiguities of popular language. Mill has succeeded in getting rid of most of these ambiguities, but he has hardly given due emphasis to the fundamental character of the law. He argues, after the brief consideration allotted to the element of utility, that the other preliminary condition necessary for value—

difficulty of attainment—is not always the same kind of difficulty, and he arrives at three distinct laws of value, according to three forms or degrees of this difficulty. (1) In the first place, the difficulty may consist in an absolute limitation of the supply, and in this case the corresponding law is said to be the law of supply and demand. Even on Mill's view the class of commodities which comes under this heading is both large and important, for it includes not only the favourite examples of old pictures, china, &c., but also land, and especially building sites in large cities. Again, it is pointed out that, although comparatively few commodities may be absolutely limited, almost all commodities may be so locally and temporarily, which is really only another way of saying that the law of supply and demand governs all market values; for it is obvious that the supply actually forthcoming or obtainable in a specified time in any market is limited—a point which may be well illustrated by the extreme case of a "corner." Again, under certain circumstances the supply may be artificially limited, as in the case of monopolies, the classical example being the destruction by the Dutch of some of their spice, in order that the limited quantity might sell for a total higher price. Besides all these important instances of the operation of the law of supply and demand, Mill is compelled also to bring under the same law the wages of labour, the values of the staples of international trade, and some other peculiar cases of value. In fact, step by step he is almost forced to the conclusion, now generally accepted, that the law of supply and demand is the fundamental law of value, of which the other laws are only particular cases. At the outset, however, he appears to consider the two others as of co-ordinate importance. (2) When the difficulty of attainment consists not in the absolute limitation but simply in the fact that the article requires labour and capital to produce it, the normal or natural value is said to be determined by the cost of production. (3) In the last case taken by Mill it is supposed that an article can be increased in quantity, but only at an increasing cost, and in this case the corresponding law of value is the cost of production of that portion which is obtained under the most unfavourable circumstances. These three laws of value may now be examined critically and their mutual relations discussed, for the last two, if not properly of co-ordinate importance with the first, are at any rate wide generalizations.

Three laws of value.

Supply and demand.

Law of demand.

In order to understand the law of supply and demand, it is best to take separately the general law of demand and the general law of supply, and then effect a combination. Demand must be defined as the quantity of any article demanded at some particular price, it being assumed of course that the bidder of the price can meet his engagements, or, as is sometimes said, that the demand is an effectual demand. It is quite clear that by demand we cannot simply mean desire to possess, because in a sense every one desires everything, and the less the means of payment so much greater in general is the desire. Again, it is obviously necessary to insert the qualifying clause "at some particular price," because, as a rule, with a change in price a different quantity will be demanded. It is, indeed, this variation of quantity demanded, according to variation in price, which gives rise to the statement of the general law of demand, namely: As the price of any article falls, other things remaining the same, the quantity demanded increases, and, conversely, as the price rises the quantity demanded decreases. A very good example of this law is found in the effects of the remission of taxes. The repeal of a tax leads to a fall in price, and the fall in price is accompanied by increased consumption. Conversely, it has often been found that to increase the amount of a tax does not increase the revenue from it, because the demand for the article falls off. The general law of demand is best expressed as by Cournot by saying that the quantity demanded is a function of the price. If we suppose that corresponding to the smallest change in price there is a change in the quantity demanded the law of demand may be illustrated by curves. Marshall has introduced the idea of demand schedules, the quantities demanded being written in one column and the corresponding prices in another. The precise connexion between the price and the quantity demanded differs in different cases, and, strictly speaking, is probably never the same for any two commodities. Every commodity has its own curve or schedule. At the same time, however, commodities may be placed in large classes according to the general character of the variation. The variation of quantity demanded according to price will ultimately rest on the principle of *marginal utility* explained above. A person with a limited amount of money to spend will hit the economic mark in the centre if the final utilities of his several purchases are equal. This is a rather technical way of saying that a prudent man will not spend a penny more on any particular thing if the penny spent upon some new object would give him a little greater satisfaction. Reverting to the variations of demand according to price, a contrast will at once be observed between necessaries and luxuries. However much the price rises, so long as people have the means they must consume a certain amount of necessaries, but, however much the price falls, the limit of consumption of bread, for example, must soon be reached. On the other hand, a great fall in price of many luxuries may cause an enormous increase in the demand, whilst a great rise may almost destroy the demand. The rate of charge—the quantity demanded according to the changes in price—is referred to as *elasticity* of demand. If for a small change in price there is a considerable increase in the quantity demanded, the demand is said to be very *elastic*. Other characteristics of demand are indicated by the terms direct, derived, compounded, &c., the demand for any one thing being obviously affected by the possible use of substitutes on the one side and on the other by the emergence of other uses. Recent writers, notably Marshall, have given much attention to the development of the law of demand in its various aspects, which has been too much neglected in the Ricardian analysis followed by Mill. A great deal of light might be thrown on many interesting problems in the progress of a nation and of its various component classes, if the laws of demand, or the statistics of consumption according to price, were obtainable.

Law of supply.

Turning to the element of supply, this term in a similar way may be defined as the quantity offered for sale at some particular price, and the general law of supply may be stated thus: As the price rises, other things remaining the same, the quantity offered tends to increase, and, conversely, as the price falls the quantity offered tends to diminish. Expressed in this manner, supply appears to be exactly analogous to demand, and the analogy seems to hold good even when we push the analysis up to the utility to the seller as compared with the utility to the buyer. For, as the price rises, the seller will obtain greater utility, and will thus retain less for his own use or will be induced to produce more. On closer inspection, however, the law of supply is found to be not so simple as the law of demand. It would only be so if the seller had simply to compare the relative advantages of exchanging his commodity and of retaining it for his own use, without any further reference to the conditions of, or the motives for, production. In most commodities, however, the determining influence is not the comparative utility of consumption by the owner on the one hand or of the consumption of something else obtained by exchange on the other, but it is rather a comparison of the trouble of producing with the advantage of selling the article when produced. Of course, if we are considering finished products in any market the case is more simple; but even here the question of the relative advantages of present sale and reservation for a future market or distant place must be determined, and then the element of cost of production will again be brought back. The law of supply may be developed on lines corresponding to the law of demand, and we may construct supply schedules on curves indicating the relations between the range of prices and the quantities offered at those prices.

Before considering the relation of cost of production to supply, it will be convenient to combine the laws of supply and demand, taking the former in its simplest aspect, and

Equation between demand and supply.

to state the general law of supply and demand as governing value. Excluding the simple case of the barter of two commodities of which the rate of exchange will be determined as explained above in reference to marginal utility, and meaning by demand the quantity demanded in a market at a certain price, and by supply the quantity there and then offered at a certain price, the general law may be stated thus: In any market the price of any article will be so adjusted that the quantity demanded will exactly equal the quantity offered at that price. The force by which the adjustment is made is, in general, competition. Thus, if the price were above the point indicated by the law, there would be a lessened demand, and the competition of sellers would tend to lower the price. Conversely, if the price were lower the competition caused by the increased demand would tend to raise it. The law as thus stated corresponds to what Mill calls the equation between demand and supply. He was induced to adopt this phrase in place of the more popular expression, the ratio of demand to supply, on the ground of its greater accuracy. And, if the term ratio is to be taken strictly, no doubt Mill's criticism is perfectly just. At the same time the equation must be stated very carefully to avoid falling into the truism suggested by Cairnes, namely, that in any market the quantity bought at any price is equal to the quantity sold at that price. The point is that in accordance with the general principles of supply and demand the quantities offered and demanded vary with the price. And, however inaccurate the literal use of the term ratio may be, it has the advantage of suggesting a change of price according to changes in demand and supply. The equilibrium between demand and supply was illustrated by Cournot by the intersection of the demand and supply curves, and for purposes of theory this mathematical method offers great advantages.

Monopoly values.

It may be useful at this point to consider the principles by which monopoly values are regulated. The simplest case is when one individual possesses the whole stock, and the cost of production is so small that it may be neglected. Take the case, for example, of some natural well having a unique character for the mineral waters it supplies. The monopolist will, in the first place, have to discover the law of demand for his article. If he fixes a very high price, he may only occasionally sell a pint to a king or a millionaire; whilst, if he fixes a very low price, he may sell to every peasant and yet get a very poor return. He will, in fact, have to work out a problem in mathematics, and must so adjust his price that the quantity sold multiplied by the price per unit will be a maximum. The same kind of difficulty is found in the case in which the expenses of production, although considerable, are practically fixed or only increase slightly in proportion to the quantity furnished. The minimum price will be given by the expenses of production, whilst the actual price will tend to be such as to yield the maximum profit. Take, for example, the case of a steamer which has a practical monopoly and is not controlled by government. The owner will not send out the steamer at all unless the passengers and cargo pay the expenses; but, if there is a great demand, he will raise the price so as to secure a maximum profit. In general, however, any increase in the quantity of the article produced (or the service rendered) will be accompanied by an increase in the necessary outlays, and this increase may be greater or less per unit. In these cases the calculation of the maximum profit is a matter of great difficulty. Take, for example, the case of a railway which has a monopoly in a certain tract of country. The manager may aim at keeping down expenses and charging high rates, being contented with a moderate traffic; or he may lower his charges and incur additional expense to increase the gross income. It is worthy of remark that in many cases the monopolist has a choice of two methods which give practically equally good results, one starting with low and the other with high prices. But it is clear that the mass of the general public or the great body of consumers have an interest in low prices being adopted, whilst, on the other hand, the tendency is usually for the monopolist to charge higher prices than are really profitable in a maximum degree. The simplicity of the method of high prices is always attractive and often deceptive. Accordingly, even on these very general grounds, the interference of government with monopolies may sometimes be defended as being in the interests of the public and not against the interests of the monopolists. The case of the parliamentary third-class tickets furnishes an instructive example. At first the railways made their parliamentary trains as slow and inconvenient as possible, whereas now there is hardly a train which does not carry passengers at parliamentary rates without compulsion. As a rule, however, in modern commercial countries legal monopolies are an exception. Any one, for example, can prosecute any trade or manufacture if he can provide the requisite skill, labour and capital; and even as regards land—at any rate in the greater part of England and Scotland—there is from the point of view of cultivation no real monopoly. But although legal monopolies (apart from patents and the like) are not general, and in most countries the law is adverse to the creation of monopolies,[1] as a matter of fact in modern times there has been an increasing tendency to the amalgamation of businesses of all kinds into large combinations (trusts, kartells, &c.), which have the power of monopolies. In the same way in the relation of labour and capital the method of collective bargaining partakes of the character of monopoly. There may be *buyers'* as well as sellers' monopoly, and capitalistic combinations operate by this method in dealing with the production of raw material or other requisites and also with labour.

Competition values.

The theory of monopolies being a case of the determination of *maxima* is essentially mathematical, and many of the problems, especially as regards the incidence of taxes and the benefits of the public acquisition of "natural" monopolies, can only be fully explained mathematically as by Marshall. In recent years great attention has been given to the realistic study of monopolies (J. W. Jenks, H. W. Macrosty, &c.; see TRUSTS). When competition arises, and is effective, exceptional profit ceases, and thus a new principle for determining values comes into play. If the producer of any article is obtaining more than the usual rate of profit, he at once provokes competition, and thus even the dread of this possible competition may keep down prices. This is often expressed by saying that the potential supply affects prices almost as much as the actual supply. It thus becomes obvious that, as regards freely produced commodities the production of which may be extended indefinitely at the same or at a decreasing cost, the value tends to conform to the minimum cost of production, and that any other value is consequently unstable. It will be observed, however, that cost of production only determines values by operating through the actual or potential supply, and thus that the law of demand and supply is fundamental. Once a thing is made, the actual cost of production has no influence on its value, except as indicating the conditions of future possible supply.

Cost of production.

At this point it becomes necessary to analyse and explain the nature of cost of production. In the last resort it will be found that nothing can be produced without labour, and in a modern society capital must be added. Thus the component elements of production are labour and capital acting by natural forces upon raw material. But, since both the forces and the produce of nature require labour and capital for their exploitation, the elements that must be considered primary and fundamental in the case of commodities that can be indefinitely increased are labour and capital. Capital, again, is itself a product of labour, and it is also wealth set aside by the owner for future use instead of for present consumption. Accordingly, in order that a thing may be continuously produced, labour must obtain a sufficient reward for toil, and capital a sufficient reward for "abstinence" or "waiting," or for preservation and accumulation of wealth. Thus the ultimate elements in the real cost of production are the toil and trouble and irksomeness of labour and of saving. But this toil and trouble will not be submitted to unless in any particular case the fair reward of industrial competition is forthcoming. However much pleasure a good workman may take in his work or a prudent man in his savings, in the industrial world as at present constituted both labour and capital will be attracted towards the point of highest reward (compare WAGES); and, accordingly, it is a necessary condition of the production of any article that the price obtained will yield the average rate of wages and profit obtainable for that species of work. Now these rates of wages and profit can be expressed in terms of money, and may be designated, following Marshall, the *expenses of production* as distinguished from the *real cost*. The real cost of production would on analysis consist of a confused unworkable mass of "efforts and abstinences," or "disutilities," and the relation of these mental strains to their material rewards is the problem of wages and profits. But for the purpose of relative values it is not necessary to push the analysis so far; and thus, if we regard the capitalist as the producer, we may look on the elements of production as consisting of wages and profits. And this is quite in accordance with customary thought and language: every one who asks for the details of the cost of a thing expects to have a statement of the wages and profits directly involved, and of the material, which again directly involves wages and profits. So far, then, as freely produced commodities are concerned, the general law is that they tend to sell at such a price as will yield on the average the ordinary rate of wages and profits which by industrial competition the occupation can command. It is at this point that the difficulty emerges as to the precise nature of the connexion between the prices of commodities and the money wages and profits of producers. Are we to consider that the former are determined by the latter, or the latter by the former? If, for example, commodity A sells for twice as much as commodity B, are we to say that this is because wages are higher in the former case, or are the wages higher because the price is higher? The answer to this question is given in the theory of WAGES (*q.v.*). It is sufficient to state here that, in discussing relative values, we may assume that industrial competition has established certain relative rates of wages and profits in various employments, and that any prices of articles which yielded more than these rates, whilst in other cases no corresponding rise took place, would be unstable. Thus, in discussing the normal values of freely produced commodities, we have to consider the quantity of labour and the rates of wages and the quantity of capital and the rate of profits, the *normal* rates of these wages and profits being given.

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[1] The general theory of monopolies was admirably treated by the French mathematician and economist Cournot, *Recherches sur les principes mathématiques de la théorie des richesses* (1838), and as far as possible without mathematics in the *Revue sommaire des doctrines économiques* (1877).

Expenses of production.

Wages and values.

The use of the term "normal" requires some explanation. The word *norma* properly refers to the square used by masons and carpenters, &c., and thus a thing may be said to be in its normal position when no change will be made: that is to say, the normal position is the stable position, or it is the position to which the workman will try to adjust his work. And, similarly, by the use of normal as applied to wages and profits, we mean the stable rate or the rate towards which they are attracted. It is thus quite possible that the normal rate may differ from the average rate or the rate obtained over a term of years. For it may easily happen that as regards wages, for example, a high rate for a short period may lead to such an increase in that kind of production that for a much longer period the rate will fall below the normal. The normal rate seems to refer to the actual conditions of industry, the rate which can be obtained for a given amount of exertion, taking the average of employments at the time, rather than to the particular rate obtained for some class of work over a period of years.

Normal value.

With these explanations the proposition holds good that the normal values of freely produced commodities tend to be equal to their cost, or rather expenses, of production, and any price which yields a greater or less return to labour and capital is unstable.

Marshall (*Principles of Economics*, bk. v. 5th ed., 1907) has treated very fully the subject of normal values and the relations of normal and market values from the side of theory; but the nature and importance of the distinction is perhaps best realized if we compare the normal relative values of important commodities over a period of centuries, as was done by Adam Smith and in the monumental work by Thorold Rogers on the *History of Agriculture and Prices*. At this stage in the analysis the difficulty must be met that even in a position of stable equilibrium, *i.e.* when the normal demand is just satisfied by the normal supply, the different portions of the aggregate supply may be produced at different costs according to differences in the natural environment or in the availability of different *factors of production*. In dealing with this difficulty the modern conception of *marginal cost* is of importance. If a commodity is produced at a uniform cost per unit whatever the amount, then the normal value depends simply on this uniform or normal cost; any temporary divergence in market prices will lead to a contraction or increase in the supply until the exceptional gains or losses are got rid of. It may happen, however, that portions of the supply can be obtained at different costs, and in this case the normal value is determined by the cost at the margin. It is this *marginal cost* which just gives the rates of remuneration to labour and capital which suffice to keep up the continuous supply of the requisite factors of production. If a commodity is produced according to the law of *diminishing return*, or, what is the same thing, if the supply can only be increased after a certain point at an increasing cost per unit, then the marginal portion just pays its expenses and the previous portions yield a differential remuneration which constitutes economic rent. If the conditions of difference in cost are natural and permanent we have the case of pure economic rent (see below), but if the factors of production in response to the stimulus of extra remuneration can be increased or improved the extra rates of remuneration tend to disappear with the increase in supply of the more advantageous factors, and instead of pure economic rent we have various species of *quasi*-rents. "Even the rent of land is seen not as a thing by itself but as the leading species of a large genus; though indeed it has peculiarities of its own which are of vital importance from the point of view of theory as well as of practice" (Marshall). Marshall has given special attention to the development of this application of the principle of continuity, of which Cournot was the first writer to realize the significance.

If a commodity is produced according to the law of *increasing return* (or diminishing cost per unit as the quantity is increased) the solution of the problem of normal value presents peculiar difficulties which cannot be treated in a preliminary survey. Two results, however, of practical importance may be noted. In the first, under increasing return the first established business can be expanded more easily than it is possible to start a new concern, and if new competing concerns are started there are obvious advantages in amalgamation, so that we arrive at the modern generalization that the natural tendency of increasing return production is to monopoly. This again gives the chief economic justification for "trusts"; it being said that through the adoption of various external and internal economies they more than neutralize the higher prices of monopoly.

The other result of importance is that under competition the less advantageous methods of production tend to be extruded and the law of increasing return gives way to that of constant return. For further consideration of these difficulties the reader may refer to the analysis by Marshall (*Principles of Economics*, bk. v. ch. xi.). The economic analysis of cost of production (or if we take the money measures of the various elements involved, expenses of production) involves a reference to the other great departments of economics, namely, production and distribution; and it is necessary to take account of the interconnexion and mutual dependence of these departments and that of exchange, in which the idea of value is predominant. In the last resort production will not be carried on unless labour and capital receive a sufficient reward and the sufficient reward is the normal value of the factors of production. But when we are comparing the relative values of commodities and are seeking to explain, for example, how it is that for long periods of time these relative values are stable, or conform to some regular law, we have to break up the elements of value into the constituents of the expenses of the various factors of production. This leads up to the analysis of cost (or expenses) of production as dependent on the amounts and qualities of the labour and capital required.

Elements of expenses of production.

If all commodities were produced directly by the expenditure of labour, and in such a way that capital need not be considered, as in the simple natural state of society taken by Ricardo, then the only element to consider in value would be the quantity of labour. And in a society of a more developed character, in which wages are paid, if we consider that the rate of wages is uniform, and that profits may be disregarded in comparison with wages, the quantity of labour is the most important consideration, and a fall in the relative value of any article can only take place through some economy of labour. But, as we approach more nearly to the actual constitution of modern industrial societies, we find serious differences in the rates of wages in different employments, the use of fixed capital becomes of greater importance, and in some cases the lapse of time necessary for the completion of the commodity is considerable. Thus interest and profits, as well as the differential rates of wages, have to be taken into account just as much as the quantity of labour, and it is generally convenient to consider also the established differences in various returns to capital under different conditions (risk, irregularity, &c.). Indirectly, of course, since all capital in the ordinary sense is the result of labour, the quantity of labour is always of primary importance; but, in considering the proximate causes of relative values, it is best to consider capital and labour as independent factors. It follows, then, that, in order to compare the relative values of two commodities, A and B, freely produced in a modern industrial society, we must take into account, first of all, the relative wages and relative profits, and the relative amounts of labour and capital employed. If the producers of A are skilled workmen, and if the return to the capital is uncertain, whilst in the case of B the labour is unskilled and profit steady, then the value of A will be higher than that of B, supposing each produced by the same amount of capital and the same quantity of labour. Obviously, too, any change in the relative wages and profits will affect the relative values. If the commodities considered are not capable of division into similar parts (such as yards of cloth or silk), but must be considered in their entirety (*e.g.* ships and houses), then we must take into account also the different quantities of labour and capital required for their completion, as well as the relative rates of wages and profits. As regards changes of value in this case, it will be observed that, if the proportions are different in which labour and capital are employed in the production of two commodities, then any change in the *general* rates of wages and profits will affect relative values. By making various suppositions as to changes in the different elements of the expenses of production, a great many cases may be obtained, as is done, for example, by Mill (*Pol. Econ.* bk. iii. ch. iv.).

General formula for expenses of production.

All the cases enumerated and others may, however, be deduced from a general formula. Let E_1 represent the total expenses of production of commodity A. Let Q_1 be the quantity of fixed capital employed, and let r_1 be the rate of wear and tear per annum, so that the loss is Q_1/r_1. Let P_1 be the rate of profits per cent. per annum which must be obtained on the whole capital. Let Q_2 be the number of labourers, and w_2 the rate of wages per annum. Let t_1 represent the time taken for production reckoned in years (t_1 may be less than unity, thus t_1/Q_1 would be weeks). Then the total expenses of production are

$$E_1 = \left\{ Q_1\left(\frac{P_1}{100} + \frac{1}{r}\right) + Q_2 \cdot w_2\left(1 + \frac{P_1}{100}\right) \right\} t_1.$$

This simply means that the commodity must return in the normal case profits on the fixed capital with repair of waste, and also the wages expended (the amount depending on the number of labourers and the rate of wages), with profit on the circulating capital over all the time necessary to complete production. In some cases, it may be observed, it would be necessary to take t differently for the fixed capital and the labour or circulating capital. Then, in a similar way E_2, the expenses of production of B, may be expressed:

$$E_2 = \left\{ Q_3\left(\frac{P_3}{100} + \frac{1}{r_3}\right) + Q_4 \cdot w_4\left(1 + \frac{P_3}{100}\right) \right\} t_2.$$

Changes in relative values.

Thus the relative values of A and B will be found by comparing the aggregate of these several elements expressed on the right-hand sides of the equations. It will now be evident on what a number of variable elements relative values must depend, even when we consider that the commodities can be indefinitely increased by the proper expenditure of capital and employment of labour. With the progress of invention and the development of industrial competition, constant changes are taking place in the various elements, and in the somewhat complicated formula given certain practical elements have been eliminated. Even if we suppose, for the sake of simplicity, that P_1 and P_3 are equal, as also w_2 and w_4 and t_1 and t_2—that is, if we suppose a uniform rate of wages and profits, and the same amount of time required—still any change in these *general* rates will affect relative values, owing to the different proportions in which fixed and circulating capital may be employed in the two cases. Thus, for example, we arrive at Mill's statement: "All commodities in the production of which machinery bears a large part, especially if the machinery is very durable, are lowered in their relative value when profits fall." And it will be found on trial that by making various suppositions as to the identity of certain of the elements, or as to their disappearance, many other causes of changes in relative values may be deduced. Two important practical conclusions of a general character may be drawn from this analysis. (1) Relative values are liable to constant disturbances, and accordingly, since relative prices tend to be adjusted to relative values, relative prices must be constantly changing. (2) It is extremely difficult to measure changes in the value of the monetary standard, or movements in the general level of prices, or variations in the purchasing power of money incomes.

Value and rent.

These difficulties are further increased by the importance of the group of commodities which can only be increased (the arts of production remaining the same) at an increasing cost, and which are placed by Mill under a third law of value. The most important examples of this law are agricultural and mining produce. In order to make the principles on which this law depends clear and intelligible, it is necessary to proceed at first by the abstract method. Assume then that there is an isolated country and that its agricultural produce consists of corn. Then at any given stage of the growth of wealth and population the amount of corn may be increased (the art of agriculture remaining stationary) either by taking into cultivation inferior lands or else by cultivating with greater care and expense the lands already in cultivation. But in either case what is known as the law of diminishing return would come into play, and the additional supply could only be obtained at an additional cost. It may be assumed that at any stage of development the cultivation would be carried to such a point as to give just the ordinary return to capital on the last "dose" of capital expended. Further it cannot be carried, for no farmer will work at a continuous loss; and competition will ensure that it is carried so far, for, if this last application of capital yields ordinary profit, the former "doses" must yield more, that is to say, rent as well as profit. It thus becomes manifest that, under the conditions supposed, the extent to which "the margin of cultivation" will extend depends upon the price of the produce, and in the normal case—The price must be equal to the expenses of production of that part which is produced under the most unfavourable circumstances. This then is the third law of value, from which the economic theory of rent is an immediate deduction. For, if the last dose obtains just a sufficient return, the former doses must yield more, and the sum of these extra profits is rent. It thus appears, also, that rent depends upon price and not price upon rent.

Qualifications of pure theory of rent.

The pure theory of rent is arrived at by making certain hypotheses and abstractions, and accordingly it must not be applied to particular practical cases without further consideration. The theory certainly indicates the effect of very important causes, but requires in practice a certain amount of qualification. (1) The essence of the theory is that the return to each dose of capital applied can be separated, and that the application of capital will cease when the last dose yields only ordinary profits; and no doubt it is roughly true to say that a farmer will discover on trial at what point he should cease applying capital, and that this will depend upon the price of the produce. At the same time, however, it is quite possible that a farmer who owns the land which he tills may find it advantageous to carry cultivation to a further pitch than if he only rented his land. For he will apply his own labour and capital at a less return on his own land. There can be little doubt that very many important improvements made by landowners have yielded less than the ordinary rate of profit, just as peasant proprietors obtain a poor return by way of wages for their own labour. A landowner cultivating his own land has the whole margin of economic rent to fall back upon, but a farmer has to pay his rent as a first charge. Thus it is possible, provided always that the land is cultivated in both cases with the same skill, that food would be cheaper if all the land were cultivated by the owner and not by tenants farming for a profit, and thus the fact that many American farmers pay no rent may account partially for the lower prices at which they sell their corn. (2) Again, the pure theory takes no account of the size of the portions into which the land is divided, nor of the kinds of crops which are grown. But, when most of the land of a country is rented, both of these factors have to be considered, and it may be more convenient to the landowner to let the land with certain restrictions, which again indirectly operate on the price. (3) It has been well observed by Passy[1] that the principal effect of various land laws is to increase or diminish the amount of the gross produce, which in Ricardian phraseology would mean to extend or contract the margin of cultivation. It thus appears that it is not always true to say that the payment of rent makes no real difference to the general public, and that it is simply a necessary method of equalizing farmers' profits. At the same time, however, with the necessary qualifications, there is no doubt that price determines rents, and not rent price, especially when prices are affected by foreign competition. In Great Britain a striking example has been afforded both of the abandonment of inferior lands (the contraction of the margin) and of a heavy fall in rent under the influence of falling prices.

Progress and rent.

The hypothetical history implied in Ricardo's theory as to the effects of the progress of society upon the value of agricultural produce also requires some criticism, such as that given by the historian of agriculture and prices, Thorold Rogers. The theory assumes that in the first place population increases, and thus there is a greater demand for food, and that therefore the margin of cultivation extends and the price rises, and rent rises also. But, as Rogers observes, history shows that agricultural improvements of all kinds have first of all increased the amount of food, and thus allowed of an increase in population. It is worth noticing that in our own times an increasing population in rural districts (*e.g.* the Highlands of Scotland and the west of Ireland) may indirectly tend to lower or destroy rents through minute subdivision. Ricardo's theory, however, accounts very well for the rise in the ground-rents of towns and cities, and it is there far more than in the rural districts that the unearned increment is to be found.

Value of mining produce.

The value of mining produce is determined generally in the same way as that of agricultural produce; but similar qualifications must be introduced. The theory is that both extensively and intensively the produce of mines is subject to the law of diminishing return, that the margin recedes as the price falls and extends as it rises, and that thus the price is determined by the most costly portion which it just pays to bring to market. The principal point to observe is that mines are gradually quite exhausted. In general the produce of mines is, like that of land, consumed in a comparatively short time, and thus the value is subject to fluctuations according to the conditions of the annual demand and supply.

Precious metals.

The peculiar durability of the precious metals, however, makes them in this respect differ widely from most mining produce. It is of course undeniable that (supposing coinage free) the value of standard coins will be equal to the value of the same amount of bullion, and, conversely, that the bullion will be equal in value to the same amount of coins. The older economists argued that the precious metals had their value determined by their cost of production under the most unfavourable circumstances, and then argued that in consequence the value of money (or coins) tended to be governed by the cost of production of bullion. If, however, it is remembered that the annual production does not probably amount to 2% of the quantity in the hands of man, that cost of production can only operate through actual or potential supply, and that in the case of money the increase must be real to affect prices, it will be readily seen that the value of bullion is determined by the general level of prices (or the value of money), and not that the value of money depends upon the value of the bullion. At the same time, however, it is true that, if prices become very high,—in other words, if the value of money, and thus of bullion, becomes very low,—then a check is placed upon production from the mines, and, conversely, with falling prices or a rise in the value of the precious metals mining for them is extended and encouraged. But the difference in the annual supply due to this influence will be small under present or similar conditions. On the whole, this case of the precious metals furnishes perhaps the best example of the way in which the cost of production can only act through the law of supply and demand.

Law governing value of joint products.

There is one other part of the general theory of value which requires some notice. Some articles can only be produced in conjunction with others (*e.g.* hides and beef, wool and mutton), and some modification of the theory is needed to suit this case. The law deduced is that—The sum of the values must be equal to the joint expenses of production, and the relative values *inter se* are determined by demand and supply. Thus the Australian sheep-farmers will extend their sheep-farms so long as for wool and mutton together they obtain a fair profit, but the amount contributed by each portion will be determined by the relative demand. It is interesting to observe that in the progress of society the value of the meat has risen as compared with that of the hides and the wool. The same principle determines the kind of produce which will be raised from land, though the application is rather more difficult owing to rotation of crops, &c.

Theory of international values.

Much discussion has taken place recently on the question whether a distinct theory of international values is required. In the limits assigned to this article it is only possible to indicate the principal points in dispute. The "orthodox" theory, as held by Ricardo, Mill and Cairnes, has been attacked by Cournot, Sidgwick and others, and has been re-stated with admirable clearness and much original power by C. F. Bastable.[2] The best way to answer the question seems to be to make clear the assumptions

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[1] *Systèmes de culture en France.*

[2] *Theory of International Trade.*

Comparative cost.

Reciprocal demand.

Foreign exchanges.

on which the values of commodities produced within any "nation" are determined, and then to consider whether any change must be made when we bring in other nations. We are at once met with the difficulty, What is a "nation"? The orthodox answer appears to be that within any nation (for which the term "economic area" might perhaps be advantageously substituted) there is effective industrial and commercial competition. This appears to imply no more than is contained in the principle noticed above, that relative values tend to be equal to the normal expenses of production (*commercial* competition), and that the expenses tend to be proportioned to the real cost (*industrial* competition). The question then arises, Do these conditions not exist in international trade? The answer appears to be, first, that commercial competition certainly holds good; for as soon as a trade is established the commodities will sell at the same prices in both countries (allowance being made for cost of carriage). It would plainly be absurd to say that the value of Manchester goods is determined by their expenses of production if they are consumed in England, but by something else if they are sent to India. If then there is any difference between domestic and international values, it must arise owing to the absence of effective industrial competition; that is to say, in the same country (or economic area) the real cost determines the expenses of production on account of the supposed perfect mobility of labour and capital, but between different economic areas these agents of production do not pass with sufficient readiness to secure a similar correspondence. It thus follows that a country may import articles which it could produce at less real cost, provided that it pays for these imports with exports which cost even less. A very striking example of this doctrine of *comparative cost*, as it is termed, was furnished by Victoria after the great gold discoveries. All kinds of produce were imported and paid for with gold, because there was less real cost involved in obtaining the gold to pay for imports than in making the articles. According to this theory every country will devote its labour and capital to its most productive uses; and, if by some new imports a domestic industry is checked or abolished, it is argued that the labour and capital will be devoted to increasing the exports so as to pay for the new imports. It must clearly be assumed as axiomatic that in the absence of loans, tributes, &c., imports can in the long run only be paid for by exports, and also that those articles will be exported which can be produced at the least comparative real cost. This theory then may be held to explain in a satisfactory manner the origin and development of international *trade*; but the question of *values* is still undetermined. Consistently with exports paying for imports many different rates of exchange are possible, and the particular rate actually adopted is said to depend entirely on reciprocal demand. And in an extreme case, in which new countries trade solely in articles of which each has a monopoly, this answer would seem to be correct; but, when we consider that under present conditions trading countries have many articles in common, and that a slight margin of profit suffices to expand or diminish an export trade, this answer seems too vague and unreal. In general it is clear that the rate will be determined independently of the foreign trade, or at least that the foreign trade is only one factor to be considered. If the rate of profit falls, a trade which before was impossible becomes possible. The opinion may be hazarded that the best way of explaining the general theory of international values would be to start with the foreign exchanges; but such an investigation is too technical and difficult for this place (see EXCHANGE).

See J. S. Nicholson's *Principles of Political Economy*, vol. ii. book iii. ch. 25–28, for the development of this line of criticism of the Ricardian theory; and C. F. Bastable's *Theory of International Trade* (Appendix) for reply to this and other criticisms. (J. S. N.)

VALVE (Lat. *valva*, a leaf of a double or folding door, allied to *volvere*, to roll, as of a door on its hinges), a term applied to many mechanical appliances, devices or natural features, which control, by opening and shutting, the flow of air, liquids, vapour, gas, &c., through a passage, tube, pipe or other vessel.

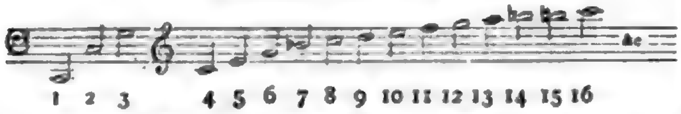
VALVES, or PISTONS (Fr. *pistons*, *cylindres*; Ger. *Ventile*; Ital. *pistoni*), in music, mechanical contrivances applied to wind instruments in order to establish a connexion between the main tubing and certain supplementary lengths required for the purpose of lowering the pitch. Various devices have been tried from the days of ancient Greece and Rome to produce this effect, the earliest being the additional tubes (πλάγιαι ὁδοί) inserted into the lateral holes of the aulos and tibia in order to prolong the bore and deepen the pitch of each individual hole; these tubes were stopped by the fingers in the same manner as the holes. This device enabled the performer to change the mode or key in which he was playing, just as did the crooks many centuries later. But the resourcefulness of the ancients did not stop there. The tibiae found at Pompeii (see AULOS) had sliding bands of silver, one covering each lateral hole in the pipe; in the band were holes (sometimes one large and one small, probably for semitone and tone) corresponding with those on the pipe. By turning the band the holes could be closed, as by keys when not required. By fixing the ὁδοί in the holes of the bands, the bore was lengthened instantly at will, and just as easily shortened again by withdrawing them; this method was more effective than the use of the crooks, and foreshadowed the valves of eighteen centuries later. The crooks, or coils of tubing inserted between the mouthpiece and the main tube in the trumpet and horn, and between the slide and the bell joint in the trombone, formed a step in this direction.

Although the same principle underlies all these methods, *i.e.* the lengthening of the main column of air by the addition of other lengths of tubing, the valve itself constitutes a radical difference, for, the adjustment of crooks demanding time and the use of both hands, they could only be effective for the purposes of changing the key and of rendering a multiplicity of instruments unnecessary. The action of the valve being as instantaneous as that of the key, the instrument to which it was applied was at once placed on a different basis; it became a chromatic instrument capable of the most delicate modulations from key to key. The slide had already accomplished this desirable result, but as its application was limited to instruments of which the greater part of the bore was cylindrical, *i.e.* the trumpet and trombone, its influence on concerted musical composition could not be far-reaching. In fact it is doubtful whether the chromatic possibilities of the slide were fully realized until the end of the 18th century, when key mechanism having made some advance, it was being applied successfully to the transverse flute and to the clarinet and oboe families. In 1760 Kolbel, a Bohemian horn-player engaged in the St Petersburg Imperial Orchestra, turned his attention to this method of extending the compass of brass instruments. His experiments, followed up by Anton Weidinger of Vienna at the beginning of the 19th century, produced a trumpet with five keys and a complete chromatic compass. Halliday followed with the keyed bugle in 1810. Halary applied the principle of the keyed bugle to the bass horn in 1817, and produced the ophicleide—an ideal chromatic bass as far as technical possibilities were concerned. The horn had become a chromatic instrument through Hampel's discovery of *bouché* sounds, but the defects in intonation and timbre still remained.

Such were the conditions prevailing among the wind instruments of the orchestra when the successful application of the valve to brass wind instruments by Heinrich Stölzel of Silesia caused an instantaneous revolution among makers of wind instruments. Further efforts to perfect the key system as applied to the brass wind were abandoned in favour of valves. The short space of two decades witnessed the rise of the Flügelhorns, the tubas, the saxhorns and the cornet-à-pistons; the trombone, French horn and trumpet having led the van.

Sound is produced on brass wind instruments by overblowing the members of the harmonic series (see HORN). The harmonic series itself is invariable, whether obtained from a string or a column of air; the structural features of the instrument determine which members of the series it is able to produce.

Harmonic Series in C



Although the valves of brass wind instruments vary in form and detail according to the makers, the general principles governing their action are the same for all types. The piston placed on some branch of the main tube must be so constructed that on being depressed it closes the natural windways through the main bore and opens others into the additional piston length. The piston seated on a spring instantly regains its normal position when the finger is removed. After the actual shape and construction of the valve and its box had been successfully evolved, it was the boring and disposition of the windways which engaged the attention of makers, whose object was to avoid complexity and sharp angles and turns in the tubing. The pitch of all tubes is determined by the length of the column of air set in vibration therein. Any variation in the length of this column of air produces a proportional variation in the pitch of the instrument. When the piston is depressed, therefore, a partition wall is removed and the column of air within the additional length of tubing representing a definite interval is added to the main column, so that the length of the sound wave is proportionally increased whether the column is vibrating as a whole (when it gives the fundamental or first note of the series) or whether it has been induced to divide into equal portions in which sound waves of equal length are simultaneously generated. The numbers under the notes of the harmonic series represent the aliquot parts into which the column of air must divide in order to produce the harmonics. The length of tubing attached to each valve is therefore calculated on the basis of the length of the main column, to give for the first piston a tone, for the second a semitone, for the third a tone and a half, and for the fourth two tones.

In order to illustrate the working of the pistons, we will take as an example the bombardon or bass tuba in E♭. Depressing the second piston lowers the pitch of the instrument to D, giving it the harmonic series proper to that key; the third harmonic, which on the open tube would be B♭, now becomes A; the fifth harmonic, which was G, is now F♯, and so on. The first piston on being depressed similarly transforms the E♭ bombardon into an instrument in D♭, a tone lower; the third piston lowering the pitch 1½ tones changes the key to C. So far the intonation of the notes produced by means of the pistons is as accurate as that of the harmonics. The variations in the length of the column of air correspond to the positions of the slide on the trombone, the first position being that of the instrument with all valves in their normal position. The use of the three pistons in turn gives the second, third and fourth positions. In order to obtain a complete chromatic compass there must be seven positions or different lengths of tubing available, as on the trombone, each having its proper harmonic series. On valve instruments the three other positions are obtained by means of combinations of pistons; the fifth position consists of a combination of pistons 2 and 3 (½ and 1½ tones), which would transpose our bombardon into the key of B; the sixth position consists of a combined use of pistons 1 and 3, producing a drop in pitch of 2½ tones from E♭ to B♭. In the seventh position all three pistons come into play simultaneously, lowering the pitch three tones. The intonation of the notes obtained in positions 5, 6, 7 is not so faultless as that of notes from the other positions, for the following reason:—On the bombardon in E♭ piston 1 lowers the pitch one tone to D♭; in the sixth position, when pistons 1 and 3 are used simultaneously, the third piston is no longer attached to a bombardon in E♭, on which it would produce the effect of C, but to one in D♭, on which it lowers the pitch to B♭; it is clear, therefore, that the supplementary tubing will not be quite long enough to give the correct intonation, and that the B♭ obtained as the 2nd harmonic in the sixth position will be a little too sharp, a defect which the performer corrects as best he can with his lip. The exact differences in length can be found from the table of ratios given by Victor Mahillon in *La Trompette, son histoire, sa théorie, sa construction* (Brussels and London, 1907), p. 38.

This inherent defect of the valve system was understood and explained a few years after the invention of valves by Gottfried Weber,[1] and the record of the successive endeavours of brass instrument makers to overcome this defect without unduly complicating the mechanism or adding greatly to the weight of the instruments constitutes the history of valve instruments.

The accredited inventor and patentee of valves applied to musical instruments was Heinrich Stölzel[2] of Pless in Silesia in 1815. The credit, however, is really due to Blümel,[3] also a Silesian, who sold his rights to Stölzel.

The first valves made by Stölzel worked in large square brass boxes and consisted of square blocks of solid brass through which the windways were bored in the same horizontal plane. A trumpet having two valves of this make is preserved in the museum of the Brussels Conservatoire (No. 1310 in catalogue). In 1825 Stölzel had improved upon this primitive valve, making it tubular and calling it *Schub-Ventil*: its action was lighter and more rapid than that of the original valve. Charles Sax of Brussels took up the manufacture of these valves and applied them to the cornet with two pistons. The scale of instruments with only two pistons had several gaps, and could not be strictly termed chromatic. In order to complete the scale, C. A. Müller of Mainz constructed a trumpet in the early 'thirties which not only had three valves, but also tuning-slides for all three additional lengths of tubing[4] and key crooks, for which corresponding piston lengths could be inserted. This was, therefore, the first attempt at compensation, for which the honour is due to Germany.

The early improvements and modifications of Stölzel's invention may be briefly[5] summed up as follows:—

In 1824 John Shaw, of Glossop, invented a system of valves known as transverse spring slides, both ascending and descending, *i.e.* respectively having pistons which cut off certain lengths of tubing, thereby raising the pitch, or pistons adding certain lengths, and lowering the pitch thereby. These transverse slides were afterwards improved by Schott in 1830, and became known as the *Wiener Ventil*, which had an enormous success on the continent of Europe, and were applied to all kinds of brass instruments. In 1827 Blümel invented the rotary valve or cylinder action known as *Dreh* or *cylinder Ventil*, a system still in use in Germany and Austria, and preferred to piston systems by many.

In 1833 J. G. Moritz (who was associated with Wieprecht, inventor of the batyphone and bass tuba) made the large pistons of generous diameter known as *Berliner Pumpen*. In 1835 John Shaw patented a variation of the rotary valve, known as *patent lever*. In 1839 Périnet of Paris invented the most modern form of valve, called by his name, similar to the Schub-Ventil and Berliner Pumpen, but of a diameter between the two. In 1851 and 1852 Dr J. P. Oates made his equilateral valves adopted by Antoine Courtois for his cornets; the same clever acoustician invented a piston with four straight windways, afterwards patented by A. Sax of Paris.

Various attempts to improve the windways and get rid of angularities were made by Gustave Besson in 1851, 1854 and 1855, when a system was devised having the same bore throughout the windways. This decided improvement forms the basis of the present system of the same firm. Until now efforts had mainly been directed towards the improvement of the technical construction of valves and windways. The first attempt since Müller's (which appears to have passed unnoticed in France and England) to remedy by compensation the inherent defect of the valve system when pistons are used in combination was made in 1850, when Adolphe Sax devised a system of six pistons, one for each position, in which it was impossible to use any two pistons in combination: this system was ascending instead of descending. Gustave Besson's *registre* in 1856–57 followed, providing a large horizontal piston, which, by connecting other duplicate lengths of tubing of the proper theoretical length, gave eight independent positions. In 1858 G. Besson and Girardin produced the *transpositeur*, in which two extra pistons when depressed automatically lengthened the slides of the three usual pistons to the required length for combination. In 1859 came the first suggestion for automatic compensation made by Charles Mandel in his book on the *Instrumentation of Military Bands*, p. 39. It does not appear that he put his suggestion into practice or patented it. In this ingenious system the valves were so constructed that when two or three pistons were used simultaneously the length of tubing thrown open was automatically adjusted to the correct theoretical length required. The same ingenious principle, elaborated and admirably carried out in practice, was patented by D. J. Blaikley in 1878. The working of his device differs from the action of ordinary valves only when the pistons are used in combination. The exact theoretical length is then obtained by bringing into use extra compensating lengths of tubing corresponding to the difference between the piston length for a semitone, a tone and one and a half tones on the open tube and on the tube already lengthened by means of one of the other pistons. The value of this invention, enhanced by the advantage of leaving the fingering unaltered, is more especially appreciated on the large brass instruments, in which correction of faulty intonation by means of the lips is more difficult to accomplish satisfactorily than on the smaller instruments. A similar device was patented in France in 1881 by Sudre.

Victor Mahillon, who had been for some years at work on similar lines, did not patent his invention till 1886, when his *piston*

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[1] *Caecilia* (Mainz, 1835), xvii. 89–91.

[2] See Captain G. B. Bierey in *Allg. musik. Ztg.* (Leipzig, 1815), p. 309, and idem for patent 1817, p. 814.

[3] Ibid. 1818, p. 531.

[4] Gottfried Weber, *op. cit.* p. 98.

[5] Fuller accounts may be derived from Captain C. R. Day, *Descriptive Catalogue of Musical Instruments* (London, 1891), pp. 182 seq.; Victor Mahillon, *Catalogue descriptif*, vol. i. 2nd ed. pp. 282 seq.; and from the pages of the *Allg. musik. Ztg.* (Leipzig) and *Caecilia* (Mainz).

régulateur was introduced: this first device was not automatic, and was shortly afterwards improved and patented as the *automatic regulating pistons.*

A later valuable development in the history of valve systems is the *enharmonic*, invented by Messrs Besson & Co., in which they have perfected and simplified the principle of independent positions tried in the *registre* of the fifties. In the enharmonic valve system each position has its independent length of tubing theoretically accurate, which comes into play as the valves are depressed, and there is besides a tuning slide for the open notes.

Finally, there is an improvement in a different direction to be chronicled, unconnected with compensation, in Rudall Carte & Co.'s system (Klussmann's patent) of conical bore throughout, the open tube and the valve slides, which by means of ingeniously combined joints and slides preserve the tone without loss of air. This system has been applied to all valve instruments, and has been found to produce a remarkable improvement in the timbre. (K. S.)

VALYEVO (sometimes written Valjevo or Valievo), a town of western Servia, prettily situated on the river Kolubara, in a well-wooded valley, 627 ft. above the sea. Valyevo gives its name to the department of which it is the capital. It is a garrison town, with streets lighted by electricity, a high-school or gymnasium, a prefecture and a court of first instance. In the neighbouring Medvenik mountains lead-mining and smelting are carried on by an English company; lead and antimony being also worked at Podgora and other places in the same department. Besides being the centre of the plum-growing and distilling industries, Valyevo has a considerable trade in cattle, for which the pastures watered by the Kolubara are celebrated. Pop (1900) about 6800.

VÁMBÉRY, ÁRMIN (1832–), Hungarian Orientalist and traveller, was born of humble parentage at Duna-Szerdahely, a village on the island of Shütt, in the Danube, on the 19th of March 1832. He was educated at the village school until the age of twelve, and owing to congenital lameness had to walk with crutches. At an early age he showed remarkable aptitude for acquiring languages, but straitened circumstances compelled him to earn his own living. After being for a short time apprentice to a ladies' tailor, he became tutor to an innkeeper's son. He next entered the untergymnasium of St Georgen, and proceeded thence to Pressburg. Meanwhile he supported himself by teaching on a very small scale, but his progress was such that at sixteen he had a good knowledge of Hungarian, Latin, French and German, and was rapidly acquiring English and the Scandinavian languages, and also Russian, Servian and other Slavonic tongues. At the age of twenty he had obtained sufficient knowledge of Turkish to lead him to go to Constantinople, where he set up as teacher of European languages, and shortly afterwards became a tutor in the house of Pasha Hussein Daim. Under the influence of his friend and instructor, the Mollah Ahmed Effendi, he became, nominally at least, a full Osmanli, and entering the Turkish service, was afterwards secretary to Fuad Pasha. After spending six years in Constantinople, where he published a *Turkish-German Dictionary* and various linguistic works, and where he acquired some twenty Oriental languages and dialects, he visited Teheran; and then, disguised as a dervish, joined a band of pilgrims from Mecca, and spent several months with them in rough and squalid travel through the deserts of Asia. He succeeded in maintaining his disguise, and on arriving at Khiva went safely through two audiences of the khan. Passing Bokhara, they reached Samarkand, where the emir, whose suspicions were aroused, kept him in audience for a full half-hour; but he stood the test so well that the emir was not only pleased with "Resid Effendi" (Vámbéry's assumed name), but gave him handsome presents. He then reluctantly turned back by way of Herat, where he took leave of the dervishes, and returned with a caravan to Teheran, and subsequently, in March 1864, through Trebizond and Erzerúm to Constantinople. By the advice of Prokesch-Osten and Eötvös, he paid a visit in the following June to London; there his daring adventures and linguistic triumphs made him the lion of the day. In the same year he published his *Travels in Central Asia.* In connexion with this work it must be remembered that Vámbéry could write down but a few furtive notes while with the dervishes, and dared not take a single sketch; but the weird scenes, with their misery and suffering, were so strongly impressed on his memory that his book is convincing by its simplicity, directness and evidence of heroic endurance. Vámbéry also called the attention of politicians to the movements of Russia in Central Asia, and aroused much general interest in that question. From London he went to Paris, and he notes in his *Autobiography* that the Parisians were much more interested in his strange manner of travelling than in the travels themselves. He had an interview with Napoleon III., who failed to impress him "as the great man which the world in general considers him." Returning to Hungary, he was appointed professor of Oriental languages in the university of Budapest: there he settled down, contributing largely to periodicals, and publishing a number of books, chiefly in German and Hungarian. His travels have been translated into many languages, and his *Autobiography* was written in English. Amongst the best known of his works, besides those alluded to, are *Wanderings and Adventures in Persia* (1867); *Sketches of Central Asia* (1868); *History of Bokhara* (1873); *Manners in Oriental Countries* (1876); *Primitive Civilization of the Turko-Tatar People* (1879); *Origin of the Magyars* (1882); *The Turkish People* (1885); and *Western Culture in Eastern Lands* (1906).

VAMPIRE, a term, apparently of Servian origin (*wampir*), originally applied in eastern Europe to blood-sucking ghosts, but in modern usage transferred to one or more species of blood-sucking bats inhabiting South America.

In the first-mentioned meaning a vampire is usually supposed to be the soul of a dead man which quits the buried body by night to suck the blood of living persons. Hence, when the vampire's grave is opened, his corpse is found to be fresh and rosy from the blood which he has thus absorbed. To put a stop to his ravages, a stake is driven through the corpse, or the head cut off, or the heart torn out and the body burned, or boiling water and vinegar are poured on the grave. The persons who turn vampires are generally wizards, witches, suicides and those who have come to a violent end or have been cursed by their parents or by the church. But any one may become a vampire if an animal (especially a cat) leaps over his corpse or a bird flies over it. Sometimes the vampire is thought to be the soul of a living man which leaves his body in sleep, to go in the form of a straw or fluff of down and suck the blood of other sleepers. The belief in vampires chiefly prevails in Slavonic lands, as in Russia (especially White Russia and the Ukraine), Poland and Servia, and among the Czechs of Bohemia and the other Slavonic races of Austria. It became specially prevalent in Hungary between the years 1730 and 1735, whence all Europe was filled with reports of the exploits of vampires. Several treatises were written on the subject, among which may be mentioned Ranft's *De masticatione mortuorum in tumulis* (1734) and Calmet's *Dissertation on the Vampires of Hungary*, translated into English in 1750. It is probable that this superstition gained much ground from the reports of those who had examined the bodies of persons buried alive though believed to be dead, and was based on the twisted position of the corpse, the marks of blood on the shroud and on the face and hands—results of the frenzied struggle in the coffin before life became extinct. The belief in vampirism has also taken root among the Albanians and modern Greeks, but here it may be due to Slavonic influence.

Two species of blood-sucking bats (the only species known)—*Desmodus rufus* and *Diphylla ecaudata*—representing two genera (see CHIROPTERA), inhabit the tropical and part of the subtropical regions of the New World, and are restricted to South and Central America. They appear to be confined chiefly to the forest-clad parts, and their attacks on men and other warm-blooded animals were noticed by some of the earliest writers. Thus Peter Martyr (Anghiera), who wrote soon after the conquest of South America, says that in the Isthmus of Darien there were bats which sucked the blood of men and cattle when asleep to such a degree as to even kill them. Condamine, a writer of the 18th century, remarks that at Borja (Ecuador) and in other places they had entirely destroyed the cattle introduced by the missionaries. Sir Robert Schomburgk relates that at Wicki, on the river Berbice, no fowls could be kept on account of the ravages of these creatures, which attacked their combs, causing them to appear white from loss of blood. The present writer, when in South and Central America, had many accounts given him as to the attacks of the vampires, and it was agreed upon by most of his informants that these bats when attacking horses showed a decided preference for those of a grey colour. It is interesting to speculate how far the vampire bats may have been instrumental—when they were, perhaps, more abundant—in causing the destruction of the horse, which had disappeared from America previous to the discovery of that continent.

Although these bats were known thus early to Europeans, the species to which they belonged were not determined for a long time, several of the large frugivorous species having been wrongly set down as blood-suckers, and named accordingly. Thus the name *Vampyrus* was suggested to Geoffroy and adopted by Spix, who also considered that the long-tongued bats of the group *Glossophaga* were addicted to blood, and accordingly described *Glossophaga soricina* as a very cruel blood-sucker (*sanguisuga crudelissima*), believing that the long brush-tipped tongue was used to increase the flow of blood. *Vampyrus spectrum*, a large bat inhabiting Brazil, of sufficiently forbidding aspect, which was long considered by naturalists to be thoroughly sanguivorous in its habits, and named accordingly by Geoffroy, has been shown by the observations of travellers to be mainly frugivorous, and is considered by the inhabitants of the countries in which it is found to be perfectly harmless. Charles Waterton believed *Artibeus planirostris*, a common bat in British Guiana, usually found in the roofs of houses, and now known to be frugivorous, to be the veritable vampire; but neither he nor any of the naturalists that preceded him had succeeded in detecting any bat in the act of drawing blood. It fell to the lot of Charles Darwin to determine one of the blood-sucking species at least, and the following is his account of the circumstances under which the discovery of the sanguivorous habits of *Desmodus rufus* was made: "The vampire bat is often the cause of much trouble by biting the horses on their withers. The injury is generally not so much owing to the loss of blood as to the inflammation which the pressure of the saddle afterwards produces. The whole circumstance has lately been doubted in England; I was therefore fortunate in being present when one was actually caught on a horse's back. We were bivouacking late one evening near Coquimbo, in Chile, when my servant, noticing that one of the horses was very restive, went to see what was the matter, and, fancying he could detect something, suddenly put his hand on the beast's withers, and secured the vampire" (*Naturalist's Voyage Round the World*, p. 22).

Desmodus rufus, the common blood-sucking bat, is widely spread over the tropical and subtropical parts of Central and South America from Oaxaca to southern Brazil and Chile. It is a comparatively small bat, a little larger than the noctule, the head and body about 3 in. in length, the forearm 2¼, with a remarkably long and strong thumb; it is destitute of a tail, and has a very peculiar physiognomy (fig. 1). The body is covered with rather short fur of a reddish-brown colour but varying in shade, the extremities of the hairs sometimes ashy. The teeth are peculiar and characteristic, admirably adapted for the purposes for which they are employed. The upper front teeth (incisors), of which there are only two, are enormously enlarged (see fig. 2), and in shape obliquely triangular like small guillotines. The canines, though smaller than the incisors, are large and sharp; but the cheek-teeth, so well developed in other bats, are very small and reduced in number to two above and three below, on each side, with laterally compressed crowns rising but slightly above the level of the gum, their longitudinally disposed cutting edges (in the upper jaw) being continuous with the base of the canine and with each other. The lower front teeth (incisors) are small, bifid, in pairs, and separated from the canines, with a space in front. The lower cheek-teeth are narrow, like those in the upper jaw, but the anterior tooth is slightly larger than the others, and separated by a small space from the canines. Behind the lower incisors the jaw is deeply hollowed out to receive the extremities of the large upper incisors.

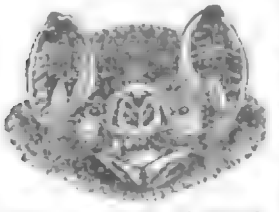
FIG. 1.—Head of Blood-sucking Vampire (*Desmodus rufus*).

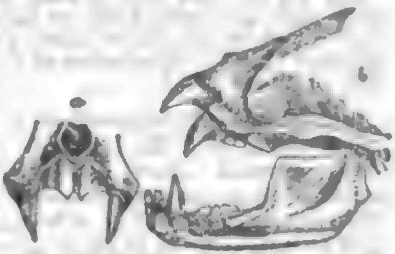
FIG. 2.—Teeth of *D. rufus*.

With this peculiar dentition there is associated as remarkable a departure from the general type in the form of the digestive apparatus. The exceedingly narrow oesophagus opens at right angles into a narrow, intestine-like stomach, which almost immediately terminates on the right, without a distinct pylorus, in the duodenum, but on the left forms a greatly elongated caecum, bent and folded upon itself, which appears at first sight like part of the intestines. This, the cardiac extremity of the stomach, is, for a short distance to the left of the entrance of the oesophagus, still very narrow, but soon increases in size, till near its termination it attains a diameter quite three times that of the short pyloric portion. The length of this cardiac diverticulum of the stomach appears to vary from 2 to 6 in., the size in each specimen probably depending on the amount of food obtained by the animal before it was captured.

The only other known species of blood-sucking bat, *Diphylla ecaudata*, inhabits Brazil, and appears to be much less abundant than *Desmodus rufus*, from which it is distinguished by its slightly smaller size, by the absence of a groove in the front of the lower lip, the non-development of the interfemoral membrane in the centre, and the presence of a short calcaneum (absent in *D. rufus*), but more particularly by the presence of an additional rudimentary cheek-tooth (?molar) above and below, and the peculiar form of the lower incisors, which are much expanded in the direction of the jaws and pectinated, forming a semicircular row touching each other, the outer incisors being wider than the inner ones, with six notches, the inner incisors with three each.

Travellers describe the wounds inflicted by the large sharp-edged incisors as being similar to those caused by a razor when shaving: a portion of the skin is shaved off and, a large number of severed capillary vessels being thus exposed, a constant flow of blood is maintained. From this source the blood is drawn through the exceedingly narrow gullet—too narrow for anything solid to pass—into the intestine-like stomach, whence it is, probably, gradually drawn off during the slow progress of digestion, while the animal, sated with food, is hanging in a state of torpidity from the roof of its cave or from the inner sides of a hollow tree. (G. E. D.)

VAMPYRELLA (L. Cienkowski), a genus of azoosporous Proteomyxa (*q.v.*), parasitic on freshwater algae.

VAN. (1) The chief town of a vilayet of the same name in Asiatic Turkey; altitude, 5400 ft. Pop. 28,000, of whom 14,000 are Armenians, and the remainder Moslems, mostly of a mixed Kurdish race. It is situated about a mile from the eastern shore of Lake Van, and built along the south side of the citadel rock, an isolated rocky ridge 1300 yds. long, rising 360 ft. out of a plain which extends up to the sharply defined rocky mass of the Varak range, 8 m. distant. On the gently sloping ground east of the citadel are the Gardens, covering an area of 5 m. by 3, and containing several suburbs and detached houses, along central avenues fringed with trees, and having channels of running water by the sides for irrigation.

The town itself is a poor place with flat-roofed mud houses, narrow winding streets, and surrounded by a ruinous mud wall; but it still contains the business quarter, the government offices and the principal bazaars. In the Gardens are vineyards and orchards of apple, pear, quince, plum and apricot; the houses of the wealthier inhabitants are imposing, built of a wood-framework on a stone foundation and filled in with sun-dried bricks. Many of them are brightly ornamented in the Persian style. Water comes from *kares* or underground channels and streams from Varak, fed from the Sikhe Lake, an ancient reservoir which preserves the snow waters on the summit of the mountain. For the southern quarter there is the Shemiram Canal, also of very ancient construction, which derives its supply from a large spring 19 m. distant, near Meshingird. There are British, Russian and French consuls who reside in the Gardens. There are a large American Mission with schools, orphanage and a resident doctor, a French (Dominican) Mission with schools, and also a branch of the archbishop of Canterbury's Mission to the Nestorian Christians who live in the mountains to the south. The climate is generally healthy, extremely cold in winter, with 2 to 3 ft. of snow from December to March, while the summer heat is not excessive. The Persian trade of Van has declined; European goods, with which the bazaars are fairly well supplied, come from Trebizond through Erzerum. There is a fair local trade in wheat and agricultural produce, also sheep and cattle, wool, hides and furs for export. A thick woollen cloth called *shayak*, coarse cotton chintzes and a kind of soap prepared from the efflorescences of the lake, with dried and salted fish, are also produced.

The cuneiform inscriptions of Van are very numerous, the town having been the capital of the Vannic kingdom of the Assyrian period. At the end of the Gardens is the rocky mass of Toprak Kale, on which was a fire temple and altar; near it is the Meker Kapusi ("Door of Mithridates"), a large inscribed slab of rock with the names of several deities. On the citadel rock are several inscriptions, the principal being a trilingual one of Xerxes on the southern face. Many other inscribed stones and tablets have been found built into modern buildings, while the excavation of a mound brought to light relics of a stone age.

Van occupies the site of Dhuspas, of which the native name was Biainas (Assyrian, *Urardhu*), the Byana of Ptolemy and the Ivan of Cedrenus, whence the modern Van. Dhuspas, the Thospia of Ptolemy, gave its name to the district of Thospitis, the modern Thosp. The Biainian dynasty, of which Sarduris I. (*c.* 833 B.C.) was the first king, died out with Sarduris II., who in 645 B.C. entered into an alliance with Assur-bani-pal. Inscriptions of nearly all the kings exist, and the various excavations at Toprak Kale show an advanced state of civilization and great technical skill (see illustrations in Maspero's *Histoire ancienne*, vol. iii., *Les Empires*). In the 6th century B.C. Van passed into the hands of the Persians, and shortly before it fell to Alexander the Great it was rebuilt, according to Armenian historians, by a native prince called Van. In 149 B.C. Valarsaces or Vagharshag, the first Armenian king of the Arsacidae, rebuilt the town, and a colony of Jews was settled in it by Tigranes (94–56 B.C.). In the middle of the 4th century A.D. it was taken by Sapor (Shapur) II., and became the capital of an autonomous province of the Sassanian Empire, until it fell into the hands of the Arabs (*c.* 640), under whom it regained its autonomy. About 908 the governor of Van or Vaspuragan was crowned king by the caliph Moktadir, and in 1021 his descendant Senekherim was persuaded by Basil II. to exchange his kingdom for the viceroyalty of the Sebasteian theme. After having formed part of the possessions of the Seljuks, Mongols, Tatars and Persians, Van passed in 1514, after the defeat of Shah Ismail by Selim I. at the battle of Kalderan, to the Osmanlis, who only occupied the town in 1543. In 1636 it was taken by the Persians, but soon recovered. In 1845 the town was held for a time by the Kurd chief Khan Mahmud, who eventually surrendered and was exiled.

(2) The vilayet of Van lies along the Persian frontier between the vilayets of Erzerum and Mosul. The northern sanjak comprises open plateau country N. and E. of the lake (with a large Armenian agricultural population and Kurdish semi-nomad tribes occupied chiefly in cattle and sheep raising), also of several fertile districts along the south shore of the lake. The southern sanjak is entirely mountainous, little developed and having the tribes only partly under government control. This comprises most of the upper basin of the Great Zab, with the country of the Nestorian Christians and many districts inhabited by Kurdish tribes, some of them large nomad tribes who descend for the winter to the plains of the Tigris.

The mineral wealth of the vilayet has never been fully explored, but is believed to be great. There are petroleum springs at Kordzot, deposits of lignite at Sivan and Nurduz, several hot springs at Zilan Deresi and Julamerk. Excellent tobacco is grown in Shemsdinan for export to Persia.

(3) Lake Van, called Arsissa Palus and also Thospitis from its Armenian names, is roughly rectangular 55 m. long and 40 broad, with a long north-eastern arm which increases the greatest length to 80 m. It stands about 5260 ft. above sea-level. It is without an outlet, and its greatest depth is along the southern shore. It has constant steady fluctuations, rising and falling some 8 ft. in a periodic movement of five years. In the middle of the 19th century a sudden rise submerged several places on the banks, including Arjish Kale, and the waters did not again subside. The north-eastern arm is much shallower than the rest. The water is bitter and undrinkable, being largely impregnated with carbonate and sulphate of soda with some borax. The salts are evaporated in pans, and called *perek*, being sold for washing purposes. There is, however, good water along the coast from springs and streams.

The lake has been navigated from the earliest times, and about 80 sailing boats, carrying about 20 tons burden, now ply on it, chiefly with wheat and firewood. Severe storms make navigation dangerous in winter. The southern shore is fringed by a steep range of mountains, with several thriving villages along the coast. The hills have now been almost denuded of trees. At the south-eastern corner is the island of Akhtamar with its ancient church, erected (*c.* 928) by Gagig, first king of the Ardzrunian dynasty. The Catholicos of Akhtamar is one of the highest offices in the Armenian Church, and dates from 1113. The small islands of Lim and Gdutz have also monasteries and churches. Large numbers of *darekh*, a kind of herring, exist in the lake, and are caught in nets from boats or when they enter the shallow lagoons in the spring and summer. Either fresh or salted they form an important article of diet of the poorer people.

See Sayce, "Cuneiform Inscriptions of Lake Van," in *Journal of Royal Asiatic Society*, vols. xiv., xx. and xxvi.; Lynch, *Armenia*, vol. ii. (1901); Belck and Lehmann, papers in *Verhand. d. Berliner Ges. für Anthropologie* (1892–99); *Zeit. für Ethnologie* (1892, 1899); *Mitt. d. Geog. Ges.* (Hamburg, 1898, 1899). (C. W. W.; F. R. M.)

VAN, an homonymous word, whose different meanings have no etymological connexion. In the most common sense "van" is merely an abbreviation of the Oriental word "caravan" (*q.v.*), and is applied to any large covered cart or vehicle used for the conveyance of goods, especially furniture, or, on railways, to a closed carriage for passengers' luggage, or for the accommodation of the guard. In the sense of the front portion of an army or fleet, or the advanced portion of any body, actually or metaphorically, "van" represents the French *avant* (Lat. *ab ante*), in front, as in *avant-garde*, van-guard, the earliest form in which the word came into English. Lastly, the word is used as a variant of "fan" (Lat. *vannus*), for a contrivance for winnowing grain, for a bird's wing, and in mining to an appliance for separating ore by washing.

VANADINITE, a mineral consisting of lead chloro-vanadate, $(PbCl)Pb_4(VO_4)_3$, crystallizing in the hexagonal system and isomorphous with pyromorphite and mimetite (*q.v.*). The crystals are usually six-sided prisms terminated by the basal planes, but are sometimes modified by numerous pyramidal planes which exhibit parallel hemihedrism. Rounded crystals and groups also occur. The colour is usually light brown or yellow, but crystals from Arizona are bright red. Owing to isomorphous replacement of the vanadium by phosphorus and arsenic, the specific gravity varies from 6·6 to 7·2; a variety containing much arsenic is called *endlichite*. The hardness is 3. The mineral is one of secondary formation in veins of lead ore. It was first found in Mexico, and in 1801 was asserted to contain a new element, which was called "erythronium"; this was later proved to be identical with the subsequently discovered element vanadium. Other well-known localities are Wanlockhead in Dumfriesshire, Kappel (Eisen-Kappel), near Klagenfurt in Carinthia, Arizona and New Mexico. (L. J. S.)

VANADIUM [symbol, V; atomic weight, 51·2 (O=16)], a metallic chemical element. It was first mentioned in 1801 by M. del Rio (*Gilb. Ann.*, 1801, 71, p. 7), but subsequently thought by him to be an impure chromium. Later, it was examined by N. G. Sefström, who found it in the slags of the Taberg iron ores (*Pogg. Ann.*, 1830, 21, p. 48), by J. J. Berzelius (ibid., 1831, 22, p. 1), and finally by Sir H. Roscoe (*Trans. Roy. Soc.*, 1868–1870), who showed that the supposed vanadium obtained by previous investigators was chiefly the nitride or an oxide of the element. In his researches, Roscoe showed that the atomic weight of the metal as determined by Berzelius and the formulae given to the oxides were incorrect, and pointed out that the element falls into its natural place in group V of the periodic classification along with phosphorus and arsenic, and not in the chromium group where it had originally been placed.

In small quantities, vanadium is found widely distributed, the chief sources being vanadite, mottramite, descloizite, roscoelite, dechenite and pucherite, whilst it is also found as a constituent of various clays, iron-ores and pitchblendes. Vanadium salts may be obtained from mottramite by digesting the mineral with concentrated hydrochloric acid, the liquid being run off and the residue well washed; the acid liquid and the washings are then evaporated with ammonium chloride, when ammonium metavanadate separates. This is recrystallized and roasted to vanadium pentoxide, which is then suspended in water into which ammonia is passed, when ammonium metavanadate is again formed and may be purified by recrystallization. The pure metal may be obtained by reducing vanadium dichloride in hydrogen, the operation being exceedingly difficult (for details, see Roscoe's original papers). In a somewhat impure condition it may be obtained by the reduction of vanadium pentoxide with a mixture of the rare earth metals which are obtained by reduction of the waste oxides formed in the manufacture of thoria (Weiss and Aichel, *Ann.*, 1904, 337, p. 380); from the oxide by Goldschmidt's thermite method (Koppel and Kaufmann, *Zeit. anorg. Chem.*, 1905, 45, p. 352); by electrolysis in a bath of fused fluorspar containing a steel cathode and an anode composed of carbon and vanadium pentoxide (M. Gin, *L'Électricien*, 1903, 25, p. 5); and by the electrolysis of vanadium trioxide when heated in an evacuated glass tube (W. v. Bolton, *Zeit. f. Elektrochem.*, 1905, 11, p. 45). H. Moissan (*Comptes rendus*, 1896, 122, p. 1297) obtained a vanadium containing from 10 to 16% of carbon by fusing vanadic anhydride with carbon in the electric furnace. For other methods of obtaining vanadium and its compounds, see Cowper Cowles, *Engin. and Mining Journ.* 67, p. 744; Herrenschmidt, *Comptes rendus*, 1904, 139, p. 635; M. Gin, *Elektrochem. Zeit.*, 1906, 13, p. 119; W. Prandtl and B. Bleyer, *Zeit. anorg. Chem.*, 1909, 64, p. 217.

Vanadium is a light-coloured metal of specific gravity 5·5. It is not volatilized even when heated to redness in a current of hydrogen, and it burns readily to the pentoxide when heated in oxygen. It dissolves slowly in hydrofluoric acid and in nitric acid, the solution turning blue; it is insoluble in hydrochloric acid. When fused with caustic soda, hydrogen is liberated and a vanadate is formed. It precipitates platinum, gold and silver from solutions of their salts, and also reduces mercuric, cupric and ferric salts. It absorbs nitrogen when heated in a current of that gas, forming a nitride. Vanadium may be detected by converting it into the pentoxide, which on passing sulphuretted hydrogen through its acid solution becomes reduced to the dioxide, the solution at the same time becoming lavender blue in colour; or if zinc be used as a reducing agent; the solution becomes at first green and ultimately blue.

Five oxides of vanadium are known (cf. Nitrogen), the mono-, di- and trioxides being basic in character, the tetra- and pentoxides being acidic and also feebly basic. The *monoxide*, V_2O, is formed when the metal is oxidized slowly in air. In a hydrated form it is obtained by the reduction of vanadyl monochloride, VOCl, with sodium amalgam, being precipitated from the liquid by the addition of ammonia (Locke and Edwards, *Zeit. anorg. Chem.*, 1899, 19, p. 378). The *dioxide*, V_2O_2, is formed in the reduction of vanadyl trichloride by hydrogen (Roscoe). It is a grey powder which is insoluble in water, but dissolves in acids to give a lavender-blue solution which possesses strong reducing properties. The addition of ammonia to this solution precipitates a brown hydrated oxide. The dioxide when heated in oxygen burns, forming the pentoxide. The *trioxide*, V_2O_3, is formed when the pentoxide is reduced at a red heat in a current of hydrogen, or by the action of oxalic acid on ammonium metavanadate. It forms a black amorphous powder or a dark green crystalline mass, and is insoluble in water and in most acids. The *tetroxide*, V_2O_4, results when the pentoxide is heated with dry oxalic acid and the resulting mixture of the tri- and pentoxide is warmed in the absence of air, or when the pentoxide is reduced by sulphur dioxide. It is an amorphous or crystalline mass of indigo-blue or steel-grey colour, which is insoluble in water and is also infusible. It oxidizes slowly in moist air, and dissolves easily in acids with the formation of blue solutions. The *pentoxide*, V_2O_5, is obtained when ammonium metavanadate is strongly heated, on calcining the sulphide, or by the decomposition of vanadyl trichloride with water. According to Ditte (*Comptes rendus*, 101, p. 698) it exists in three forms: a red amorphous soluble form which results when ammonium metavanadate is heated in a closed vessel and the residue oxidized with nitric acid and again heated; a yellow amorphous insoluble form which is obtained when the vanadate is heated in a current of air at 440° C.; and a red crystalline form which is almost insoluble in water. It is soluble in hot concentrated sulphuric acid and in concentrated hydrochloric acid. It is an energetic oxidizing agent and is consequently readily reduced when heated with various metals (zinc, magnesium, &c.), with carbon and with oxalic acid. On fusion with the caustic alkalis and alkaline carbonates it yields vanadates. It forms numerous compounds with potassium fluoride. Many complex derivatives are known, such, for example, as phosphor-vanadates, arsenio-vanadates, tungsto-vanadates, molybdo-vanadates, &c. For the use of this oxide in the electrolytic oxidation and reduction of organic compounds, see German Patents 172654 (1903) and 183022 (1905).

Many salts of oxy-acids of vanadium are known, but of the more common oxy-acids, metavanadic acid, HVO_3, and pyrovanadic acid, $H_4V_2O_7$, alone appear to have been isolated. *Metavanadic acid* is obtained in the form of yellow scales by boiling copper vanadate with an aqueous solution of sulphur dioxide. It is only very slightly soluble in water. *Pyrovanadic acid* is deposited as a dark brown unstable powder when an acid vanadate is decomposed by nitric acid. Of the salts of these acids, those of the ortho- and pyro-acids are the least stable, the orthovanadates being obtained on fusion of vanadium pentoxide with an alkaline carbonate. The metavanadates are usually yellowish or colourless solids. Ammonium metavanadate is obtained when the hydrated vanadium pentoxide is dissolved in excess of ammonia and the solution concentrated. It has been used in dyeing with aniline black. Tetra- and hexavanadates have also been described (see Ditte, *Comptes rendus*, 104, pp. 902, 1061; 102, p. 918; Manasse, *Ann.* 240, p. 23). The hypovanadates are insoluble in water, except those of the alkali metals, which are obtained by the addition of caustic alkalis to concentrated solutions of the chloride or sulphate of the tetroxide. They are brown in colour and easily oxidize. Pure hypovanadic acid has been obtained by G. Gain (*Comptes rendus*, 1906, 143, p. 823) by calcining ammonium metavanadate and saturating a solution of the resulting oxides with sulphur dioxide; the resulting blue solution (from which a sulphate of composition $2V_2O_4{\cdot}3SO_2{\cdot}10H_2O$ can be isolated) is then boiled with water, when sulphur dioxide is liberated and a pale red crystalline powder of hypovanadic acid, $H_2V_2O_5$, is precipitated.

Vanadium dichloride, VCl_2, is a green crystalline solid obtained when the tetrachloride is reduced with hydrogen at a dull red heat. It is very deliquescent and readily soluble in water. The *trichloride*, VCl_3, is a deliquescent solid formed when the tetrachloride is heated in a retort as long as chlorine is given off (Roscoe), or by heating vanadium trisulphide in a current of chlorine and fractionally distilling the resulting product at 150° C. in a current of carbon dioxide (Halberstadt, *Ber.*, 1882, 15, p. 1619). The *tetrachloride*, VCl_4, is formed by the direct union of vanadium and chlorine or by the action of sulphur chloride on vanadium pentoxide (Matignon, *Comptes rendus*, 1904, 138, p. 631). It is a fuming liquid, which is soluble in benzene and in acetic acid; it dissolves in water to form a deep blue solution. Several oxychlorides have also been described. *Vanadium carbide*, VC, was prepared by H. Moissan (*Comptes rendus*, 1896, 122, p. 1297) by heating vanadium pentoxide and carbon for a few minutes in the electric furnace. It is a volatile compound which burns when heated in oxygen and which is unacted upon by sulphuric and hydrochloric acids.

For vanadium steels, see Iron and Steel Manufacture.

VAN BEERS, JAN (1821–1888), Belgian poet, usually called "the elder" to distinguish him from his son, Jan van Beers, the well-known painter, was born at Antwerp on the 22nd of February, 1821. He was essentially a Netherlander, though politically a Belgian, expressing his thoughts in the same language as any North Netherland writer. In fact, the poems of Jan van Beers are perhaps more popular in Holland than in Belgium, and of many of them there exist more editions printed in Holland than in his political fatherland. Van Beers started life as a teacher of Dutch language and literature, first at Malines, then at Lierre, and in 1860 was appointed a professor of both at the Athenaeum (high school) in Antwerp, where he had also been a sub-librarian in the communal library. Van Beers as a teacher was early in the field, with Hendrik Conscience, Willems and others, when the Flemish movement began. He composed a Dutch grammar (1852), which, in enlarged editions, still holds the field, and a volume of selections from Dutch authors, both books being so much appreciated that the Belgian government made them text-books in the public schools. Van Beers's historical poems, the principal of which is, perhaps, *Jakob Van Maerlant* (Amsterdam, 1860), helped the Flemish revival in Belgium as powerfully as his school-books. He is best known, however, as the writer of ballads and songs. *Jongelingsdroomen* ("A Young Man's Dreams") first appeared at Antwerp and Amsterdam in 1853. These poems were followed by *Levensbeelden* ("Life Figures or Pictures," Amsterdam, 1858) and by *Gevoel en Leven* ("Feeling—Living," Amsterdam, 1861). His *Rijzende Bladen* ("Rising Leaves") first made its appearance at Ghent and Rotterdam in 1883. In the following year an *édition de luxe* of his poetry was published, adorned with pen-and-ink sketches by Jan van Beers the younger, and a popular edition of his collected poems was published at Ghent and Rotterdam in 1873 and 1884. Among the best known are *De Blinde* ("Blind"), *De Zieke Jongeling* ("Young and Doomed"), *Bij 't Kerkportaal* ("At the Church Porch"). Van Beers's poetry, full of glow and pathos, simple yet forcible, is somewhat akin to that of Longfellow. Van Beers died at Antwerp on the 14th of November 1888.

VANBRUGH, SIR JOHN (1664–1726), British dramatist and architect, was born in the parish of St Nicolas Acons in the City of London, and christened on the 24th of January 1664. His grandfather, Gillis van Brugg, of Ghent, migrated to England in the reign of James I., was naturalized, resided as a merchant and was buried in the parish of St Stephen's Walbrook. The dramatist's father, Giles (1631–1689), a wealthy sugar baker, who married into the Carleton family, was driven from London by the plague and settled at Chester. The mother (Elizabeth Carleton, of the Dorchester family) survived to see her son famous; she died at Claygate, near Esher, in 1711, and was buried at Thames Ditton. After a few years at the King's School, Chester, John at nineteen was sent to France to study the arts; after two years' absence he returned to take up a commission in the regiment soon to be known as the 13th Foot. In the early autumn of 1690 Vanbrugh was arrested at Calais on a charge of espionage. The informant against him was a lady. He was imprisoned at Vincennes, but on the 1st of Feb. 1692, by a *lettre de cachet*, he was removed to the Bastille. On the 12th of November he found surety to the extent of one thousand pistoles, but was confined to the fortifications of Paris until his exchange was effected on the cartel. His enforced leisure was responsible for the first draft of the *Provok'd Wife*. Voltaire said in his *Lettres sur les Anglais* that he could not imagine what had gained such a comic writer the distinction of detention in such a grim fortress. As a matter of fact, a considerable number of English officers were arrested about this time on a similar charge, as may be seen from the Bastille archives.[1] For a time after his return he resumed his commission and was known as Captain Vanbrugh.

The production of Cibber's *Love's Last Shift* at the Theatre Royal in January 1696 kindled afresh his attachment to the comic muse. He thought it would be interesting to develop the situation upon which Cibber had rung down the curtain, and the result was *The Relapse*, "got, conceived and born in six weeks' space." It was given on Boxing Day 1696, with Cibber as Foppington, one of the three parts borrowed from the preceding comedy. The Sir Novelty Fashion of Cibber was developed in this play into Lord Foppington, who has been pronounced "the best fop ever brought upon the stage." The play has been revived in various forms: Sheridan adapted it in *A Trip to Scarborough*, and it inspired two modern versions in 1870 and 1890, *The Man of Quality* and *Miss Tomboy*. *Aesop*—produced at Drury Lane immediately after *The Relapse*—was an adaptation of Boursault's dramatic sermon on the same subject. It ran for a week only, but the success of *The Relapse* was so triumphant that Montague, afterwards Lord Halifax, asked at once for the *Provok'd Wife* for the theatre in Lincoln's Inn Fields, and it was produced at that theatre in May 1697. All that could be said in answer to those who condemned it on account of its unblushing libertinism was that Sir John Brute is sufficiently brutal to drive any woman into rebellion, and that since the glorious days of the Restoration a wife's rebellion and a wife's adultery were synonymous terms. The play was a complete triumph, and Brute was one of Garrick's great parts. Vanbrugh was fiercely attacked by Jeremy Collier for immorality in 1698, and wrote nothing more for the stage until 1700, when an adaptation of the *Pilgrim* of Beaumont and Fletcher was produced at Drury Lane. In this play, in the part of Alinda, Anne Oldfield scored her first success. Two years later appeared *The False Friend*, a version of Le Sage's *Traître puni*. Other adaptations from the French were *A Country House*, from Dancourt's *Maison de campagne*; *Confederacy* (1705), from the same author's *Bourgeoises à la mode*; *Squire Trelooby* (1704), a version of Molière's *Monsieur de Pourceaugnac*; and *The Mistake* (1705), from Molière's *Dépit amoureux*.

Collier's attack and the resulting movement must have been responsible in part for "Van" turning his attention to architecture. The demand for splendid country seats in the new Palladian style was steadily increasing, and his reputation as a modern wit was an introduction in itself. In 1702 he was entered as comptroller of the Royal Works (now the Board of Works, where several of his designs may still be seen). In 1703 he wrote to ask his friend Jacob Tonson to procure him a "Palladio," and in the same year he was a commissioner at Greenwich, where the secretary William Vanbrugh was a kinsman of his own, whom Evelyn had appointed at his request. In the meantime, Vanbrugh had been appointed architect to the earl of Carlisle, and the result, completed in 1714, was the Corinthian mansion of Castle Howard. The work is an extension of the Palladian plan introduced by Inigo Jones, with the addition of immense corridors in segmental colonnades leading from the main entrance to the wing blocks. From a scenic artist's point of view, it is a magnificent (and certainly his best) piece of work. The earl, then deputy earl-marshal, testified his satisfaction by procuring for Vanbrugh a high place in the College of Arms. In March 1704 he was actually promoted Clarenceux, though he not only knew nothing of heraldry but had openly ridiculed that grave science in *Aesop*. The indignant college protested in vain, and the architect stuck to his place. His next work was to prepare designs for Kneller Hall near Hounslow. But the success of Castle Howard now caused him to entertain the rash project of building a theatre in the Haymarket, from his own design, for the acting of his own plays. The joyous courage with which, having persuaded thirty people in the fashionable world to aid him in finding the money, and Congreve to aid him in finding the plays, he began to build in perfect unconsciousness of the danger before him, is the only passage in his life which may be called pathetic, save of course his struggle with the "wicked woman of Marlborough." The magnitude of Vanbrugh's architectural ideas grew as the work went on, and with the ideas the structure grew till a theatre meant for the delicate *bijouterie* work of polite comedy seemed growing to the proportions of the Roman Colosseum. Whether Congreve endeavoured to put a check upon his friend's architectural and authorial fervour does not appear. But it must be remembered that not only Vanbrugh's plays but his own were to be acted there, and that, although Congreve was a man of great sagacity, no man, not even he who pretended to set his gentility above his genius, is sagacious when confronted by the surpassing excellence of his own poems and plays. When at length the time came to test the acoustics of the pile, it was found to be sadly defective. What changes were made to rectify the errors of structure does not appear. The theatre was opened to the public with an Italian opera, which was followed by three of Molière's comedies, and these by the *Confederacy*, Vanbrugh's masterpiece on the whole, though perhaps its finest scenes are not equal to the finest scenes in *The Relapse*.

Vanbrugh at last withdrew from the disastrous speculation; Congreve had already withdrawn. But a man to whom Fortune had been so kind as she had been to Vanbrugh could hardly be depressed by any of her passing frowns. Queen Anne at once sent him abroad on an important state errand, and afterwards he was commissioned to build Blenheim. Upon the merits and demerits of this famous "hollowed quarry" there has been much conflict of opinion. As to the sarcasms by Swift, Walpole, Evans, and the rest, they are as nothing when set against Sir Joshua Reynolds's defence of Vanbrugh and his style. Blenheim Palace is probably the largest domestic building in England, and consists of three blocks, the centre containing the private living rooms, one wing the stables, and the other the kitchens and storehouses. It is planned on a colossal scale. Vanbrugh considered a building and the parts of a building as simply so much material for effect, without regard to their reasonable use and the necessary limitations of design. Thus he would support his main block by subordinate groups without considering for a moment the inconvenience that might be caused by the kitchen being removed by four hundred yards from the dining-room. Personal comfort was sacrificed to perspective. Windows were to adorn the elevation, not to light the interior; and, as Voltaire said, if the rooms had only been as wide as the walls were thick, the château would have been convenient enough. After Blenheim and Castle Howard, his next largest palace was probably Fleurs, near Kelso. His plans were only suitable to the largest kind of palace. Blenheim, however, was a source of great sorrow to the kindly dramatist. Though parliament had voted for the building of it, no provision had been made for the supplies. The queen while she lived paid them, and then Vanbrugh was left to the meanness of the duke of Marlborough, and afterwards to the insolence of the "wicked woman," who did her best to embitter his life. Besides Castle Howard and Blenheim, he built many other country mansions, such as Grimsthorpe and Duncombe Hall in Yorkshire, Eastbury in Dorsetshire, Seaton-Delaval in Northumberland, King's Weston near Bristol, Oulton Hall in Cheshire, old Claremont House at Esher, old Eaton Hall, Iver Grove, Bucks. He also restored Kimbolton Castle for the earl of Manchester. In 1716 he became architect to Greenwich Hospital.

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[1] Ravaisson; and Funck-Brentano, *Liste des prisonniers de la Bastille*.

In January 1719 Vanbrugh married Henrietta Maria, daughter of Colonel Yarborough of Heslington, and four years afterwards, at the accession of George I., he was knighted. He afterwards wrote again for the stage, and the unfinished fragment of the *Journey to London* (completed by Cibber as *The Provok'd Husband* in 1728) shows that his powers remained to the last as fine as ever. His married life was mostly spent at Blackheath, very probably in "Bastile House" on Maze Hill, repaired in 1904 and now known as Vanbrugh Castle. His wife died there at a great age in 1776, but "Van" himself died on the 26th of March 1726 in his modest town house, built in 1703 out of the ruins of Whitehall and satirized by Swift as the "goose pie." The site is occupied to-day by the War Office. The famous epitaph, "Lie heavy on him, earth," is attributed to Abel Evans. The best portrait of the dramatist is the kit-cat by Kneller.

Vanbrugh's works were edited in 2 vols., 1893, by W. C. Ward (portraits). *Select Plays* were issued in the Mermaid Series (ed. A. E. H. Swaen) in 1896. See G. H. Lovegrove's *Life, Works and Influence of Sir John Vanbrugh* (1902), Max Dametz's *Vanbrughs Leben und Werke* (1898), and *Swift's Works* (Bohn), xii. 80 sq. (T. Se.)

VAN BUREN, MARTIN (1782–1862), eighth president of the United States, was born at Kinderhook, New York, on the 5th of December 1782, of Dutch descent. His father was a farmer and tavern-keeper. His education was limited to that which could be obtained in the common schools and at Kinderhook Academy, and there is testimony to the effect that as late as 1829, when he became secretary of state, he wrote crudely and incorrectly. In 1796 he began the study of law, completing his preparation in 1802 at New York, where he studied under William Peter Van Ness (1778–1826), an eminent lawyer and later Aaron Burr's second in the duel with Alexander Hamilton. Van Buren made the acquaintance of Burr, but did not fall under his influence. In 1803 he was admitted to the bar and continued in active and successful practice for twenty-five years. His practice made him financially independent, and paved the way for his entrance into politics. New York politics after 1800, the year of the election of Jefferson and the downfall of the Federalists, were peculiarly bitter and personal. The Republicans were divided into three factions, followers respectively of George Clinton (and later of his nephew, De Witt Clinton), Robert R. Livingston and Aaron Burr; and such Federalist control as there was from time to time after 1799 depended upon coalition with one or other of these groups. Van Buren, who early allied himself with the Clintonians, was surrogate of Columbia county from 1808 until 1813, when he was removed. In 1812 he entered the state Senate, and he also became a member of the court for the correction of errors, the highest court in New York until 1847.

His career in the Senate covered two terms (1812–1820). In 1815 he became attorney-general, an office which he held, still as a member of the Senate, until 1819, when he was displaced to make room for a Federalist. He had already, in 1808, removed from Kinderhook to Hudson, and in 1816 he took up his residence in Albany, where he continued to reside until he entered Jackson's cabinet in 1829. As a member of the state Senate he supported the War of 1812 and drew up a classification act for the enrolment of volunteers. He was chosen to draft the resolution of thanks voted by the legislature to General Andrew Jackson after the battle of New Orleans. He broke with De Witt Clinton in 1813, but nevertheless favoured, in 1817, Clinton's plan for the Erie Canal. His attitude towards slavery at the moment was shown by his vote, in January 1820, for a resolution opposing the admission of Missouri as a slave state. In the same year he was chosen a presidential elector. It is at this point that Van Buren's connexion began with so-called "machine politics," a connexion which has made his name odious to some historians of the period. He was a leading member of the "Albany regency," a group of politicians who for more than a generation controlled the politics of New York and powerfully influenced those of the nation, and which did more than any other agency to make the "spoils system" a recognized procedure in national, state and local affairs. Van Buren did not originate the system, for it was already well developed when he entered public life; but the nickname of "Little Magician" which presently attached to him testifies to the skill with which he exploited it, and to the popular impression which his political methods produced.

In February 1821 he was elected to the United States Senate. Before taking his seat he served also as a member of the state constitutional convention, where he opposed the grant of universal suffrage. His course in the Senate was not altogether consistent, though in this respect he is not to be judged more harshly than some of his associates. He at first favoured internal improvements, and in 1824 proposed a constitutional amendment to authorize such undertakings, but the next year took ground against them. He voted for the tariff of 1824, then gradually abandoned the protectionist position. In the presidential election of 1824 he appeared as a strong supporter of William H. Crawford, and received the electoral vote of Georgia for vice-president; but he shrewdly kept out of the acrimonious controversy which followed the choice of John Quincy Adams. He early recognized the availability of Andrew Jackson, however, as a presidential candidate, and after the election sought to bring the Crawford and Jackson followers together, at the same time strengthening his control as a party leader in the Senate. Always notably courteous in his treatment of opponents, he showed no bitterness either towards J. Q. Adams or Henry Clay, and voted for Clay's confirmation as secretary of state notwithstanding the "corrupt bargain" charge; at the same time he opposed internal improvements and declined to support the proposal for a Panama Congress. As chairman of the judiciary committee, he brought forward a number of measures for the improvement of judicial procedure, and in May 1826 joined with Benton in presenting a report on executive patronage. In the debate on the "tariff of abominations" in 1828 he took no part, but voted for the measure in obedience to instructions from the New York legislature—an action which was cited against him as late as the presidential campaign of 1844. Van Buren was not an orator, but his more important speeches show careful preparation and his opinions carried weight; and the oft-repeated charge that he refrained from declaring himself on crucial questions is hardly borne out by an examination of his senatorial career. In February 1827 he was re-elected to the Senate by a large majority. He was now one of the recognized managers of the Jackson campaign, and a tour of Virginia, the Carolinas and Georgia in the spring of 1827 won support for Jackson from Crawford.

In 1828 Van Buren was elected governor of New York for the term beginning on the 1st of January 1829, and resigned his seat in the Senate. But on the 5th of March he was appointed by President Jackson secretary of state, an office which probably had been assured to him before the election, and he resigned the governorship. As secretary of state he took care to keep on good terms with the "kitchen cabinet," the group of politicians who acted as Jackson's advisers, and won the lasting regard of Jackson by his courtesies to Mrs John H. Eaton, wife of the secretary of war, with whom the wives of the cabinet officers had refused to associate. He did not oppose Jackson in the matter of removals from office, but was not himself an active "spoilsman," and protested strongly against the appointment of Samuel Swartwout (1783–1856), who was later a defaulter to a large amount as collector of the port of New York. He skilfully avoided entanglement in the Jackson-Calhoun imbroglio. No diplomatic questions of the first magnitude arose during his service as secretary of state, but the settlement of long-standing claims against France was prepared for, and trade with the British West India colonies was opened. In the controversy with the Bank of the United States he sided with Jackson. After the breach between Jackson and Calhoun, Van Buren was clearly the most prominent candidate for the vice-presidency. Jackson in December 1829 had already made known his own wish that Van Buren should receive the nomination. In April 1831 Van Buren resigned, though he did not leave office until June. In August he was appointed minister to England, and arrived in London in September. He was cordially received, but in February learned that his nomination had been rejected by the Senate on the 25th of January. The rejection, ostensibly attributed in large part to Van Buren's instructions to Louis McLane, the American minister to England, regarding the opening of the West India trade, in which reference had been made to the results of the election of 1828, was in fact the work of Calhoun, the vice-president; and when the vote was taken enough of the majority refrained from voting to produce a tie and give Calhoun his longed-for "vengeance." No greater impetus than this could have been given to Van Buren's candidacy for the vice-presidency. After a brief tour on the Continent he reached New York on the 5th of July. In May the Democratic convention, the first held by that party, had nominated him for vice-president on the Jackson ticket, notwithstanding the strong opposition to him which existed in many states. No platform was adopted, the widespread popularity of Jackson being relied upon to win success at the polls. His declarations during the campaign were vague regarding the tariff and unfavourable to the United States Bank and to nullification, but he had already somewhat placated the South by denying the right of Congress to abolish slavery in the District of Columbia without the consent of the slave states. In the election he received 189 electoral votes, while Jackson received 219 for President. Jackson now determined to make Van Buren president in 1836, and bent all his energies to that end. In May 1835 Van Buren was unanimously nominated by the Democratic convention at Baltimore. He expressed himself plainly during the canvass on the questions of slavery and the bank, at the same time voting, perhaps with a touch of bravado, for a bill offered in 1836 to subject abolition literature in the mails to the laws of the several states. Calhoun, bitterly hostile to the last, objected to the usual vote of thanks to the retiring vice-president, but withdrew his objection. In the election Van Buren received 170 electoral votes against 73 for William Henry Harrison, his principal opponent; but the popular vote showed a plurality of less than 25,000 in a total vote of about 1,500,000. The election was in fact a victory for Jackson rather than for Van Buren.

The details of Van Buren's administration belong to the history of the United States (see UNITED STATES). He announced his intention "to follow in the footsteps of his illustrious predecessor," took over all but one of Jackson's cabinet, and met with statesmanlike firmness the commercial crisis of 1837, already prepared for before he took office. No exhibition of ability or courage, however, nor yet the most skilful manipulation of the political machinery of the party, could prevent continued hostility to him and to the methods for which he was widely believed to stand. The state elections of 1837 and 1838 were disastrous for the Democrats, and the partial recovery in 1839 was offset by a second commercial crisis in that year. Nevertheless, Van Buren was unanimously renominated by the Democrats in 1840. Charged with being "a Northern man with Southern principles," he was frequently interrogated during the campaign, and his nomination obviously failed to arouse enthusiasm or even inspire confidence. The revolt against Democratic rule was undoubtedly serious, but a study of the popular vote shows that the election of Harrison, the Whig candidate, was less of a revolution than many affected to think. On the expiration of his term Van Buren retired to his estate at Kinderhook, but he did not withdraw from politics or cease to be a figure of national importance. It was even proposed to make him a member of the Federal Supreme Court in order to get him out of political life. He confidently expected to be nominated for president in 1844, and his famous letter of the 27th of April, in which he frankly opposed the immediate annexation of Texas, though doubtless contributing greatly to his defeat, was not made public until he felt practically sure of the nomination. In the Democratic convention, though he had a majority of the votes, he did not have the two-thirds which the rule of the convention required, and after eight ballots his name was withdrawn. In 1848 he was again nominated, first by the "Barnburner" faction of the Democrats, then by the Free Soilers, with whom the "Barnburners" coalesced, but no electoral vote was won by the party. In the election of 1860 he voted for the fusion ticket in New York which was opposed to Abraham Lincoln, but he could not approve of President Buchanan's course in dealing with secession, and later supported Lincoln. He died in Kinderhook on the 24th of July 1862. His memoirs, to 1834, remain unpublished, but an *Inquiry into the Origin and Course of Political Parties in the United States* was compiled from it by his sons and published in 1867. Van Buren married in 1807 Hannah Hoes (1782–1819), by whom he had four sons.

Van Buren's son ABRAHAM (1807–1873) graduated at West Point in 1827, served under General Winfield Scott against the Seminole Indians in 1836, and was made captain of the First Dragoons. In 1837 he resigned from the army to become his father's private secretary, but in 1846, at the outbreak of the war with Mexico, he was reappointed with the rank of major and paymaster. In August 1847 he was breveted lieutenant-colonel for gallant and meritorious conduct at Contreras and Churubusco. In 1854 he retired to private life. Another son, JOHN (1810–1866), graduated at Yale in 1828, was admitted to the bar at Albany in 1830 and was attorney-general of New York in 1845–1846. He was popularly known as "Prince John" because of his manners and appearance.

The best biography of Van Buren is by Edward M. Shepard, in the "American Statesmen Series" (revised ed., Boston, 1899). The Life by George Bancroft (New York, 1889) is highly eulogistic. Von Holst's *United States*, MacDonald's *Jacksonian Democracy*, Garrison's *Westward Extension* and T. C. Smith's *Parties and Slavery* (the last three in the "American Nation Series") give much attention to Van Buren's public career. The Van Buren manuscripts are in the Library of Congress. (W. MacD.*)

VANCE, ZEBULON BAIRD (1830–1894), American political leader, was born in Buncombe county, North Carolina, on the 13th of May 1830. He was educated at Washington College, at Salem, Tennessee, and the university of North Carolina (1851–52). Entering politics as a Whig, he was elected solicitor of Buncombe county (1852) and a member of the state House of Commons (1854), and served in the national House of Representatives from December 1858 until the 3rd of March 1861. As captain of a company in the 14th and as colonel of the 26th North Carolina regiments, he took part in the Virginia campaigns of 1861–62. From 1862 until the close of the war he was governor of the state, and from the 20th of May to the 5th of July 1865, when he was released on parole, was held as a prisoner by the United States authorities in Washington. Having been elected to the United States Senate in 1870 and been refused admission because his disabilities—due to his participation in the war—had not been removed, he took the lead in the fight against "carpet-bag" misrule and was chosen governor in the political revolution of 1876, serving in 1877–79. He was again elected to the Senate in 1878 and was re-elected in 1884 and 1890, serving from March 1879 until his death. Senator Vance was a typical Southern Whig. He disliked slavery and he hated secession. In common with other Whigs, he was forced to remain in the Democratic party after the war by the fear of negro domination. He died at Asheville, North Carolina, on the 14th of April 1894.

See the Life by Clement Dowd (Charlotte, N.C., 1897).

VANCOUVER, GEORGE (*c.* 1758–1798), English navigator, was born in 1758. He entered the navy at the age of thirteen, and accompanied James Cook in his second (1772–74) and third (1776–80) voyages of discovery. After serving for several years in the West Indies, both under Rodney (his commander in the action of the 12th of April 1782) and under Alan Gardner (1786–89), Vancouver, on Gardner's recommendation, was appointed to command an expedition to the north-west coast of America, to take over from the Spaniards the territory they had seized (and subsequently relinquished) in that region, to explore the coast from 30° N. round to Cook's River (or Inlet), to search for an eastward passage to the great lakes, and to ascertain the true character of Juan de Fuca Strait. Vancouver, accompanied by Lieutenant Broughton, left Falmouth on the 1st of April 1791 and proceeded by way of the Cape of Good Hope to Australia, where he carefully surveyed part of the south-west coast, especially King George's Sound, whose value as a harbour he pointed out. He next made for Dusky Bay, New Zealand (which he was the first properly to explore), and thence sailing north-east, discovered Oparo Islet (27° 36′ S.; 144° 12′ W.), and on the 30th of December reached Tahiti, where he was again joined by Broughton, who meanwhile had discovered Chatham Island. After staying about three weeks at Tahiti and several weeks at the Hawaiian Islands, Vancouver on the 18th of April 1792 sighted the west coast of North America (California, then known as New Albion) in 39° 27′ N. He examined the coast up to 52° 18′ N. with minute care, surveying all inlets, discovering the Gulf of Georgia, and circumnavigating Vancouver Island (named after him). After another visit (February–March 1793) to the Hawaiian Islands, in whose races and affairs he took great interest, Vancouver resumed his exploration of the American coast in April, surveying north to 56° N., and south (past the Spanish Californian settlements) to 35° N. During a fresh stay at the Hawaiian Islands (January–March 1794) Vancouver accepted their submission to Great Britain, but his annexation seems never to have been officially ratified. Quitting the group again in March 1794, Vancouver sailed, by Chernigov Island and Kodiak Island, to Cook's Inlet, which was now proved to be no river. After a fresh survey of much of the coast north of San Francisco, Vancouver set out homewards via Cape Horn and St Helena in October 1794. On the way he made a careful examination of Cape St Lucas, the southern point of Lower California, the Galapagos Islands and some other points. He reached the mouth of the Shannon on the 13th of September 1795 (the Thames on the 20th of October), and immediately set about the preparation of his narrative; but he died at Petersham in Surrey on the 10th of May 1798, before he had completed his task. His brother John, assisted by Captain Puget, published the complete record in 1798.

See *A Voyage of Discovery to the North Pacific Ocean and round the World . . . in 1790–5 . . . under Captain George Vancouver*, 3 vols. (1798), with an atlas of maps and plates.

VANCOUVER, a city and the county-seat of Clarke county, Washington, U.S.A., on the Columbia river about 100 m. from its mouth, about 5 m. E. of its confluence with the Willamette, and 8 m. N. of Portland, Oregon. Pop. (1890) 3545; (1900) 3126 (547 foreign-born); (1910) 9300. It is served by the Northern Pacific, the Great Northern, the Oregon & Washington, and the Spokane, Portland & Seattle railways, and by steamship lines, being accessible to sea-going vessels; a ferry connects with the Portland Electric railway. The city is the seat of St James College (Roman Catholic; 1856) and of the state school for defective youth (1886). Vancouver Barracks, east of the city, is an important U.S. military post (established in 1849) and the headquarters of the Military Department of the Columbia (including Washington, Oregon, Idaho, except the part in Yellowstone Park, and Alaska); the military reservation includes some 640 acres. The post commands an excellent view of the Columbia, and of the mountain peaks, Mt Hood, Three Sisters, Jefferson and St Helens. The city has a public library and a public park, and there is a U.S. Land Office here. Vancouver lies in a region of extensive forests and of fruit-growing and farming lands; among its manufactures are lumber products, barrels, condensed milk, flour, beer and canned fruit. It was a post of the Hudson's Bay Company in 1828–1846, and was protected by a large stockade, to which settlers fled for protection when attacked by the Indians. It was made the county-seat in 1854, was incorporated as a village in 1858 and was chartered as a city in 1889.

VANCOUVER, a city and port in the province of British Columbia, Canada, on the southern side of Burrard Inlet. Pop. (1906) about 45,000. It is the western terminus of the Canadian Pacific railway. The harbour of Vancouver is one of the finest natural harbours in the world. The city is the largest in British Columbia, and is the chief Canadian shipping port for Japan, China, Australia and the islands at which the C.P.R. mail steamers call. There are regular lines of steamers running between Vancouver and Alaska and the points of connexion with the Yukon territory, as well as lines to Puget Sound and San Francisco in the United States. The port also has regular and frequent communication by steamer with Victoria, and is the headquarters of an extensive coasting trade. In 1886, soon after its establishment, a fire swept the whole town out of existence, but the inferior wooden buildings at first erected have been largely replaced by stone and brick structures, giving a handsome appearance to the principal streets. Vancouver has well-paved streets and is well supplied with water, electric lighting, electric cars and all the improvements of a modern city. Stanley Park, a large reserve of 900 acres, is one of the principal pleasure resorts. There is also fine sea-bathing at English Bay on the outskirts of the city. The "McGill University College of British Columbia" at Vancouver is one of the colleges of McGill University (Montreal). There are a sugar refinery and cooperage works, as well as large sawmills, shingle factories and many other industrial concerns. A large wholesale trade is carried on with all the settlements of the province. Vancouver is the centre of the important timber industry of British Columbia.

VANCOUVER ISLAND, the largest of an archipelago of innumerable islands which fringes the Pacific coast of Canada, being at the same time the largest island on the west coast of North America. It forms part of British Columbia. It extends from 48° 20′ to 51° N. and from 123° to 128° 30′ W., and is thus 285 m. long and from 40 to 80 m. wide, with an area of about 20,000 sq. m., being nearly the size of Nova Scotia, which occupies a corresponding position on the Atlantic coast. It is bounded on the south by the Strait of Juan de Fuca, and is separated from the mainland of the province by the Strait of Georgia and Queen Charlotte Sound. A partially submerged range of mountains, which has been termed the Vancouver Range, runs parallel to the coast of British Columbia; a portion of this range forms Vancouver Island, and it again rises above the level of the sea farther north, forming the Queen Charlotte Islands. The coast-line is generally precipitous. The west coast is much broken by bays and inlets—the transverse valleys of the sunken range—which penetrate far inland. Among these may be mentioned the Alberni Canal, which is 20 m. long with a fine harbour at its head, the width of the inlet varying from a half to one mile; Nootka Sound, 6 m. wide, and sending three arms inland which are from 40 to 160 fathoms deep, as well as Clayoquot, Esperanza, Kyuquot and Quatsino Sounds, which also penetrate deeply into the island. The general height of the mountain-range on Vancouver Island is from 2000 to 3000 ft.; some peaks are 6000 ft.; and Victoria Peak is 7484 ft. high. The island is composed largely of crystalline and metamorphic rocks, but contains some cretaceous areas which hold extensive beds of coal, especially on the east coast. These are mined at Nanaimo, Ladysmith and other points. The island is covered everywhere with an exceedingly dense forest, which makes its interior very difficult to traverse, so that there are still portions of the island which have not been thoroughly explored. These forests yield immense supplies of magnificent timber, which together with the coal-field and fisheries constitute the chief resources of the island. There are some level tracts on the south-east coast, as well as in the narrow, well-watered valleys of the interior, which afford excellent agricultural land on which cereals of all kinds, as well as all the fruits of the temperate zone, flourish, and which are also suitable for raising sheep and cattle. The climate of Vancouver Island, especially in the south, is wonderfully mild for the latitude—as mild as that of Great Britain, with dryer summers. The mean temperature of December at Victoria in the south of the island is about 41° Fahr., while that of July is about 60°. In the north and west the rainfall is greater than on the south and east coasts. (F. D. A.)

VANDALS (Lat. *Vandili* or *Vandilii*), a term used by early writers only as a collective designation for a group of Teutonic tribes including, according to Pliny, the Burgundians and the Goths. As a tribal name Vandali occurs first in connexion with the Marcomannic War. The people to whom the name is there applied seem to be identical with those formerly known as Lugii. Another tribe called Silingae by Ptolemy likewise appears among the Vandals at a later time. Both these tribes appear to have inhabited the upper part of the basin of the Oder, and the name of the Silingae is preserved in Silesia. The Vandals figure in the earliest legends both of the Goths and the Lombards, both of whom they are said to have encountered unsuccessfully. They first came into contact with the Romans during the Marcomannic War. In the time of Aurelian they invaded Pannonia, and during the reign of Probus we find them fighting in Dacia. In the time of Constantine I., according to Jordanes, they suffered a great defeat at the hands of Geberich, king of the Goths, their own king Visimar being killed, and the survivors were allowed by the Romans to settle in Pannonia. Here they seem to have remained in subjection to the Romans for about sixty years. In the year 406 they moved westward, according to some writers at the instigation of Stilicho, who is himself said to have been of Vandal origin, and crossing the Rhine at Mainz proceeded towards Gaul. A portion of the nation is, however, said to have remained behind, and Procopius tells a story that these remnants sent an embassy to Gaiseric, asking that their kinsfolk in Africa should renounce their claims to the lands which their forefathers had held in the old homes of the race. (F. G. M. B.)

In Gaul the Vandals fought a great battle with the Franks, in which they were defeated with the loss of 2000 men, and their king Godégisel was slain. In 409 his son Gunderic led them across the Pyrenees. They appear to have settled in Spain in two detachments. One, the Asdingian Vandals, occupied Galicia, the other, the Silingian, Andalusia. Twenty years of bloody and purposeless warfare with the armies of the empire and with their fellow-barbarians, the Goths and the Suevi, followed. The Silingian Vandals were well-nigh exterminated, but their Asdingian brethren (with whom were now associated the remains of a Turanian people, the Alani, who had been utterly defeated by the Goths) marched across Spain and took possession of Andalusia.

In 428 or 429 the whole nation set sail for Africa, upon an invitation received by their king from Bonifacius, count of Africa, who had fallen into disgrace with the court of Ravenna. Gunderic was now dead, and supreme power was in the hands of his bastard brother, who is generally known in history as Genseric, though the more correct form of his name is Gaiseric. This man, short of stature and with limping gait, but with a great natural capacity for war and dominion, reckless of human life and unrestrained by conscience or pity, was for fifty years the hero of the Vandal race and the terror of Constantinople and Rome. Probably in the month of May 428 he assembled all his people on the shore of Andalusia, and numbering the males among them from the greybeard down to the newborn infant found them to amount to 80,000 souls. The passage was effected in the ships of Bonifacius, who, however, soon returning to his old loyalty, besought his new allies to depart from Africa. They, of course, refused, and Bonifacius turned against them, too late, however, to repair the mischief which he had caused. Notwithstanding his opposition, the progress of the Vandals was rapid, and by May 430 only three cities of Roman Africa—Carthage, Hippo and Cirta—remained untaken. The long siege of Hippo (May 430 to July 431), memorable for the last illness and death of St Augustine, which occurred during its progress, ended unsuccessfully for the Vandals. At length (30th January 435) peace was made between the emperor Valentinian III. and Gaiseric. The emperor was to retain Carthage and the small but rich proconsular province in which it was situated, while Hippo and the other six provinces of Africa were abandoned to the Vandal. Gaiseric observed this treaty no longer than suited his purpose. On the 19th of October 439, without any declaration of war, he suddenly attacked Carthage and took it. The Vandal occupation of this great city, the third among the cities of the Roman empire, lasted for ninety-four years. Gaiseric seems to have counted the years of his sovereignty from the date of its capture. Though most of the remaining years of Gaiseric's life were passed in war, plunder rather than territorial conquest seems to have been the object of his expeditions. He made, in fact, of Carthage a pirate's stronghold, whence he issued forth, like the Barbary pirates of a later day, to attack, as he himself said, "the dwellings of the men with whom God is angry," leaving the question who those men might be to the decision of the elements. Almost alone among the Teutonic invaders of the empire he set himself to form a powerful fleet, and was probably for thirty years the leading maritime power in the Mediterranean. Gaiseric's celebrated expedition against Rome (455), undertaken in response to the call of Eudoxia, widow of Valentinian, was only the greatest of his marauding exploits. He took the city without difficulty, and for fourteen days, in a calm and business-like manner, emptied it of all its movable wealth. The sacred vessels of the Jewish temple, brought to Rome by Titus, are said to have been among the spoils carried to Carthage by the conqueror. Eudoxia and her two daughters were also carried into captivity. One of the princesses, Eudocia, was married to Hunneric, eldest son of Gaiseric; her mother and sister, after long and tedious negotiations, were sent to Constantinople.

There does not seem to be in the story of the capture of Rome by the Vandals any justification for the charge of wilful and objectless destruction of public buildings which is implied in the word "vandalism." It is probable that this charge grew out of the fierce persecution which was carried on by Gaiseric and his son against the Catholic Christians, and which is the darkest stain on their characters. This persecution is described with great vividness, and no doubt with some exaggeration, by the nearly contemporary Victor Vitensis. Churches were burned; bishops and priests were forced by cruel and revolting tortures to reveal the hiding-places of the sacred vessels; the rich provincials who were employed about the court, and who still adhered to the Catholic faith, were racked and beaten, and put to death. The bishops were almost universally banished, and the congregations were forbidden to elect their successors, so that the greater part of the churches of Africa remained "widowed" for a whole generation. In 476, at the very close of Gaiseric's life, by a treaty concluded with the Eastern emperor, the bishops were permitted to return. There was then a short lull in the persecution; but on the death of Gaiseric (477) and the accession of Hunneric it broke out again with greater violence than ever, the ferocity of Hunneric being more thoroughly stupid and brutal than the calculating cruelty of his father.

On the death of Hunneric (484) he was succeeded by his cousin Gunthamund, Gaiseric having established seniority among his own descendants as the law of succession to his throne. Gunthamund (484–96) and his brother Thrasamund (496–523), though Arians, abated some of the rigour of the persecution, and maintained the external credit of the monarchy. Internally, however, it was rapidly declining, the once chaste and hardy Vandals being demoralized by the fervid climate of Africa and the sinful delights of their new capital, and falling ever lower into sloth, effeminacy and vice. On the death of Thrasamund, Hilderic (523–31), the son of Hunneric and Eudocia, at length succeeded to the throne. He adhered to the creed of his mother rather than to that of his father; and, in spite of a solemn oath sworn to his predecessor that he would not restore the Catholic churches to their owners, he at once proceeded to do so and to recall the bishops. Hilderic, elderly, Catholic and timid, was very unpopular with his subjects, and after a reign of eight years he was thrust into prison by his warlike cousin Gelimer (531–34).

The wrongs of Hilderic, a Catholic, and with the blood of Theodosius in his veins, afforded to Justinian a long-coveted pretext for overthrowing the Vandal dominion, the latent weakness of which was probably known to the statesmen of Constantinople. A great expedition under the command of Belisarius (in whose train was the historian Procopius) sailed from the Bosporus in June 533, and after touching at Catana in Sicily finally reached Africa in the beginning of September. Gelimer, who was strangely ignorant of the plans of Justinian, had sent his brother Tzazo with some of his best troops to quell a rebellion in Sardinia (that island as well as the Balearic Isles forming part of the Vandal dominions), and the landing of Belisarius was entirely unopposed. He marched rapidly towards Carthage and on the 13th of September was confronted by Gelimer at Ad Decimum, 10 m. from Carthage. The battle did not reflect any great credit either on Byzantine or Vandal generalship. It was in fact a series of blunders on both sides, but Belisarius made the fewest and victory remained with him. On the 14th of September 533 the imperial general entered Carthage and ate the feast prepared in Gelimer's palace for its lord. Belisarius, however, was too late to save the life of Hilderic, who had been slain by his rival's orders as soon as the news came of the landing of the imperial army. Still Gelimer with many of the Vandal warriors was at liberty. On the return of Tzazo from Sardinia a force was collected considerably larger than the imperial army, and Gelimer met Belisarius in battle at a place about 20 m. from Carthage, called Tricamarum (December 533). This battle was far more stubbornly contested than that of Ad Decimum, but it ended in the utter rout of the Vandals and the flight of Gelimer. He took refuge in a mountain fortress called Pappua on the Numidian frontier, and there, after enduring great hardships in the squalid dwellings of the Moors, surrendered to his pursuers in March 534. The well-known stories of his laughter when he was introduced to Belisarius, and his chant, "Vanitas vanitatum," when he walked before the triumphal car of his conqueror through the streets of Constantinople, probably point to an intellect disordered by his reverses and hardships. The Vandals who were carried captive to Constantinople were enlisted in five squadrons of cavalry and sent to serve against the Parthians under the title "Justiniani Vandali." Four hundred escaped to Africa and took part in a mutiny of the imperial troops, which was with difficulty quelled by Belisarius (536). After this the Vandals disappear from history. The overthrow of their kingdom undoubtedly rendered easier the spread of Saracen conquest along the northern shore of Africa in the following century. In this as in many other fields Justinian sowed that Mahomet might reap. (T. H.)

See Pliny, *Natural History*, iv. 99; Tacitus, *Germania*, cc. 2, 43; Ptolemy, ii. c. 11, §§ 18 ff.; Julius Capitolinus, *De Bello Marcomannico*, 17; Vopiscus, *Probus*, 18; Dexippus, *Excerpta*, pp. 19 ff. (Bonn); and Jordanes, 4, 16, 22; Procopius, *De Bello Vandalico*, a first-rate authority for contemporary events, must be used with caution for the history of the two or three generations before his time. The chroniclers Idatius, Prosper and Victor Tunnunensis supply some facts, and for the persecution of the Catholics Victor Vitensis and the *Vita Augustini* of Posidius may be consulted. See also E. Gibbon, *Decline and Fall*, chaps. xxxiii. and xli., Papencordt *Geschichte der vandalischen Herrschaft in Afrika* (Berlin, 1837); T. Hodgkin, *Italy and her Invaders* (1880–99); L. Schmidt, *Geschichte der Wandalen* (Leipzig, 1901); and F. Martroye, *L'Occident à l'époque byzantine* (1904).

VANDAMME, DOMINIQUE RENÉ, COUNT (1770–1830), French soldier, was born at Cassel, near Dunkirk, on the 5th of November 1770. He enlisted in the army in 1786, served in Martinique in 1788 and on returning to France entered into the Revolutionary movement, raising a company of light infantry at his native place. His extraordinary bravery and vigour in the campaign of 1793 ensured his rapid promotion, and after Hondschoote he was made a general of brigade. He served in this rank in the campaigns of 1794 in the Low Countries, 1795 on the Rhine and 1796 in Germany, and at the outbreak of the war in 1799 he was promoted general of division. In that year and in 1800 he served under Brune, Moreau and Macdonald in Holland, Germany and Switzerland. He was renowned for his tenacity and fearlessness as a fighting general as well as for his frank, rough manners and plundering and dissolute life, but once he came under Napoleon's influence he was (unlike most of the Rhine Army officers) his absolutely devoted servant. In 1805, for his splendid leadership at Austerlitz, he was given the Grand Eagle of the Legion of Honour, and in 1806–7 he commanded a small corps of the *Grande Armée* which reduced the Silesian fortresses. In 1808 he was made count of Unebourg. In 1809 he served in the Eckmühl campaign with distinction, but in 1812, while commanding the Westphalian contingent he quarrelled with King Jerome Bonaparte and returned to France. He returned to the army in 1813. But his corps, sent against the line of retreat of the Allies at the time of the battle of Dresden, was entangled in the mountains, surrounded and after a fierce resistance compelled to surrender at Kulm (see NAPOLEONIC CAMPAIGNS). In his captivity he appears to have been treated with especial harshness, and when the end of the war released him he was forbidden to enter Paris, and sent to Cassel by Louis XVIII. He was thus free of all obligations towards the Bourbons, and when Napoleon returned, joined him without hesitation. The emperor made him a peer of France and placed him at the head of the III. corps in the Army of the North (see WATERLOO CAMPAIGN). After Waterloo, under Grouchy's command, he brought back his corps in good order to Paris and thence to the Loire. The Restoration first imprisoned and then exiled him, and unlike most of his comrades he was never reemployed as a general. He died at Cassel on the 15th of July 1830.

See Du Casse, *Le Général Vandamme et sa correspondance.*

VANDERBILT, CORNELIUS (1794–1877), American capitalist, was born near Stapleton, Staten Island, New York, on the 27th of May 1794. He was a descendant of Jan Aersten Van der Bilt, who emigrated from Holland about 1650 and settled near Brooklyn. The family removed to Staten Island in 1715. At the age of 16 he bought a sailboat, in which he carried farm produce and passengers between Staten Island and New York. He was soon doing a profitable carrying business, and in 1813 carried supplies to fortifications in New York Harbour and the adjacent waters. Recognizing the superiority of steam over sailing vessels, he sold his sloops and schooners, and in 1817–1829 was a captain on a steam ferry between New York and New Brunswick. During the next twenty years he developed an extensive carrying trade along the coast in a fleet which became so large as to win for him the popular designation of "Commodore." In 1849 he got from the Nicaraguan government a charter for a route from Greytown on the Atlantic by the San Juan river and Lake Nicaragua to San Juan del Sur, on the Pacific; and in 1851–1853 by means of this route he conducted a semi-monthly steamship line between New York and San Francisco. In 1855–1861 he operated a freight and passenger line between New York and Havre, and by carrying the United States mails free drove out of business his only rival, the Collins line—the Cunard boats being at that time in use for the Crimean War. In 1857–1862 he sold his steamships and turned his attention more and more to the development of railways. In 1857 he became a director, and in 1863 president, of the New York & Harlem railway company, operating a line between New York and Chatham Four Corners, in Columbia county, and he greatly improved this service. He then acquired a controlling interest in the Hudson River railway, of which he became president in 1865; and after a sharp struggle in 1868 he became president of the New York Central (between Albany and Buffalo), which in 1869 he combined with the Hudson River road, under the name of the New York Central & Hudson River railroad, of which he became president. His acquisition of the Lake Shore & Michigan Southern railway in 1873 established a through line (controlled by him) between New York and Chicago. At the time of his death (in New York City on the 4th of January 1877) he owned a majority interest in the New York Central & Hudson River, the Lake Shore & Michigan Southern, the Harlem, and the Canada Southern railways, and had holdings in many others, and his fortune was variously estimated at from $90,000,000 to $100,000,000, about $80,000,000 of which he left to his son, William Henry. He made considerable benefactions to Vanderbilt University, and gave $50,000 during his life to the Church of the Strangers in New York.

His eldest son, William Henry Vanderbilt (1821–1885), was born in New Brunswick, New Jersey, on the 8th of May 1821. He was a clerk in a New York banking house from 1839 to 1842, when his father bought him a farm of 75 acres near New Dorp, Staten Island, New York. In 1860 he was appointed receiver of the Staten Island railway, of which he was elected president in 1862, and which he brought into connexion with New York by means of a line of ferry-boats. He became vice-president of the Hudson River railway in 1865, vice-president of the New York Central & Hudson River railway in 1869, and president in June 1877, succeeding his father as president of the Lake Shore & Michigan Southern, the Canada Southern, and the Michigan Central railways. He died in New York on the 8th of December 1885. His fortune at the time of his death was estimated at $200,000,000. In 1880 he paid all the expenses ($100,000) incident to the removal of the obelisk ("Cleopatra's Needle") from Egypt to Central Park, New York; in the same year he gave $100,000 to found the Theological School of Vanderbilt University, which his father had endowed. In 1884 he gave $500,000 to found a school of medicine in connexion with the College of Physicians and Surgeons in New York. By his will he left $200,000 to Vanderbilt University, $100,000 to the Domestic and Foreign Missionary Society of the Protestant Episcopal Church, $100,000 to St Luke's Hospital in New York, $100,000 to the Young Men's Christian Association of New York, $100,000 to the Metropolitan Museum of Art in New York, $50,000 to the American Museum of Natural History, $100,000 to the Protestant Episcopal Mission Society of New York, and $250,000 in all to various other religious and charitable organizations and institutions.

William Henry's eldest son, Cornelius (1843–1899), became assistant treasurer of the Harlem railway in 1865, and treasurer in 1867; in 1877, after the death of his grandfather, was elected first vice-president of the New York Central, and in 1878 became treasurer of the Michigan Central and vice-president and treasurer of the Canada Southern. In 1883, under a reorganization of the New York Central and Michigan Central railways, he became chairman of the boards of directors of those two systems and their responsible head. His benefactions included $250,000 (1897) for an addition to St Bartholomew's Hospital in New York; to Yale, $1,500,000, part of which was used in building Vanderbilt Hall (a dormitory); and $100,000 to the fund for the building of the Episcopal Cathedral of St John the Divine in New York. To the Metropolitan Museum of Art in New York he presented Rosa Bonheur's "Horse Fair."

See W. A. Croffut, *The Vanderbilts and the Story of their Fortune* (Chicago, Ill., 1886); D. W. Cross, "The Railroad Men of America," in *Magazine of Western History*, vol. viii. (Cleveland, Ohio, 1888); and Burton J. Hendrick, "The Vanderbilt Fortune," in *McClure's Magazine*, vol. xxxii. (New York, 1908–1909).

VANDERLYN, JOHN (1776–1852), American artist, was born at Kingston, New York, on the 15th of October 1776. He was employed by a print-seller in New York, and was first instructed in art by Archibald Robinson (1765–1835), a Scotsman who was afterwards one of the directors of the American Academy. He copied some of Gilbert Stuart's portraits, including one of Aaron Burr, who placed him under Gilbert Stuart as a pupil. In 1796 Vanderlyn went to Paris, and in 1805 to Rome, where he painted his picture of "Marius amid the Ruins of Carthage," which was shown in Paris, and obtained a gold medal there. This success caused him to remain in Paris for seven years, during which time he prospered greatly. In 1812 he showed a nude "Ariadne" (engraved by Durand, and now in the Pennsylvania Academy), which increased his fame. When Aaron Burr fled to Paris, Vanderlyn was for a time his only support. Vanderlyn returned to America in 1815, but did not meet with success; he worked very slowly, and neither his portraits nor various panorama which he exhibited brought him any considerable financial return. In 1842, through friendly influences, he was commissioned by Congress to paint "The Landing of Columbus" for one of the panels in the rotunda of the Capitol at Washington. Going to Paris, he employed to assist him a French artist, who, it is said, did most of the work. He died in absolute want at Kingston, New York, on the 23rd of September 1852. Vanderlyn was the first American to study in France instead of in England, and to acquire accurate draughtsmanship. He was more academic than his fellows; but, though faithfully and capably executed, his work was rather devoid of charm. He painted portraits of Presidents Washington (a copy of Stuart's portrait, for the National House of Representatives), Monroe, Madison, Jackson and Taylor, and of the statesmen Robert R. Livingston (New York Historical Society), John C. Calhoun and George Clinton.

VAN DER STAPPEN, CHARLES (1843–1910), Belgian sculptor, was born in Brussels, September 1843. His first contribution to the Brussels Salon was "The Faun's Toilet" of 1869, and thereafter he began to produce work of a high and novel order in every class of sculpture, and soon, along with Paul de Vigne, became recognized as the leader of the section of the new Belgian school of sculpture which, while aiming at truth to life, allowed itself nevertheless to be inspired by the classic perfection of the art of Greece and the spirit of the Italian Renaissance. Van der Stappen has shown his greatest power in decorative sculpture, such as we see in the decoration on the Palais des Postes, Brussels (1872), as well as the pediment "Orchestration" for the Conservatoire de Musique, and the noble bronze group, "The Teaching of Art," on the façade of the Palace of Fine Arts, Brussels. Among his other decorative work are the statues for the Alhambra Theatre and the caryatides for the house of the architect M. de Curté (1874). His best-known monuments are those to "Alexandre Gendebien" (1874) and "Baron Coppens," at Sheel (1875). His statues include "William the Silent," set up in the Square du Petit Sablon, "The Man with the Sword," and "The Sphinx"—the last two in the Brussels Museum. The bronze group "Ompdrailles" was acquired by the Belgian government (1892). In 1893 the sculptor began his collaboration with Constantin Meunier for the elaborate decoration of the botanical gardens of Brussels, and the result of the connexion may be seen in "The Builders of Cities," a group which might almost have come from his companion, so strongly is it imbued with the sentiment and illustrative of the types of the "socialistic art" of Meunier.

See *Charles van der Stappen*, by Camille Lemonnier; *Les Artistes belges contemporains*, by E. L. de Taye; *The Renaissance of Sculpture in Belgium*, by O. G. Destrée (London, 1895).

VAN DER WEYDEN, ROGER (*c.* 1400–1464), Flemish painter, also known as Roger de la Pasture, Rogier de Bruxelles, &c., was born at Tournay, where in 1427 he entered the studio of Robert Campin. He established himself in Brussels about 1435. He was in Italy in 1449–1450, but his visit shows no result on his style, which owes nothing to Italian models; and he returned to Brussels, where he died on the 18th of June 1464. His vigorous, subtle and expressive painting and popular religious conceptions had considerable influence on the art of Flanders and Germany. Memlinc was his greatest pupil; and his place in the early Flemish school is second only to that of the Van Eycks. He was not a pupil of Jan van Eyck, as was at one time supposed. His principal paintings were: a "Descent from the Cross" (1440), now in Madrid, and another (1443) in the church of St Pierre at Louvain; a triptych (1438–1440), now in the Berlin Museum; "Madonna with Saints" (1450), at the Städel Institute, Frankfort; a "Last Judgment" (1451), in the hospital of Beaune, France; the portraits of Philip the Good (Antwerp Museum) and Charles the Bold (Brussels Museum), painted about 1456–1458, the "Altar-piece of St John" and the triptych from Middelburg (Berlin Museum); an "Entombment of Christ" (National Gallery); a "Woman Crying" (Brussels Museum); "Descent from the Cross" (Louvre); "Adoration of the Magi" (Old Pinakothek at Munich); "Descent from the Cross" (the Hague); "Seven Sacraments" (Antwerp Museum), "Descent from the Cross" (Brussels Museum). Some of these latter, and others, are only doubtfully attributed to the master. The "Crucifixion" in the Brussels Museum, assigned either to him or to Memlinc, and containing portraits of the Sforzas, probably represents Roger van der Weyden in some of the principal figures at least, though Memlinc may have completed the picture.

There was a younger Roger van der Weyden (*c.* 1450–1529), to whom a brilliant "Mary Magdalen" in the National Gallery is attributed.

There are Lives of the elder Van der Weyden by A. Wauters (1856) and Alex. Pinchart (1876).

VANDEVELDE, ADRIAN (1639–1672), Dutch animal and landscape painter, a brother of William Vandevelde (*q.v.*), the marine painter, was born at Amsterdam in 1639. He was trained in the studio of Jan Wynants, the landscape painter, where he made the acquaintance of Philip Wouwerman, who is believed to have aided him in his studies of animals, and to have exercised a powerful and beneficial influence upon his art. Having made exceptionally rapid progress, he was soon employed by his master to introduce figures into his landscape compositions, and he rendered a similar service to Hobbema, Ruysdael, Verboom and other contemporary artists. His favourite subjects are scenes of open pasture land, with sheep, cattle and goats, which he executed with admirable dexterity, with much precision of touch and truth of draughtsmanship, and with clear silvery colouring. He painted a few small but excellent winter scenes with skaters, and several religious subjects, such as the "Descent from the Cross," for the Roman Catholic church in Amsterdam. In addition to his paintings, of which nearly two hundred have been catalogued, he executed about twenty etchings, several of which appear from their dates to have been done in his fourteenth year. They are simple but pleasing in tonality, and are distinguished by great directness of method and by delicacy and certainty of touch. Adrian Vandevelde died at Amsterdam in January 1672.

VANDEVELDE, WILLIAM (1633–1707), the younger, Dutch painter, a son of William Vandevelde, the elder, also a painter of sea-pieces, was born at Amsterdam in 1633. He was instructed by his father, and afterwards by Simon de Vlieger, a marine painter of repute at the time, and had achieved great celebrity by his art before he came to London. In 1674 he was engaged by Charles II., at a salary of £100, to aid his father in "taking and making draughts of sea-fights," his part of the work being to reproduce in colour the drawings of the elder Vandevelde. He was also patronized by the Duke of York and by various members of the nobility. He died in London on the 6th of April 1707. Most of Vandevelde's finest works represent views off the coast of Holland, with Dutch shipping. His best productions are delicate, spirited and finished in handling, and correct in the drawing of the vessels and their rigging. The numerous figures are tellingly introduced, and the artist is successful in his renderings of sea, whether in calm or storm.

Vandevelde was a most prolific artist: in addition to his paintings, of which Smith catalogues about three hundred and thirty, he executed an immense number of drawings, sketches and studies, which are prized by collectors.

VAN DORN, EARL (1820–1863), American soldier, was born near Vicksburg in 1820, and entered the army of the United States from West Point in 1842. For several years previous to the Mexican War he was employed in garrison duty, but in that war he saw a good deal of active service, distinguishing himself at Cerro Gordo and Churubusco, returning to the United States a brevet-major. He also fought in the Seminole War and in 1858 against the Comanches. When his state seceded in 1861 he resigned his commission in the U.S. army, and in the September of that year became major-general C.S.A. He commanded the Confederates in the hard-fought battle of Pea Ridge, but was superseded for failing to win it. Later in 1862 he won promotion and a second independent command in the West, and led the Confederates at the battle of Corinth (the 3rd and 4th of October 1862) at which he came very near to success. In spite of the verdict of a court of inquiry, he was again superseded. As a subordinate of Lieut.-General Pemberton he did splendid service to the Confederate cause in defeating Grant's first advance on Vicksburg at Holly Springs (1862). He was shot in a private quarrel on the 8th of May 1863.

VAN DYCK, SIR ANTHONY (1599–1641), Flemish painter, was born in Antwerp on the 22nd of March 1599. Though the name of Van Dyck is frequently met with in the list of Antwerp painters, Anthony's pedigree cannot be traced beyond his grandparents, who were silk mercers of some standing. He was the seventh of twelve children of Frans Van Dyck, an Antwerp tradesman in good circumstances. His mother, Maria Cupers, who died when he was scarcely eight years of age, seems to have attained a certain degree of excellence in art needlework. Of the boy's early education nothing is known. He was little over ten when he was apprenticed to Hendrick Van Balen, the painter of many delicate little pictures as well as an occasional collaborator of Rubens and Breughel, and the master of Snyders. From a document in the state paper office at Brussels, relating to a lawsuit between a picture dealer and an Antwerp churchman, which arose out of the sale, in 1660, of a series of Apostles' heads ascribed to Van Dyck, it appears that, as far back as 1615, Van Dyck had worked independently, with pupils of his own, and that his pictures were greatly valued by artists and amateurs. Professor Woermann has identified several of the Apostles' heads here spoken of with some paintings in the gallery at Dresden. Another is in the possession of Earl Spencer at Althorp.

Before he was nineteen (February 1618) Van Dyck became a full member of the Antwerp gild of painters; and some idea of his ability at the time may be gained from the excellent portraits of an old lady and gentleman, formerly ascribed to Rubens, in the Dresden gallery. Dated 1618, they were originally entered as works of Van Dyck, and, as Professor Woermann observes, are undoubtedly the same as those spoken of by Mols in his MS. annotations on Walpole's *Anecdotes*, now in the library at Brussels. But the same admiration cannot be accorded to the earliest religious composition known to have been painted by him—"Christ falling under the Cross," in St Paul's at Antwerp. This picture, of some ten life-size figures, still preserved in the place for which it was originally destined, distinctly proves that from the outset of his career Van Dyck's power of conception was vastly inferior to his refined taste as a portrait painter. At first sight it seems also that with him, as with most other Flemish painters of the period, every conception, whether sacred or profane, needed to be cast in the mould of Rubens. It would be too much, however, to assert that Van Dyck at this time stood under the guidance of that master; their association, indeed, does not seem to have begun until 1619, and Bellori (1672), who got his information from Sir Kenelm Digby, Van Dyck's bosom friend, tells us that he was first employed in making drawings (probably also chiaroscuros) for the use of the great master's engravers, and that among works of the kind one of the first was the "Battle of the Amazons" (1619).

In 1620, we know, Van Dyck was working with Rubens, for on 20th March, in making arrangements with the Antwerp Jesuits for the decoration of their church, the master is allowed to avail himself of his pupil's assistance, and obtains for him the promise of a picture. This proof of Van Dyck's personal reputation is fully confirmed (17th July) by a correspondent of the earl of Arundel, who speaks of Van Dyck as a young man of one-and-twenty whose works are scarcely less esteemed than those of his master, and adds that, his relations being people of considerable wealth, he could hardly be expected to leave his home. Van Dyck was, however, thus persuaded, for on 28th November Sir Toby Mathew mentions the artist's departure to Sir Dudley Carleton, adding that he is in receipt of an annual pension of £100 from the king. There is evidence of Van Dyck's presence in London till the end of February 1621. He is first mentioned in the order-books of the Exchequer on the 27th of that month as receiving a reward of £100 "for special service by him performed for His Majesty," and on the 28th, "Antonio van Dyck, gent., *His Majesties servant*, is allowed to travaile 8 months, he havinge obtayneid his Maties leave in that behalf, as was signified by the E. of Arundell." What Van Dyck did in London is not known. Among his numerous paintings still preserved in English houses one only is admitted as belonging to the period of this first visit, a full-length portrait of James I. in the royal collection. That he was at the time a portrait painter of the rarest merit may easily be seen from the portrait of "Van der Geest" in the National Gallery (London), and from his own likenesses of himself when still quite young and beardless, in the National Gallery, in the Pinakothek at Munich and in the Wallace Collection. In this last admirable specimen the young painter has represented himself in the character of Paris. Early paintings by Van Dyck are certainly not scarce in British galleries; at Dulwich there is his admirable Samson and Delilah, ascribed to the school of Rubens.

Though the leave of absence was probably obtained by Van Dyck for the purpose of studying the masters in Italy, the eight months had almost elapsed before he started from Antwerp, whither he had gone from London. He left Antwerp on the 3rd of October 1621, and arrived at Genoa on the 21st of November of the same year. Though Van Dyck unquestionably first became acquainted with the masterpieces of the great Venetian colourists in Rubens's *atelier*, there can be little doubt that most of the pictures which were formerly ascribed to his earliest period really date from the years of his Italian journey. In fact, studies for some of them can be found in the Chatsworth sketch-book. Among these early works are the "Martyrdom of St Peter" (Brussels), the "Crowning with Thorns" (Berlin), the "Betrayal of Christ" (Madrid and Lord Methuen), "St Martin dividing his Cloak" (Windsor Castle),—a magnificent production, generally ascribed to Rubens, but easily identified through Van Dyck's admirable sketch at Dorchester House.

It is unnecessary to dwell on a number of tales connected with Van Dyck's early life, all of which have on closer examination proved to be apocryphal; but one story has been too frequently told to be altogether ignored. At the very outset of his Italian journey the inflammable youth was captivated by the beauty of a country girl, and for the love of her painted the altar-piece still to be seen in the church at Saventhem, near Brussels, in which he himself is supposed to be represented on a grey horse, given by Rubens to his pupil. It is now known, however, that the picture was commissioned by a gentleman living at Saventhem (to the charms of whose daughter Van Dyck in reality seems not to have been altogether insensible), and a closer study makes it almost certain that it was executed after, not before, his Italian journey. On a reduced scale, and with the omission of two or three figures, the "St Martin" at Saventhem is a reproduction of the picture at Windsor Castle.

With the exception of a short visit to Antwerp at the time of his father's death in 1622, Van Dyck spent the next five years in Italy. No master from beyond the Alps ever took up a higher position than Van Dyck among the most celebrated representatives of Italian art. Study, as a matter of course, had been one of his principal objects. No doubt can be entertained as to the great influence exerted by the works of Titian, Paul Veronese and the other great masters of the Venetian school in the development of his genius; still the individuality of the painter remains a striking feature of what may be termed his Italian works, especially portraits. Their peculiar character seems to originate even more in the stateliness of the personages he was fortunate enough to have as sitters than in any desire to follow individual predilection or prevailing fashion. As in later years Van Dyck gives us a striking picture of the higher classes in England, so at this stage he makes us acquainted with Italian beauty and style; and at no other period is his talent more advantageously shown than in some of the glorious portraits he painted at Rome, at Florence, and, above all, at Genoa. At Rome, whither he journeyed after a prolonged stay in Venice, he resided with Cardinal Guido Bentivoglio, who had been papal nuncio in Flanders from 1607 to 1617. For this patron were painted several works of very great importance, the most renowned being the prelate's own portrait, now in the Pitti Palace at Florence. Another work was a "Crucifixion," representing Christ dying on the cross with uplifted eyes. Most probably the picture spoken of by Bellori ought to be identified with the admirable canvas now in the gallery at Naples, catalogued as "Scuola di Van Dyck," unsurpassed by any of those at Antwerp, Paris, Vienna, Rome or elsewhere. Besides these he painted religious subjects and portraits, several of which are reckoned among his finest examples, such as the portrait of Duquesnoy, better known as Fiammingo, the famous sculptor, formerly belonging to the king of the Belgians, and those of Sir Robert Shirley and his wife, in Persian attire, now at Petworth.

Bellori tells us of Van Dyck's prepossessing appearance, of his elegance and distinction, altogether so different from the habits of his compatriots in Rome, who formed a jovial "gang," as they termed their association. Van Dyck seems to have kept out of their way, and incurred in consequence such annoyance as made his stay in Rome much shorter than it would otherwise have been. In the company of Lady Arundel he travelled to Turin, but he was eager to reach Genoa, where Rubens had worked with great success some twenty years before, and where his Antwerp friends, Luke and Cornelis de Wael, for many years resident in Italy, now were. Van Dyck remained their guest for several months, and their portraits, now in the Pinacoteca Capitolina at Rome (engraved by W. Hollar from the monochrome at Cassel), may be supposed to have been one of his first Genoese productions. Though several of the palaces of the "proud" city no longer retain their treasures, and, among the specimens of Van Dyck's genius still left, too many have been greatly injured by cleaning and retouching, Genoa can still boast of a good number of his most attractive productions, portraits of the beautiful ladies and haughty cavaliers of the noble houses of Doria, Brignole Sale, Pallavicini, Balbi, Cattaneo,[1] Spinola, Lommelini and Grimaldi. It would scarcely be possible to speak too highly of such works as the portrait of the lady in white satin and the Durazzo children at the Durazzo Palace, the Balbi children at Panshanger, the Marchesa Balbi at Dorchester House, the equally beautiful portraits of the Lommelini and of the knight in black armour, buff jacket and boots in the Scottish National Gallery at Edinburgh, or the Marchesa Brignole Sale (formerly at Warwick Castle, and afterwards in America). Van Dyck's "Genoese manner" is a current expression, and indeed his Genoese portraits are remarkable for their richness of tonality and what might be called royal splendour, perhaps never before attained in works of the kind. This we may suppose to have had its origin, not only in his recent study of Titian, but also in decorative necessities—the size of the palatial galleries and the rich hues of the Genoese velvets, on which these portraits were to find their place, obliging the painter to find a most uncommon strength of contrast. It must also be acknowledged that the beauty and distinction of Van Dyck's models are greatly enhanced by a splendour of costume entirely different from the dullness then prevalent almost everywhere else. In Italy, moreover, he found the reality of those gorgeous backgrounds—flowing draperies, beautiful gardens, ornamental pillars, marble terraces and balustrades—which elsewhere must be regarded as fictions merely. Here, finally, he was for the first time called upon to paint some of his grandest equestrian portraits, and the often-recurring grey steed with flowing mane (an admirable study of which belongs to Lord Brownlow) was first employed for the portrait of Antonio Giulio Brignole (still at Genoa) and for another picture which we may suppose to represent the same personage at Stafford House. As with Rubens, Titian seems to have been paramount in Van Dyck's regard. Copies in great number we know he possessed of the master's best works, and several little sketches in the British Museum and in the Chatsworth sketch-book bear proof of his devout study of the great Venetian. Some of Van Dyck's earlier paintings, religious and mythological—the "Tribute Money" (Brignole Palace), "Holy Family" (Turin), "Virgin and Saints" (Louvre), "Virgin" (Grosvenor House), "Martyrdom of St Lawrence" (S. Maria dell' Orto, Venice), "Bacchanal" (Lord Belper)—engraved at Genoa as early as 1628—"St Sebastian" (Edinburgh)—are certainly Titianesque in the extreme. Still the master's individuality is not obliterated, and the gallery at Parma has a "Virgin with the Infant Asleep," which may be termed a marvel of realistic simplicity.

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[1] Of the Cattaneo portraits, originally eight in number, seven were privately sold out of Italy in 1906, and in the following year one, a half-length "Portrait of a Man," was acquired for the National Gallery, London, for £13,500. The official acquisition

In 1624 Van Dyck sailed from Genoa to Palermo and there painted several persons of rank, including the viceroy, Emmanuel Philibert of Savoy. While in Sicily he became acquainted with the painter Sofonisba Anguisciola (or Angussola), who was then ninety-six years of age and blind; and he was wont to say that he had received more valuable information from a blind woman than from many a seeing man. No important works of Van Dyck are now to be found in Sicily, except the "Virgin and Child" at S. Caterina in Palermo, and a "Virgin and Child with Saints" in the same city. Bellori tells us that a plague broke out and compelled him to leave abruptly, taking with him an unfinished picture of St Rosalia, which was destined for a confraternity of that name, and was completed in Genoa. The composition was repeated in Antwerp for the Bachelors' Brotherhood, a picture now in Vienna. Van Dyck most probably remained in Genoa till 1626, and here in all likelihood he painted the De Jodes, father and son, the celebrated engravers, who are represented together in a masterly portrait in the Capitol at Rome, the companion picture to the brothers De Wael; and Nicholas Lanière, musician-in-chief to Charles I., a painting spoken of in Van der Dort's catalogue as "done beyond the seas." Lanière was in Italy precisely at this time, and it was through his portrait (now at Windsor Castle), Walpole assures us, that Van Dyck attracted the notice of Charles I.

Traversing the Mont Cenis pass, Van Dyck stopped at Aix with Peiresc, the famous scholar and friend of Rubens, and probably proceeded straight to Antwerp. His beautiful portrait of Langlois, the Paris print-seller, from which it was conjectured that he spent some time at Paris, was unquestionably painted in Genoa. It is very likely that, before settling again at Antwerp, Van Dyck at this time paid a second visit to England, to paint a portrait of Queen Henrietta Maria, but left again when he found Mytens firmly established as court favourite. He probably returned to Antwerp in 1627, though there is no recorded proof of his presence before the 3rd of March 1628. One of his sisters had died in a convent the year before, and he now made a will in favour of Susan and Isabella, two other sisters, also nuns. That Van Dyck was in Antwerp on the 18th of May is proved by a letter from Lord Carlisle to Buckingham (Sainsbury, ciii.).

Great as may have been the strength of Italian reminiscence, from the moment Van Dyck again trod Flemish soil the influence of Rubens became predominant, and we can scarcely doubt that a competition speedily arose between master and pupil. At this period churches and convents were numerous and richly endowed; and the number of pictures, stained glass windows and elaborate carvings in Belgian churches before the French conquest was enormous. Hardly fifty years had elapsed since these buildings had been stripped of their artistic treasures, and the devout were now eager once more to adorn them with productions of the greatest painters. Hence Van Dyck's share could be very copious without in any degree interfering with the vast undertakings assigned to Rubens. The latter was also absent for many months in 1629 and 1630, so that Van Dyck was for a time the first master in the Netherlands. Among the earliest works after his return to Antwerp we find the "Crucifixion," given to the Dominican nuns, in accordance with the wish expressed by the painter's dying father, and now in the Antwerp museum. The figures are life-size, and at the foot of the cross, besides a weeping angel, are St Catherine of Siena and St Dominic. Neither in type nor in general effect does it suggest the master's immediately preceding works. As a new feature we observe a kind of elegance, not entirely free from mannerism, which is often conspicuous with Van Dyck even when the technical excellence commands our warmest admiration. Inspiration, as Waagen observes, was far more limited with Van Dyck than with Rubens. His truly delicate nature led him to restrain his conceptions within the bounds of an academic evenness, generally more pleasing to the uninitiated than the strength of expression which sometimes imparts a sort of violence to the works of Rubens. To Van Dyck's second—more justly speaking third—manner belong some of his best religious works. The "Crucifixion" in the cathedral at Mechlin is termed by Sir Joshua Reynolds one of the finest pictures in the world. Other Crucifixions are in St Michael's at Ghent (sketches in Lord Brownlow's collection and the Brussels museum) and in the church at Termonde. Still finer are the two works painted for the Antwerp Jesuits and now at Vienna—"The Mystic Marriage of the Blessed Herman Joseph" and "St Rosalia Crowned by the Infant Saviour." To this period likewise belong the celebrated "Elevation of the Cross" at Courtrai and the "St Augustine in Ecstasy," in the church of the Jesuits at Antwerp; the general effect of this last, it must be acknowledged with Reynolds, is inferior to that of the beautiful engraving by De Jode, and also to the earl of Northbrook's magnificent sketch. At Dulwich we find the first idea of the composition, with many interesting differences. It may be a matter of individual preference to pronounce Van Dyck's Flemish portraits superior to those of an earlier period; but nobody can fail to admit that, technically speaking, they indicate a further step towards perfection. The darkness of the Genoese portraits has vanished; broad daylight now freely illuminates the model, and such works as the portraits of Franciseo de Moncada (Louvre) and of the Count de Bergh (Prado) are perhaps as close to material excellence as any painting could be. The full-length likenesses of Philip Le Roy (1630) and his wife

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of this picture, in view of the Italian law of 1902, created considerable discussion in Italy and England. The companion female portrait was soon after also purchased.

(1631) (Wallace Collection) and of Mary Louisa of Tassis (Prince Liechtenstein, Vienna) are not only the finest examples of the master's talent, but deserve to rank among the most beautiful portraits ever painted. The "Snyders" at Castle Howard is regarded by Waagen as not inferior to the most celebrated Raphaels, Titians or Holbeins; and of almost equal excellence are the "Wife of Colin de Nole" in the Munich gallery, the "Lady and her Daughter" at the Louvre, and the "Lady in Black" at Cassel.

Rapidly rising to honour and wealth, Van Dyck shared with Rubens the official title of court painter, and his numerous portraits of the infanta in her monastic garb (Paris, Vienna, Turin, Parma, &c.) bear testimony to the great favour in which he stood with her. When Marie de Medicis, after her flight from France, took up her residence in Brussels (1631), she honoured Van Dyck, as well as Rubens, with repeated visits, and several times called upon him to paint her likeness, as well as those of Gaston of Orleans and his wife Margaret of Lorraine, and several of the personages of their court. From Gerbier's letters we learn that Van Dyck at this time was contemplating another journey to England, and was very anxious to be commissioned by the infanta and the queen of France to take over their portraits as presents for the king and royal family. He soon travelled to the Hague to paint the prince and princess of Orange and their son. Quite at the beginning of 1632 Constantine Huygens, who was then living at the Hague, inscribes in his diary, "Pingor a Van Dyckio." When, towards the end of March, Van Dyck sailed for England, he took all these portraits with him, as we learn from an account of the 8th of August 1632 (Carpenter's *Pictorial Notices*). Dutch authors speak of a visit paid by Van Dyck to Frans Hals at Haarlem, and of a portrait of the latter through which the Antwerp master was at once recognized by his Dutch colleague. An engraving of a portrait of Hals after Van Dyck seems to confirm the story.

In undertaking this new journey to London, Van Dyck was assured of success, for Gerbier's letters show that the king had personally desired his presence. As early as March 1629 Endymion Porter, one of the gentlemen of the king's bedchamber, had been commissioned to order a picture from Van Dyck, "Rinaldo and Armida." The canvas, now belonging to the duke of Newcastle, may be looked upon as one of the master's finest creations. Exceptional favours were bestowed upon Van Dyck almost from the day of his arrival in London. Besides the title of painter in ordinary, and the grant of an annual pension of £200, he received the honour of knighthood after a residence of less than three months at court (5th July 1632). He rapidly achieved popularity among the higher classes, and, as Walpole says, his works are so frequent in England that to most Englishmen it is difficult to avoid thinking of him as their countryman.

His refined nature is strikingly illustrated in his admirable interpretation of English beauty and style. And, if Van Dyck be compared to Mytens and Cornelius Janssen, the most distinguished painters employed by the English court immediately before him, few artists, whether in England or elsewhere, have more richly endowed their models with distinction of feature and elegance in bearing. To him may be applied what Opie says of Titian, "that he combines resemblance with dignity, costume with taste, and art with simplicity." We are particularly struck with the thorough and immediate identification of his talent with local tastes and exigencies. Charles I. and Henrietta Maria, although pictured by several other painters, are known to posterity almost exclusively through Van Dyck, not from a greater closeness of resemblance to the original, but from a particular power of expression and bearing which, once seen, it is impossible to forget. The artist was lodged at the expense of the crown, with a summer residence at Eltham Palace, and was frequently honoured with the visits of the king at his studio at Blackfriars. Portraits now followed each other with a rapidity scarcely credible to those unacquainted with the artist's method. In fact, his mode of living and his love of pleasure sufficiently explain his great need of money. During the first year of his presence in England he painted the king and queen a dozen times. The first of these noble portraits is the admirable full-length of Charles I., with the queen and their two eldest children, at Windsor Castle. The style he adopted in England is generally termed his third manner; we might better say his fourth, as he already had a very particular style before he set out on his Italian journey. De Piles gives us some account of Van Dyck's methods at this period of his career. He began with a small sketch on grey paper with black and white chalks, or a monochrome in oils. This study was passed on to assistants in order to be copied on the required scale. When the clothes were sufficiently advanced by the pupils from those sent by the model, as well as the background and accessories, the master was enabled in a few sittings of an hour each to complete the work. Van Dyck excelled in painting the hands; he is said to have kept special models for this part of his work. It need hardly be said that a system of this kind, although employed by Rubens for his larger creations, was exceedingly ill adapted to portrait painting. In Van Dyck's later productions we too often detect marks of haste, as if the brush were becoming a mere implement of trade.

Nearly the whole of 1634 and 1635 were spent by Van Dyck in the Netherlands, whence his brother, an Antwerp priest, had been called over by the queen to act as her chaplain. The archduchess died on 1st December 1633, and Van Dyck naturally wished to get his official title renewed by her successor, Ferdinand of Austria, brother of Philip IV. That Van Dyck's residence in Antwerp was only to be temporary is shown by the power given to his sister Susan for the administration of his affairs in Belgium (14th April 1634). On the arrival of the new governor Van Dyck was immediately called upon to paint his likeness, a picture now in the Madrid gallery, where the same personage is also represented by Rubens and Velazquez. Several other portraits of Ferdinand, either in his cardinal's robes or in military dress, by Van Dyck, occur elsewhere. One on horseback was exhibited at the Grosvenor Gallery, London, in 1887, as the duke of Alva (lent by Mr S. Kynaston Mainwaring). Van Dyck was greatly in demand at this time, and his prices were correspondingly high, as the Antwerp municipality found when they asked for a portrait of the late infanta to decorate one of the triumphal arches for the reception of the new governor. The most important of Van Dyck's works, at any rate as a portrait painter, belong to this period. The picture representing in life-size the members of the Brussels corporation, which was destroyed by fire during the siege of 1695, is spoken of with intense admiration by several writers. Bullart, for instance, is very enthusiastic about its fine colour and life-like qualities. Among the religious paintings of undisputed excellence belonging to the same period are the "Adoration of the Shepherds" in the church at Termonde, and the "Deposition," where the body of Christ rests upon the lap of the Virgin, in the Antwerp museum. Among the portraits are the admirable full-length of Scaglia, the king's frequent agent in the Netherlands (at Dorchester House; a replica in the museum at Antwerp), the equestrian portrait of Albert of Arenberg (Arenberg Palace at Brussels), and a portrait of the same nobleman on foot, in the black velvet Spanish dress with golden chamberlain's key (long said to be Rubens) at Althorp, the full-length of Helena Fourment, Rubens's second wife (at St Petersburg), the beautiful duchess of Havre, Mary Clara de Croy, signed and dated 1634 (Mr Ayscough Fawkes), and other members of the same family (at Munich), Thomas of Savoy (at Berlin), an admirable half-length of a lady in black (in the Vienna gallery), and above all the grandiose picture in which John of Nassau is represented at full-length, with his wife and children (at Panshanger). Several portraits of Brussels and Antwerp magistrates must also be mentioned, the most important being John Van Merstraeten, a Brussels lawyer (at Cassel).

After being chosen honorary president of the Antwerp gild of St Luke, Van Dyck returned to London before the end of 1635. In spite of the vast number of his later portraits, some of them deserve to be ranked among the most celebrated of his productions. The group of three English royal children in the gallery at Turin (1635), the portraits of Charles I. in the Louvre and in the National Gallery, London, the picture of the Pembroke family at Wilton House, Sir George and Sir Francis Villiers, and the earls of Bristol and Bedford, at Althorp, as well as those of Francis Russell, fourth earl of Bedford, and Anne Carr, his consort, at Woburn Abbey (1636), all belong to the years immediately following the master's return from the Netherlands.

He now married Lady Mary Ruthven, daughter of Sir Patrick Ruthven and granddaughter of the earl of Gowrie. There are several portraits of her by her husband, the most important being in the Munich gallery, in which she is represented in white satin, playing on the violoncello. She is also said to figure as the Virgin in a picture belonging to Lord Lyttelton. There is a capital engraving of her by Bolswert. In another picture, said to be Mary Ruthven, an exceedingly handsome lady is represented as "Herminia Putting on Clarinda's Armour." There can be no doubt as to the model having been Margaret Lemon, a celebrated beauty, whose portrait was engraved by W. Hollar and J. Morin and painted by Van Dyck at Hampton Court. "She was," says Mr Ernest Law, in his excellent catalogue of this gallery, "the most beautiful and celebrated, though far from being the only mistress of Van Dyck. The great artist, in fact, loved beauty in every form, and found the seduction of female charms altogether irresistible. She lived with him at his house at Blackfriars." The precise date of Van Dyck's marriage has not been ascertained. It was probably towards the end of 1639. The union is said to have been promoted by the artist's friends in order to save him from the consequence of his pernicious way of living. Margaret Lemon resented the event most cruelly, and tried to maim Van Dyck's right hand.

Van Dyck found few occasions in England to paint anything but portraits. There exists at Belvoir Castle a sketch by him representing a procession of the knights of the Garter, a really grandiose composition, engraved by Cooper. We know from Bellori that Van Dyck had suggested, through his friend Sir Kenelm Digby, for the banqueting-room at Whitehall, a series of decorations illustrating the history of the order of the Garter, and that the king had been much pleased with the idea. The plan, however, failed through the excessively high price asked by the painter, and perhaps also because the king had thought of having the work done in tapestry. Van Dyck's pension was five years in arrear, and, instead of £560, he received finally, besides his pension, only £200.

When the news of Rubens's death reached London (June 1640) Van Dyck contemplated a return to his native country, and a letter from Ferdinand of Austria to Philip IV. speaks of his intended journey to Antwerp on St Luke's Day (18th October). Rubens had left unfinished a series of paintings commanded by the king of Spain, and from correspondence published by Professor Justi we learn that Van Dyck had been thought of to give them the finishing touch. But he absolutely refused to finish them. It was then agreed that he should paint an independent canvas destined to complete the series. Van Dyck was delighted with this order, and Ferdinand tells his brother that he returned to London in great haste "to make preparations for his change of residence; possibly," adds the letter, "he may still change his mind, for he is stark mad." Whether Van Dyck found it possible to work during his short stay in the Netherlands is a matter of doubt. Most authors suppose that Van Dyck's principal object in travelling to the continent was to be entrusted with the decoration of one of the galleries of the Louvre. There may be some truth in this, for Mariette speaks of a letter he saw, written by Claude Vignon, the French painter, in January 1641, asking Langlois for an introduction to Van Dyck, who was then in Paris. Unfortunately the great painter was thwarted in his aspirations. His health was beginning to fail. After his return to London he was frequently obliged to interrupt his work; and a letter written (13th August) from Richmond by Lady Anne Roxburgh to Baron W. van Brederode at the Hague states that the portraits of the Princess Mary had been greatly delayed through Van Dyck's illness, and that the prince's (William II. of Orange) would be ready in eight days. "As Van Dyck intends leaving England in the course of ten or twelve days at latest," she adds, "he will take the paintings himself to the princess of Orange." These portraits, now in the museum at Amsterdam, are the last Van Dyck painted in England. Of works dated 1639 the portrait of Lady Pembroke, in the gallery of Darmstadt, is a fine example; and to the same year belongs a full-length portrait of Arthur Goodwin at Chatsworth. The twin portrait of Thomas Carew and Thomas Killigrew, in the royal collection, dated 1638, is certainly most delicate, but very weak in tone and slight in handling. Van Dyck sailed in September, and probably spent some time with his Antwerp friends. Early in November he reached Paris, and succeeded in obtaining some important work, when, on 16th November, he was compelled to resign his commissions on account of the state of his health. Scarcely three weeks later (9th December 1641) he died at his residence at Blackfriars. Van Dyck was buried in old St Paul's, where a Latin inscription was placed on his tomb by Charles I.

An elegy in Cowley's *Miscellanies* speaks, not only of the painter's talent, but of his amiable disposition. We may perhaps point to the coincidence that a Mrs Cowley is in Van Dyck's will (of 1st December) named guardian of his child, Justiniana Anna, born only eight days before her father's death. The painter had in the Netherlands an illegitimate daughter, Maria Theresia, who was entrusted to his sister, and to whom he bequeathed £4000. The name of her mother is not known. Not long after her husband's death Lady Van Dyck became the second wife of Sir Richard Pryse of Gogerddan in Cardiganshire. She was dead in 1645. Justiniana Van Dyck, who was married when scarcely twelve years old to Sir John Stepney of Prendergast, was also something of an artist: she painted a "Crucifixion," with four angels receiving Christ's blood in chalices. A similar subject had been painted by Van Dyck, as Bellori tells us, for the duke of Northumberland. After the Restoration a pension of £200 for life was granted to Justiniana Van Dyck, who died before 1690.

Properly speaking, Van Dyck cannot be said to have formed a school. He was followed to London by some of his earlier collaborators, and there soon met a considerable number of others. Jan van Reyn, David Beek, Adrian Hanneman, Mathew Merian, John Bockhorst (Lang Jan), Remy van Leemput and Peter Thys were foremost among foreigners, Henry Stone and William Dobson among Englishmen. To their assistance the master owed much; but they are also responsible for the vast number of constantly recurring copies which go by his name. It often requires a very discriminating eye to distinguish some of these copies from the original paintings. Nevertheless, after Van Dyck's death many of his coadjutors produced works of undeniable merit. No school more strikingly reflects the influence of Van Dyck than the British school. Stone and Dobson were, properly speaking, the most fortunate of his continuators; and there is little doubt that such masters as Reynolds, Gainsborough, Lawrence and Raeburn owe a large measure of their superiority to their study of his works.

Though Van Dyck's reputation greatly suffered through the numerous copies he allowed his pupils to take from his works, the case is otherwise with engraving: Vorsterman, Pontius, Peter de Jode, P. Balliu and S. Bolswert were seldom more fortunate than when under his guidance. De Jode's "St Augustine," Bolswert's "Ecce Homo" and "Crucifixion," Vorsterman's "Deposition," and especially Pontius's "Herman Joseph" rank among the masterpieces of the art of engraving. Van Dyck was himself an incomparable etcher, and with the needle arrived at a degree of excellence scarcely inferior to that exhibited in his paintings. Such prints as the portraits of Vorsterman, John de Wael, Snyders, Josse de Momper, Adam van Noort, and above all his own effigy, bear witness to his prodigious knowledge of design. Print collectors pay extravagant prices for a first proof taken from the plates engraved by Van Dyck himself. Van Dyck also employed some of the best engravers of his time for the production of a gallery of illustrious heads, men and women, of different countries. Whether all were taken from life is questionable. Gustavus Adolphus and Wallenstein he can hardly have met. Du Breucq, the architect, he never knew. But all the sketches and drawings were done by himself, and are often met with in public and private galleries. The engravings are sometimes very beautiful and in their first states very rare. Published successively by Martin van der Enden, Giles Hendrickx and John Meyssens, the collection originally consisted of sixteen warriors and statesmen, twelve scholars and fifty-two artists. Hendrickx raised the number to ninety-nine, and used as a frontispiece the portrait of Van Dyck, with the following inscription: *Icones principum, virorum doctorum, &c. &c., numero centum ob Antonio Van Dyck pictore ad vivum expressae eiusq. sumtibus aeri incisae*, 1645. Seventeen editions were published, the last in 1759, with 124 plates. Many of the plates are the property of the French Government, and belong to the Chalcographie Nationale in Paris.

Literature.—See W. Hookham Carpenter, *Pictorial Notices, consisting of a Memoir of Sir Anthony Van Dyck, with a descriptive catalogue of the etchings executed by him* (London, 1844); John Smith, *A Catalogue Raisonné of the Works of the most Eminent Dutch, Flemish, and French Painters*, part iii. (London, 1841); J. Guiffrey, *Antoine Van Dyck, sa vie et son œuvre* (Paris, 1882); A. Michiels, *Ant. Van Dyck et ses élèves* (Paris, 1881); Ign. von Szwykowski, *A. Van Dycks Bildnisse bekannter Personen* (Leipzig, 1858); Fr. Wibiral, *L'Iconographie d'A. Van Dyck d'après les recherckes de H. Weber* (Leipzig, 1877); Carl Lemcke, *A. Van Dyck* (in Robert Dohme's *Kunst und Künstler*, vol. i., Leipzig, 1877); Alfr. Woltmann and K. Woermann, *Gesch. der Malerei*, vol. iii. (Leipzig, 1886); Max Rooses, *Geschiedenis der Antwerpsche Schilderschool* (Ghent, 1879); F. J. Van den Branden, *Gesch. der Antw. Schilderschool* (Antwerp, 1883); Percy Rendall Head, *Van Dyck* (London, 1887); F. G. Stephens, *Catalogue of the Exhibition of the Works of Sir A. Van Dyck* (London, 1887); E. Knackfuss, *Van Dyck* (Bielefeld, 1896); Lionel Cust, *Anthony Van Dyck* (London, 1900), an abridgment with emendations, *Van Dyck* (1906), and *A Description of the Sketch-Book by Sir Anthony Van Dyck . . . at Chatsworth* (London, 1902); Max Rooses, *Chefs-d'œuvres d'Antoine van Dyck* (Antwerp, 1901); *Antoine Van Dyck* (Paris, 1902); Frank Newbolt, *Etchings of Van Dyck* (London, 1906). (H. H.; P. G. K.)

VANE, SIR HENRY (1589–1654), English secretary of state, eldest son of Henry Vane or Fane, of Hadlow, Kent, a member of an ancient family of that county, by his second wife, Margaret, daughter of Roger Twysden of East Peckham, Kent, was born on the 18th of February 1589. He matriculated from Brasenose College, Oxford, on the 15th of June 1604, was admitted to Gray's Inn in 1606, and was knighted by James I. on the 3rd of March 1611. He purchased several offices at court, was made comptroller of the king's household about 1629, and in spite of a sharp quarrel with Buckingham managed to keep the king's favour, in 1639 becoming treasurer. He was returned to parliament in 1614 for Lostwithiel, from 1621 to 1626 for Carlisle, in 1628 for Retford, and in the Short and Long Parliament, assembled in 1640, he sat for Wilton. He was despatched on several missions in 1629 and 1630 to Holland, and in 1631 to Gustavus Adolphus to secure the restitution of the Palatinate, but without success. In 1630 Vane had become a privy councillor and one of the chief advisers of the king. He was made a commissioner of the Admiralty in 1632 and for the colonies in 1636. He was one of the eight privy councillors appointed to manage affairs in Scotland on the outbreak of the troubles there, and on the 3rd of February 1640, through the influence of the queen and of the marquis of Hamilton and in opposition to the wishes of Strafford, he was made secretary of state in the room of Sir John Coke. In the Short Parliament, which assembled in April, it fell to Vane, in his official capacity, to demand supplies. He proposed a bargain by which the king should give up ship-money and receive in return twelve subsidies. Parliament, however, proved intractable and was dissolved on the 5th of May, to prevent a vote against the continuance of the war with the Scots. In the impeachment of Strafford, Vane played a very important part and caused the earl's destruction. He asserted that Strafford had advised the king at a meeting of the privy council, "You have an army in Ireland; you may employ it to reduce this kingdom." He refused to admit or deny the meaning attributed by the prosecution that "this kingdom" signified England; he was unsupported by the recollection of any other privy councillor, and his statement could not be corroborated by his own notes, which had been destroyed by order of the king, but a copy obtained through his son, the younger Vane, was produced by Pym and owned by Vane to be genuine. He was on bad terms with Strafford, who had opposed his appointment to office and who had given him special provocation by assuming the barony of Raby, a title ardently desired by Vane himself. He was not unnaturally accused of collusion and treachery, and there is no doubt that he desired Strafford's removal not only on private but on public grounds, believing that his sacrifice would satisfy the demands of the parliament. Nevertheless, there has appeared no evidence to support the charge that he deliberately compassed his destruction. Suspicions of his fidelity, however, soon increased, and after having accompanied the king to Scotland in August 1641, he was dismissed from all his appointments on the 4th of November on Charles's return. Vane immediately joined the parliament; on Pym's motion, on the 13th of December, he was placed on the committee for Irish affairs, was made lord lieutenant of Durham on the 10th of February 1642, became a member of the committee of both kingdoms on the 7th of February 1644, and in this capacity attended the Scots army in 1645, while the parliament in the treaty of Uxbridge demanded for him from Charles a barony and the repayment of his losses. He adhered to the parliament after the king's death, and in the first parliament of the Protectorate he was returned for Kent, but the House had refused to appoint him a member of the council of state in February 1650. He died in 1654. He had married Frances, daughter and co-heir of Thomas Darcy of Tolleshurst Darcy in Essex, by whom he had a large family of children, of whom the eldest son, Sir Henry Vane, the younger, is separately noticed.

Clarendon invariably speaks of Vane in terms of contempt and reproach. He describes him as merely fit for court duties, "of very ordinary parts by nature and . . . very illiterate. But being of a stirring and boisterous disposition, very industrious and very bold, he still wrought himself into some employment." He declares that motives of revenge upon Strafford influenced not only his conduct in the impeachment but his unsuccessful management of the king's business in the Short Parliament, when he "acted that part maliciously and to bring all into confusion." The latter accusation, considering the difficulties of the political situation and Vane's total want of ability in dealing with them, is probably unfounded. On the general charge of betraying the king's cause, Vane's mysterious conduct in the impeachment, his great intimacy with Hamilton, and the favour with which he was immediately received by the Opposition on his dismissal from office, raise suspicions not altogether allayed by the absence of proof to substantiate them, while the alacrity with which he transferred himself to the parliament points to a character, if not of systematic treachery, yet of unprincipled and unscrupulous time-serving. Materials, however, to elucidate the details and motives of his ill-omened career have hitherto been wanting.

VANE, SIR HENRY (1613–1662), English statesman and author, known as "the younger" to distinguish him from his father, Sir Henry Vane (*q.v.*), was baptized on the 26th of May 1613, at Debden, Essex. After an education at Westminster, where he was noted for his high and reckless spirits, and at Magdalen Hall, Oxford, where he neither matriculated nor took his degree, he was attached to the embassy at Vienna and at Leiden and Geneva. He had already acquired strong Puritan views which, in spite of the personal efforts of Laud, who made the attempt at the king's request, he refused to give up. In 1635, in order to obtain the free exercise of his religion, he emigrated to Massachusetts, where he was elected governor in 1636. After one year in office, during which he showed some administrative ability, he was defeated by Winthrop, the former governor, chiefly on account of the protection he had given to Mrs Hutchinson in the religious controversies which she raised. He, however, never lost his interest in the colonies, and used his influence hereafter on several occasions in their support.

Vane returned to England in August 1637. He was made joint-treasurer of the navy with Sir W. Russell in January 1639, was elected for Hull in the Short and Long Parliaments, and was knighted on the 23rd of June 1640. Accidentally finding among his father's papers some notes of Strafford's speech in the council of May 5, 1640, he allowed Pym to take a copy, and was thus instrumental in bringing about Strafford's downfall. He carried up the impeachment of Laud from the Commons, was a strong supporter, when on the committee of religion, of the "Root and Branch" bill, and in June 1641 put forward a scheme of church government by which commissioners, half lay and half cleric, were to assume ecclesiastical jurisdiction in each diocese. During the absence of Pym and Hampden from the House at the time of Charles's attempted arrest of the five members, Vane led the parliamentary party, and was finally dismissed from his office in December 1641, being reinstated by the parliament in August 1642. The same month he was placed upon the committee of defence. In 1643 he was the leading man among the commissioners sent to treat for a league with the Scots. Vane, who was bitterly opposed to the tyranny of the Presbyterian system, was successful in two important points. The aim of the Scots was chiefly the propagation of their discipline in England and Wales, and for this they wanted only a "covenant." The English desired a political "league." Vane succeeded in getting the bond termed the Solemn League and Covenant, and further in substituting the whole expression "*according to the word of God and* the example of the best Reformed churches" for the latter part alone. He succeeded to the leadership of the party on Pym's death. He promoted, and became a chief member of, the committee of both kingdoms established in February 1644, and was sent to York in the summer of the year to urge Fairfax and Manchester to march against Prince Rupert, and secretly to propose the king's deposition. In 1645 he was one of the negotiators of the treaty of Uxbridge. He was, with Cromwell, a prime mover in the Self-Denying Ordinance and the New Model, and his adherence to the army party and to religious tolerance now caused a definite breach with the Scots. Vane had at the Westminster Assembly, writes Baillie indignantly, "prolixly, earnestly and passionately reasoned for a full liberty of conscience to all religions," a policy directly opposed to Presbyterianism, and his leadership terminated when the latter party obtained the supremacy in parliament in 1646. During the subsequent struggle he was one of the six commissioners appointed to treat with the army by the parliament, and endeavoured to effect a compromise, but failed, being distrusted by both the Levellers and the Presbyterians. His views of government may be studied in *The People's Case Stated*, written shortly before his death. "The power which is directive, and states and ascertains the morality of the rule of obedience, is in the hand of God; but the original, from whence all just power arises, which is magistratical and coercitive, is from the will or free gift of the people, who may either keep the power in themselves or give up their subjection and will in the hand of another." King and people were bound by "the fundamental constitution or compact," which if the king violated, the people might return to their original right and freedom.

In spite, however, of these free opinions, Vane still desired the maintenance of the monarchy and the constitution. He voted for a declaration to this effect on the 28th of April 1648, and had consistently opposed the various votes of "non-addresses." Several communications had already been fruitlessly attempted with Vane from the king's side, through the agency of Lord Lovelace in January 1644, and through that of John Ashburnham in March 1646. Vane now supported the renewal of negotiations, and was appointed on the 1st of September 1648 one of the commissioners for the treaty of Newport. He here showed a desire to come to terms on the foundation of toleration and a "moderate episcopacy," of which Cromwell greatly disapproved, and opposed the shaking off of the conferences. He absented himself from parliament on the occasion of "Pride's Purge," and remained in retirement until after the king's death, a measure in which he took no part, though he continued to act as a member of the government. On the 14th of February 1649 he was placed on the council of state, though he refused to take the oath which expressed approbation of the king's execution. Vane now showed himself an able administrator. He served on innumerable committees of importance, and was assiduous in his attendance. He furnished the supplies for Cromwell's expedition to Scotland, and was one of the commissioners sent there subsequently to settle the government and negotiate a union between the two countries. He showed great energy in colonial and foreign affairs, was a leading member of the committee dealing with the latter, and in 1651 went on a secret mission to negotiate with Cardinal de Retz, who was much struck with his ability, while his knowledge of foreign policy, in which he inclined in favour of Holland, earned the praise also of Milton. To Vane, as chief commissioner of the navy, belongs largely the credit of the victories obtained against Van Tromp.

In domestic politics Vane continued to urge his views of toleration and his opposition to a state church. On the 9th of January 1650 he brought forward as chairman the report of a committee on the regulation of elections. He wished to reform the franchise on the property basis, to disfranchise some of the existing boroughs, and to give increased representation to the large towns; the sitting members, however, were to retain their seats. In this he was opposed to Cromwell, who desired an entirely new parliament and the supremacy of the army representation. On the 20th of April Cromwell forcibly dissolved the Long Parliament while in the act of passing Vane's bill. On the latter's protesting, "This is not honest; yea, it is against morality and common honesty," Cromwell fell a-railing at him, crying out with a loud voice, "O Sir Henry Vane, Sir Henry Vane; the Lord deliver me from Sir Henry Vane!" (Ludlow, *Mem.* i. 353). Hitherto they had lived on intimate terms of friendship, but this incident created a permanent breach. In his seclusion at Raby he now wrote the *Retired Man's Meditations* (1655). In 1656 he proposed in *A Healing Question* (reprinted in the "Somers Tracts," vol. vi. ed. Scott) a new form of government, insisting as before upon a Puritan parliament supreme over the army. The seditious movements of the Anabaptists were also attributed to his influence, and on the 29th of July 1656 he was summoned before the council. Refusing to give security not to disturb the public peace, he was on the 9th of September sent prisoner to Carisbrooke Castle, and there remained until the 31st of December. He addressed a letter to Cromwell in which he repudiated the extra-parliamentary authority he had assumed. In the parliament of Richard Cromwell he was elected for Whitchurch, when he urged that the protector's power should be strictly limited, and the negative voice of the new House of Lords disallowed.

Subsequently he allied himself with the officers in setting aside the protectorate and in restoring the Long Parliament, and on Richard Cromwell's abdication he regained his former supremacy in the national counsels. He was a member of the committee of safety and of the council of state appointed in May, was commissioner for the navy and for the appointment of army officers, managed foreign affairs and superintended finance. He adhered to Lambert, remained a member of the government after the latter had turned out the Long Parliament, and endeavoured to maintain it by reconciling the disputing generals and by negotiating with the navy, which first deserted the cause. In consequence, at the restoration of the Long Parliament he was expelled the House and ordered to retire to Raby.

At the Restoration Vane was imprisoned in the Tower by the king's order. After several conferences between the houses of parliament, it was agreed that he should be excepted from the indemnity bill, but that a petition should be sent to Charles asking that his life might be spared. The petition was granted. On the meeting, however, of the new parliament of 1661, a vote was passed demanding his trial on the capital charge, and Vane was taken back to the Tower in April 1662 from the Scilly Isles, where he had been imprisoned. On the 2nd of June he appeared before the king's bench to answer the charge of high treason, when he made a bold and skilful defence, asserting the sovereign power of parliament in justification of his conduct. He was, however, found guilty, and executed on Tower Hill on the 14th of June 1662. He had married, in 1640, Frances, daughter of Sir Christopher Wray of Barlings, by whom he had a large family of sons and daughters. Of these Christopher, the fifth son, succeeded to his father's estates and was created Baron Barnard by William III.

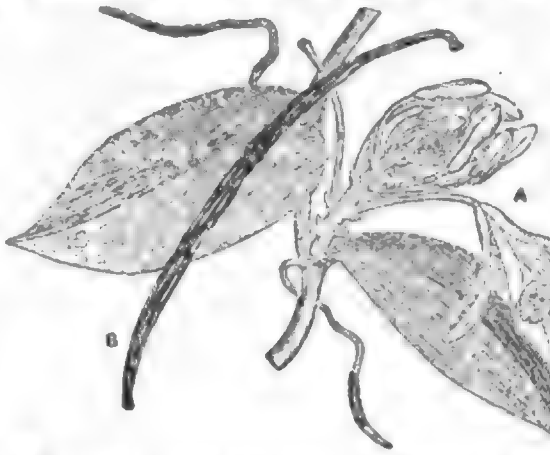
Vane's great talents as an administrator and statesman have been universally acknowledged. He possessed, says Clarendon, "extraordinary parts, a pleasant wit, a great understanding, a temper not to be moved," and in debate "a quick conception and a very sharp and weighty expression." His patriotism and assiduity in the public service, and complete freedom from corruption, were equally admirable and conspicuous. His religious writings, apart from his constant devotion to toleration and dislike of a state church, are exceedingly obscure both in style and matter, while his enthusiasm and fanaticism in speculative doctrine combine curiously, but not perhaps incongruously, with exceptional sagacity and shrewdness in practical affairs. "He had an unusual aspect," says Clarendon, "which . . . made men think there was something in him of the extraordinary; and his whole life made good that imagination." Besides the works already mentioned and several printed speeches, Vane wrote: *A Brief Answer to a certain Declaration* of John Winthrop (reprinted in the Hutchinson Papers, publ. by the Prince Society, 1865); *A Needful Corrective or Balance in Popular Government* . . . in answer to Harrington's *Oceana*; *Of Love of God and Union with God*; two treatises, viz. (1) *An Epistle General to the Mystical Body of Christ on Earth*, (2) *The Face of the Times: A Pilgrimage into the Land of Promise* . . . (1664). *The Trial of Sir Henry Vane, Knight* (1662), contains, besides his last speech and details relating to the trial, *The People's Case Stated* (reprinted in Forster's *Life of Vane*), *The Valley of Jehoshaphat*, and *Meditations concerning Man's Life*. *A Letter from a True and Lawful Member of Parliament to one of the Lords of His Highness's Council* (1656), attributed to Vane, was written by Clarendon; and *The Light Shining out of Darkness* was probably by Henry Stubbe; while *The Speech against Richard Cromwell* is the composition of some contemporary pamphleteer.

Bibliography.—Article by C. H. Firth in *Dict. of Nat. Biog.*; *Life and Death of Sir Henry Vane*, by G. Sikes, 1662 (a treatise on the "course of his hidden life"); and Lives by John Forster, in Lardner's *Cabinet Encyclopaedia: Eminent British Statesmen*, vol. iv. (1838); by C. W. Upham in "Library of American Biography," vol. iv. (1851); by J. K. Hosmer (1888); and by C. Dalton in *Hist. of the Family of Wray* (1881), ii. 93–137; also Wood's *Ath. Oxon.* (Bliss), iii. 578, and *Biographia Britannica*. See especially S. R. Gardiner's *Hist. of England*, his *Great Civil War* and his *Commonwealth*, and Clarendon's *Hist. of the Rebellion*, and the contemporary memoirs and diaries; Hist. MSS. Comm. MSS. of duke of Buccleuch, ii. pt. ii. 756; Masson's *Life of Milton*, iv. 442 and *passim*; the sonnet addressed by Milton to Vane; and W. W. Ireland, *Life of Sir Henry Vane the Younger* (1907). (P. C. Y.)

VANE (formerly spelt "fane," *i.e.* pennon, flag; cf. Ger. *Fahne*, Du. *vaan*, Fr. *girouette*, Ital. *banderuola*, Ger. *Wetterfahne*), the weathercock on a steeple. Vanes seem in early times to have been of various forms, as dragons, &c.; but in the Tudor period the favourite design was a beast or bird sitting on a slender pedestal and carrying an upright rod, on which a thin plate of metal is hung like a flag, ornamented in various ways.

VAN HORNE, SIR WILLIAM CORNELIUS (1843–   ), Canadian financier, was born in Will county, Illinois, U.S.A., on the 3rd of February 1843, of Dutch descent. He was educated in the common schools of the state, and in 1857 began work as office boy in a railway station. His ability and force brought him to the front, and he rose till in 1881 he was appointed general manager of the Canadian Pacific railway. For the successful completion of this great road his strong will and mental grasp were largely responsible, and he it was who not only controlled but steadily extended its operations during the lean years which followed. In 1884 he became vice-president of the line, in 1888 president, and in 1899 chairman of the board of directors. From 1885 onward he was more and more associated with every branch of Canadian mercantile and financial life, and as a publicist gave shrewd expression to his views on political and economic questions. After the Spanish-American War (1898) he became one of the chief promoters of railway and industrial enterprise in Cuba. In May 1894 he was knighted by Queen Victoria in acknowledgment of his distinguished public services. He was also known as a patron of art and literature and an amateur painter of no little merit.

VANILLA, a flavouring agent largely used in the manufacture of chocolate, in confectionery and in perfumery. It consists of the fermented and dried pods of several species of orchids belonging to the genus *Vanilla*.[1] The great bulk of the commercial article is the produce of *V. planifolia*, a native of south-eastern Mexico, but now largely cultivated in several tropical countries, especially in Bourbon, the Seychelles, Tahiti and Java. The plant has a long fleshy stem and attaches itself by its aerial rootlets to trees; the roots also penetrate the soil and derive a considerable portion of their nourishment from it. The leaves are alternate, oval-lanceolate and fleshy; the light greenish flowers form axillary spikes. The fruit is a pod from 6 to 10 in. long, and when mature about half an inch in diameter. The wild plant yields a smaller and less aromatic fruit, distinguished in Mexico as *Baynilla cimarona*, the cultivated vanilla being known as *B. corriente*.



Vanilla Plant (*Vanilla planifolia*). A, shoot with flower, leaf and aerial rootlets; B, pod or fruit.

Vanilla was used by the Aztecs of Mexico as an ingredient in the manufacture of chocolate before the discovery of America by the Spaniards, who adopted its use. The earliest botanical notice is given in 1605 by Clusius (*Exoticorum Libri Decem*), who had received fruits from Hugh Morgan, apothecary to Queen Elizabeth; but he seems to have known nothing of its native country or uses. The Mexican vanilla had been introduced to cultivation before the publication of the second edition of Philip Miller's *Gardeners' Dictionary* (1739). It was reintroduced by the marquis of Blandford, and in 1807 a flowering specimen was figured and described by R. A. Salisbury (*Paradisus*, London, t. 82). Mexican vanilla is regarded as the best. It is principally consumed in the United States. In Bourbon about 3000 acres are under cultivation; the crop is sent to Bordeaux, the chief centre of the trade in France. Its odour is said to differ from the Mexican variety in having a suggestion of tonqua bean. The Seychelles produce large quantities of exceedingly fine quality; the produce of these islands goes chiefly to the London market. The Java vanilla, grown chiefly in Krawang and the Preanger Regencies, is shipped to Holland. The Tahiti produce is inferior in quality.

Mr Hermann Mayer Senior, in the *Chemist and Druggist*, June 30, 1906, gives the following figures, which approximately represent the world's output of vanilla during the seasons 1905–1906: Bourbon, 70 tons; Seychelles, 45 tons; Mauritius, 5 tons; Comores, Mayotte, Madagascar, &c., 120 tons; Guadeloupe, Java, Ceylon and Fiji, 10 tons; Mexica, 70 tons; Tahiti, 100 tons—total, about 420 tons.

The best varieties of vanilla pods are of a very dark chocolate brown or nearly black colour, and are covered with a crystalline efflorescence technically known as *givre*, the presence of which is taken as a criterion of quality. The peculiar fragrance of vanilla is due to vanillin, $C_8H_8O_3$, which forms this efflorescence. Chemically speaking, it is the aldehyde of methyl-protocatechuic acid. It is not naturally present in the fleshy exterior of the pod, but is secreted by hair-like papillae lining its three internal angles, and ultimately becomes diffused through the viscid oily liquid surrounding the seeds. The amount of vanillin varies according to the kind: Mexican vanilla yields 1·69, Bourbon or Réunion 1·9 to 2·48, and Java 2·75%. Besides vanillin, the pods contain vanillic acid (which is odourless), about 11% of fixed oil, 2·3% of soft resin, sugar, gum and oxalate of lime.

Vanillin forms crystalline needles, fusible at 81° C., and soluble in alcohol, ether and oils, hardly soluble in cold, but more so in boiling water. Like other aldehydes, it forms a compound with the alkaline bisulphites, and can by this means be extracted from bodies containing it. Vanillin has been found in Siam benzoin and in raw sugar, and has been prepared artificially from coniferin, a glucoside found in the sapwood of fir-trees, from asafoetida, and from a constituent of oil of cloves named eugenol. It is from the last-named that vanillin is now prepared on a commercial scale, chiefly in Germany. Vanillin does not appear to have any physiological action on human beings when taken in small doses, as much as 10 to 15 grains having been administered without noxious results. On small animals, however, such as frogs, it appears to act as a convulsive. It has been suggested as a stimulant of an excito-motor character in atonic dyspepsia. It is a constituent of Günzburg's reagent (phloro-vanillin-glucin) for the detection of free hydrochloric acid in the gastric contents. The poisonous effects that have on several occasions followed from eating ices flavoured with vanilla are not to be attributed to the vanilla, but probably to the presence of *tyrotoxicon* (*Pharm. Journ.* [3], xvii. p. 150), a poison found in milk which has undergone certain putrefactive changes, and producing choleraic effects, or perhaps to the presence of microscopic fungi in the vanilla, the plantations being liable to the attack of *Bacterium putredinis*. Workmen handling the beans in the Bordeaux factories are subject to itching of the hands and face; but this is caused by an *Acarus* which occupies the end of the pod. In some cases, however, symptoms of dizziness, weariness and malaise, with muscular pains, have been felt, due possibly to the absorption of the oily juice by the hands of the workmen.

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[1] Span. *vainilla*, dim. of *vaina*, a pod.

See also R. A. Rolfe, "Vanillas of Commerce," in *Kew Bulletin* (1895), p. 169, and "Revision of the Genus Vanilla," in *Journal of The Linnean Society* (Botany), xxxii. 439 (1896); also S. J. Galbraith, on "Cultivation in the Seychelles," *U.S. Dept. of Agriculture, Division of Botany, Bulletin 21* (1898).

VANINI, LUCILIO, or, as he styled himself in his works, GIULIO CESARE (1585–1619), Italian free-thinker, was born at Taurisano, near Naples, in 1585. He studied philosophy and theology at Rome, and after his return to Naples applied himself to the physical studies which had come into vogue with the Renaissance. Like Giordano Bruno, though morally and intellectually inferior to him, he was among those who led the attack on the old scholasticism and helped to lay the foundation of modern philosophy. Vanini resembles Bruno, not only in his wandering life and in his tragic death, but also in his anti-Christian bias. From Naples he went to Padua, where he came under the influence of the Alexandrist Pomponazzi (*q.v.*), whom he styles his divine master. At Padua he studied law, and was ordained priest. Subsequently he led a roving life in France, Switzerland and the Low Countries, supporting himself by giving lessons and disseminating anti-religious views. He was obliged to flee from Lyons to England in 1614, but was imprisoned in London for some reason for forty-nine days. Returning to Italy he made an attempt to teach in Genoa, but was driven once more to France, where he made a valiant effort to clear himself of suspicion by publishing a book against atheists, *Amphitheatrum Aeternae Providentiae Divino-Magicum* (1615). Though the definitions of God are somewhat pantheistic, the book is sufficiently orthodox, but the arguments are largely ironical, and cannot be taken as expounding his real views. Vanini expressly tells us so in his second (and only other published) work, *De Admirandis Naturae Reginae Deaeque Mortalium Arcanis* (Paris, 1616), which, originally certified by two doctors of the Sorbonne, was afterwards re-examined and condemned to the flames. Vanini then left Paris, where he had been staying as chaplain to the maréchal de Bassompierre, and began to teach in Toulouse. In November 1618 he was arrested, and after a prolonged trial was condemned, as an atheist, to have his tongue cut out, and to be strangled at the stake, his body to be afterwards burned to ashes. The sentence was executed on the 9th of February 1619.

See Cousin, *Fragments de philosophie cartésienne* (Brussels, 1838–40), i. 1–99; French trans. M. X. Rousselot (Paris, 1842); John Owen, *Skeptics of the Italian Renaissance* (London, 1893), 345–419; J. Toulan, *Étude sur L. Vanini* (Strassburg, 1869); Cesare Cantu, *Gli Eretici d'Italia* (Turin, 1867), iii. 72 ff.; Fuhrmann, *Leben und Schicksale* (Leipzig, 1800); Vaïsse, *L. Vanini* (Paris, 1871); Palumbo, *Vanini, e i suoi tempi* (Naples, 1878); Passamonti in *Rivista italiana di filosofia* (1893), vol. iii.

VANLOO, CHARLES ANDREW (1705–1765), subject painter, a younger brother of John Baptist Vanloo (*q.v.*), was born at Nice on the 15th of February 1705. He received some instruction from his brother, and like him studied in Rome under Luti. Leaving Italy in 1723, he worked in Paris, where he gained the first prize for historical painting. After again visiting Italy in 1727, he was employed by the king of Sardinia, for whom he painted a series of subjects illustrative of Tasso. In 1734 he settled in Paris, and in 1735 became a member of the French Academy; and he was decorated with the order of St Michael and appointed principal painter to the king. By his simplicity of style and correctness of design, the result of his study of the great Italian masters, he did much to purify the modern French school; but the contemporary praise that was lavished upon his productions now appears undue and excessive. His "Marriage of the Virgin" is preserved in the Louvre. He died at Paris on the 15th of July 1765.

VANLOO, JOHN BAPTIST (1684–1745), French subject and portrait painter, was born at Aix in Provence on the 14th of January 1684. He was instructed in art by his father. Having at an early age executed several pictures for the decoration of the church and public buildings at Aix, he was employed on similar work at Toulon, which he was obliged to leave during the siege of 1707. He was patronized by the prince of Carignan, who sent him to Rome, where he studied under Benedetto Luti. Here he was much employed on church pictures, and in particular executed a greatly praised "Scourging of Christ" for St Maria in Monticelli. At Turin he painted the duke of Savoy and several members of his court. Then, removing to Paris, where he was elected a member of the French Academy, he executed various altar-pieces and restored the works of Primaticcio at Fontainebleau. In 1737 he went to England, where he attracted attention by his portrait of Colley Cibber and of Owen McSwiny, the theatrical manager; the latter, like many other of Vanloo's works, was engraved in mezzotint by the younger Faber. He also painted Sir Robert Walpole, whose portrait by Vanloo in his robes as chancellor of the exchequer is in the National Portrait Gallery (London), and the prince and princess of Wales. He did not, however, practise long in England, for his health failing he retired to Paris in 1742, and afterwards to Aix, where he died on the 19th of December 1745. His likenesses were striking and faithful, but seldom flattering, and his heads are forcible in colouring. The draperies and accessories in his pictures were usually painted by Van Achen, Eccardt and Root.

VANNES, a town of western France, capital of the department of Morbihan, 84 m. N.W. of Nantes on the railway to Brest. Pop. (1906), town, 16,728; commune, 23,561. It is situated 10 m. from the open sea, at the confluence of two streams forming the Vannes river, which debouches into the land-locked Gulf of Morbihan about a mile below the town. The narrow, steep and crooked streets of the old town, which lie on a hill facing the south, are surrounded by fortifications of the 14th, 15th and 17th centuries, pierced by four gates and flanked by nine towers and five bastions, connected by battlements. In the Constable's Tower Olivier de Clisson was confined in 1387. The modern suburbs, with the port, the public buildings, barracks, convents, squares and promenades, notably the Garenne and the park of the Prefecture, surround the old town. The archaeological museum, the contents of which are mainly the fruit of excavations at Carnac and elsewhere in the vicinity, includes one of the richest collections of prehistoric remains in Europe. There are also a museum of natural history and a library. The cathedral of St Peter overlooks the old town; burnt by the Normans in the 10th century, it was rebuilt in the 13th, 15th and 18th centuries. It has remains of a cloister and contains the relics and tomb of the Spanish Dominican preacher St Vincent Ferrier, who died at Vannes in 1419. The curious round Chapelle du Pardon to the left of the nave was built in 1537 in the Italian style. Some interesting old houses, including that of the presidents of the parlement of Brittany, the rich private collections of M. de Limur, and the church of St Paterne (18th century) are also worthy of mention. There is a monument to Le Sage, born near Vannes. Vannes is the seat of a prefect, a bishop and a court of assizes, and has tribunals of first instance and of commerce and a branch of the Bank of France. A communal college is among the educational institutions. Among the industries are building, tanning and cotton-weaving. The port of Vannes, to the south of the town, is formed by the Vannes river and is accessible only to small vessels. Vessels of 800 tons can make the harbour of Conleau about 2½ m. from the town.

Vannes (*Dariorigum*), the capital of the Veneti (whence *Gwened*, the Breton name of the town), was at the head of the Armorican league against Julius Caesar, who in 56 B.C. overcame their fleet and opened up their country by six roads. St Paternus, the first bishop, was consecrated in 465. In the 5th century Vannes was ruled for a time by independent counts, but soon came under the yoke of the Franks. Nomenoé, the lieutenant of Louis I., the Pious, in Brittany, assumed the title of king in 843, and one of his brothers was the founder of a line of counts who distinguished themselves against the Normans in the 9th and 10th centuries. Vannes became part of the duchy of Brittany at the end of the 10th century. The estates of Brittany met there for the first time in 1203 to urge Philip Augustus to avenge the death of Arthur of Brittany. In the course of the War of Succession the town was besieged four times in 1342. Duke John IV. built here the castle of L'Hermine and made it his habitual residence. In 1487 the town was for a year in the hands of Charles VIII. of France. In 1532 Brittany was definitively united to France. The estates met at Vannes several times in the 17th and 18th centuries. During the Revolution this town was the scene of the execution in 1795 of some of the prisoners after the royalist disaster at Quiberon.

VAN RENSSELAER, STEPHEN (1764–1839), American political leader and soldier, "last of the patroons," was born at New York City on the 1st of November 1764. He was fifth in descent from KILLIAN VAN RENSSELAER (*c.* 1580–1645), the original patroon of Rensselaerwyck, New York, who acquired his large estates between 1630 and 1637. Stephen was graduated at Harvard in 1782. In 1789–90 he was a member of the New York Assembly, and from 1791 to 1795 served as a member of the state Senate. He was lieutenant-governor of New York (1795–1801) for the two terms in which John Jay was governor. In 1801 he presided over the state constitutional convention, and from 1808 to 1810 was again in the Assembly. He was an ardent promoter of the Erie Canal, and as a commissioner to examine the proposed route, &c., he reported favourably to the Assembly in 1811. In the second war with Great Britain he commanded the First Division of the detached militia of the state of New York, with the rank of major-general, and on the 13th of October 1812 was defeated at the battle of Queenston Heights. As he was a Federalist he was severely criticised and censured for this defeat and resigned from the army. At the close of the war the Erie Canal project was renewed, and from 1816 till his death he was a member of the board of canal commissioners, and for nearly fifteen years was its president. In 1818 he was again elected to the Assembly; in 1819 he became a regent of the State University of which he was for a time chancellor; and in 1821 he was a delegate to the New York constitutional convention. From 1822 to 1829 he was a member of the National House of Representatives,[1] and there voted for John Quincy Adams for the presidency, and served as chairman of the committee on agriculture. In 1820–23 he sent out at his own expense Professors Amos Eaton (1776–1842) and Edward Hitchcock to make extensive surveys, results of which were published as *An Agricultural and Geological Survey of the District adjoining the Erie Canal* (Albany, 1824). In 1824 he founded a school in Troy which was incorporated two years later as the Rensselaer Polytechnic Institute. He died at Albany, New York, on the 26th of January 1839.

See D. D. Barnard, *A Discourse on the Life, Services and Character of Stephen Van Rensselaer* (Albany, 1839).

VANSITTART, HENRY (1732–1770 or 1771), Anglo-Indian governor, was born in London on the 3rd of June 1732. His father, Arthur van Sittart (1691–1760), and his grandfather, Peter van Sittart (1651–1705), were both wealthy merchants and directors of the Russia company. Peter, a merchant adventurer, who had migrated from Danzig to London about 1670, was also a director of the East India company. The family name is taken from the town of Sittard in Limburg. Educated at Reading school and at Winchester college, Henry Vansittart joined the society of the Franciscans, or the "Hell-fire club," at Medmenham, his elder brothers, Arthur and Robert, being also members of this fraternity. In 1745 he entered the service of the East India company and sailed for Fort St David; here he showed himself very industrious, made the acquaintance of Robert Clive and rose rapidly from one position to another. As a member of the council of Madras he helped to defend the city against the French in 1759, and in July 1760 he went to Bengal as president of the council and governor of Fort William. Courageously facing the difficulties of his new position, which included a serious lack of funds, he deposed the subadar of Bengal, Mir Jafar, whom he replaced by his son-in-law, Mir Kasim, a circumstance which increased the influence of England in the province. He was, however, less successful in another direction. Practically all the company's servants were traders in their private capacity, and as they claimed various privileges and exemptions this system was detrimental to the interests of the native princes and gave rise to an enormous amount of corruption. Vansittart sought to check this, and in 1762 he made a treaty with Mir Kasim, but the majority of his council were against him and in the following year this was repudiated. Reprisals on the part of the subadar were followed by war, and, annoyed at the failure of his pacific schemes, the governor resigned and returned to England in 1764. His conduct was attacked before the board of directors in London, but events seemed to prove that he was in the right, and in 1769 he became a director of the company, having in the previous year obtained a seat in parliament. He was now sent on an important mission to India; he left England in September 1769, but the ship in which he sailed was lost at sea late in 1770 or early in 1771. One of his five sons was Nicholas Vansittart, Baron Bexley (*q.v.*). To defend his conduct in Bengal Vansittart published some papers as *A Narrative of the Transactions in Bengal from 1760 to 1764* (London, 1766).

Vansittart's brother, Robert Vansittart (1728–1789), who was educated at Winchester and at Trinity College, Oxford, was regius professor of civil law at Oxford from 1757 until his death on the 31st of January 1789. Another brother, George Vansittart (1745–1825), of Bisham Abbey, Berkshire, was the father of General George Henry Vansittart (1768–1824) and of Vice-Admiral Henry Vansittart (1777–1843).

VAN'T HOFF, JACOBUS HENDRICUS (1852–), Dutch chemist and physicist, was born in Rotterdam on the 30th of August 1852. He studied from 1869 to 1871 at the polytechnic at Delft, in 1871 at the university of Leiden, in 1872 with F. A. Kekulé at Bonn, in 1873 with C. A. Wurtz at Paris, and in 1874, when he took his doctor's degree, with E. Mulder at Utrecht. In 1876 he became lecturer on physics at the veterinary school at Utrecht, and two years later he was chosen professor of chemistry, mineralogy and geology in Amsterdam University. In 1894 he declined an invitation to the chair of physics at Berlin University, but in 1896 he went to Berlin as professor to the Prussian Academy of Sciences, with a salary and a laboratory, but freedom to do whatever he liked; and at the same time he accepted an honorary professorship in the university so that he might lecture if he were so minded. On taking up these appointments he announced that, the application of mathematics to chemistry remaining his chief aim, he proposed to devote himself to the study of the formation of oceanic salt deposits, with special reference to the Stassfurt deposits. He may be regarded as the founder of the doctrine of stereoisomerism (*q.v.*), for he was the first, in 1874, to introduce a definite mechanical theory of valency, and to connect the optical activity exhibited by many carbon compounds with their chemical constitution. In respect of this doctrine of the "asymmetric carbon atom," van't Hoff's name is generally linked with that of J. A. le Bel (born on the 21st of January 1847, at Pechelbronn, Lower Alsace), who, only two months later, independently enunciated the theory of asymmetric combinations with carbon; though it must be noted that J. Wislicenus, to whom van't Hoff, in fact, acknowledged his indebtedness, had already suggested that in order to explain the constitution of certain organic bodies, the tridimensional arrangement of atoms in space must be taken into account. For this work van't Hoff and Le Bel received the Davy medal jointly from the Royal Society in 1893. From 1874 to 1884 van't Hoff's attention was mainly given to the law of mass-action, and he established the theorem known by his name, which connects quantitative displacement of equilibrium with change of temperature. From 1885 to 1895 he was engaged on the theory of solutions, and developing the analogy between dilute solutions and gases he showed that the osmotic pressure of a solution has the same value as the pressure that solute would exert if it were contained as a gas in the same volume as is occupied by the solution. From 1885 he published the *Zeitschrift für physikalische Chemie*, in collaboration with Professor W. Ostwald of Leipzig.

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[1] He succeeded his cousin, Solomon Van Rensselaer (1744–1852), who was in the regular army in 1792–1800, who had fought under General Anthony Wayne at Maumee Rapids in 1794 and under Stephen Van Rensselaer at Queenston Heights in 1812, and who was in the House of Representatives in 1819–1822.

VAN WERT, a city and the county-seat of Van Wert county, Ohio, U.S.A., about 28 m. W. by N. of Lima. Pop. (1890) 5512, (1900) 6422 (221 foreign-born); (1910) 7157. Van Wert is served by the Pennsylvania and the Cincinnati Northern railways, and by an interurban electric line. Among the principal buildings are the city hall, the court house, the Brumback Library of Van Wert county (containing 14,650 volumes in 1908), the Home Office Building of the Home Guards of America (a fraternal society incorporated in 1899 and having about 16,000 members in 1910), and the Home Office Building of the Central Manufactures' Insurance Co. Van Wert is situated in a rich agricultural region. It has railway and machine shops and various manufactures. The municipality owns and operates the waterworks. Van Wert was settled about 1840, was incorporated as a town in 1848 and was chartered as a city in 1903. The county and the city were named in honour of Isaac Van Wert (1760–1828), one of the captors of Major John André.

VAPEREAU, LOUIS GUSTAVE (1819–1906), French man of letters and lexicographer, was born at Orleans on the 4th of April 1819. Educated at the École Normale he became a teacher of philosophy, and was entrusted by Victor Cousin with the preparation of his studies on the *Pensées* of Pascal. Under the empire his republican principles cost him his position, and Vapereau studied for the bar. He practised, however, little or not at all, and after 1870 he was appointed prefect of Cantal (1870) and of Tarn et Garonne (1871–73). From 1877 to 1888 he was inspector-general of public instruction. He was the author of some excellent editions of the classics, and of works on political and social questions, but he is famous for his valuable *Dictionnaire universel des contemporains* (1858; 6th ed., 1893), brought up to date in 1895 by a supplementary volume. He also drew up a *Dictionnaire universel des littérateurs* (1876). At the time of his death at Norsang-sur-Orge in 1906, he had been for twenty-six years a regular contributor to *L'Illustration*, some of his notes written for this journal being collected in 1896 as *L'Homme et la vie*.

VAPHIO, an ancient site in Laconia, Greece, on the right bank of the Eurotas, some 5 m. S. of Sparta. It is famous for its "bee-hive" tomb, excavated in 1889 by Dr Tsountas. This consists of a walled approach, or δρόμος, about 97 ft. long, leading to a vaulted chamber some 33 ft. in diameter, in the floor of which the actual grave was cut. The objects found here and transferred to the National Museum in Athens include a large number of gems and amethyst beads, together with articles in gold, silver, bronze, iron, lead, amber and crystal. But by far the finest of them are two golden cups decorated with scenes in relief, picturing the capture of bulls. These form perhaps the most perfect works of "Mycenaean" or "Minoan" art which have survived. It seems likely that the Vaphio cups do not represent a local art but were imported from Crete, which at that early period was far ahead of mainland Greece in artistic development. The tomb, which probably belonged to Amyclae rather than to Pharis, as is commonly stated, is now almost entirely destroyed.

See C. Tsountas, Ἐφημερὶς Ἀρχαιολογική (1889), 136–172; J. G. Frazer, *Pausanias's Description of Greece*, iii. 135 f. (with full bibliography); W. Ridgeway, *The Early Age of Greece*, i. 26–28; R. C. Bosanquet, *Journal of Hellenic Studies* (1904), xxiv. 317 ff.; A. Riegl, *Jahreshefte d. österr. arch. Institutes* (1906), ix. 1 ff.

(M. N. T.)

VAPORIZATION. 1. In common language a *vapour* is a gaseous or elastic fluid, which emanates or evaporates from the surface of a solid or liquid at temperatures below its boiling-point. A *volatile* liquid or solid is one which evaporates rapidly at ordinary temperatures. It is a matter of common experience that evaporation is accelerated by currents of air, or by the use of an exhaust pump, or by any process which removes the vapour rapidly from the liquid. On the other hand, it is retarded, and finally ceases, if the vapour is allowed to accumulate in a closed space. When this equilibrium state is reached, the space is said to be *saturated* with the vapour; the density of the vapour is then the maximum which can exist in the presence of the liquid at the temperature of the experiment, and its pressure is called the *saturation-pressure*. The term vapour-pressure, when used without qualification, is also generally employed to denote the saturation or maximum pressure. Dalton showed that the saturation-pressure of a vapour depends only on the temperature, and is unaffected by the presence of any neutral gas or vapour. This relation has been more accurately verified by many subsequent observers, and the exceptions to it have been minutely studied and elucidated. The saturation-pressure invariably increases rapidly with rise of temperature, according to a regular law which has been the subject of many elaborate investigations. When the vapour-pressure of a liquid becomes equal to the external pressure, bubbles of vapour are freely formed in the interior of the liquid by the familiar process of boiling or ebullition. The temperature at which this occurs under the normal atmospheric pressure of 760 mm. of mercury (reduced to 0° C. and sea-level in latitude 45°) is termed the *boiling-point* (B.P.) of the liquid, and is usually determined by taking the temperature of the saturated vapour under normal pressure, to avoid error from superheating (see below, 3) of the liquid. If the external pressure remains constant, the temperature will also remain constant, provided that the liquid is pure and that its composition remains unaltered, until the whole is vaporized. If, on the other hand, the liquid is contained in a *closed* space, it may be made to boil at much lower temperatures by diminishing the pressure; or the temperature of the liquid may be raised considerably above the normal boiling-point, as in the boiler of a steam-engine, if the pressure is raised by preventing the free escape of the vapour. In all cases, if the temperature is given, there is a corresponding equilibrium or saturation-pressure of the vapour, and vice versa, in accordance with Dalton's law. It was shown, however, by Cagniard de la Tour (*Ann. Chim. Phys.*, 1822, 1823) that the temperature and pressure of the liquid could not be raised indefinitely in this manner. By heating liquids in strong glass bulbs with manometers attached, he found that at a certain temperature the meniscus or curved surface separating the liquid from the vapour disappeared, and the bulb became filled with an apparently uniform substance. The temperature at which this mixing of liquid and vapour occurs is definite for each liquid, and is called the *critical temperature*. La Tour found the critical temperature in the case of water to be 362° C., a result which has been remarkably confirmed by later researches (Cailletet, *Ann. Chim. Phys.* 25, p. 519, 1892). In many books of recent years it has been the custom, following a suggestion of Andrews, to restrict the term "gas" to temperatures above the critical temperature, and the term "vapour" to temperatures below. But this is often inconvenient in practice, as there is no sudden change in the gaseous phase at ordinary pressures on passing the critical temperature. It is more convenient to employ the terms "vapour" only when discussing the properties of the gaseous phase in relation to the liquid or solid, and to follow the common usage in describing substances like CO_2, or even SO_2 and NH_3, as gases at ordinary temperatures and pressures.

2. *Continuity of State.*—The form of the isothermal curve, representing the compression of a vapour at constant temperature, consists, as shown in fig. 1, A, of three discontinuous branches. The relation between pressure and volume for an

unsaturated vapour is represented by the branch DE, which is similar to the isothermal of a gas obeying Boyle's law. When the saturation-pressure is reached at D the vapour begins to condense, and the volume diminishes without further increase of pressure, giving the isopiestic branch DCB. At B, when the vapour is completely liquefied, further compression produces a rapid rise of pressure, as shown by the branch BA, representing the behaviour of the liquid. It is possible, however, to trace the branch DN for the supersaturated vapour continuously beyond D without liquefaction in the absence of nuclei. It is similarly possible to trace the liquid branch ABM beyond B to lower pressures in the absence of dissolved gases. As the temperature is raised, the length of the branch BD, representing the increase of volume in passing from the liquid to the gas, diminishes, as shown in fig. 1, B, which represents the isothermals of CO_2,[1] according to Andrews (*Phil. Trans.* 1869). Above the critical temperature, the discontinuities at B and D disappear from the isothermal curve, and it is impossible to obtain separation of the two states, liquid and gas, however great the pressure applied. The critical pressure is the vapour-pressure of the liquid at the critical temperature. It is possible to obtain a perfectly continuous passage from the gaseous to the liquid state by keeping the vapour at a pressure greater than the critical pressure while it is cooled from a temperature above the critical point, at which it would expand indefinitely (if the pressure were reduced) without separation into two phases, to a temperature below the critical point, at which expansion would produce separation into liquid and vapour as soon as the pressure was reduced to the saturation value. It was maintained by Andrews, on the basis of these and similar observations, that the gaseous and liquid states were merely widely separated forms of the same condition of matter, since one could be converted into the other without any breach of continuity or sudden evolution of heat or change of volume; just as an amorphous solid in the process of fusion becomes gradually more and more plastic as the temperature is raised, and passes into the state of a viscous liquid with continually diminishing viscosity. The same idea was further developed by James Thomson (*Proc. R.S.*, 1871), who suggested that the discontinuity of the isothermal at temperatures below the critical point was only apparent. He supposed that the extensions of the liquid and vapour curves BM, DN, in fig. 1, A, representing the states of superheated liquid and supersaturated vapour, might theoretically be joined by a continuous curve MN, representing a homogeneous transformation, which, however, could not be realized in practice, as the state of the substance corresponding to this part of the curve would be unstable. Maxwell (*Nature*, 1875) showed that the straight line BCD representing the saturation-pressure must cut off loops BMC, CND, of equal area from this imaginary isothermal; otherwise it would be theoretically possible to obtain a balance of work without any difference of temperature by taking the substance through the isothermal cycle BCDNCMB. The theoretical isothermal of James Thomson is qualitatively represented by an equation of the type devised by Van der Waals, in which the mutual attraction of the molecules of a gas is regarded as equivalent to an internal pressure of the form a/v^2, which he supposes identical with the capillary pressure of the liquid. It has been found, however, that this simple expression is not sufficiently exact. It is probable that it is not merely a question of varying attraction between similar molecules. A vapour should rather be regarded as containing a certain proportion of compound or coaggregated molecules, which partially dissociate when the pressure is diminished or the temperature raised. A liquid similarly contains dissolved molecules of vapour, and the state of equilibrium is more nearly analogous to that between conjugate saturated solutions (*e.g.* water and phenol).

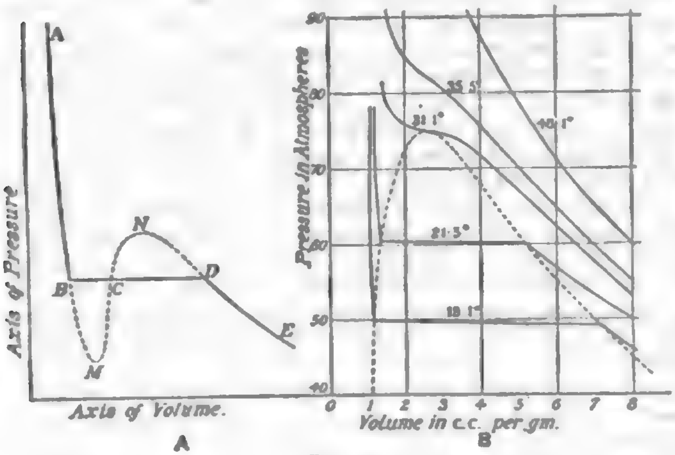

FIG. 1.

A, James Thomson Isothermal; B, Isothermals of CO_2 (Andrews).

3. *Effect of Capillary Pressure on Ebullition.*—It was remarked at a very early date that water and other liquids could be raised under atmospheric pressure several degrees above their normal boiling-points in a clean glass vessel without ebullition occurring, and that, when a bubble was formed, it would expand explosively, producing the phenomenon of "bumping"; but that, if metallic filings or other bodies capable of supplying small bubbles of air were introduced, ebullition would proceed quietly at the normal temperature. L. Dufour succeeded in raising small drops of water, suspended in an oil mixture of suitable density, to a temperature of nearly 180° C. under atmospheric pressure. Similar observations lead to the conclusion that the phenomenon of ebullition, or boiling with the formation of bubbles, depends essentially on the presence of air or dissolved gas to provide nuclei for the starting-points of the bubbles. This is a natural consequence of the capillary pressure due to surface tension. The vapour-pressure p inside a small spherical bubble of radius r must exceed the pressure P in the liquid just outside the bubble by $2T/r$, where T is the surface tension of the liquid. The capillary pressure $2T/r$ may be very large if r is small. It is often stated on the strength of this relation that a bubble of radius r in a liquid will not expand indefinitely and rise to the surface as in ebullition, until the vapour-pressure p inside the bubble exceeds the external pressure P by $2T/r$. But this neglects the effect of the air or gas contained in the bubble, which plays an essential part in the phenomenon. A bubble of vapour containing no air or gas could not exist at all in stable equilibrium in a liquid. If its radius r were such as to make $2T/r$ greater than $p-P$, it would collapse entirely. A bubble containing gas, on the contrary, is in stable equilibrium when its radius r is such that the pressure of the gas and vapour inside it balance the external pressure P together with the capillary pressure $2T/r$. Any diminution of r produces an increase in the pressure of the gas which is more than sufficient to balance the increase of the capillary pressure $2T/r$. Supposing that the external pressure and temperature remain constant, the partial pressure of the gas inside the bubble varies inversely as the volume of the bubble, and may be represented by a/r^3. The size of the bubble is determined by the equation $p+a/r^3=P+2T/r$. The equilibrium is always stable if p is less than P. If p is greater than P, the equilibrium becomes unstable (and the bubble expands indefinitely), when the gas-pressure a/r^3 is one-third of the capillary pressure $2T/r$. This follows immediately by differentiating the above equation with respect to r, assuming the difference $p-P$ to remain constant. Substituting $2T/3r$ for a/r^3 we obtain the condition of stability,

$$p-P<4T/3r. \quad . \quad . \quad . \quad . \quad . \quad (1)$$

In other words, the temperature of a liquid containing bubbles of radius r will rise until the excess pressure given by (1) is reached, and ebullition will begin as soon as the excess pressure amounts to two-thirds of the capillary pressure, and will not be delayed until the full capillary pressure is reached, as might appear at first sight. Bubbles 1 millimetre in diameter in water at $P=760$ mm. become unstable when the temperature reaches 100·05° C. approximately. To obtain a superheat of 10° C., where the excess pressure is 316 mm., the bubbles must not exceed about $\frac{1}{260}$th mm. diameter. The condensation of a vapour is also retarded by the effect of capillary pressure, but the relation in this case is somewhat different.

4. *Effect of Capillary Pressure on Vapour-Pressure.*—It was observed by Sir W. Thomson (Lord Kelvin) (*Phil. Mag.* iv. 42, p. 448, 1871) that if a capillary tube of radius r is immersed in a liquid of surface tension T, and the liquid rises to a height h above the plane surface (the whole being enclosed in a vessel of uniform temperature containing only the vapour of the liquid) the pressure of the vapour at the curved surface of the meniscus in the capillary tube will be less than that at the plane surface by the amount, gh/v, where g is the acceleration of gravity, and $1/v$ is the density of the vapour. But the vapour must be in equilibrium with the liquid at both surfaces. Otherwise perpetual motion would ensue

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[1] The slight increase of pressure observed during condensation was attributed by Andrews to the presence of a trace of air in the CO_2.

in an enclosure at uniform temperature. Consequently the equilibrium value of the vapour-pressure must vary with the curvature of the surface, or with the capillary pressure due to the curvature.

If P, p are the hydrostatic pressures in the liquid and vapour close to the meniscus, the difference $P-p=2T/r$. This is negative if r is negative, *i.e.* if the liquid rises in the tube, but is positive if the meniscus is convex and the liquid is depressed in the tube. If P_0, p_0 are the pressures in the liquid and vapour at the plane surface, $P_0=p_0$, and if $1/V$ is the density of the liquid, the differences of pressure in the liquid and vapour respectively corresponding to a difference of level h, are $P-P_0=-gh/V$, $p-p_0=-gh/v$. Combining these with the relation $P-p=2T/r$ and eliminating gh, we obtain, for the change of vapour-pressure $p-p_0$, due to change of pressure $P-p_0$, or to curvature $1/r$,

$$p-p_0=(P-P_0)V/v=2TV/r(v-V). \quad . \quad . \quad . \quad (2)$$

This increase of vapour-pressure with curvature affords a natural explanation of the fact that it is possible to cool a vapour considerably below the saturation temperature without condensation. The vapour-pressure in a fog containing small drops of radius r must exceed the normal vapour-pressure over a plane surface at the same temperature by the amount $2TV/r(v-V)$, which may be considerable if r is small. The same expression measures the supersaturation required to induce condensation in the presence of dust or other nuclei of radius r, and explains why it is that condensation always takes place on dust particles if any are present. This phenomenon forms the basis of J. Aitken's method of counting dust particles, or Wilson's method of counting electrical ions, which are also capable of acting as nuclei for starting condensation.

5. *Extension to Higher Pressures.*—The approximate formula above given for the effect of hydrostatic pressure on the vapour-pressure assumes the densities of the liquid and vapour constant, and is true for small differences of pressure only. If we take P_0 and p_0 to represent corresponding values of the pressure in the liquid and vapour at the same level (and not necessarily at the plane surface where $P_0=p_0$), and if the difference of level from P, p is small, substituting dP and dp for the small differences of pressure, we have accurately the relation $v\,dp=V\,dP$, where V and v are the specific volumes of the liquid and vapour under the pressures P and p respectively. In order to apply the formula to large differences of pressure, it is only necessary to integrate it at constant temperature between the required limits of P and p. We thus obtain the general equation,

$$\int_{p_0}^{p} v\,dp=\int_{P_0}^{P} V\,dP. \quad . \quad . \quad . \quad . \quad (3)$$

In applying the general equation (3) to an actual case, the compressibility of the liquid is the most uncertain factor. Assuming the compressibility constant, we may write $V=V_0(1-aP)$. For the vapour we may employ equation (17) THERMODYNAMICS, viz. $v=R\theta/p-c+b$, as a very close approximation over a wide range. The small quantities c and b are functions of the temperature only. Making these substitutions and integrating the equation we obtain

$$R\theta \log_e(p/p_0)=(c-b)(p-p_0)+V_0(P-P_0)-\tfrac{1}{2}aV_0(P^2-P_0^2). \quad (4)$$

C. T. R. Wilson (*Phil. Trans.* 1898) has observed that in the absence of nuclei a very fine mist is formed in a vapour on sudden expansion when its density is about eight times the saturation value. Putting $p/p_0=8$ in equation (4), and taking for water vapour $R=4{\cdot}61\times10^6$, and $\theta=300°$ Abs. we find $P-P_0$ equal to 3000 atmospheres approximately as the pressure required to produce this degree of supersaturation, allowing for compressibility of V. The term $(c-b)$ may be neglected in this case, as p is small, but it would amount to about 17% of PV at 200° C. The result obtained from the approximate formula (2) would be 9200 atmospheres, which is more than treble, and indicates the inapplicability of the simple formula in an extreme case. Taking $P=3000$ atmospheres, and assuming that the formula $2T/r$ applies for the capillary pressure, we find the equivalent radius of a nucleus corresponding to the fine misty condensation to be $5{\cdot}0\times10^{-8}$ cm. This is a quantity of molecular dimensions, and lends support to the view that a vapour contains a certain proportion of coaggregated molecules, represented by the term c in the equation, which are capable of acting as nuclei for condensation. The analogous phenomenon of cloudy crystallization, which takes place in a supercooled liquid in the labile state, suggests that a liquid may similarly contain molecular crystals of solid, which would account, in the case of water, for its anomalous expansion and for the variation of its specific heat near the freezing-point.

For small values of the vapour-pressure p, the term $(c-b)(p-p_0)$ in equation (4) may generally be neglected, as in the case of water at ordinary temperatures. For moderate values of P, not exceeding say 100 atmospheres, V may be taken as nearly constant, and the equation reduces to the simpler form $PV/R\theta=\log_e(p/p_0)$, which is often sufficiently exact.

6. *Application to a Solid.*—If we imagine a vertical column of solid in a porous vessel at uniform temperature surrounded by vapour, it would appear probable by similar reasoning that it would be in equilibrium under its own hydrostatic pressure with the pressure of the vapour at different levels. This would give the same formula as (2) for the variation of vapour-pressure, with V', the specific volume of the solid, in place of V. But since the surface tension analogy does not exactly apply in the case of a solid, it is perhaps better to deduce the formula from a consideration of the effect of pressure on the freezing-point. The freezing-point θ_0 is the point at which the solid and liquid have the same vapour-pressure p_0. Otherwise they could not remain together in equilibrium. When the freezing-point is changed by pressure, the vapour-pressures p', p'', of the solid and liquid must be the same at the new freezing-point. The rise of the freezing-point $\theta-\theta_0$, for an increase of pressure $P-P_0$, is given by the thermodynamic equation (THERMODYNAMICS, equation (5))

$$L(\theta-\theta_0)/\theta_0=(P-P_0)(V''-V'), \quad . \quad . \quad . \quad (5)$$

where L is the latent heat of fusion, and V', V'' are the specific volumes of the solid and liquid respectively. The difference $(p'-p'')$ of the vapour-pressures of the solid and liquid under normal pressure P_0 at a temperature θ near the normal freezing-point θ_0, is deduced from the same equation (see section 24 below)

$$p'-p''=L(\theta-\theta_0)/v\theta_0, \quad . \quad . \quad . \quad (6)$$

where v is the specific volume of the vapour. Substituting for θ in terms of P from (5), we have for the difference of the vapour-pressures at θ_0 under pressure P,

$$p'-p''=(P-P_0)(V''-V')/v. \quad . \quad . \quad . \quad (7)$$

The increase of vapour-pressure of the liquid when the pressure is increased to P is given by (2), viz. $p''-p_0=(P-P_0)V''/v$. The increase of vapour-pressure of the solid must be less than that of the liquid by the amount given by (7), in order that their vapour-pressure may be the same at the new freezing-point θ. We thus obtain by subtraction

$$p'-p_0=(P-P_0)\{V''/v-(V''-V')/v\}=(P-P_0)V'/v.$$

Which is precisely the same as relation (2) for the liquid, with V' substituted for V''. Hence the effect of pressure on the vapour-pressure follows the same law for both liquid and solid (J. H. Poynting, *Phil. Mag.* xii. p. 40, 1881).

7. *Vapour-Pressure of Solutions.*—The rise of boiling-point produced by a substance in solution was demonstrated by M. Faraday in 1820, but the effect had been known to exist for a long time previously. C. H. L. Babo, 1847, gave the law known by his name, that the "relative lowering" $(p-p_0)/p_0$ of the vapour-pressure of a solution, or the ratio of the diminution of vapour-pressure $(p-p_0)$ to the vapour-pressure p_0 of the pure solvent at the same temperature, was constant, or independent of the temperature, for any solution of constant strength. A. Wüllner (*Pogg. Ann.* 1858, 103, p. 529) found the lowering of the vapour-pressure to be nearly proportional to the strength of the solution for the same salt. W. Ostwald, employing Wüllner's results, found the lowering of vapour-pressure produced by different salts in solution in water to be approximately the same for solutions containing the same number of gramme-molecules of salt per c.c. F. M. Raoult (*Comptes Rendus*, 1886–87) employed other solvents besides water, and showed that the relative lowering for different solvents and different dissolved substances was the same in many cases for solutions in which the ratio of the number of gramme-molecules n of the dissolved substance to the number of molecules N of the solvent was the same, or that it varied generally in proportion to the ratio n/N. The relative lowering of the vapour-pressure can be easily measured by Dalton's method of the barometer tube for solvents such as ether, which have a sufficient vapour-pressure at ordinary temperatures. But in many cases it is more readily determined by observing the rise of the boiling-point or the depression of the freezing-point of the solution. For the rise in the boiling-point, we have by Clapeyron's equation, $dp/d\theta=L/\theta v$, nearly, neglecting the volume of the liquid as compared with that of the vapour v. If dp is the difference of vapour-pressure of solvent and solution, and $d\theta$ the rise in the boiling-point, we have the approximate relation,

$$n/N=dp/p=mL\,d\theta/R\theta^2, \text{ Raoult's law,} \quad . \quad . \quad . \quad (8)$$

where m is the molecular weight of the vapour, and R the gas-constant which is nearly 2 calories per degree for a gramme-molecule of gas. For the depression of the freezing-point a relation of the same form applies, but $d\theta$ is negative, and L is the latent heat of fusion. At the freezing-point, the solution must have the same vapour-pressure as the solid solvent, with which it is in equilibrium. The relation follows immediately from Kirchhoff's expression (below, section 14) for the difference of vapour-pressure of the liquid and solid below the freezing-point.

The most important apparent exceptions to Raoult's law in dilute solutions are the cases, (1) in which the molecules of the dissolved substance in solution are associated to form compound molecules, or dissociated to form other combinations with the solvent, in such a way that the actual number of molecules n in the solution differs from that calculated from the molecular weight corresponding to the accepted formula of the dissolved substance; (2) the case in which the molecules of the vapour of the solvent are associated in pairs or otherwise so that the molecular weight m of the vapour is not that corresponding to its accepted formula. These cases are really included in the equation if we substitute the proper values of n or m. In the case of electrolytes, S. Arrhenius (*Zeit. phys. Chem.* i. p. 631) showed how to calculate the effective number of molecules $n'=(1+ck/k_0)n$, from the molecular conductivity

k of the solution and its value k_0 at infinite dilution, for an electrolyte giving rise to $e+1$ ions. The values thus found agreed in the main with Raoult's law for dilute solutions (see SOLUTIONS). For strong solutions the discrepancies from Raoult's law often become very large, even if dissociation is allowed for. Thus for calcium chloride the depression of the freezing-point, when $n=7$, $N=100$, is nearly 60° C. At this point $n''=10$ nearly, and the depression should be only 10·4° C. These and similar discrepancies have been very generally attributed to a loose and variable association of the molecules of the dissolved substance with molecules of the solvent, which, according to H. C. Jones (*Amer. Chem. Jour.* 1905, 33, p. 584), may vary all the way from a few molecules of water up to at least 30 molecules in the case of $CaCl_2$, or from 12 to 140 for glycerin. It has been shown, however, by Callendar (*Proc. R.S.A.* 1908) that, if the accurate formulae for the vapour-pressure given below are employed, the results for strong solutions are consistent with a very slight, but important, modification of Raoult's law. It is assumed that each molecule of solute combines with a molecules of solvent according to the ordinary law of chemical combination, and that the number a, representing the degree of hydration, remains constant within wide limits of temperature and concentration. In this case the ratio of the vapour-pressure of the solution p'' to that of the solvent p' should be equal to the ratio of the number of free molecules of solvent $N-an$ to the whole number of molecules $N-an+n$ in the solution. The explanation of this relation is that each of the n compound molecules counts as a single molecule, and that, if all the molecules were solvent molecules, the vapour-pressure would be p', that of the pure solvent. This assumption coincides exactly with Raoult's law for the relative lowering of vapour-pressure, if $a=1$, and agrees with it in the limit in all cases for very dilute solutions, but it makes a very considerable difference in strong solutions if a is greater or less than 1. It appears that the relatively enormous deviations of $CaCl_2$ from Raoult's law are accounted for on the hypothesis that $a=9$, but there is a slight uncertainty about the degree of ionization of the strongest solutions at −50° C. Cane-sugar appears to require 5 molecules of water of hydration both at 0° C. and at 100° C., whereas KCl and NaCl take more water at 100° C. than at 0° C. The cases considered by Callendar (*loc. cit.*) are necessarily limited, because the requisite data for strong solutions are comparatively scarce. The vapour-pressure equations are seldom known with sufficient accuracy, and the ionization data are incomplete. But the agreement is very good so far as the data extend, and the theory is really simpler than Raoult's law, because many different degrees of hydration are known, and the assumption $a=1$ (all monohydrates), which is tacitly involved in Raoult's law, is in reality inconsistent with other chemical relations of the substances concerned.

8. *Vapour-Pressure and Osmotic Pressure.*—W. F. P. Pfeffer (*Osmotische Untersuchungen*, Leipzig, 1877) was the first to obtain satisfactory measurements of osmotic pressures of cane-sugar solutions up to nearly 1 atmosphere by means of semi-permeable membranes of copper ferrocyanide. His observations showed that the osmotic pressure was nearly proportional to the concentration and to the absolute temperature over a limited range. Van't Hoff showed that the osmotic pressure P due to a number of dissolved molecules n in a volume V was the same as would be exerted by the same number of gas-molecules at the same temperature in the same volume, or that $PV=R\theta n$. Arrhenius, by reasoning similar to that of section 5, applied to an osmotic cell supporting a column of solution by osmotic pressure, deduced the relation between the osmotic pressure P at the bottom of the column and the vapour-pressure p'' of the solution at the top, viz. $mPV/R\theta = \log_e(p'/p'')$, which corresponds with the effect of hydrostatic pressure, and is equivalent to the assumption that the vapour-pressure of the solution at the bottom of the column under pressure P must be equal to that of the pure solvent. Poynting (*Phil. Mag.* 1896, 42, p. 298) has accordingly defined the osmotic pressure of a solution as being the hydrostatic pressure required to make its vapour-pressure equal to that of the pure solvent at the same temperature, and has shown that this definition agrees approximately with Raoult's law and van't Hoff's gas-pressure theory. It is probable that osmotic pressure is not really of the same nature as gas-pressure, but depends on equilibrium of vapour-pressure. The vapour-molecules of the solvent are free to pass through the semi-permeable membrane, and will continue to condense in the solution until the hydrostatic pressure is so raised as to produce equality of vapour-pressure. Lord Berkeley and E. J. G. Hartley (*Phil. Trans.* A. 1906, p. 481) succeeded in measuring osmotic pressures of cane-sugar, dextrose, &c., up to 135 atmospheres. The highest pressures recorded for cane-sugar are nearly three times as great as those given by van't Hoff's formula for the gas-pressure, but agree very well with the vapour-pressure theory, as modified by Callendar, provided that we substitute for V in Arrhenius's formula the actual specific volume of the solvent in the solution, and if we also assume that each molecule of sugar in solution combines with 5 molecules of water, as required by the observations on the depression of the freezing-point and the rise of the boiling-point. Lord Berkeley and Hartley have also verified the theory by direct measurements of the vapour-pressures of the same solutions.

9. *Total Heat and Latent Heat.*—To effect the conversion of a solid or liquid into a vapour without change of temperature, it is necessary to supply a certain quantity of heat. The quantity required per unit mass of the substance is termed the *latent heat of vaporization.* The *total heat* of the saturated vapour at any temperature is usually defined as the quantity of heat required to raise unit mass of the liquid from any convenient zero up to the temperature considered, and then to evaporate it at that temperature under the constant pressure of saturation. The total heat of steam, for instance, is generally reckoned from the state of water at the freezing-point, 0° C. If h denote the heat required to raise the temperature of the liquid from the selected zero to the temperature t° C., and if H denote the total heat and L the latent heat of the vapour, also at t° C., we have evidently the simple relation

$$H=L+h. \quad . \quad . \quad . \quad . \quad . \quad (9)$$

The pressure under which the liquid is heated makes very little difference to the quantity h, but, in order to make the statement definite, it is desirable to add that the liquid should be heated under a constant pressure equal to the final saturation-pressure of the vapour. The usual definition of total heat applies only to a saturated vapour. For greater simplicity and generality it is desirable to define the total heat of a substance as the function $(E+pv)$, where E is the intrinsic energy and v the volume of unit mass (see THERMODYNAMICS). This agrees with the usual definition in the special case of a saturated vapour, if the liquid is heated under the final pressure p, as is generally the case in heat engines and in experimental measurements of H.

The method commonly adopted in measuring the latent heat of a vapour is to condense the vapour at saturation-pressure in a calorimeter. The quantity of heat so measured is the total heat of the vapour reckoned from the final temperature of the calorimeter, and the heat of the liquid h must be subtracted from the total heat measured to find the latent heat of the vapour at the given temperature. It is necessary to take special precautions to ensure that the vapour is dry or free from drops of liquid. Another method, which is suitable for volatile liquids or low temperatures, is to allow the liquid to evaporate in a calorimeter, and to measure the quantity of heat required for the evaporation of the liquid at the temperature of the calorimeter and at saturation-pressure. The first method may be called the method of condensation. It was applied in the most perfect manner by Regnault to determine the latent heats of steam and several other vapours at high pressures. The second method may be called the method of evaporation. It is more difficult of application than the first, but has given some good results in the hands of Griffiths[1] and Dieterici, although the experiments of Regnault by this method were not very successful.

It was believed for many years, in consequence of some rough experiments made by J. Watt, that the total heat of steam was constant. This was known as Watt's law, and was sometines extended to other vapours. An alternative supposition, due to J. Southern, was that the latent heat was constant. The very careful experiments of Regnault, published in 1847, showed that the truth lay somewhere between the two. The formula which he gave for the total heat H of steam at any temperature t° C., which has since been universally accepted and has formed the basis of all tables of the properties of steam, was as follows:—

$$H=606{\cdot}5+0{\cdot}305t. \quad . \quad . \quad . \quad (10)$$

He obtained similar formulae for other vapours, but the experiments were not so complete or satisfactory as in the case of steam, which may conveniently be taken as a typical vapour in comparing theory and experiment.

10. *Total Heat of Ideal Vapour.*—It was proved theoretically by W. J. M. Rankine (*Proc. R.S.E.* vol. xx. p. 173) that the increase of the total heat of a saturated vapour between any two temperatures should be equal to the specific heat S of the vapour at constant pressure multiplied by the difference of temperature, provided that the saturated vapour behaved as an ideal gas, and that its specific heat was independent of the pressure and temperature. Expressed in symbols, the relation may be written

$$H'-H''=S(\theta'-\theta''). \quad . \quad . \quad . \quad . \quad (11)$$

This relation gives a linear formula for the variation of the total heat, a result which agrees in form with that found by Regnault for steam, and implies that the coefficient of t in his formula should be equal to the specific heat S of steam. Rankine's equation follows directly from the first law of thermodynamics, and may be proved as follows: The heat absorbed in any transformation is the change of intrinsic energy *plus* the external work done. To find the total heat H of a vapour, we have $H=E+p(v-b)$, where the intrinsic energy E is measured from the selected zero θ_0 of total heat. The external work done is $p(v-b)$, where p is the constant pressure, v the volume of the vapour at θ, and b the volume of the liquid at θ_0. If the saturated vapour behaves as a perfect gas, the change of intrinsic energy E depends only on the temperature limits, and is equal to $s\,(\theta-\theta_0)$, where s is the specific heat at constant volume. Taking the difference between the values of H for any two temperatures

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[1] "Latent Heat of Steam," *Phil. Trans.* A. 1895; of "Benzene," *Phil. Mag.* 1896.

θ' and θ'', we see that Rankine's result follows immediately, provided that $p(v-b)$ is equal to $(S-s)\theta$ or $R\theta/m$, which is approximately true for gases and vapours when v is very large compared with b. We may observe that the equation (11) is accurately true for an ideal vapour, for which $pv=(S-s)\theta$, provided that the total heat is defined as equal to the change of the function $(E+pv)$ between the given limits. Adopting this definition, without restriction to the case of an ideal vapour or to saturation-pressure, the rate of variation of the total heat with temperature $(dH/d\theta)$ at constant pressure is equal to S under all conditions, whether S is constant, or varies both with p and θ. (See THERMODYNAMICS, § 7.)

11. *Specific Heat of Vapours.*—The question of the measurement of the specific heat of a vapour possesses special interest on account of this simple theoretical relation between the specific heat and the variation of the latent and total heats. The first accurate calculations of the specific heats of air and gases were made by Rankine in a continuation of the paper already quoted. Employing Joule's value of the mechanical equivalent of heat, then recently published, in connexion with the value of the ratio of the specific heats of air $S/s=1{\cdot}40$ deduced from the velocity of sound, Rankine found for air $S=\cdot240$, which was much smaller than the best previous determinations (*e.g.* Delaroche and Berard, $S=\cdot267$), but agreed very closely with the value $S=\cdot238$, found by Regnault at a later date. Adopting for steam the same value of the ratio of the specific heats, viz. 1·40, Rankine found $S=\cdot385$, a value which he used, in default of a better, in calculating some of the properties of steam, although he observed that it was much larger than the coefficient ·305 in Regnault's formula for the variation of the total heat. The specific heat of steam was determined shortly afterwards by Regnault (*Comptes Rendus*, 36, p. 676) by condensing superheated steam at two different temperatures (about 125° and 225° C.) successively in the same calorimeter at atmospheric pressure, and taking the difference of the total heats observed. The result found in this manner, viz. $S=\cdot475$, greatly increased the apparent discrepancy between Regnault's and Rankine's formulae for the total heat. The discrepancy was also noticed by G. R. Kirchhoff, who rediscovered Rankine's formula (*Pogg. Ann.* 103, p. 185, 1858). He suggested that the high value for S found by Regnault might be due to the presence of damp in his superheated steam, or, on the other hand, that the assumption that steam at low temperatures followed the law $pv=R\theta$ might be erroneous. These suggestions have been frequently repeated, but it is probable that neither is correct. G. A. Zeuner, at a later date (*La Chaleur*, p. 441), employing the empirical formula $pv=B\theta+Cp^{\cdot25}$ for saturated steam, found the value $S=\cdot568$, which further increased the discrepancy. G. A. Hirn and A. A. Cazin (*Ann. Chim. Phys.* iv. 10, p. 349, 1867) investigated the form of the adiabatic for steam passing through the state $p=760$ mm., $\theta=373°$ Abs., by observing the pressure of superheated steam at any temperature which just failed to produce a cloud on sudden expansion to atmospheric pressure. Assuming an equation of the form $\log(p/760)=a\log(\theta/373)$, their results give $a=S/R=4{\cdot}305$, or $S=0{\cdot}474$, which agrees very perfectly with Regnault's value. It must be observed, however, that the agreement is rather more perfect than the comparative roughness of the method would appear to warrant. More recently, Macfarlane Gray (*Proc. Inst. Mech. Eng.* 1889), who has devoted minute attention to the reduction of Regnault's observations, assuming $S/s=1{\cdot}400$ as the theoretical ratio of specific heats of all vapours on his "aether-pressure theory," has calculated the properties of steam on the assumption $S=0{\cdot}384$. He endeavours to support this value by reference to sixteen of Regnault's observations on the total heat of steam at atmospheric pressure with only 19° to 28° of superheat. These observations give values for S ranging from 0·30 to 0·46, with a mean value 0·3778. But it must be remarked that the superheat of the steam in these experiments is only 1 or 2 % of the total heat measured. A similar objection applies, though with less force, to Regnault's main experiments between 125° and 225° C., giving the value $S=0{\cdot}475$, in which the superheat (on which the value of S depends) is only one-sixteenth of the total heat measured. Gray explains the higher value found by Regnault over the higher range as due to the presence of particles of moisture in the steam, which he thinks "would not be evaporated up to 124° C., but would be more likely to be evaporated in the higher range of temperature." J. Perry (*Steam Engine*, p. 580), assuming a characteristic equation similar to Zeuner's (which makes v a linear function of the temperature at constant pressure, and S independent of the pressure), calculates S as a function of the temperature to satisfy Regnault's formula (10) for the total heat. This method is logically consistent, and gives values ranging from 0·305 at 0° to 0·341 at 100° C. and 0·464 at 210° C., but the difference from Regnault's $S=0{\cdot}475$ cannot easily be explained.

12. *Throttling Calorimeter Method.*—The ideal method of determining by direct experiment the relation between the total heat and the specific heat of a vapour is that of Joule and Thomson, which is more commonly known in connexion with steam as the method of the throttling calorimeter. It was first employed in the case of steam by Peabody as a means of estimating the wetness of saturated steam, which is an important factor in testing the performance of an engine. If steam or vapour is "wire-drawn" or expanded through a porous plug or throttling aperture without external loss or gain of heat, the total heat $(E+pv)$ remains constant (THERMODYNAMICS, § 11), provided that the experiment is arranged so that the kinetic energy of flow is the same on either side of the throttle. Thus, starting with saturated steam at a temperature θ' and pressure p', as represented by the point A on the $p\theta$ diagram (fig. 2), if the point B represent the state $p''\theta''$ after passing the throttle, the total heat at A is the same as that at B, and exceeds that at any other point D (at the same pressure p'' as at B, but at a lower temperature θ) by the amount $S\times(\theta''-\theta)$, which would be required to raise the temperature from D to B at constant pressure. We have therefore the simple relation between the total heats at A and D—

$$H_A-H_D=S(\theta''-\theta). \quad (12)$$

If the steam at A contains a fraction z of suspended moisture, the total heat H_A is less than the value for dry saturated steam at A by the amount zL. If the steam at A were dry and saturated, we should have, assuming Regnault's formula (10), $H_A-H_D=\cdot305\,(\theta'-\theta)$, whence, if $S=\cdot475$, we have $zL=\cdot305\,(\theta'-\theta)-\cdot475\,(\theta''-\theta)$. It is evident that this is a very delicate method of determining the wetness z, but, since with dry saturated steam at low pressures this formula always gives *negative* values of the wetness, it is clear that Regnault's numerical coefficients must be wrong.

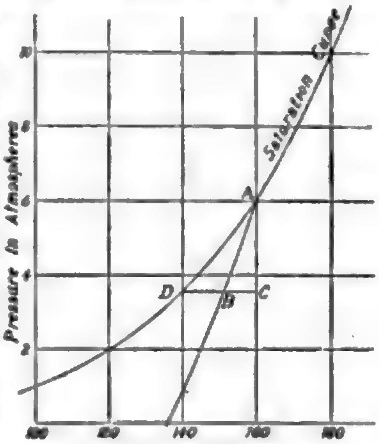

FIG. 2.—Throttling Calorimeter Method.

From a different point of view, equation (12) may be applied to determine the specific heat of steam in terms of the rate of variation of the total heat. If we assume Regnault's formula (10) for the total heat, we have evidently the simple relation $S=0{\cdot}305(\theta'-\theta)/(\theta''-\theta)$, supposing the initial steam to be dry, or at least of the same quality as that employed by Regnault. This method was applied by J. A. Ewing (*B.A. Rep.* 1897) to steam near 100° C. He found the specific heat smaller than 0·475, but no numerical results were given. A very complete investigation on the same lines was carried out by J. H. Grindley (*Phil. Trans.* 1900) at Owens College under the direction of Osborne Reynolds. Assuming $dH/d\theta=0{\cdot}305$ for saturated steam, he found that S was nearly independent of the pressure at constant temperature, but that it varied with the temperature from 0·387 at 100° C. to 0·665 at 160° C. Writing Q for the Joule-Thomson "cooling effect," $d\theta/dp$, or the slope BC/AC of the line of constant total heat, he found that Q was nearly independent of the pressure at constant temperature, a result which agrees with that of Joule and Thomson for air and CO_2; but that it varied with the temperature as $(1/\theta)^{3\cdot8}$ instead of $(1/\theta)^2$. These results for the variation of Q are independent of any assumption with regard to the variation of H. Employing the values of S calculated from $dH/d\theta=0{\cdot}305$, he found that the product SQ was independent of both pressure and temperature for the range of his experiments. Assuming this result to hold generally, we should have $S=0{\cdot}306$ at 0° C., which agrees with Rankine's view; but increasing very rapidly at higher temperatures to $S=1{\cdot}043$ at 200° C., and 1·315 at 220° C. The characteristic equation, if SQ = constant, would be of the form $(v+SQ)=R\theta/p$, which does not agree with the well-known behaviour of other gases and vapours. Whatever may be the objections to Regnault's method of measuring the specific heat of a vapour, it seems impossible to reconcile so wide a range of variation of S with his value $S=0{\cdot}475$ between 125° and 225° C. It is also extremely unlikely that a vapour which is so stable a chemical compound as steam should show so wide a range of variation of specific heat. The *experimental* results of Grindley with regard to the mode of variation of Q have been independently confirmed by Callendar (*Proc. R.S.* 1900), who quotes the results of similar experiments made at McGill College in 1897, but gives an entirely different interpretation, based on a direct measurement of the specific heat at 100° C. by an electrical method.

The method of deducing the specific heat from Regnault's formula for the variation of the total heat is evidently liable in a greater degree to the objections which have been urged against his method of determining the specific heat, since it makes the value of the specific heat depend on small differences of total heat observed under conditions of greater difficulty at various pressures. The more logical method of procedure is to determine the specific heat independently of the total heat, and then to deduce the variations of total heat by equation (12). The simplest method of measuring the specific heat appears to be that of supplying heat electrically to a steady current of vapour in a vacuum-jacket calorimeter, and observing the rise of temperature produced. Employing this method, Callendar finds $S=0{\cdot}497$ for steam at one atmosphere between 103° C. and 113° C. This is about 4% larger than Regnault's value, but is not really inconsistent with it, if we suppose that the specific heat at any given pressure diminishes slightly with rise of temperature, as indicated in formula (16) below.

13. *Corrected Equation of Total Heat.*—Admitting the value $S=0{\cdot}497$ for the specific heat at 108° C., it is clear that the form of Regnault's equation (10) must be wrong, although the numerical value of the coefficient 0·305 may approximately represent the average rate of variation over the range (100° to 190° C.) of the experiments on which it chiefly depends. Regnault's experiments at lower temperatures were extremely discordant, and have been shown by the work of E. H. Griffiths (*Proc. R.S.* 1894) and C. H. Dieterici (*Wied. Ann.* 37, p. 504, 1889) to give values of the total heat 10 to 6 calories too large between 0° and 40° C. At low pressures and temperatures it is probable that saturated steam behaves very nearly as an ideal gas, and that the variation of the total heat is closely represented by Rankine's equation with the ideal value of S. In order to correct this equation for the deviations of the vapour from the ideal state at higher temperatures and pressures, the simplest method is to assume a modified equation of the Joule-Thomson type (THERMODYNAMICS, equation (17)), which has been shown to represent satisfactorily the behaviour of other gases and vapours at moderate pressures. Employing this type of equation, all the thermodynamical properties of the substance may conveniently be expressed in terms of the diminution of volume c due to the formation of compound or coaggregated molecules,

$$(v-b)=R\theta/p-c_0(\theta_0/\theta)^n=V-c. \qquad (13)$$

The index n in the above formula, representing the rate of variation of c with temperature, is approximately the same as that expressing the rate of variation of the cooling effect Q, which is nearly proportional to c, and is given by the formula

$$SQ=(n+1)c-b. \qquad (14)$$

The corresponding formula for the total heat is

$$H-H_0=S_0(\theta-\theta_0)-(n+1)\ (cp-c_0p_0)+b(p-p_0). \qquad (15)$$

and for the variation of the specific heat with pressure

$$S=S_0+n(n+1)pc/\theta, \qquad (16)$$

where S_0 is the value of S when $p=0$, and is assumed to be independent of θ, as in the case of an ideal gas.

Callendar's experiments on the cooling effect for steam by the throttling calorimeter method gave $n=3{\cdot}33$ and $c=26{\cdot}3$ c.c. at 100° C. Grindley's experiments gave nearly the same average value of Q over his experimental range, but a rather larger value for n, namely, 3·8. For purposes of calculation, Callendar (*Proc. R.S.* 1900) adopted the mean value $n=3{\cdot}5$, and also assumed the specific heat at constant volume $s=3{\cdot}5$ R (which gives $S_0=4{\cdot}5$ R) on the basis of an hypothesis, doubtfully attributed to Maxwell, that the number of degrees of freedom of a molecule with m atoms is $2m+1$. The assumption $n=s/R$ simplifies the adiabatic equation, but the value $n=3{\cdot}5$ gives $S_0=0{\cdot}497$ at zero pressure, which was the value found by Callendar experimentally at 108° C. and 1 atmosphere pressure. Later and more accurate experiments have confirmed the experimental value, and have shown that the limiting value of the specific heat should consequently be somewhat smaller than that given by Maxwell's hypothesis. The introduction of this correction into the calculations would slightly improve the agreement with Regnault's values of the specific heat and total heat between 100° and 200° C., where they are most trustworthy, but would not materially affect the general nature of the results.

Values calculated from these formulae are given in the table below. The values of H at 0° and 40° agree fairly with those found by Dieterici (596·7) and Griffiths (613·2) respectively, but differ considerably from Regnault's values 606·5 and 618·7. The rate of increase of the total heat, instead of being constant for saturated steam as in Regnault's formula, is given by the equation

$$dH/d\theta=S(1-Q\,dp/d\theta) \qquad (17)$$

and diminishes from 0·478 at 0° C. to about 0·40 at 100° and 0·20 at 200° C., decreasing more rapidly at higher temperatures. The mean value, 0·313 of $dH/d\theta$, between 100° and 200° agrees fairly well with Regnault's coefficient 0·305, but it is clear that considerable errors in calculating the wetness of steam or the amount of cylinder condensation would result from assuming this important coefficient to be constant. The rate of change of the latent heat is easily deduced from that of the total heat by subtracting the specific heat of the liquid. Since the specific heat of the liquid increases rapidly at high temperatures, while $dH/d\theta$ diminishes, it is clear that the latent heat must diminish more and more rapidly as the critical point is approached. Regnault's formula for the total heat is here again seen to be inadmissible, as it would make the latent heat of steam vanish at about 870° C. instead of at 365° C. It should be observed, however, that the assumptions made in deducing the above formulae apply only for moderate pressures, and that the formulae cannot be employed up to the critical point owing to the uncertainty of the variation of the specific heats and the cooling effect Q at high pressures beyond the experimental range. Many attempts have been made to construct formulae representing the deviations of vapours from the ideal state up to the critical point. One of the most complete is that proposed by R. J. E. Clausius, which may be written

$$R\theta/p-v=R\theta(v-b)(A-B\theta^{n})/p(v+a)^2\theta_n; \qquad (18)$$

but such fomulae are much too complicated to be of any practical use, and are too empirical in their nature to permit of the direct physical interpretation of the constants they contain.

14. *Empirical Formulae for the Saturation-Pressure.*—The values of the saturation-pressure have been very accurately determined for the majority of stable substances, and a large number of empirical formulae have been proposed to represent the relation between pressure and temperature. These formulae are important on account of the labour and ingenuity expended in devising the most suitable types, and also as a convenient means of recording the experimental data. In the following list, which contains a few typical examples, the different formulae are arranged to give the logarithm of the saturation-pressure p in terms of the absolute temperature θ. As originally proposed, many of these formulae were cast in exponential form, but the adoption of the logarithmic method of expression throughout the list serves to show more clearly the relationship between the various types.

$\log p=A+B\theta$	(Dalton, 1800).	(19)
$\log p=C\log(A+B\theta)$	(Young, 1820).	
$\log p=A\theta/(B+C\theta)$	(Roche, 1830).	
$\log p=A+Bb^{\theta}+Cc^{\theta}$	(Biot, 1844; Regnault).	
$\log p=A+B/\theta+C/\theta^2$	(Rankine, 1849).	
$\log p=A+B/\theta+C\log\theta$	(Kirchhoff, 1858; Rankine, 1866).	
$\log p=A+B/\theta^n$	(Unwin, 1887).	
$\log p=A+B\log\theta+C\log(\theta+c)$.	(Bertrand, 1887).	
$\log p=A+B/(\theta+C)$	(Antoine, 1888).	

The formula of Dalton would make the pressure increase in geometrical progression for equal increments of temperature. In other words, the increase of pressure per degree ($dp/d\theta$) divided by p should be constant and equal to B; but observation shows that this ratio decreases, *e.g.* from 0·0722 at 0° C. to 0·0357 at 100° C. in the case of steam. Observing that this rate of diminution is approximately as the square of the reciprocal of the absolute temperature, we see that the almost equally simple formula $\log p=A+B/\theta$ represents a much closer approximation to experiment. As a matter of fact, the two terms $A+B/\theta$ are the most important in the theoretical expression for the vapour-pressure given below. They are not sufficient alone, but give good results when modified, as in the simple and accurate formulae of Rankine, Kirchhoff, L. C. Antoine and Unwin. If we assume formulae of the simple type $A+B/\theta$ for *two different substances* which have the same vapour-pressure p at the absolute temperatures θ' and θ'' respectively, we may write

$$\log p=A'+B'/\theta'=A''+B''/\theta'', \qquad (20)$$

from which we deduce that the ratio θ'/θ'' of the temperatures at which the vapour-pressures are the same is a linear function of the temperature θ' of one of the substances. This approximate relation has been employed by Ramsay and Young (*Phil. Mag.* 1887) to deduce the vapour-pressures of any substance from those of a standard substance by means of two observations. More recently the same method has been applied by A. Findlay (*Proc. R.S.* 1902), under Ramsay's direction, for comparing solubilities which are in many respects analogous to vapour-pressures. The formulae of Young and Roche are purely empirical, but give very fair results over a wide range. That of Biot is far more complicated and troublesome, but admits greater accuracy of adaptation, as it contains five constants (or six, if θ is measured from an arbitrary zero). It is important as having been adopted by Regnault (and also by many subsequent calculators) for the expression of his observations on the vapour-pressures of steam and various other substances. The formulae of Rankine and Unwin, though probably less accurate over the whole range, are much simpler and more convenient in practice than that of Biot, and give results which suffice in accuracy for the majority of purposes.

15. *Theoretical Equation for the Saturation-Pressure.*—The empirical formulae above quoted must be compared and tested in the light of the theoretical relation between the latent heat and the rate of increase of the vapour-pressure ($dp/d\theta$), which is given by the second law of thermodynamics, viz.

$$\theta(dp/d\theta)=L/(v-w), \qquad (21)$$

in which v and w are the volumes of unit mass of the vapour and liquid respectively at the saturation-point (THERMODYNAMICS, § 4). This relation cannot be directly integrated, so as to obtain the equation for the saturation-pressure, unless L and $v-w$ are known as functions of θ. Since it is much easier to measure p than either L or v, the relation has generally been employed for deducing either L or v from observations of p. For instance, it is usual to calculate the specific volumes of saturated steam by assuming Regnault's formulae for p and L. The values so found are necessarily erroneous if formula (10) for the total heat is wrong. The reason for adopting this method is that the specific volume of a saturated vapour cannot be directly measured with sufficient accuracy on account of the readiness with which it condenses on the surface of the containing vessel. The specific volumes of superheated vapours may, however, be measured with a satisfactory degree of approximation. The deviations from the ideal volume may also be deduced by the method of Joule and Thomson. It is found by these methods that the behaviour of superheated vapours closely resembles that of non-condensible gases, and it is a fair inference that similar behaviour would be observed up to the saturation-point if surface condensation could be avoided. By assuming suitable forms of the characteristic equation to represent the variations of the specific volume within certain limits of pressure and temperature, we may therefore with propriety deduce equations to represent the saturation-pressure, which will certainly be thermodynamically consistent, and will probably give correct numerical results within the assigned limits.

The simplest assumptions to make are that the vapour behaves as a perfect gas (or that $p(v-w)=R\theta$), and that L is constant. This leads immediately to the simple formula

$$\log_e(p/p_0)=(1/\theta_0-1/\theta)L/R, \quad . \quad . \quad . \qquad (22)$$

which is of the same type as $\log p = A + B/\theta$, and shows that the coefficient B should be equal to L/R. A formula of this type has been widely employed by van't Hoff and others to calculate heats of reaction and solution from observations of solubility and vice versa. It is obvious, however, that the assumption L = constant is not sufficiently accurate in many cases. The rate of variation of the latent heat at low pressures is equal to $S-s$, where s is the specific heat of the liquid. Under these conditions both S and s may be regarded as approximately constant, so that L is a linear function of the temperature. Substituting $L=L_0+(S-s)(\theta-\theta_0)$, and integrating between limits, we obtain the result

$$\log_e p = A + B/\theta + C \log_e \theta, \quad . \quad . \quad . \qquad (23)$$

where

$$C=(S-s)/R,\ B=-[L_0+(s-S)\theta_0]/R,$$

and

$$A=\log_e p_0 - B/\theta_0 - C\log_e\theta_0.$$

A formula of this type was first obtained by Kirchhoff (*Pogg. Ann.* 103, p. 185, 1858) to represent the vapour-pressure of a solution, and was verified by Regnault's experiments on solutions of H_2SO_4 in water, in which case a constant, the heat of dilution, is added to the latent heat. The formula evidently applies to the vapour-pressure of the pure solvent as a special case, but Kirchhoff himself does not appear to have made this particular application of the formula. In the paper which immediately follows, he gives the oft-quoted expression for the difference of slope $(dp/d\theta)_s-(dp/d\theta)_l$ of the vapour-pressure curves of a solid and liquid at the triple point, which is immediately deducible from (21), viz.

$$\theta(dp/d\theta)_s-\theta(dp/d\theta)_l=(L_s-L_l)/(v-w)=L_f/(v-w), \qquad (24)$$

in which L_s and L_l are the latent heats of vaporization of the solid and liquid respectively, the difference of which is equal to the latent heat of fusion L_f. He proceeds to calculate from this expression the difference of vapour-pressures of ice and water in the immediate neighbourhood of the melting-point, but does not observe that the vapour-pressures themselves may be more accurately calculated for a considerable interval of temperature by means of formula (23), by substituting the appropriate values of the latent heats and specific heats. Taking for ice and water the following numerical data, $L_s=674{\cdot}7$, $L_l=595{\cdot}2$, $L_f=79{\cdot}5$, $R=0{\cdot}1103$ cal./deg., $p_0=4{\cdot}61$ mm., $s-S={\cdot}519$ cal./deg., and assuming the specific heat of ice to be equal to that of steam at constant pressure (which is sufficiently approximate, since the term involving the difference of the specific heats is very small), we obtain the following numerical formulae, by substitution in (23),

Ice . . $\log_{10}p=0{\cdot}6640+9{\cdot}73t/\theta$.
Water : $\log_{10}p=0{\cdot}6640+8{\cdot}585t/\theta-4{\cdot}70(\log_{10}\theta/\theta_0-Mt/\theta)$.

where $t=\theta-273$, and $M=0{\cdot}4343$, the modulus of common logarithms. These formulae are practically accurate for a range of 20° or 30° C. on either side of the melting-point, as the pressure is so small that the vapour may be treated as an ideal gas. They give the following numerical values:—

Temperature, C.	−20°	−10°	0°	+10°	+20°
V.P. of ice, mms.	0·79	1·97	4·61	10·20	21·27
V.P. of water, mms.	0·96	2·17	4·61	9·27	17·58

The error of the formula for water is less than 1 mm. (or a tenth of a degree C.), at a temperature so high as 60° C.

Formula (23) for the vapour-pressure was subsequently deduced by Rankine (*Phil. Mag.* 1866) by combining his equation (11) for the total heat of gasification with (21), and assuming an ideal vapour. A formula of the same type was given by Athenase Dupré (*Théorie de chaleur*, p. 96, Paris, 1869), on the assumption that the latent heat was a linear function of the temperature, taking the instance of Regnault's formula (10) for steam. It is generally called Dupré's formula in continental text-books, but he did not give the values of the coefficients in terms of the difference of specific heats of the liquid and vapour. It was employed as a purely empirical formula by Bertrand and Barus, who calculated the values of the coefficients for several substances, so as to obtain the best general agreement with the results of observation over a wide range, at high as well as low pressures. Applied in this manner, the formula is not appropriate or satisfactory. The values of the coefficients given by Bertrand, for instance, in the formula for steam, correspond to the values $S={\cdot}576$ and $L=573$ at 0° C., which are impossible, and the values of p given by his formula (*e.g.* 763 mm. at 100° C.) do not agree sufficiently with experiment to be of much practical value. The true application of the formula is to low pressures, at which it is very accurate. The close agreement found under these conditions is a very strong confirmation of the correctness of the assumption that a vapour at low pressures does really behave as an ideal gas of constant specific heat. The formula was independently rediscovered by H. R. Hertz (*Wied. Ann.* 17, p. 177, 1882) in a slightly different form, and appropriately applied to the calculation of the vapour-pressures of mercury at ordinary temperatures, where they are much too small to be accurately measured.

16. *Corrected Equation of Saturation-Pressure.*—The approximate equation of Rankine (23) begins to be 1 or 2% in error at the boiling-point under atmospheric pressure, owing to the coaggregation of the molecules of the vapour and the variation of the specific heat of the liquid. The errors from both causes increase more rapidly at higher temperatures. It is easy, however, to correct the formula for these deviations, and to make it thermodynamically consistent with the characteristic equation (13) by substituting the appropriate values of $(v-w)$ and $L=H-h$ from equations (13) and (15) in formula (21) before integrating. Omitting w and neglecting the small variation of the specific heat of the liquid, the result is simply the addition of the term $(c-b)/V$ to formula (23)

$$\log p = A + B/\theta + C\log\theta + (c-b)/V. \quad . \quad . \qquad (25)$$

The values of the coefficients B and C remain practically as before. The value of c is determined by the throttling experiments, so that all the coefficients in the formula with the exception of A are determined independently of any observations of the saturation-pressure itself. The value of A for steam is determined by the consideration that $p=760$ mm. by definition at 100° C. or 373° Abs. The most uncertain data are the variation of the specific heat of the liquid and the value of the small quantity b in the formula (13). The term b, however, is only 4% of c at 100° C., and the error involved in taking b equal to the volume of the liquid is probably small. The effect of variation of the specific heat is more important, but is nearly eliminated by the form of the equation. If we write $h=s_0t+dh$, where s_0 is a selected constant value of the specific heat of the liquid, and dh represents the difference of the actual value of h at t from the ideal value s_0t, and if we similarly write $\phi=s_0\log_e(\theta/\theta_0)+d\phi$ for the entropy of the liquid at t, where $d\phi$ represents the corresponding difference in the entropy (which is easily calculated from a table of values of h), it is shown by Callendar (*Proc. R.S.* 1900, *loc. cit.*) that the effect of the variation of the specific heat of the liquid is represented in the equation for the vapour-pressure by adding to the right-hand side of (23) the term $-(d\phi-dh/\theta)/R$. If we proceed instead by the method of integrating the equation $H-h=\theta(v-w)dp/d\theta$, we observe that the expression above given results from the integration of the terms $-dh/R\theta^2+w(dp/d\theta)/R\theta$, which were omitted in (25). Adopting the formula of Regnault as corrected by Callendar (*Phil. Trans. R.S.* 1902) for the specific heat of water between 100° and 200° C., we find the values of the difference $(d\phi-dh/\theta)$ to be less than one-tenth of $d\phi$ at 200° C. The whole correction is therefore probably of the same order as the uncertainty of the variation of the specific heat itself at these temperatures. It may be observed that the correction would vanish if we could write $dh=w\theta dp/d\theta=wL/(v-w)$. This assumption is made by Gray (*Proc. Inst. C.E.* 1902). It is equivalent, as Callendar (*loc. cit.*) points out, to supposing that the variation of the specific heat is due to the formation and solution of a mass $w/(v-w)$ of vapour molecules per unit mass of the liquid. But this neglects the latent heat of solution, unless we may suppose it included by writing the internal latent heat L_i in place of L in Callendar's formula. In any case the correction may probably be neglected for practical purposes below 200° C.

It is interesting to remark that the simple result found in equation (25) (according to which the effect of the deviation of the vapour from the ideal state is represented by the addition of the term $(c-b)/V$ to the expression for $\log p$) is independent of the assumption that c varies inversely as the nth power of θ, and is true generally provided that $c-b$ is a function of the temperature only and is independent of the pressure. But in order to deduce the values of c by the Joule Thomson method, it is necessary to assume an empirical formula, and the type $c=c_0(\theta_0/\theta)^n$ is chosen as being the simplest. The justification of this assumption lies in the fact that the values of c found in this manner, when substituted in equation (25) for the saturation-pressure, give correct results for p within the probable limits of error of Regnault's experiments.

17. *Numerical Application to Steam.*—As an instance of the application of the method above described, the results in the table below are calculated for steam, starting from the following fundamental data: $p=760$ mm. at $t=100°$ C. or 373·0° Abs. $pV/\theta=0{\cdot}11030$ calories per degree for ideal steam. $S_0=0{\cdot}478$ calories per degree at zero pressure. $L=540{\cdot}2$ calories at 100° C. (Joly-Callendar). $n=3{\cdot}33$, $c_{100}=26{\cdot}30$ c.c., $b=1$ c.c., $h=0{\cdot}9970t+wL$ $(v-w)$. 750 mm. Hg. = 1 megadyne per sq. cm.

TABLE OF PROPERTIES OF SATURATED STEAM[1]

Temp. Cent.	Coaggregation, c, cub. cms.	Total Heat, H, calories.	Latent Heat, L, calories.	Specific Heat, S, cals./deg.	Saturation-Pressure, p, mm. of Hg.
0°	74·43	595·2	595·2	·4786	4·6
20°	58·81	604·7	584·7	·4796	17·6
40°	47·19	614·0	574·0	·4818	55·4
60°	38·68	623·1	536·1	·4860	149·4
80°	31·60	631·9	551·9	·4926	355·0
100°	26·30	640·3	540·2	·5027	760·0
120°	21·93	648·1	527·8	·5163	1490·4
140°	18·73	655·1	514·5	·5347	2715·8
160°	16·00	661·4	500·3	·5571	4647
180°	13·76	666·9	485·3	·5834	7534
200°	11·92	671·6	469·3	·6134	11660

The values of the coaggregation-volume c, which form the starting-point of the calculation, are found by taking $n=10/3$ for convenience of division in formula (13). The unit of heat assumed in the table is the calorie at 20° C., which is taken as equal to 4·180 joules, as explained in the article CALORIMETRY. The latent heat L (formula 9) is found by subtracting from H (equation 15) the values of the heat of the liquid h given in the same article. The values of the specific heat in the next column are calculated for a constant pressure equal to that of saturation by formula (16) to illustrate the increase of the specific heat with rise of pressure. The specific heat at any given pressure diminishes with rise of temperature. The values of the saturation-pressure given in the last column are calculated by formula (25), which agrees with Regnault's observations better than his own empirical formulae. The agreement of the values of H with those of Griffiths and Dieterici at low temperatures, and of the values of p with those of Regnault over the whole range, are a confirmation of the accuracy of the foregoing theory, and show that the behaviour of a vapour like steam may be represented by a series of thermodynamically consistent formulae, on the assumption that the limiting value of the specific heat is constant, and that the isothermals are generally similar in form to those of other gases and vapours at moderate pressures. Although it is not possible to represent the properties of steam in this manner up to the critical temperature, the above method appears more satisfactory than the adoption of the inconsistent and purely empirical formulae which form the basis of most tables at the present time.

A similar method of calculation might be applied to deduce the thermodynamical properties of other vapours, but the required experimental data are in most cases very imperfect or even entirely wanting. The calorimetric data are generally the most deficient and difficult to secure. An immense mass of material has been collected on the subject of vapour-pressures and densities, the greater part of which will be found in Winkelmann's *Handbook*, in Landolt's and Bornstein's *Tables*, and in similar compendiums. The results vary greatly in accuracy, and are frequently vitiated by errors of temperature measurement, by chemical impurities and surface condensation, or by peculiarities of the empirical formulae employed in smoothing the observations; but it would not be within the scope of the present article to discuss these details. Even at the boiling-points the discrepancies between different observers are frequently considerable. The following table contains the most probable values for a few of these points which have been determined with the greatest care or frequency:—

Table of Boiling-Points at Atmospheric Pressure on Centigrade Scale

Hydrogen	−252°·6	Benzophenone	+305°·8
Oxygen	−182°·8	Mercury	+356°·7
Carbon dioxide	− 78°·3	Sulphur	+444°·5
Sulphur dioxide	− 10°·0	Cadmium	+756°
Aniline	+184°·1	Zinc	+916°
Naphthalene	+218°·0		

Alphabetical Index of Symbols

A, B, C, Empirical constants in formulae; section 14.
b, Minimum volume or co-volume of vapour, equation (13).
C, Concentration of solution, gm. mols. per c.c.
c, Coaggregation-volume of vapour, equation (13).
D, d, Density of liquid and vapour.
E, Intrinsic energy of vapour.
g, Acceleration of gravity.
H, Total heat of vapour.
h, Heat of the liquid; height of capillary ascent.
L, Latent heat of vaporization.
M, Modulus of logarithms.
m, Molecular weight.
n, Index of θ in expression for c, equation (13).
P, Osmotic or capillary pressure.
p, Pressure of vapour.
Q, Cooling effects in adiathermal expansion.
R, Constant in gas equation, $pv=R\theta$.
r, Radius of curvature, formula (1).
S, Specific heat of vapour at constant pressure.
s, Specific heat of liquid, equation (23).
Specific heat of vapour at constant volume; section 8.
T, Surface tension of liquid.
t, Temperature Centigrade.
V, Ideal volume of vapour, equation (13).
Specific volume of solid or liquid, equation (5).
v, Specific volume of vapour or steam.
w, Specific volume of water or liquid.
θ, Temperature on thermodynamic scale.
ϕ, Entropy of vapour or liquid.

(H. L. C.)

VAQUERO, a Spanish word meaning a cowherd or herdsman, and so particularly used in Mexico and Spanish America for the whole class of men employed on the large cattle-ranches or *vaquerias*. The word, like the corresponding Fr. *vacher*, cowherd, comes from the Med. Lat. *vaccarius* (*vacca*, cow).

VAR, a department in S.E. France. It was formed in 1790 of a part of Lower Provence, but in 1860 it was reduced by the transfer of the district of Grasse to the newly formed department of the Alpes Maritimes, which is the reason why the Var does not now flow in the department to which it gives its name. It is bounded N. by the department of the Basses Alpes (the Verdon river forming the boundary), E. by that of the Alpes Maritimes (the Siagne stream forming the limit), S. by the Mediterranean, and W. by the department of the Bouches du Rhône. Its area is 2266 sq. m., its greatest length is about 62 m., and its greatest breadth about 56 m.

The surface of the department is very hilly, the highest point being the Signal des Chens (5620 ft.) at its north-east corner. These calcareous hills are much fissured and very dry on the highest plateaux, but are rich in springs, which is the cause of very beautiful verdure in the valleys. To the W. is the chain (3786 ft.) of the Ste Baume, wherein is the celebrated grotto (now a frequented pilgrimage place) wherein St Mary Magdalene is said to have taken refuge. This chain is connected with the hills (2329 ft.) above Toulon. The thickly wooded Montagnes des Maures (2556 ft.), which extend above the coast from Hyères to near Fréjus are separated from the Ste Baume chain by the Gapeau stream and from that of the Estérel by the Argens river: the Maures chain, with the Argens valley, forms a sort of geological island in Provence being composed of granite, gneiss and schists. To the north of the Argens valley and in the north-eastern portion of the department rises the Estérel chain, the highest summit of which (the Mont Vinaigre) attains 2021 ft.: this chain is mainly composed of igneous rocks, with some schists and porphyry. The principal river in the department is the Argens, which traverses it from W. to E., and falls into the sea near Fréjus after a course of about 68 m. Its chief tributary is the Nartuby, on which stands Draguignan, the chief town, while other streams are the Arc, the Huveaune and the Gapeau. The extreme north-western extremity of the department borders for 2½ m. the Durance, which separates it from the department of Vaucluse. The coast line, which is one of the most picturesque and varied in France, runs first W. to E., from the Gulf of La Ciotat to Cape Camarat, and then S.W. to N.E., from the Gulf of St Tropez to that of La Napoule. The shore is dotted (from W. to E.) successively by the sand-covered remains of the Phocaean city of Tauroentum; the little ports of Bandol and St Nazaire; the peninsula of Cape Sicié (on which rises the chapel of Notre Dame de la Garde, and a famous lighthouse, 1178 ft.) with its eastward projection Cape Cépet (338 ft.), bristling with fortifications to protect the great harbour of Toulon, to the north-east; the roads of Toulon; those of Giens, on the site of the Gallo-Roman town of Pomponiana; the curious peninsula of Giens, formerly an island, but now attached to the mainland by two long spits of sand, between which lies the lagoon of Les Pesquiers, with its *salines*; the great anchorage of Hyères, shut off from the Mediterranean by the hilly and wooded islands of Porquerolles, Port Cros and Le Levant; the bold promontories of the Montagnes des Maures, that divide the coast into lovely bays; Cape Camarat (1066 ft.), with a lighthouse; the deep Gulf of St Tropez, with perhaps the best natural anchorage in all Provence; the Gulf of Fréjus, where, owing to the accumulated alluvial deposits at the mouth of the Argens, the Roman port of Forum Julii is now occupied by the inland town of Fréjus; the red porphyry headlands of the Estérel chain, with the roads of Agay between them; and Cape Roux (1486 ft.) looking towards Cannes, still farther N.E. The department is divided into three arrondissements (Draguignan, Brignoles and Toulon), 30 cantons and 148 communes. The climate is remarkably fine and mild on the coast, where there is complete shelter from the wind, St Raphael (with Valescure above it) and Hyères being now much frequented winter resorts. The department now forms the bishopric of Fréjus (4th century), which is in the ecclesiastical province of Aix en Provence: in 1801 there was annexed to it the episcopal see of Toulon, founded in the 5th century, and in the ecclesiastical province of Arles. There are in the department 135 m. of broad gauge railways, and 148½ m. of narrow gauge lines. The principal towns are Toulon, La Seyne, Hyères, Draguignan, its political capital, Brignoles and Fréjus. There are a number of mines (chiefly iron and coal) in the department, and salt is extracted from the marshes near Hyères, while there are manufactories of pottery and extensive vineyards. La Seyne is the principal centre of industrial activity. Cut flowers are largely exported from Hyères. In 1901 the population of the department was 326,384. (W. A. B. C.)

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[1] Complete tables of the properties of steam have been worked out on the basis of Callendar's formulae by Professor Dr R. Mollier of Dresden, *Neue Tabellen und Diagramme für Wasserdampf*, published by J. Springer (Berlin, 1906).

VARALLO SESIA, a town of Piedmont, Italy, in the province of Novara, from which it is 34 m. N.N.W. by rail, situated in the valley of the Sesia, 1480 ft. above sea-level. Pop. (1901) 3330 (town); 4265 (commune). The churches of S Gaudenzio, S Maria delle Grazie and S Maria di Loreto, all contain works by Gaudenzio Ferrari (1471–1546), who was born in the neighbouring Val Duggia, while the Sacro Monte, a place of pilgrimage rising above the town (1995 ft.), is approached by a path leading past forty-five chapels containing groups of life-size painted terra-cotta figures representing scenes from sacred history, with backgrounds in fresco (by Ferrari and others), to the pilgrimage church built by Pellegrino Tibaldi after 1578. In the works mentioned, as Burckhardt remarks, Ferrari's whole development may be traced.

VARCHI, BENEDETTO (1502–1565), Florentine historian. He fought in the defence of Florence during the siege by the Mediceans and imperialists in 1530, and was exiled after the surrender of the city. In 1536 he took part in Piero Strozzi's unsuccessful expedition against Medicean rule, but seven years later he was called back to Florence by Cosimo I., who gave him a pension and commissioned him to write a history of the city; the work covers the period from 1527 to 1538. Varchi also wrote a number of plays, poems, dialogues and translations from the classics. His history, in sixteen books, was first published in Florence in 1721.

VARDANES, the name of two Parthian kings.

Vardanes I., succeeded Artabanus II., probably his father, in A.D. 40 (Joseph. *Ant.* xx. 3, 4), but had continually to fight against his rival Gotarzes (*q.v.*). The coins show that he was in full possession of the throne from 42 to 45. In 43 he forced Seleucia on the Tigris to submit to the Parthians again after a rebellion of seven years (Tac. *Ann.* xi. 9). Ctesiphon, the residence of the kings on the left bank of the Tigris, opposite to Seleucia, naturally profited by this war; and Vardanes is therefore called founder of Ctesiphon by Ammianus Marc. xxiii. 6. 23. He also prepared for a war against Rome, with the aim of reconquering Armenia (cf. Joseph. *Ant.* xx. 3, 4), but did not dare to face the Roman legions (Tac. *Ann.* xi. 10). In a new war with Gotarzes he gained a great success against the eastern nomads. He is praised by Tacitus as a young and highly gifted ruler of great energy (cf. Philostratus, *Vita Apollon. Tyan.* i. 21. 28), but lacking in humanity. In the summer of 45 he was assassinated while hunting, and Gotarzes became king again.

Vardanes II. rebelled against his father Vologaeses I. in A.D. 54 (Tac. *Ann.* xiii. 7). We know nothing more about him and it is not certain whether the coins of a young beardless king, which are generally attributed to him, really belong to him (Wroth, *Catalogue of the Coins of Parthia*, p. L. ff.). (Ed. M.)

VARENIUS, BERNHARDUS [Bernhard Varen] (1622–1650), German geographer, was born at Hitzacker on the Elbe, in the Lüneburg district of Hanover. His early years (from 1627) were spent at Uelzen, where his father was court preacher to the duke of Brunswick. Varenius studied at the gymnasium of Hamburg (1640–42), and at Königsberg (1643–45) and Leiden (1645–49) universities, where he devoted himself to mathematics and medicine, taking his medical degree at Leiden in 1649. He then settled at Amsterdam, intending to practise medicine. But the recent discoveries of Tasman, Schouten and other Dutch navigators, and his friendship for Blaeu and other geographers, attracted Varenius to geography. He died in 1650, aged only twenty-eight, a victim to the privations and miseries of a poor scholar's life.

In 1649 he published, through L. Elzevir of Amsterdam, his *Descriptio Regni Japoniae*, an excellent compilation. In this was included a translation into Latin of part of Jodocus Schouten's account of Siam (*Appendix de religione Siamensium, ex Descriptione Belgica Iodoci Schoutenii*), and chapters on the religions of various peoples. Next year (1650) appeared, also through Elzevir, the work by which he is best known, his *Geographia Generalis*, in which he endeavoured to lay down the general principles of the subject on a wide scientific basis, according to the knowledge of his day. The work is divided into—(1) absolute geography, (2) relative geography and (3) comparative geography. The first investigates mathematical facts relating to the earth as a whole, its figure, dimensions, motions, their measurement, &c. The second part considers the earth as affected by the sun and stars, climates, seasons, the difference of apparent time at different places, variations in the length of the day, &c. The third part treats briefly of the actual divisions of the surface of the earth, their relative positions, globe and map-construction, longitude, navigation, &c.

Varenius, with the materials at his command, dealt with the subject in a truly philosophic spirit; and his work long held its position as the best treatise in existence on scientific and comparative geography. The work went through many editions. Sir Isaac Newton introduced several important improvements into the Cambridge edition of 1672; in 1715 Dr Jurin issued another Cambridge edition with a valuable appendix; in 1733 the whole work was translated into English by Dugdale; and in 1736 Dugdale's second edition was revised by Shaw. In 1716 an Italian edition appeared at Naples; in 1750 a Dutch translation followed; and in 1755 a French version, from Shaw's edition, came out at Paris. Among later geographers d'Anville and A. von Humboldt especially drew attention to Varen's genius and services to science.

See Breusing, "Lebensnachrichten von Bernhard Varenius" (*Geogr. Mittheil.*, 1880); H. Blink's paper on Varenius in *Tijdschr. van het Nederl. Aandrijksk. Genotschap* (1887), ser. ii. pt. 3; and F. Ratzel's article "Bernhard Varenius," in *Allgemeine Deutsche Biographie*, vol. xxxix. (Leipzig, 1895).

VARESE, a town of Lombardy, Italy, in the province of Como, 18 m. by rail W. of that town, and 37 m. N.W. of Milan, 1253 ft. above sea-level. Pop. (1901) 7692 (town); 17,666 (commune). It is a well-to-do place, beautifully situated near the Lake of Varese, and for this reason a favourite summer and autumn resort of the Milanese, who have numerous country houses in the vicinity. Among them the Villa Litta and the Villa Ponte may be specially mentioned. The principal church is that of S. Victor (rebuilt 1580–1615 and 1795), to which is attached an ancient baptistery (dating from the 9th century but rebuilt in the 13th). The fine campanile of the church is 246 ft. high. There is an archaeological museum with prehistoric antiquities from the lake-dwellings on an island in the Lake of Varese. To the N.W. (a journey of 2½ hours) is the pilgrimage church of the Madonna del Monte (2885 ft.), approached by a path which passes fourteen chapels adorned with 17th-century frescoes and groups in stucco illustrating the mysteries of the rosary. Varese is the seat of active silk-spinning, tanning, paper-making and the manufacture of organs and vehicles. Excellent wine is made. Varese is a junction for Porto Ceresio and Laveno.

VARIA (mod. Vicovaro), an ancient village of Latium, Italy, in the valley of the Anio, on its right bank, and on the Via Valeria, 8 m. N.E. of Tibur (Tivoli). It was probably an independent town and not within the territory of Tibur, and Horace speaks of it as Sabine. Some remains of its walls, in rectangular blocks of travertine, still exist. One mile to the east is a picturesque gorge of the Anio, in which may be seen remains of the ancient aqueducts which supplied Rome, consisting partly of rock-cut channels and partly of ruined bridges: above it is the monastery of S Cosimato. Close to this point begins the valley of the Digentia (mod. Licenza) in which Horace's Sabine farm was situated. On the hill at the east of the entrance is the village of Cantalupo or Bardella, which has now assumed the name of Mandela, being identified thus (correctly) with Horace's "rugosus frigore pagus" (*Epist.* i. 18, 104). An inscription of the Christian period, found at S Cosimato, speaks of the Massa Mandelana (*Corp. Inscr. Lat.* xiv. 3482). About 3 m. up the valley, close to the road on the west (right) bank of the stream, are traces of a Roman dwelling-house in *opus reticulatum* with remains of two mosaic pavements; this is generally identified with the villa of Horace, and probably corresponds fairly closely with its site. That the Fons Bandusiae was near the Sabine farm is not a necessary inference from *Od.* iii. 13, in which alone it is mentioned; though the scholiasts state it; indeed a fountain of this name near Venusia is mentioned in a bull of 1103. On the other hand, that there was an abundant fountain near the Sabine farm is clear from *Epist.* i. 16. 12, and *Sat.* ii. 6. 2. It is generally identified with the Fonte dei Ratini, but the spring of Vigna la Corte, a little farther north, is still more plentiful. Some have supposed that the site of the villa was higher up the hillside, above Rocca Giovane. For Horace speaks of having written *Epist.* i. 10 "post fanum putre Vacunae," and an inscription recording a temple of Victoria restored by Vespasian was copied at Rocca Giovane in the 16th century (*Corp. Inscr. Lat.* xiv. 3485). The identification of Victoria with the Sabine goddess Vacuna is not, however, absolutely certain: and there is here, as elsewhere in Roman literature, a play on the connexion of the name with *vacare*, "to take a holiday." In any case, the site of the Sabine farm can be approximately, if not exactly, fixed as in the neighbourhood of Rocca Giovane.

See T. Berti, *La Villa di Orazio* (Rome, 1886); G. Boissier, *Nouvelles promenades archéologiques* (Paris, 1886). (T. As.)

VARIATION AND SELECTION, in biology. Since the publication in 1859 of Charles Darwin's *Origin of Species*, the theory of evolution of animals and plants (see EVOLUTION) has rested on a linking of the conceptions of variation and selection. Living organisms vary, that is to say, no two individuals are exactly alike; the death-rate and the multiplication-rate are to a certain extent selective, that is to say, on the average, in the long run, they favour certain variations and oppress other variations. Co-operation of the two factors appears to supply a causal theory of the occurrence of evolution; the suggestion of their co-operation and the comparison of the possible results with the actual achievements of breeders in producing varieties were the features of Charles Darwin's theoretical work which made it a new beginning in the science of biology, and which reduced to insignificance all earlier work on the theory of evolution. P. Geddes, J. H. Stirling, E. Clodd and H. F. Osborn have made careful studies of pre-Darwinian writers on evolution, but the results of their inquiries only serve to show the greatness of the departure made by Darwin.

Several of the ancients had a vague belief in continuity between the inorganic and the organic and in the modifying or variation-producing effects of the environment. Medieval writers contain nothing of interest on the subject, and the speculations of the earliest of the modern evolutionists, such as C. Bonnet, were too vague to be of value. G. L. L. Buffon, in a cautious, tentative fashion, suggested rather than stated the mutability of species and the influence of the forces of nature in moulding organisms. Immanuel Kant, in his *Theory of the Heavens* (1755), foreshadowed a theory of the development of unformed matter into the highest types of animals and plants, and suggested that the gradations of structure revealed by comparative anatomy pointed to the existence of blood relationship of all organisms, due to derivation from a common ancestor. He appeared to believe, however, that the successive variations and modifications had arisen in response to mechanical laws of the organisms themselves rather than to the influence of their surroundings. J. G. von Herder suggested that increase by multiplication with the consequent struggle for existence had played a large part in the organic world, but his theme remained vague and undeveloped. Erasmus Darwin, the grandfather of Charles Darwin, set forth in *Zoonomia* a much more definite theory of the relation of variation to evolution, and the following passage, cited by Clodd, clearly expresses it:—

> "When we revolve in our minds the metamorphoses of animals, as from the tadpole to the frog; secondly, the changes produced by artificial cultivation, as in the breeds of horses, dogs and sheep; thirdly, the changes produced by conditions of climate and season, as in the sheep of warm climates being covered with hair instead of wool, and the hares and partridges of northern climates becoming white in winter; when, further, we observe the changes of structure produced by habit, as shewn especially by men of different occupations; or the changes produced by artificial mutilation and prenatal influences, as in the crossing of species and production of monsters; fourth, when we observe the essential unity of plan in all warm-blooded animals—we are led to conclude that they have been alike produced from a single living filament."

G. R. Treviranus, in the beginning of the 19th century, laid stress on the indefiniteness of variation, but assumed that some of it was adaptive response to the environment, and some due to sexual crossing. J. B. P. Lamarck was the first author to work out a connected theory of descent and to suggest that the relationships of organic forms were due to actual affinities. He believed that life was an expanding, growing force, and that animals responded to the environment by developing new wants, seeking to satisfy these by new movements and thus by their own striving producing new organs which were transmitted to their descendants. Variation was in fact a purposive response.

In 1813 W. C. Wells definitely propounded the theory of natural selection, but applied it only to certain human characters. In 1831 Patrick Matthew, in the appendix to a book on naval timber and arboriculture, laid stress on the extreme fecundity of nature "who has in all the varieties of her offspring a prolific power much beyond (in many cases a thousandfold) what is necessary to fill up the vacancies caused by senile decay. As the field of existence is limited and pre-occupied, it is only the hardier, more robust, better-suited-to-circumstance individuals, who are able to struggle forward to maturity, these inhabiting only the situations to which they have superior adaptation and greater power of occupancy than any other kind; the weaker and less circumstance-suited being prematurely destroyed. This principle is in constant action; it regulates the colour, the figure, the capacities and instincts; those individuals in each species whose colour and covering are best suited to concealment or protection from enemies, or defence from inclemencies or vicissitudes of climate, whose figure is best accommodated to health, strength, defence and support; whose capacities and instincts can best regulate the physical energies to self-advantage according to circumstances—in such immense waste of primary and youthful life those only come to maturity from the strict ordeal by which nature tests their adaptation to her standard of perfection and fitness to continue their kind by reproduction." G. St Hilaire and afterwards his son Isodore regarded variation as not indefinite but directly evoked by the demands of the environment. L. von Buch laid stress on geographical isolation as the cause of production of varieties, the different conditions of the environment and the segregated interbreeding gradually producing local races. K. E. von Baer and M. J. Schleiden regarded variation and the production of new or improved structures as an unfolding of possibilities latent in the stock. Robert Chambers, in the once famous *Vestiges of Creation*, interested and shocked his contemporaries by his denial of the fixity of species and his insistence on creation by progressive evolution, but had no better theory of the cause of variation than to suppose that organisms—"from the simplest and oldest to the highest and most recent" were possessed of "an inherent impulse, imparted by the Almighty both to advance them from the several grades and modify their structure as circumstances required." In 1852 C. Naudin compared the origin of species in nature with that of varieties under cultivation. Herbert Spencer from 1852 onwards maintained the principle of evolution and laid special stress on the moulding forces of the environment which called into being primarily new functions and secondarily new structures.

Although the pre-Darwinian writers amongst them invoked nearly every principle that Darwin or his successors have suggested, they failed to carry conviction with regard to evolution, and they neither propounded a coherent philosophy of variation nor suggested a mechanism by which variations that appeared might give rise to new species. The anticipations of Darwin were little more than formal and verbal. As T. H. Huxley pointed out in his essay on the reception of the *Origin of Species* in the second volume of Darwin's *Life and Letters*, "The suggestion that new species may result from the selective action of external conditions upon the variations from their specific type which individuals present—and which we call 'spontaneous' because we are ignorant of their causation—is as wholly unknown to the historian of scientific ideas as it was to biological specialists before 1858. But that suggestion is the central idea of the *Origin of Species*, and contains the quintessence of Darwinism."

C. Darwin opened his argument by consideration of plants and animals under domestication. He pointed to the efflorescence of new forms that had come into existence under the protection of man. A multitude of varieties of cultivated plants and domesticated animals existed, and these differed amongst themselves and from their nearest wild allies to an extent that, but for the fact of their domestication, would entitle them to the systematic rank of species. Some of these changes he supposed to have been the result of new conditions, including abundance of food and protection from enemies, but most he attributed to the accumulated results of selective breeding. No doubt such domesticated species might revert, and it has been shown that many do revert when restored to wild conditions, but such reversion is natural if we reflect that the domestic varieties are under the guardianship of man and have been selected according to his whim and advantage. Comparing domesticated varieties with species and varieties in nature, Darwin showed that the distinction between varieties and species was chiefly a matter of opinion, and that the discovery of new linking forms often degraded species to varieties. Species, in fact, were not fixed categories, but halting-places, often extremely difficult to choose, for the surveying mind of the systematist. He considered that a struggle for existence was the inevitable result of the operation of the principle of Malthus in the animal and vegetable worlds. The struggle would be most acute between individuals and varieties of the same species, with the result that "any being, if it vary however slightly, in any manner profitable to itself, under the complex and somewhat varying conditions of life, will have a better chance of surviving, and thus be naturally selected." Under natural selection the less well-adapted forms of life would on the average have a heavier death-rate and a lower multiplication-rate. He did not suggest that every variation and every character must have a "selection value," although he pointed out that, because of our ignorance of animal physiology, it was extremely rash to set down any characters as valueless to their owners. It is even more important to notice that he did not suggest that every individual with a favourable variation must be selected, or that the selected or favoured animals were better or higher, but merely that they were more adapted to their surroundings.

With regard to variation, Darwin was urgent in stating his opinion that the laws of variation were not understood and that the phrase "chance" variation was a wholly incorrect expression. He thought it probable that circumstances affecting the reproductive system of the parents had much influence in producing a plastic condition of the progeny. He doubted, but did not exclude, the importance of the direct effect of differences of climate and food and of increased use and disuse, except so far as the individual was concerned, but his opinion as to these Lamarckian factors changed from time to time. He laid much stress on the unity of the organism in every stage of its existence, with the resulting correlation of variations, so that the favouring of one particular variation entailed modifications of correlated structures. He recognized the existence of the large variations, but he believed these to be of little value in evolution, and he attached preponderating importance to relatively minute indeterminate variations. On the other hand, he was far from advocating the view that has been pithily expressed as the "selection of the fit from the fortuitous"; he recognized that variations, although perhaps suggested or excited by the environment, were determined by internal causes. He showed how different varieties in a species, or species in a genus, tended to display parallel variation, clearly indicating that the range and direction of variation were limited or determined by the nature of the organism.

Alfred Russel Wallace, the co-discoverer of the Darwinian principles, had sent to Darwin early in 1858 an outline of a theory of the origin of species. Darwin found that it was, in all essential respects, identical with his own theory at the exposition of which he had been working for many years. With an unselfish generosity which must always shine in the history of science, and indeed of the human race, Darwin proposed at once to communicate his correspondent's essay to the Linnaean Society of London, but was persuaded by his friends to send with it an outline of his own views. Accordingly, on the same evening, in July 1858, both communications were made to the Linnaean Society. When Wallace found how much more fully Darwin was equipped for expounding the new views, he exhibited an unselfish modesty that fully repaid Darwin's generosity, henceforth described himself as a follower of Darwin, entitled his most important publication on the theory of evolution *Darwinism*, and did not issue it until 1889, long after the world had given full credit to Darwin. In most respects his ideas were closely parallel with those of Darwin. He believed that species had been formed by means of natural selection. He insisted that the great powers of increase of all organisms led to a tremendous struggle for existence, and that variability extended to every part and organ of every organism; that the variability was large in amount in proportion to the size of the part affected, and occurred in a considerable proportion of the individuals of those large and dominant species which might be supposed to be breaking up into new species. He pointed to the changes wrought on domesticated organisms by the artificial selection of similar variations, and drew the inference that there must be parallel occurrences under wild nature. In the sphere of nature, with its vast numbers and constant pressure, not every more favoured individual would survive, nor every surviving individual be the more favoured, but throughout the changes and chances there would be a constant and important bias in favour of the individuals more fitted to their conditions. Wallace, however, brought into his scheme a factor excluded by Darwin. He believed that behind the natural world lay a spiritual world, irruptions from which had disturbed the natural sequence of causation, certainly in the production of the higher emotional and mental qualities of man, probably in the appearance of self-consciousness, and possibly in the first origin of life.

It is to be remembered that the origin of species by the modification of pre-existing species,—in fact, the doctrine of organic evolution,—although first made credible by Darwin and Wallace, does not depend upon their theory of the relation of natural selection to variation. The theory of evolution is supported by a great range of evidence, much of which was first collected by Darwin, and which has been enormously increased by subsequent workers excited by his genius. Such evidence relates to the facts of classification, structure, development, and geographical and geological distribution. It now remains to examine in closer detail the further knowledge that has been gained with regard to variation and the bearing of that on the Darwinian position.

Magnitude of Variation.—Darwin was well aware that variation ranged from differences so minute as to become apparent only on careful measurement to those large departures from the normal which may be called abnormalities, malformations or monstrosities. He was of the opinion that the summation of minute differences had played a preponderating if not exclusive part in the formation of species. Wallace, whilst insisting that the range of observed and measured variation was much larger in proportion to the size of the organisms or parts of organism affected than was generally believed, leaned to the Darwinian view in excluding from the normal factors in the origin of species variations of the extremer ranges of magnitude. Later writers, and in particular W. Bateson and H. de Vries, have urged that as species are discontinuous—that is to say, marked off by structural differences of considerable magnitude—it is more probable that they have arisen from similarly discontinuous variations. De Vries gave the name "mutations" to such considerable variations (it is to be noted that a further concept, that of the mode of origin, has been added to the word mutation, and that the conception of relative size is being removed from it), and Bateson, de Vries and other writers have added many striking cases to those recorded by Darwin. It is doubtful, however, if there is any philosophical basis for distinguishing between variations merely by their magnitude. Differences which at their first appearance are very minute may result in the kind of variations which certainly would be classed as discontinuous. When the cells of the *morula* stage of an embryo are shaken asunder, each, instead of forming the appropriate part of a single organism, may form a complete new organism. And similarly in the development of a complicated organism, the suppression or doubling of a single cell or group of cells may bring about striking differences in the symmetry of the adult, or the reduction or increase in the number of metameric organs. A slight change in the structure or activity of a gland, by altering the internal secretion, may produce widespread alterations even in an adult organism; and we have good reason to suppose that, if compatible with viability, such minute changes would have even a greater ultimate effect if they occurred in an embryo. Even amongst the extreme advocates of the theory of mutations, the importance of magnitude is being discounted by their suggestion that some of the minute variations which have hitherto been regarded by them as insignificant "fluctuating variations" may be significant mutations. This in effect is to say that not magnitude but something else has to be sought for if we are to pick out amongst observed variations those which may be the material for the differentiation of species. So far as magnitude is concerned, the attack on the Darwinian position has failed, and it is agreed that species may be discontinuous and none the less have been produced from minute variations.

Causes of Variation.—Darwin was careful to insist that we did not know the laws of variation, and that when variation was attributed to "chance" no more should be read into the statement than an expression of our ignorance of the causation. It cannot now be doubted that a very large amount of observed variation, and especially of the indefinite variation which is sometimes spoken of as fluctuating variation, and which is usually distributed indefinitely round a mean, is directly associated with or induced by the environment. On various grounds attempts have been made to exclude such variation from the material for the making of species. The variations which de Vries has called mutations, and which were at first associated by Bateson with what he called discontinuous variations as the exclusive source of new species, are now supposed by de Vries to be distinguished from fluctuating variations by their mode of origin. Such mutations are not the product of the environment, but are an outcrop of the constitution of the germinal material of the varying organism, the result either of causes as yet undetected, or of the premutations and eliminations suggested by the work of Mendel (see MENDELISM). These attempts to reject environmental variation rest on several grounds. In the first place the variations in question are "acquired characters." When Darwin and Wallace framed their theories it was practically assumed that acquired characters were inherited, and the continuous slow action of the environment, moulding each generation to a slight extent in the same direction, was readily accepted by a generation inspired by Sir C. Lyell's doctrine of uniformitarianism in geological change, as a potent force. A. Weismann, however, from theoretical considerations and from analysis of supposed cases has at the least thrown doubt on the transmission of acquired characters. And so the newer school discard acquired characters and all the Lamarckian factors and leave the board clear for "mutations." Analysis of any acquired character, however, shows that there are two factors involved. The organism is not a passive medium; the amount and nature of the response it makes to the action of environment depends on its own qualities, and these qualities, on any theory of inheritance, pass from generation to generation. Successful organisms, or well-adapted organisms, are those that have responded to the environment, whether by large or small variations, in suitable fashion. It is the character as acquired that affords the opportunity for selection, but the quality of responding to the environment so as to produce that character is transmitted. The conceptions of Weismann afford no ground for rejecting fluctuating variations from the materials for the production of species.

In the second place, it has been urged, particularly by de Vries, that experiment and observation have shown that the possible range of fluctuating variation is strictly limited. Breeders, he says, who try to build up qualities by the selection of the fluctuating variations that occur soon find that they reach a maximum beyond which their efforts fail, unless they turn to the more rarely occurring but heritable mutations. Something will be said later in this article as to the limitation of variation; here it is necessary only to say that de Vries is introducing no new idea. It is well known that some races and some organs in plants and animals are extremely variable, and that others are much less variable, and further, that whilst some of these differences may be due to intrinsic causes, others can be modified by experiment. As Sir W. T. Thiselton-Dyer has pointed out, what is called "specific stability" is a familiar obstacle to the producer of novelties, but one which he frequently succeeds in breaking down by cultural and other methods. In a survey of the palaeontological history of plants and animals, it is plain that extreme stability and extreme mutability both have occurred, sometimes having persisted for untold ages, sometimes having succeeded one another for varying periods. As yet no solid reason has been alleged for excluding fluctuating variations, on account of their limitation, from the materials for specific change. J. Cossar Ewart and H. M. Vernon have adduced experimental evidence as to the induction of variation by such causes as difference in the ages of the parents, in the maturity or freshness of the conjugating germ cells, and in the condition of nutrition for the embryos. Such cases show in the plainest way the co-operation of external or environmental and internal or constitutional factors.

With our present knowledge it is impossible to discriminate between variation that may or that may not be the material for the differentiation of species by scrutinizing either magnitude or probable causation. It is equally impossible to draw an exact line between variation induced by the environment and variation that may be termed intrinsic. Extrinsic and intrinsic factors are involved in every case, although there is a range from instances in which the external factor appears to be extreme to instances where the intrinsic factor is dominant. Even the results of mutilation involve an intrinsic factor, for they range, according to the organ and organism affected, from complete regeneration to the most imperfect healing. In the effects of exercise, of physiological activity and the gross results of such external agencies as food, temperature, climate, light, pressure and so forth the intrinsic factor appears to become more important. The interplay of extrinsic and intrinsic factors also differs with the age of the organism affected: the more nearly adult it may be, the more direct appears to be the influence of the environment; the more nearly embryonic the organism may be, the less direct is the result of a force impressed from without. The old organism is more stable and responds in obvious ways to direct assaults from without; the young organism is at once less stable and more profoundly modified by environmental change, replying in terms less easy to predict from knowledge of the nature and amount of the impinging agency. And finally, there are a series of variations, amongst which no doubt are the mutations of de Vries and the disintegrations and recombinations of the unit factors with which Mendel and his followers have worked, in which the external or environmental factor is most remote from the actual result.

Correlated Variation.—Every organism is an individual, its different parts, organs and functions being associated in a degree of intimacy that varies, but that corresponds roughly with the integration of the individual and its place in the ascending scales of animal or vegetable life. One aspect of organic individuality is the correlation of variations, the fact that when one part varies, other parts vary more or less simultaneously. So far, our knowledge of correlation is almost entirely empirical, and the arrangement of the observed facts cannot be brought into exact harmony with our guesses at their causation.

Much correlation is the inevitable result of organic structure. The various parts of a living organism affect each other in adult life and during growth. If, for instance, the testes fail to develop normally, the secretion which they discharge into the blood is abnormal in character and amount, with the result that the characters of the remotest parts of the body are more or less profoundly affected. It is now known that similar internal secretions, or hormones, pass into the blood from every organ and tissue, so reaching and affecting every part of the body. If we reflect on the multitude and complexity of such actions and reactions in operation from the youngest stages to the end of the life of each individual, we cannot be surprised at any correlation. Change in the size of any part or organ, however it may have been produced, must bring with it many others changes, directly or indirectly. A difference in calibre, elasticity or branching of a blood vessel, the smallest variation in a nerve or group of vessel-cells, any anatomical or physiological divergence, is reflected throughout the organism. Much of the character of organisms is due to various symmetries, radial, bilateral, metameric and so forth, and these symmetries arise, partly at least, from the mode of growth by cell division and the marshalling of groups of cells to the places where they are destined to proliferate. Here, again, a variation in the order, nature and number of the divisions, in itself simple, may result in symmetrical or correlated changes in all the progeny of the affected embryonic part.

Every new individual starts life (see REPRODUCTION) as a mass of germinal material derived from one or from two parents, but with a coherent individuality of its own. This individuality is the result of the particular selection of qualities it receives from its parents, a selection that obviously differs in different cases, as, save in the case of "identical twins," which are supposed to be the product of a single fertilized ovum, no individual pair of brothers, or pair consisting of brother and sister, are alike. We are still ignorant of the causes that determine the associated selection of inherited qualities that go to the making of any individual. Those who have followed up the work of Mendel believe that the qualities of the new individual are a precise selection from and reconstruction of the parental qualities, and that were complete analysis possible, the characters of the new individual could be predicted with chemical accuracy. On other views of inheritance, there would be required for prediction knowledge not only of the immediate parents but of the whole line of ancestry, with the result that prediction could reach only some degree of probability for any single individual and be accurate only for the average of a sufficient number of individuals. But whatever be the theory of the mode of inheritance, or the mechanism by which the germinal plasm of an individual is made up, it is plain that there is correlation between the various qualities of an individual due to the mode of origin of its germ plasm as a selected individual portion of the parental germ plasm.

Observed cases of correlation cover almost every kind of anatomical and physiological fact, and range from simple cases such as the relation between height of body and length of face to such an unexpected nexus as that between fertility and height in mothers of daughters. The statistical investigation of correlations forms a new branch of biological inquiry, generally termed "Biometrics," inaugurated by F. Galton and carried on by Karl Pearson and the late W. F. R. Weldon.

We quote from the article "Variation and Selection," in the tenth edition of this *Encyclopaedia*, an exposition of the biometric method by Weldon:—

> The characters of individual animals or plants depend upon so many complex conditions, most of which are generally unknown to us, that the statements we can make concerning them are of a peculiar kind. We cannot predict with any exactness the characters of a single unborn individual; but if we consider a large number of unborn individuals, we can predict with considerable accuracy the percentage of individuals which will have the mean character proper to their generation, or will differ from that mean character within any assigned limits. So long as we confine our attention to one or two individuals, we fail to detect any order in the occurrence of variations; but when we examine large numbers we find that it is possible to arrange them in an orderly series, which can be easily and simply described. The series into which we can arrange the results of observing phenomena of complex causation, whether exhibited by living organisms or not, have certain properties in common, which are dealt with by the theory of chance. Many of the properties of such series, and the methods of describing them, are dealt with elsewhere (see PROBABILITY: *Law of Error*): and the frequency with which the mean value or any deviation from the mean value of a character occurs in a race of animals or of plants may probably always be expressed in terms of one or other of the series there described. The theory of chance was applied to the study of human variation by Quetelet; but the most important applications of this theory to biological problems are due in the first instance to Francis Galton, who used the theory of *correlation* in describing the relation between the deviation of one character in an animal body from the mean proper to its race and that of a second character in the same body (correlation as commonly understood), or between deviation of a parent from the mean of its generation and deviation of offspring from the mean of the following generation (inheritance). The conceptions indicated by Galton have been extended and added to by Karl Pearson, who has also developed the theory of chance so as to provide a means of describing many series of complex results in a simpler and more accurate way than was hitherto possible.
>
> The conception of a race of animals or of plants as a group of individuals capable of being arranged in an orderly series with respect to the condition of a particular character enables us to define the "type" of that character proper to the race. Table I. shows the number of female swine which had a given number of "Müller's glands" on the right fore leg, in a sample of 2000 swine observed by Davenport in Chicago. If we take the whole number of glands in the series, and divide this by the whole number of swine, we obtain the *mean* number of glands per swine. For many purposes this is the most convenient "type" of the series. Two other ways of determining a "type" will be obvious by reference to the diagram, fig. 1, in which the observed results are recorded by the thick continuous line, and the form of Pearson's "generalized probability curve" best fitted to represent them by a dotted line. The ordinate of the dotted curve which contains its "centre of gravity" has, of course, for its abscissa the "mean" number of glands; the maximum ordinate of the curve is, however, at 2·98, or sensibly at 3 glands, showing what Pearson has called the "modal" number of glands, or the number occurring most frequently. The ordinate which divides the area of the dotted curve into two equal areas is the *median* of Galton: it lies in this case nearly at 3·38 glands. The best simple measure of the frequency of deviations from the mean character is the "standard deviation" or "error of mean square" of the system (see article PROBABILITY), in this case equal to 1·68 glands.

TABLE I.

Number of Glands.	Number of Swine.	Number of Glands.	Number of Swine.
0	15	6	134
1	209	7	72
2	365	8	22
3	482	9	8
4	414	10	2
5	277		

> In cases of nearly symmetrical distribution about the mean, the three "types," the mean, the median and the mode, may sensibly coincide. For example, in Powis's table of the frequency of statures in male Australian criminals between 40 and 50 years

of age (*Biometrika*, vol. i. part 1, p. 41), the mean stature is 66·91 in., the modal 66·96 in., the median lying between the two. In other cases the difference between the three may be considerable. As an example of extreme asymmetry we may take de Vries's record of the frequency with which given numbers of petals occur in a certain race of buttercups. Pearson has shown (*Phil. Trans.*, A., 1893) that this frequency may be closely represented by the curve whose equation is

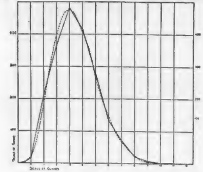

FIG. 1.

$$y=0{\cdot}211225x^{-0{\cdot}232}(7{\cdot}3253-x)^{2{\cdot}142}.$$

The curve, and the observations it represents, are drawn in fig. 2. The two are compared numerically in Table II. Here the mode is at 4·5 petals, the mean at 5·6 petals, the median lying of course between the two.

TABLE II.

Numbers of petals .	5	6	7	8	9	10	11
Frequency observed.	133	55	23	7	2	2	0
Frequency given by Pearson's curve .	136·9	48·5	22·6	9·6	3·4	0·8	0·2

The distributions represented in figs. 1 and 2 may be taken as examples of three common forms of series into which the individuals of a race may be arranged with respect to a single character; a comparison of them will show how little can be learnt from a mere statement of racial type, without some knowledge of the way in which deviations from the type are distributed.

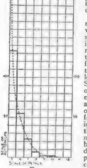

FIG. 2.

The variability of structures which are repeated in the body of the same individual (serial homologues) has been studied by Pearson and his pupils with important results. The simplest of such repeated elements are the cells of the tissues, more complex are cell-aggregates, from hairs, scales, teeth and the like, up to limbs or metameres in animals, or the leaves and their homologues in plants. Serially homologous structures, borne on the same body, are commonly differentiated into sets, the mean character of a set produced in one part of the body, or during one period of life, differing from the mean character of a set produced in a different region or at a different time. Such differentiation may be measured by determining the correlation between the position or the time of production and the character of the organs produced, the methods by which the correlation is measured being those described in the article ERROR, LAW OF. An excellent example of structures differentiated according to position is given by the appendages borne on the stem of an ordinary flowering plant—the one or two seed leaves; the stem leaves, which may or may not be differentiated into secondary sets; and the various floral organs borne at the apex of the stem or its lateral branches. The change which often occurs in the mean character and variability of the flowers produced at different periods of the flowering season by the same plant is an example of differentiation associated with time of production; as this kind of differentiation is less familiar than differentiation according to the region of production, it may be well to give an example. In a group of plants of *Aster prenanthoides*, examined by G. H. Shull (*American Naturalist*, xxxvi., 1902), the mean number of bracts, ray-florets and disc-florets, and the standard deviation of each, was determined on four different days, with the following result:—

TABLE III.

	Sept. 27.	Sept. 30.	Oct. 4.	Oct. 8.
Mean No. of bracts .	47·41	44·34	43·83	41·92
Standard deviation .	5·52	5·15	5·28	4·89
Mean No. of ray-florets	30·77	28·71	28·25	26·34
Standard deviation .	3·99	3·57	3·50	3·01
Mean No. disc-florets	56·43	51·71	49·16	45·78
Standard deviation .	3·99	4·99	4·88	4·78

Notwithstanding this differentiation, the mean character of a series of repeated organs is often constant through a considerable region of the body or a considerable period of time; and the standard deviation of an "array" of repeated parts, chosen from such an area, or within such limits of time, may be taken as a measure of the individual variability of the organism which produces them. If such an array of repeated organs be chosen from the proper region of the body, within proper limits of time, in each of a large series of individuals belonging to a race, and if all the arrays so chosen be added together, a series will be formed from which the *racial variability* can be determined. Thus a series of arrays of beech leaves, gathered, subject to the precautions indicated, from each of 100 beech trees in Buckinghamshire by Professor Pearson, gave 16·1 as the mean number of veins per leaf, the standard deviation of the veins in the series being 1·735. The number of leaves gathered from each tree was 26, and the frequency of leaves with any observed number of veins in the whole series of 2600 leaves was as follows:—

TABLE IV.

No. of veins	10	11	12	13	14	15	16	17	18	19	20	21	22
No. of leaves.	1	7	34	110	318	479	595	516	307	181	36	15	1

The whole series contains 2600 leaves. If a leaf from this series be chosen at random, it is clearly more likely to have sixteen veins than to have any other assigned number, but if a first leaf chosen at random should prove to have some number of veins other than sixteen, a second leaf, chosen at random from the same series, is still more likely to have sixteen veins than to have any other assigned number. If, however, a series of leaves *from the same tree* be examined in pairs, the fact that one leaf from the tree is known to possess an abnormal number of veins makes it probable that the next leaf chosen from the same tree will also be abnormal—or, in other words, the fact that leaves are borne by the same tree establishes a correlation between them. Professor Pearson has measured this correlation. Taking each leaf of his series, with an assigned number of veins, he has determined the array of pairs of leaves which can be formed by pairing the chosen leaf with all others from its own tree in succession. The pairs so formed were collected in a table, from which the correlation between the first leaf and the second leaf of a pair, chosen from one tree, could be determined by the methods indicated in the article PROBABILITY. The mean and standard deviation of all first leaves or of all second leaves will clearly be the same as those already determined for the series of leaves; since every leaf in the series is used once as a first member and once as a second member of a pair. The coefficient of correlation is 0·5699, which indicates that the standard deviation of an array is equal to that of the leaves in general multiplied by $\sqrt{1-(0{\cdot}5699)^2}$; and performing this multiplication, we find 1·426 as the standard deviation of an array. The variability of an array of such a table—that is, of any line or column of it—is the mean variability of pairs of leaves, each pair chosen from one tree, and having one leaf of a particular character; it may therefore be taken as a fair measure of the variability of such a tree. We see therefore that while leaves, gathered in equal numbers from each of 100 trees, are distributed about their mean with a standard deviation of 1·735 veins, the leaves gathered from a single tree are distributed about their mean with a standard deviation of 1·426 veins, the ratio between variability of the race and variability of the individual tree being $\sqrt{1-(0{\cdot}5699)^2}=0{\cdot}822$.

The correlation between undifferentiated sets of serial homologues, produced by a single individual, is the measure of what Pearson has called homotyposis. In an elaborate memoir on the homotyposis in plants (*Phil. Trans.*, vol. 197 A., 1901), from which the foregoing statements about beech leaves are taken, Pearson has given the correlation between such sets of organs in a large number of plants: he and his pupils have subsequently determined the correlation between structures repeated in the bodies of individual animals. The results obtained are sometimes puzzling, because it is sometimes difficult to choose the whole series of structures osberved from a region of the body which is not affected by differentiation. In spite of this difficulty, however, the values of the correlation coefficients so far obtained cluster fairly well round the mean value of all of them, which is almost exactly ½. From this result it follows (see PROBABILITY) that the standard deviation of the array, which we have taken as a measure of individual variability, is equal to the standard deviation of the race multiplied by $\sqrt{1-\left(\frac{1}{2}\right)^2}$ or by $\frac{\sqrt{3}}{2}$. These results cannot be accepted as final, but they are based on so many investigations of animals and plants, of such widely different kinds, that they may confidently be expected to hold for large classes of organic characters. We may therefore conclude that for large classes of characters, both animal and vegetable, the variability of an individual, as measured by the standard deviation of its undifferentiated but repeated organs, is a constant fraction of the variability of its race, as measured by the standard deviation of the corresponding series of organs produced by all the individuals of its race.

Among the most important structures produced in repeated series are the reproductive cells; and Pearson points out that if the variability of animals or of plants be supposed to depend upon that of the germ-cells from which they arise, then the correlation between brothers in the array produced by the same parents will give a measure of the correlation between the parental germ-cells, the determination requiring, of course, the same precautions to avoid the effects of differentiation as are necessary in the study of other repeated organs. After a large series of measurements, involving the most varied characters of human brothers, Pearson has shown that the correlation has a value very nearly equal to ½; so that the variability of human children obeys the same law as that of other repeated structures, the standard deviation of an array, produced by the same parents, having an average value equal to the standard deviation of the whole filial generation multiplied by $\sqrt{1-\left(\frac{1}{2}\right)^2}$ or by $\frac{\sqrt{3}}{2}$. Such measurements of fraternal correlation in the lower animal as Pearson and his pupils have at present made give values very close to ½. The evidence that the correlation between sexually produced brethren is the same as that existing between the asexually repeated organs on an individual body renders it impossible to accept Weismann's view that one of the results produced by the differentiation of animals and plants into two sexes is an increase in the variability of their offspring. Warren has shown by direct observation that the correlation between brothers among the broods produced parthenogenetically by one of the *Aphides* has a value not far from the ½ observed in sexually produced brethren (*Biometrika*, vol. i., 1902); he has obtained a fairly concordant result for the broods of parthenogenetic *Daphnia* (*Proc. Roy Soc.* vol. lxv., 1899). Finally, Simpson has measured the correlation between the pairs of young produced by the simple asexual division of *Paramoecium* (*Biometrika*, vol. i. part 4, 1902), and after some necessary corrections the value he obtains is 0.56, a value which probably does not, if we remember the difficulties of the inquiry, differ very significantly from ½. There is therefore in a large class of cases an indication that the variability of an array of brethren, produced either sexually or asexually, is a constant fraction of the variability of the race to which the brethren belong.

Variation and Mendelism.—The conceptions of the disciples of Mendel, amongst whom W. Bateson is pre-eminent, would appear to simplify the problem of variation, especially on its mechanical and physiological sides. Their experimental work shows that many facts of inheritance correspond with the theory that the essential fabric of an organism is a mosaic of unit characters. Such units frequently occur in pairs, one member of the pair being characterized by the presence, the other by the absence of a problematical body at least comparable with a ferment, the result of the presence or absence being a notable modification of the whole organism or of parts of it. According to their view, in the formation of the germ cells a segregation of the unit pairs occurs—that is to say, the peculiar body or ferment is handed on to one daughter-cell but not to the other. A similar kind of segregation may take place in the formation of the repeated parts of an organism, so that symmetrical repetition may be compared with normal heredity, and be due to the presence of similar factors in the divisions of the embryonic cells, whilst the differentiation of repeated parts may be due to the unequal distribution of such factors and be comparable with variation. On such an interpretation, variation would result from asymmetrical division and normal inheritance from symmetrical division. It is equally clear that there is a broad analogy between the kind of characters on which systematists often have to rely for the separation of species and those which Mendelian workers have shown to behave in accordance with the Mendelian theories of mosaic inheritance with segregation. The analogy possibly may be extended to such cases as the occurrence of flora or fauna with alpine characters on the summits of mountains separated by broad zones of tropical climate. Segregated inheritance may have produced the appropriate combinations which were latent in the capacities of the race, and the exigencies of the environment protected them in the suitable localities. It is to be noticed, however, that the Mendelian conceptions are in no sense an alternative to Darwinism; at the most they would serve to assist in explaining the mechanism of variation, and by enlarging our idea of the factors, increase the rate at which we may suppose selection to work.

Limitation of Variations; Orthogenesis.—Darwin and his generation were deeply imbued with the Butlerian tradition, and regarded the organic world as almost a miracle of adaptation, of the minute dovetailing of structure, function and environment. Darwin certainly was impressed with the view that natural selection and variation together formed a mechanism, the central product of which was adaptation. From the Butlerian side, too, came the most urgent opposition to Darwinism. How is it possible, it was said, that fortuitous variations can furnish the material for the precise and balanced adaptations that all nature reveals? Selection cannot create the materials on which it is supposed to operate; the beginnings of new organs, the initial stages of new functions cannot be supposed to have been useful. Moreover, many naturalists, especially those concerned with palaeontology, pointed to the existence of orthogenetic series, of long lines of ancestry, which displayed not a sporadic differentiation in every direction, but apparently a steady and progressive march in one direction. E. D. Cope put such a line of argument in the most cogent fashion; the course of evolution, both in the production of variations and their selection, seemed to him to imply the existence of an originative, conscious and directive force, for which he invented the term "bathmism" (Gr. *βαθμός*, a step or beginning). On the other hand, dislike of mystical interpretations of natural facts has driven many capable naturalists to another extreme and has led them to insist on the "all-powerfulness of natural selection" and on the complete indefiniteness of variation. The apparent opposition between the conflicting schools is more acute than the facts justify. Both sides concur in the position assumed by Darwin, that the word "chance" in such a phrase as "chance variation" does not mean that the occurrences are independent of natural causation and so far undetermined, but covers in the first place our ignorance of the exact causation. The implication of the phrase may go farther, suggesting that there is no connexion between the appearance of the variation and the use to which it may be put. No doubt a large amount of variation is truly indefinite, so that many meaningless or useless variations arise, and in one sense it is a mere coincidence if a particular variation turn out to be useful. But there are several directions in which the field of variation appears to be not only limited but defined in a certain direction. Obviously variations depend on the constitution of the varying organism; a modification, whether it be large or small, is a modification of an already definite and limited structure. When beetles, or medusae, or cats vary, the range of possible variation is limited and determined by the beetle, medusa or cat constitution, and any possible further differentiation or specialization must be in a sense at least orthogenetic—that is to say, a continuation of the line along which the ancestors of the individual in question have been forced. Darwin himself showed that different species in a genus, or varieties in a species, tended to show parallel variations, whilst comparative anatomy has made known a multitude of cases where allied series of animals or plants show successive stages of parallel but independent variations of important organs and functions. The phenomena of convergence are to some extent other instances of the same kind and supply evidence that organisms, so to say, fall into grooves, that their possibilities of change are defined and limited by their past history. Variation, again, as has been shown in this article, is limited by correlation; as any change involves other changes, the possibilities are limited by the organic whole. Finally, it is important to remember that the fundamental characteristic of a living organism is its power of response to environment, a response or series of responses being necessary in a continuous environment for the normal facies of the organism to appear, and necessary in a shifting environment if the organism is to change suitably and not to perish. A continuous environment both from the point of view of production of variation and selection of variation would appear necessarily to result in a series with the appearance of orthogenesis. The past history of the organic world displays many successful series and these, as they have survived, must inevitably display orthogenesis to some extent; but it also displays many failures which indeed may be regarded as showing that the limitation of variation has been such that the organisms have lost the possibility of successful response to a new environment.

Selection and Adaptation.—Although knowledge of variation has become much wider and more definite, the estimation in which natural selection is held has changed very little since Darwin and Wallace first expounded their theories. Variation provides the material for selection, and although opinions may differ as to the nature of that material, the modes by which it comes into existence and their relative values and permanences, there is an increasingly wide consensus of opinion that all such material has to pass through the sieve of natural selection and that the sifted products form new varieties and species, and new adaptations. It appears to be necessary to distinguish between the production of species and the production of adaptation. We have still to admit with Darwin that it is difficult or impossible to assign utility to all the characters that distinguish species, and particularly to those characters by which systematists identify species. The modern tendency for a more complete and detailed separation of individual forms into specific and sub-specific groups, and the immensely larger range of material at the disposal of systematic experts, have combined to make it increasingly difficult to imagine conditions of the environment under which the species of systematists would have been produced by selection. On the other hand, the work of modern systematists shows an extraordinarily exact relation between their species and geographical locality, and the fact of divergent evolution can be almost demonstrated in museum collections when localities have been recorded exactly. The decision as to whether it is the course of variation or the course of selection that has been different in different localities can be made only by the field naturalist and the experimental breeder.

With regard to adaptations, it is becoming more and more apparent, as experimental knowledge advances, that it is a fundamental property of every living organism in every stage of its existence to display adaptive response to its environment. To what extent such responses are transmitted to offspring, and what part they play in the formation of the adaptive characters that are conspicuous in many animals, remain dubious, but it is at least clear that natural selection can favour those individuals and those races which show the greatest power of responsive plasticity in the individual. There remains open a wide field for inquiry as to the precise relations between selection and variation on the one hand, and their products, specific differences and adaptive structures, but the advance of knowledge has supplied no alternative to the Darwinian principles.

In the broadest way variation in organisms is primarily the necessary result of the absence of uniformity in the distribution of physical forces on the globe, in fact is a mere necessary response to the variation of inorganic conditions. So, also, in the broadest way, the result of the existence of variation is equally inevitable. Some individuals happen to fit the environment better, or to respond to the environment better, and these on the average will survive their less fortunate neighbours. It is plain that whilst the existence of variation can be demonstrated and the occurrence of evolution established by induction and deduction, the part played by selection must remain largely theoretical.

We append, however, again from the late Professor Weldon's article, a summary of the lines on which it seems possible that the actual process of selection may be demonstrated.

Selection and its results can be adequately studied only in those cases which admit of statistical tabulation. In any race of animals, the number of young produced in a season is almost always greater than the number which survives to attain maturity; it is not certain that every one of those which become mature will breed, and not all of those which breed contribute an equal number of offspring to the next generation. At every stage some individuals are prevented from contributing to the next generation, and if the continual process of elimination affects individuals possessing any one character more strongly than it affects others, so that a relation is established between individual character and the chance of producing a certain number of young, selection is said to occur.

We may distinguish broadly two ways by which such selective elimination of individuals from the number of those who contribute to the next generation may occur, viz. a *differential destruction*, which prevents certain classes of individuals from breeding by killing them, and a series of processes leading to *differential fertility* among the survivors, without necessarily involving any differential death-rate. A third form of selection, which may affect the composition of the next generation without of necessity involving a differential death-rate or a differential fertility, is *assortative mating*, or the tendency of those members of one sex which exhibit a particular character to mate only with members of the other sex which exhibit the same or some other definite character.

Differential fertility may be induced in either of two ways. Individuals may not be able to pair unless they possess a character which is absent, or insufficiently developed, in some members of the race. The kind of selection involved may then be measured by comparing those animals which pair with the general body of adults. This is what Darwin especially intended to denote by the term "sexual selection." Or, again, individuals of certain character may be able to pair, but the fertility of their union may not be the same as that of unions between individuals with other characters. This kind of selection, called by Pearson "reproductive" or "genetic" selection, may be measured by finding the correlation between the characters of the individuals which pair and the number of young produced. For an attempt to treat the whole problem of differential fertility and assortative mating numerically, see Pearson, *The Grammar of Science*, 2nd edition, London, 1900.

Assortative mating exists when individuals which mate are not paired at random, but a definite correlation is established between the characters of one mate and those of the other. This kind of selection is measured by the correlation between deviation of either mate from the type, and deviation of the other. Pearson has shown that Galton's function has a value of 0·28 for stature of middle-class Englishmen and their wives.

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(P. C. M.)

VARIATIONS, in music, the term given to groups of progressively developed versions of a complete self-contained theme, retaining the form of that theme though not necessarily its melody. This at least is the classical sense of the term, though there are modern developments of the variation form to which this definition is at once too broad and too precise to apply. The aesthetic principle of variations appeared at very early stages of music; and it soon became something far more definite than the use of ornamental versions of a melodic phrase, a use which must have been natural almost as soon as music was articulate at all. During the 16th century principles aesthetically indistinguishable from some types of variation-form inevitably arose in the polyphonic treatment of Gregorian hymns verse by verse. Accordingly, the hymns and Magnificats of Palestrina might without great extravagance be described as contrapuntal sets of variations on ecclesiastical tunes, like very free examples of the type shown later in extreme simplicity and formality by Haydn's variations on his Austrian national anthem in the "Emperor" quartet (*Op.* 76, No. 3).

Already in the 16th century instrumental music was assuming such independence as it could attain by means of a primitive variation-form, growing partly out of the habit of playing vocal madrigals on the virginals or similar keyed instruments, or singing the top part as a solo to an instrumental accompaniment, with an overwhelming weight of ornaments beneath which the original madrigal was quite unrecognizable. (See, for example, the "diminutions" given in the 30th volume of Breitkopf & Härtel's complete edition of Palestrina's works.) A favourite plan, of which numerous examples may be found in the *Fitzwilliam Virginal Book*, was to put together several popular or original tunes, with an ornamental variation sandwiched between each. Sometimes, however, sets of variations on a single tune were produced, with essentially modern effect, as in Byrd's variations on "The Carman's Whistle." Such variations were naturally grouped in order of increasing complexity and brilliance. Some of the keyboard passages in which the early English variation-writers indulged are of extraordinary difficulty, even from the standpoint of modern pianoforte technique.

In the 17th century a highly artistic form of variation arose, very favourable to the earliest composers of the transition period, because of the simplicity of its principle, which relieved the composer of all the graver problems of formal organization. This was the *ground-bass*, a single phrase placed in the bass and repeating itself as long as the composer had fresh harmonies and superstructure with which to vary it. In typical examples the ground-bass was derived from the dance forms of the *passacaglia* and the *chaconne*, which in classical music resembled each other in being in slow time, and did not otherwise differ markedly, except that in the *passacaglia* the theme could be transferred now and then to the treble or to an inner part, a purely natural aesthetic resource which makes no radical difference to the art-form. The genius of Purcell was cruelly hampered by the lack of possibilities for organizing large musical forms in his time, and nothing is more significant than the avidity with which he seizes upon the ground-bass as a means of giving coherence to his ideas.

By the time of Bach and Handel a lighter type of variation-work, less capable of high organization, and more like Byrd's variations on "The Carman's Whistle," had arisen. Bach's *Aria variata alla maniera Italiana* is an instance of this; and so is the *air et doubles* that appears now and then in Handel's instrumental works. The principle of this form is simply to take a symmetrical melody (generally in binary form) and embroider it. Such variations are called *doubles* whenever each variation divides the rhythm systematically into quicker notes than the one before. The most familiar example is that known as "The Harmonious Blacksmith" in Handel's E major suite. Sometimes the air itself was stated in a tangle of ornamentation, while the *doubles* made it float in a simplified form over an accompaniment of increasingly rapid flow. (See, for example, Handel's D minor suite and the little set in B flat on a theme afterwards varied in the noblest modern style by Brahms.)

But Bach had meanwhile applied the principle of the ground-bass to variations on a complete symmetrical movement in binary form. His Air and 30 Variations, commonly known as the "Goldberg" variations, is (with the exception of Beethoven's 33 *Veränderungen* on a waltz by Diabelli) not only the most gigantic set of variations in the world, but one of the three largest compositions in any form ever written for a single instrument. Of course in so large a work the conception of the ground-bass, as a clearly recognizable theme repeated with no more than slight ornament, would be inadequate whatever the variety of the superstructure: but so steady is the drift of Bach's bass that he is enabled to represent it by countless alternative harmonies and analogous chromatic progressions, without weakening its individuality. The grouping of the thirty variations is extremely subtle in balance and climax, the more so because there are no means within the terms of Bach's art for making a free coda to the work, his ground-bass being both too long and too purely a bass to be taken as the theme of a fugue, like that in his great *passacaglia* for organ. Yet Bach contrives to round off the work perfectly by the simple direction *aria da capo* at the end. There is no question of retaining or varying the melody of the aria, which indeed is so ornamental as to be pointless and unrecognizable as a basis for variations; nor could it, like the above-mentioned Italian examples of Handel, be simplified, since most of its ornaments are integral parts of the phrases.

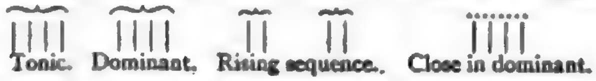
The next chapter in the history of the variation form is intimately connected with the sonata style. A set of variations used as a movement for a sonata inevitably tends to be variations on the melody. The sonata style implies the identification of themes by their melodies rather than by their texture, the very term "theme" being primarily used in a melodic connotation (see Melody). Hence a set of exclusively harmonic variations would not be in the sonata style. Now, most of the best sets of variations by Mozart and Haydn are movements in their sonata works; and this should always be remembered in discussing the tendency of their treatment of the form. Few of their independent sets are of any importance, since most are very early works, or were written for pupils, or intended as encore pieces for concerts. Haydn shows a great fondness for a special form which, even if earlier specimens can be found, he may properly be said to have invented. It consists of alternating variations on two themes, the first a highly organized complete binary melody, and the other a shorter binary melody, often beginning with the same figure as the first, but clearly contrasted with it, inasmuch as, whichever theme is in the major, the other is in the minor. The first theme usually returns as if it were going to be unvaried, but its first repeat is an ornamental variation. The form is rarely worked out far enough to include more than one variation of the second theme; but the effect is always that of a happy blend of a clearly marked variation form with a more contrasted scheme a little more highly organized than the round-and-round symmetry of a minuet and trio, but not so elaborate as a rondo. The only later example exactly corresponding to Haydn's form is the first allegretto of Beethoven's pianoforte trio in E flat, *Op.* 70, No. 2; although, with a wider range of key, a free application of the principle of alternating themes is magnificently illustrated by the slow movement of his C minor symphony.

Beethoven in his last works invented another variation-form on two themes, in which the first theme is very free in structure and the second theme is a more rigid melody in a different key and time. The examples of this are the slow movement of the 9th Symphony and the Lydian figured chorale in the A minor quartet. A fine later development of this is the slow movement of Brahms's F major string quintet, *Op.* 88, in which the alternation of the two keys gives rise, in the last line of the movement, to one of the most astonishing and subtle dramatic strokes in all music.

In sonata works, Beethoven's examples of the normal variation form based on a single theme are as wonderful as may be expected from him; but nothing is more significant than his strict adherence in sonata works to the melodic principle of variation. He uses the form as an unsurpassable means of obtaining repose in slow movements. The extreme case of this is the slow movement of the sonata, *Op.* 57 (commonly called *Appassionata*), which is described in the article on Sonata Forms. In this and in many other instances, his method is aesthetically that of the *air et doubles*, as being the simplest possible means of obtaining variety and climax without leaving the fundamental key. Until his latest works, such sets of variations are never finished. Their dramatic force is that of a repose which is too unearthly to last; and at the first sign of dramatic motion or change of key the sublime vision "fades into the light of common day," a light which Beethoven is far too great an idealist to despise. (See the andante of the B flat trio, *Op.* 97; and the slow movement of the violin concerto, which contains two episodic themes in the same key.) In his later works Beethoven found means, by striking out into foreign keys or foreign rhythms, of organizing a coda which, as it were, finally spins down in fragmentary new variations, or even returns to the plain theme. Thus he was able to end his sonatas, *Opp.* 109 and 111, with solemn slow movements in which, with the utmost richness of detail and novelty of idea, the melodic variation form is nevertheless paramount. Beethoven also found many ways of combining melodic variations with the principles of the rondo and other more highly organized continuous movements. Thus the finale of the Eroica Symphony has not only the theme but many ideas of the variations and fugue-passages in common with the brilliant set of variations for pianoforte on a theme from *Prometheus*, *Op.* 35; and the Fantasia for pianoforte, chorus and orchestra, and the choral finale of the 9th Symphony, are sets of melodic variations with freely developed connecting links and episodes. In the case of the 9th Symphony, a second thematic idea eventually combines with the figures of the first theme in double fugue.

But Beethoven's highest art in variation-form is to be found in his independent sets of variations. In some of the earliest of these, notably in the 24 on a theme by Righini (which was his chief bravura performance as a young pianoforte player), he far transcends not only the earlier or sonata-form idea of melodic variations, but fuses their resources with those of the ground-bass, and adds to them his own unparalleled grasp of rhythmic organization. Beethoven is the first composer who can be said to have discovered that a theme consists not only of melody and harmony but of rhythm and form. With earlier composers the form of the theme was automatically preserved in consequence of the preservation of either its melody or its harmony; but Beethoven had an unerring judgment as to when the form of a theme might be definite enough to remain as a basis for a variation which departed radically from both the harmony and the melody. The climax in the history of variations dates from the moment when Beethoven was just about to begin his 9th Symphony, and received from A. Diabelli a waltz which that publisher was sending round to all the musicians in Austria so that each might contribute a variation to be published for the benefit of the sufferers in the late Napoleonic wars. Diabelli's theme was absurdly prosaic, but it happened to be perhaps the sturdiest piece of musical anatomy that Beethoven or any composer since has ever seen. Not only was its harmonic form exceptionally clear and firm, but its phrase-rhythm was as simple, recognizable and heterogeneous as its other qualities. Its melodic merit was nil, yet it had plenty of recognizable melodic figures. All these prosaic technicalities are far more likely to impress a great composer as good practical resources than those high poetic qualities which critics discuss incessantly, but which are to a great artist the air he breathes. Diabelli's waltz moved Beethoven to defer his work on the 9th Symphony!

The shape of Diabelli's theme may be illustrated by a diagram which represents its first sixteen bars; the upright strokes being the bars, and the brackets and dots (together with the names underneath) indicating the way in which the rhythm is grouped by correspondence of phrase and changes of harmony. The second part also consists of sixteen bars, moving harmonically back from the dominant to the tonic, and rhythmically of exactly the same structure as the first part. This harmonic and sequential plan, together with this straightforward square tapering rhythmic structure, is so formal in effect that Beethoven can substitute for it almost anything equally familiar that corresponds in its proportions. Thus, the alternation of tonic and dominant in the first eight bars may be represented by another familiar form in which three bars of tonic and a fourth of dominant are answered by three bars of dominant and a fourth of tonic; as in variation 14 (which must be reckoned in half-bars). Again, the antithesis of tonic and dominant is accompanied in Diabelli's theme by a part of the melodic figure being repeated a step higher at the change of harmony; and this naturally produces such devices as the answering of the tonic by the supertonic in variation 8, and, still more surprisingly, by the flat supertonic in variation 30. In so enormous and resourceful a work, occupying fifty minutes in performance, it is natural that some variations should drift rather farther from the anatomy of the theme than can be explained by any strict principle; and so the jocular transformation of the beginning of Diabelli's bass into the theme of Mozart's *Notte e giorno faticar* leads to a couple of extra bars at the end of its second part; otherwise the *fughetta* (variation 24) and variations 29 and 31 are the only cases in which any considerable part of the structure of the theme is lost, except the fugue (variation 32), which is simply an elaborate movement on a salient feature of what must by courtesy be called Diabelli's melody. A free fugue is a favourite solution of the difficult problem of the coda in a set of variations.



But for the works of Brahms, which invariably retain the classical conceptions while developing them in a thoroughly modern and living language, it can hardly be claimed that the art of variation-writing has advanced since Beethoven. The term is now used for a somewhat nondescript method of stringing together a series of short fantasias on a theme; a method which may be legitimate and artistic in individual cases, but hardly constitutes an art-form. There is this great disadvantage in variations that neglect the anatomy of the theme, that the only way in which, in the absence of other means of connexion, they can show any coherence at all is by more or less frequently harping on scraps of the melody. The effect is (except in unusually happy examples such as the *Études symphoniques* of Schumann and the *Enigma Variations* of Elgar) curiously apologetic; because no ambitious composer in the "free" modern variation style thinks a melodic variation quite worthy of his dignity, and so the melodic allusions become the more tiresome from their furtive manner. Many "advanced" specimens of variation-form undoubtedly owe their origin to a vague impulse of revolt from the unsound statements of unobservant writers of mid-19th century textbooks, who contented themselves with laying down crude rules such as that a variation might "either retain the melody and change the harmony, or retain the harmony and change the melody," &c., without any attempt to see how the classical composers really analysed their themes. It is very characteristic of Schumann's modesty and grasp of facts that he, who was the first to produce serious art in a free non-anatomical variation style, did not call his experiments variations without qualification. He never wrote a set in which the anatomy of the theme was of real importance to the whole; and, with him, whenever at least the initial melodic figure of his theme is not traceable throughout a section, that section is simply an episode. But Schumann knows this perfectly well, and acknowledges it. The *Études symphoniques* are called variations only in those sections which are fairly strict variations. Elsewhere they are simply numbered as *études*. The slow movement of the F major string quartet (in which a second theme masquerades as the first variation, and some of the other variation-like sections are quite free) is called *andante quasi variazione*; and even the strictest of all his variation works is called *Impromptus, on a theme by Clara Wieck, Op.* 5. There is, no doubt, great scope for a variation-form which is neither melodic nor anatomic, and we have not a word to say against the legitimacy of many forms of effective modern fantasia-variations; but the fact remains that it is very hazardous to talk of an "advance" in the variation-form, when even the best fantasia-variations are not only unconnected with any classical type but evidently unable to get nearly as far from either the melody or the harmony of their theme as the 25th of Bach's "Goldberg" variations or many variations in the earliest sets by Beethoven. Indeed, the only sound classification of composers of modern variations, from the time of Mendelssohn onwards, is that which distinguishes the composers who seem to know their theme from those who do not. (D. F. T.)

Origin of the Calculus.

VARIATIONS, CALCULUS OF, in mathematics. The calculus of variations arose from the attempts that were made by mathematicians in the 17th century to solve problems of which the following are typical examples. (i) It is required to determine the form of a chain of given length, hanging from two fixed points, by the condition that its centre of gravity must be as low as possible. This problem of the *catenary* was attempted without success by Galileo Galilei (1638). (ii) The resistance of a medium to the motion of a body being assumed to be a normal pressure, proportional to the square of the cosine of the angle between the normal to the surface and the direction of motion, it is required to determine the meridian curve of a surface of revolution, about an axis in the direction of motion, so that the resistance shall be the least possible. This problem of the *solid of least resistance* was solved by Sir Isaac Newton (1687). (iii) It is required to find a curve joining two fixed points, so that the time of descent along this curve from the higher point to the lower may be less than the time along any other curve. This problem of the *brachistochrone* was proposed by John (Johann) Bernoulli (1696).

Early history.

The contributions of the Greek geometry to the subject consist of a few theorems discovered by one Zenodorus, of whom little is known. Extracts from his writings have been preserved in the writings of Pappus of Alexandria and Theon of Smyrna. He proved that of all curves of given perimeter the circle is that which encloses the largest area. The problems from which the subject grew up have in common the character of being concerned with the maxima and minima of quantities which can be expressed by integrals of the form

$$\int_{x_0}^{x_1} F(x, y, y')dx,$$

in which y is an unknown function of x, and F is an assigned function of three variables, viz. x, y, and the differential coefficient of y with respect to x, here denoted by y'; in special cases x or y may not be explicitly present in F, but y' must be. In any such problem it is required to determine y as a function of x, so that the integral may be a maximum or a minimum, either absolutely or subject to the condition that another integral or like form may have a prescribed value. For example, in the problem of the catenary, the integral

$$\int_{x_0}^{x_1} y(1+y'^2)^{\frac{1}{2}}dx$$

must be a minimum, while the integral

$$\int_{x_0}^{x_1} (1+y'^2)^{\frac{1}{2}}dx$$

has a given value. When, as in this example, the length of the sought curve is given, the problem is described as *isoperimetric*. At the end of the first memoir by James (Jakob) Bernoulli on the infinitesimal calculus (1690), the problem of determining the form of a flexible chain was proposed. Gottfried Wilhelm Leibnitz gave the solution in 1691, and stated that the centre of gravity is lower for this curve than for any other of the same length joining the same two points. The first step towards a theory of such problems was taken by James Bernoulli (1697) in his solution of the problem of the brachistochrone. He pointed out that if a curve, as a whole, possesses the maximal or minimal property, every part of the curve must itself possess the same property. Beyond the discussion of special problems, nothing was attempted for many years.

Euler.

The first general theory of such problems was sketched by Leonhard Euler in 1736, and was more fully developed by him in his treatise *Methodus inveniendi* . . . published in 1744. He generalized the problems proposed by his predecessors by admitting under the sign of integration differential coefficients of order higher than the first. To express the condition that an integral of the form

$$\int_{x_0}^{x_1} F(x, y, y', y'', \ldots y^{(n)})dx$$

may be a maximum or minimum, he required that, when y is changed into $y+u$, where u is a function of x, but is everywhere "infinitely" small, the integral should be unchanged. Resolving the integral into a sum of elements, he transformed this condition into an equation of the form

$$\Sigma u\Delta x\left[\frac{\partial F}{\partial y}-\frac{d}{dx}\frac{\partial F}{\partial y'}+\frac{d^2}{dx^2}\frac{\partial F}{\partial y''}-\ldots+(-1)^n\frac{d^n}{dx^n}\frac{\partial F}{\partial y^{(n)}}\right]=0,$$

and he concluded that the differential equation obtained by equating to zero the expression in the square brackets must be satisfied. This equation is in general of the $2n$th order, and the $2n$ arbitrary constants which are contained in the complete primitive must be adjusted to satisfy the conditions that $y, y', y'', \ldots y^{(n-1)}$ have given values at the limits of integration. If the function y is required also to satisfy the condition that another integral of the same form as the above, but containing a function ϕ instead of F, may have a prescribed value, Euler achieved his purpose by replacing F in the differential equation by $F+\lambda\phi$, and adjusting the constant λ so that the condition may be satisfied. This artifice is known as the *isoperimetric rule* or *rule of the undetermined multiplier*. Euler illustrated his methods by a large number of examples.

Lagrange.

The new theory was provided with a special symbolism by Joseph Louis de la Grange (commonly called Lagrange) in a series of memoirs published in 1760–62. This symbolism was afterwards adopted by Euler (1764), and Lagrange is generally regarded as the founder of the calculus of variations. Euler had been under the necessity of resolving an integral into a sum of elements, recording the magnitude of the change produced in each element by a slight change in the unknown function, and thence forming an expression for the total change in the sum under consideration. Lagrange proposed to free the theory from this necessity. Euler had allowed such changes in the position of the curve, along which the integral, to be made a maximum or minimum, is taken, as can be produced by displacement parallel to the axis of ordinates. Lagrange admitted a more general change of position, which was called *variation*. The points of the curve being specified by their co-ordinates, x, y, z, and differentiation along the curve being denoted, as usual, by the symbol d, Lagrange considered the change produced in any quantity Z, which is expressed in terms of x, y, z, dx, dy, dz, d^2x, . . . when the co-ordinates x, y, z are changed by "infinitely" small increments. This change he denoted by δZ, and regarded as the variation of Z. He expressed the rules of operation with δ by the equations

$$\delta dZ=d\delta Z,\quad \delta\int Z=\int\delta Z.$$

The symbol δ.

By means of these equations $\int\delta Z$ can be transformed by the process of integration by parts into such a form that differentials of variations occur at the limits of integration only, and the transformed integral contains no differentials of variations. The terms at the limits and the integrand of the transformed integral must vanish separately, if the variation of the original integral vanishes. The process of freeing the original integral from the differentials of variations results in a differential equation, or a system of differential equations, for the determination of the form of the required curve, and in special terminal conditions, which serve to determine the constants that enter into the solution of the differential equations. Lagrange's method lent itself readily to applications of the generalized principle of virtual velocities to problems of mechanics, and he used it in this way in the *Mécanique analytique* (1788). The terminology and notation of mechanics are still largely dominated by these ideas of Lagrange, for his methods were powerful and effective, but they are rendered obscure by the use of "infinitely" small quantities, of which, in other departments of mathematics, he subsequently became an uncompromising opponent. The same ideas were applied by Lagrange himself, by Euler, and by other mathematicians to various extensions of the calculus of variations. These include problems concerning integrals of which the limits are variable in accordance with assigned conditions, the extension of Euler's rule of the multiplier to problems in which the variations are restricted by conditions of various types, the maxima and minima of integrals involving any number of dependent variables, such as are met with in the formulation of the dynamical Principle of Least Action, the maxima and minima of double and multiple integrals. In all these cases Lagrange's methods have been applied successfully to obtain the differential equation, or system of differential equations, which must be satisfied if the integral in question is a maximum or a minimum. This equation, or equations, will be referred to as the *principal equation*, or principal equations, of the problem.

Extensions of Lagrange's method.

Formulation of the First Problem.

The problems and method of the calculus admit of more exact formulation as follows: We confine our attention to the case where the sought curve is plane, and the function F contains no differential coefficients of order higher than the first. Then the problem is to determine a curve joining two fixed points (x_0, y_0) and (x_1, y_1) so that the *line integral*

$$\int_{x_0}^{x_1} F(x, y, y')dx$$

taken along the curve may be a maximum or a minimum. When it is said that the integral is a minimum for some curve, it is meant that it must be possible to mark a finite area in the plane of (x, y), so that the curve in question lies entirely within this area, and the integral taken along this curve is less than the integral taken along any other curve, which joins the same two points and lies entirely within the delimited area. There is a similar definition for a maximum. The word *extremum* is often used to connote both maximum and minimum. The problem thus posed is known as the *First Problem of the Calculus of Variations*. If we begin with any curve joining the fixed end points, and surround it by an area of finite breadth, any other curve drawn within the area, and joining the same end points, is called a *variation* of the original curve, or a *varied curve*. The original curve is defined by specifying y as a function of x. Necessary conditions for the existence of an extremum can be found by choosing special methods of variation.

Weak variations.

One method of variation is to replace y by $y+\epsilon u$, where u is a function of x, and ϵ is a constant which may be taken as small as we please. The function u is independent of ϵ. It is differentiable, and its differential coefficient is continuous within the interval of integration. It must vanish at $x=x_0$ and at $x=x_1$. This method of variation has the property that, when the ordinate of the curve is but slightly changed, the direction of the tangent is but slightly changed. Such variations are called *weak variations*. By such a variation the integral is changed into

$$\int_{x_0}^{x_1} F(x,\ y+\epsilon u,\ y'+\epsilon u')dx,$$

and the increment, or variation of the integral, is

$$\int_{x_0}^{x_1} \{F(x, y+\epsilon u,\ y'+\epsilon u')-F(x,\ y,\ y')\}dx.$$

The first variation.

In order that there may be an extremum it is necessary that the variation should be one-signed. We expand the expression under the sign of integration in powers of ϵ. The first term of the expansion contributes to the variation the term

$$\epsilon\int_{x_0}^{x_1}\left(\frac{\partial F}{\partial y}u+\frac{\partial F}{\partial y'}u'\right)dx.$$

This term is called the *first variation*. The variation of the integral cannot be one-signed unless the first variation vanishes. On transforming the first variation by integration by parts, and observing that u vanishes at $x=x_0$ and at $x=x_1$, we find a necessary condition for an extremum in the form

$$\int_{x_0}^{x_1}\left(\frac{\partial F}{\partial y}-\frac{d}{dx}\frac{\partial F}{\partial y'}\right)u\,dx=0.$$

It is a fundamental theorem that this equation cannot hold for all admissible functions u, unless the differential equation

$$\frac{d}{dx}\frac{\partial F}{\partial y'}-\frac{\partial F}{\partial y}=0$$

Stationary curves.

is satisfied at every point of the curve along which the integral is taken. This is the principal equation for this problem. The curves that are determined by it are called the *stationary curves*, or the *extremals*, of the integral. We learn that the integral cannot be an extremum unless it is taken along a stationary curve.

A difficulty might arise from the fact that, in the foregoing argument, it is tacitly assumed that y, as a function of x, is one-valued; and we can have no a priori ground for assuming that this is the case for the sought curve. This difficulty might be met by an appeal to James Bernoulli's principle, according to which every arc of a stationary curve is a stationary curve between the end points of the arc—a principle which can be proved readily by adopting such a method of variation that the arc of the curve between two points is displaced, and the rest of the curve is not. But another method of meeting it leads to important developments. This is the method of parametric representation, introduced by K. Weierstrass. According to this method the curve is defined by specifying x and y as one-valued functions of a parameter θ. The integral is then of the form

Parametric method.

$$\int_{\theta_0}^{\theta_1} f(x,\ y,\ \dot{x},\ \dot{y})d\theta,$$

where the dots denote differentiation with respect to θ, and f is a homogeneous function of $\dot{x}$, $\dot{y}$ of the first degree. The mode of dependence of x and y upon θ is immaterial to the problem, provided that they are one-valued functions of θ. A weak variation is obtained by changing x and y into $x+\epsilon u$, $y+\epsilon v$, where u and v are functions of θ which have continuous differential coefficients and are independent of ϵ. It is then found that the principal equations of the problem are

$$\frac{d}{d\theta}\frac{\partial f}{\partial \dot{x}}-\frac{\partial f}{\partial x}=0,\ \frac{d}{d\theta}\frac{\partial f}{\partial \dot{y}}-\frac{\partial f}{\partial y}=0.$$

These equations are equivalent to a single equation, for it can be proved without difficulty that, when f is homogeneous of the first degree in $\dot{x}$, $\dot{y}$

$$\frac{1}{\dot{y}}\left\{\frac{d}{d\theta}\frac{\partial f}{\partial \dot{x}}-\frac{\partial f}{\partial x}\right\}=-\frac{1}{\dot{x}}\left\{\frac{d}{d\theta}\frac{\partial f}{\partial \dot{y}}-\frac{\partial f}{\partial y}\right\}=\frac{\partial^2 f}{\partial y\partial \dot{x}}-\frac{\partial^2 f}{\partial x\partial \dot{y}}+f_1(\ddot{x}\dot{y}-\ddot{y}\dot{x}),$$

where

$$f_1=\frac{1}{\dot{y}^2}\frac{\partial^2 f}{\partial \dot{x}^2}=-\frac{1}{\dot{x}\dot{y}}\frac{\partial^2 f}{\partial \dot{x}\partial \dot{y}}=\frac{1}{\dot{x}^2}\frac{\partial^2 f}{\partial \dot{y}^2}.$$

The stationary curves obtained by this method are identical with those obtained by the previous method.

Problem of the catenoid.

The formulation of the problem by the parametric method often enables us to simplify the formation and integration of the principal equation. A very simple example is furnished by the problem: Given two points in the plane of (x, y) on the same side of the axis of x, it is required to find a curve joining them, so that this curve may generate, by revolution, about the axis of x, a surface of minimum area. The integral to be made a minimum is

$$\int_{\theta_0}^{\theta_1} y(\dot{x}^2+\dot{y}^2)^{\frac{1}{2}}d\theta,$$

and the principal equation is

$$\frac{d}{d\theta}\left\{\frac{y\dot{x}}{(\dot{x}^2+\dot{y}^2)^{\frac{1}{2}}}\right\}=0,$$

of which the first integral is

$$y\dot{x}(\dot{x}^2+\dot{y}^2)^{-\frac{1}{2}}=c,$$

or

$$\frac{y}{c}=\left\{1+\left(\frac{dy}{dx}\right)^2\right\}^{\frac{1}{2}};$$

and the stationary curves are the catenaries

$$y=c\cosh\{(x-a)/c\}.$$

The required minimal surface is the *catenoid* generated by the revolution of one of these catenaries about its directrix.

Path of a ray.

The parametric method can be extended without difficulty so as to become applicable to more general classes of problems. A simple example is furnished by the problem of forming the equations of the path of a ray of light in a variable medium. According to Fermat's principle, the integral $\int\mu ds$ is a minimum, ds representing the element of arc of a ray, and μ the refractive index. Thus the integral to be made a minimum is

$$\int_{\theta_0}^{\theta_1}\mu(\dot{x}^2+\dot{y}^2+\dot{z}^2)^{\frac{1}{2}}d\theta.$$

The equations are found at once in forms of the type

$$\frac{d}{d\theta}\left\{\mu\frac{\dot{x}}{(\dot{x}^2+\dot{y}^2+\dot{z}^2)^{\frac{1}{2}}}\right\}-\frac{\partial\mu}{\partial x}(\dot{x}^2+\dot{y}^2+\dot{z}^2)^{\frac{1}{2}}=0;$$

and, since $(\dot{x}^2+\dot{y}^2+\dot{z}^2)^{\frac{1}{2}}d\theta=ds$, these equations can be written in the usual forms of the type

$$\frac{d}{ds}\left(\mu\frac{dx}{ds}\right)-\frac{\partial\mu}{\partial x}=0.$$

Rule of the multiplier.

The formation of the first variation of an integral by means of a weak variation can be carried out without difficulty in the case of a simple integral involving any number of dependent variables and differential coefficients of arbitrarily high orders, and also in the cases of double and multiple integrals; and the quantities of the type ϵu, which are used in the process, may be regarded as equivalent to Lagrange's δx, δy, . . . The same process may not, however, be applied to isoperimetric problems. If the first variation of the integral which is to be made an extremum, subject to the condition that another integral has a prescribed value, is formed in this way, and if it vanishes, the curve is a stationary curve for this integral. If the prescribed value of the other integral is unaltered, its first variation must vanish; and, if the first variation is formed in this way, the curve is a stationary curve for this integral also. The two integrals do not, however, in general possess the same stationary curves. We can avoid this difficulty by taking the variations to be of the form $\epsilon_1u_1+\epsilon_2u_2$, where ϵ_1 and ϵ_2 are independent constants; and we can thus obtain a completely satisfactory proof of the rule of the undetermined multiplier. A proof on these lines was first published by P. Du Bois-Reymond (1879). The rule had long been regarded as axiomatic.

The parametric method enables us to deal easily with the problem of variable limits. If, in the First Problem, the terminal point $(x_1,\ y_1)$ is movable on a given guiding curve $\phi(x_1,\ y_1)=0$, the first variation of the integral can be written

$$\epsilon\left[u_1\frac{\partial f}{\partial \dot{x}}+v\frac{\partial f}{\partial \dot{y}}\right]_{x=x_1,\ y=y_1}-\epsilon\int_{\theta_0}^{\theta_1}\Big[\Big\{\frac{d}{d\theta}\frac{\partial f}{\partial \dot{x}}-\frac{\partial f}{\partial x}\Big\}u+\Big\{\frac{d}{d\theta}\frac{\partial f}{\partial \dot{y}}-\frac{\partial f}{\partial y}\Big]v\Big\}d\theta,$$

where $(x_1+\epsilon u_1,\ y_1+\epsilon v_1)$ is on the curve $\phi(x_1,\ y_1)=0$, and u_1, v_1 denote the values of u, v at $(x_1,\ y_1)$. It follows that the required curve must be a stationary curve, and that the condition

$$\frac{\partial f}{\partial \dot{x}}\frac{\partial\phi}{\partial y_1}-\frac{\partial f}{\partial \dot{y}}\frac{\partial\phi}{\partial x_1}=0$$

must hold at $(x_1,\ y_1)$. The corresponding condition in the case of the integral

Variable limits.

$$\int_{x_0}^{x_1}F(x,\ y,\ y')dx$$

is found from the equations

$$\frac{\partial f}{\partial \dot{x}}=F-y'\frac{\partial F}{\partial y'},\ \frac{\partial f}{\partial \dot{y}}=\frac{\partial F}{\partial y'}$$

to be

$$F(x,\ y,\ y')+\left(\frac{dy_1}{dx_1}-y'\right)\frac{\partial F}{\partial y'}=0.$$

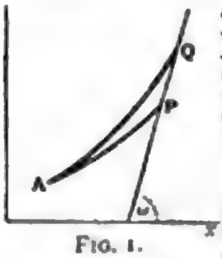


FIG. 1.

This discussion yields an important result, which may be stated as follows: Let two stationary curves of the integral be drawn from the same initial point A to points P, Q, which are near together, and let the line PQ be of length ν, and make an angle ω with the axis of x (fig. 1). The excess of the integral taken along AQ, from A to Q, above the integral taken along AP, from A to P, is expressed, correctly to the first order in ν, by the formula

$$\nu\cos\omega\left\{\mathrm{F}(x,y,y')+(\tan\omega-y')\frac{\partial\mathrm{F}}{\partial y'}\right\}.$$

Transversals of stationary curves.

In this formula x, y are the co-ordinates of P, and y' has the value belonging to the point P and the stationary curve AP. When the coefficient of $\nu\cos\omega$ in the formula vanishes, the curve AP is said to be cut *transversely* by the line PQ, and a curve which cuts a family of stationary curves transversely is described as a *transversal* of those curves. In the problem of variable limits, when a terminal point moves on a given guiding curve, the integral cannot be an extremum unless the stationary curve along which it is taken is cut transversely by the guiding curve at the terminal point. A simple example is afforded by the shortest line, drawn on a surface, from a point to a given curve, lying on the surface. The required curve must be a geodesic, and it must cut the given curve at right angles.

Alternative method.

The problem of variable limits may always be treated by a method of which the following is the principle: In the First Problem let the initial point (x_0, y_0) be fixed, and let the terminal point (x_1, y_1) move on a fixed guiding curve C_1. Now, whatever the terminal point may be, the integral cannot be an extremum unless it is taken along a stationary curve. We have then to choose among those stationary curves which are drawn from (x_0, y_0) to points of C_1 that one which makes the integral an extremum. This can be done by expressing the value of the integral taken along a stationary curve from the point (x_0, y_0) to the point (x_1, y_1) in terms of the co-ordinates x_1, y_1, and then making this expression an extremum, in regard to variations of x_1, y_1, by the methods of the differential calculus, subjecting (x_1, y_1) to the condition of moving on the curve C_1.

Principle of least action.

Principle of varying action.

An important example of the first variation of integrals is afforded by the Principle of Least Action in dynamics. The kinetic energy T is a homogeneous function of the second degree in the differential coefficients $\dot{q}_1, \dot{q}_2, \dots \dot{q}_n$ of the co-ordinates $q_1, q_2, \dots q_n$ with respect to the time t, and the potential energy V is a function of these co-ordinates. The energy equation is of the form

$$\mathrm{T}+\mathrm{V}=\mathrm{E},$$

where E is a constant. A *course* of the system is defined when the co-ordinates q are expressed as functions of a single parameter θ. The *action* A of the system is defined as the integral $\int_{t_0}^{t_1}2\mathrm{T}dt$, *taken along a course* from the initial position $(q^{(0)})$ to the final position $(q^{(1)})$, but t_0 and t_1 are not fixed. The equations of motion are the principal equations answering to this integral. To obtain them it is most convenient to write $\Phi(\dot{q})$ for T, and to express the integral in the form

$$\int_{\theta_0}^{\theta_1}\{2(\mathrm{E}-\mathrm{V})\}^{\frac{1}{2}}\{\Phi(q')\}^{\frac{1}{2}}d\theta,$$

where q' denotes the differential coefficient of a co-ordinate q with respect to θ, and, in accordance with the parametric method, the limits of integration are fixed, and the integrand is a homogeneous function of the q''s of the first degree. There is then no difficulty in deducing the Lagrangian equations of motion of the type

$$\frac{d}{dt}\frac{\partial\mathrm{T}}{\partial\dot{q}}-\frac{\partial\mathrm{T}}{\partial q}+\frac{\partial\mathrm{V}}{\partial q}=0.$$

These equations determine the actual course of the system. Now if the system, in its actual course, passes from a given initial position $(q^{(0)})$ to a variable final position (q), the action A becomes a function of the q's, and the first method used in the problem of variable limits shows that, for every q

$$\frac{\partial\mathrm{A}}{\partial q}=\frac{\partial\mathrm{T}}{\partial\dot{q}}.$$

When the kinetic energy T is expressed as a homogeneous quadratic function of the momenta $\partial\mathrm{T}/\partial\dot{q}$, say

$$\mathrm{T}=\tfrac{1}{2}\Sigma_{r,s}\left(b_{rs}\frac{\partial\mathrm{T}}{\partial\dot{q}_r}\frac{\partial\mathrm{T}}{\partial\dot{q}_s}\right),\ (b_{sr}=b_{rs}).$$

and the differential coefficients of A are introduced instead of those of T, the energy equation becomes a non-linear partial differential equation of the first order for the determination of A as a function of the q's. This equation is

$$\tfrac{1}{2}\Sigma_{r,s}\left(b_{rs}\frac{\partial\mathrm{A}}{\partial q_r}\frac{\partial\mathrm{A}}{\partial q_s}\right)+\mathrm{V}=\mathrm{E}.$$

A complete integral of this equation would yield an expression for A as a function of the q's containing n arbitrary constants, $a_1, a_2, \dots a_n$, of which one a_n is merely additive to A; and the courses of the system which are compatible with the equations of motion are determined by equations of the form

$$\frac{\partial\mathrm{A}}{\partial a_1}=b_1,\ \frac{\partial\mathrm{A}}{\partial a_2}=b_2,\dots\frac{\partial\mathrm{A}}{\partial a_{n-1}}=b_{n-1}$$

where the b's are new arbitrary constants. It is noteworthy that the differential equations of the second order by which the geodesics on an ellipsoid are determined were first solved by this method (C. G. J. Jacobi, 1839).

Principle of varying action generalized.

It has been proved that every problem of the calculus of variations, in which the integral to be made an extremum contains only one independent variable, admits of a similar transformation; that is to say, the integrals of the principal equations can always be obtained, in the way described above, from a complete integral of a partial differential equation of the first order, and this partial differential equation can always be formed by a process of elimination. These results were first proved by A. Clebsch (1858).

Condition of integrability.

Among other analytical developments of the theory of the first variation we may note that the necessary and sufficient condition that an expression of the form

$$\mathrm{F}(x,y,y',\dots y^{(n)})$$

should be the differential coefficient of another expression of the form

$$\mathrm{F}_1(x,y,y',\dots y^{(n-1)})$$

is the identical vanishing of the expression

$$\frac{\partial\mathrm{F}}{\partial y}-\frac{d}{dx}\frac{\partial\mathrm{F}}{\partial y'}+\frac{d^2}{dx^2}\frac{\partial\mathrm{F}}{\partial y''}-\dots+(-1)^n\frac{d^n}{dx^n}\frac{\partial\mathrm{F}}{\partial y^{(n)}}.$$

The result was first found by Euler (1744).

Condition that a differential equation may arise from a problem of the calculus of variations.

A differential equation

$$\phi(x,y,y',y'')=0$$

is the principal equation answering to an integral of the form

$$\int\mathrm{F}(x,y,y')dx$$

if the equation

$$\frac{d}{dx}\frac{\partial\phi}{\partial y''}=\frac{\partial\phi}{\partial y'}$$

is satisfied identically. In the more general case of an equation of the form

$$\phi(x,y,y',\dots y^{(2n)})=0,$$

the corresponding condition is that the differential expression obtained by Lagrange's process of variation, viz.,

$$\frac{\partial\phi}{\partial y}\delta y+\frac{\partial\phi}{\partial y'}\frac{d\delta y}{dx}+\dots+\frac{\partial\phi}{\partial y^{(2n)}}\frac{d^{2n}\delta y}{dx^{2n}},$$

must be identical with the "adjoint" differential expression

$$\frac{\partial\phi}{\partial y}\delta y-\frac{d}{dx}\left(\frac{\partial\phi}{\partial y'}\delta y\right)+\frac{d^2}{dx^2}\left(\frac{\partial\phi}{\partial y''}\delta y\right)-\dots+\frac{d^{2n}}{dx^{2n}}\left(\frac{\partial\phi}{\partial y^{(2n)}}\delta y\right).$$

This matter has been very fully investigated by A. Hirsch (1897).

First variation of a double integral.

To illustrate the transformation of the first variation of multiple integrals we consider a double integral of the form

$$\iint\psi(x,y,z,p,q,r,s,t)dxdy,$$

taken over that area of the z plane which is bounded by a closed curve s'. Here $p, q, \dots t$ denote the partial differential coefficients of z with respect to x and y of the first and second orders, according to the usual notation. When z is changed into $z+\epsilon w$, the terms of the first order in ϵ are

$$\epsilon\iint\left(\frac{\partial\psi}{\partial z}w+\frac{\partial\psi}{\partial p}\frac{\partial w}{\partial x}+\frac{\partial\psi}{\partial q}\frac{\partial w}{\partial y}+\frac{\partial\psi}{\partial r}\frac{\partial^2 w}{\partial x^2}+\frac{\partial\psi}{\partial s}\frac{\partial^2 w}{\partial x\partial y}+\frac{\partial\psi}{\partial t}\frac{\partial^2 w}{\partial y^2}\right)dxdy.$$

Each term must be transformed so that no differential coefficients of w are left under the sign of double integration. We exemplify the process by taking the term containing $\partial^2 w/\partial x^2$. We have

$$\iint\frac{\partial\psi}{\partial r}\frac{\partial^2 w}{\partial x^2}dxdy=\iint\left\{\frac{\partial}{\partial x}\left(\frac{\partial\psi}{\partial r}\frac{\partial w}{\partial x}\right)-\frac{\partial}{\partial x}\left(\frac{\partial\psi}{\partial r}\right)\cdot\frac{\partial w}{\partial x}\right\}dxdy$$

$$=\iint\left[\frac{\partial}{\partial x}\left(\frac{\partial\psi}{\partial r}\frac{\partial w}{\partial x}\right)-\frac{\partial}{\partial x}\left\{w\frac{\partial}{\partial x}\left(\frac{\partial\psi}{\partial r}\right)\right\}+w\frac{\partial^2}{\partial x^2}\left(\frac{\partial\psi}{\partial r}\right)\right]dxdy.$$

The first two terms are transformed into a line integral taken round the boundary s', and we thus find

$$\iint\frac{\partial\psi}{\partial r}\frac{\partial^2 w}{\partial x^2}dxdy=\int\cos(x,\nu)\left\{\frac{\partial\psi}{\partial r}\frac{\partial w}{\partial x}-w\frac{\partial}{\partial x}\left(\frac{\partial\psi}{\partial r}\right)\right\}ds'+\iint w\frac{\partial^2}{\partial x^2}\left(\frac{\partial\psi}{\partial r}\right)dxdy.$$

where ν denotes the direction of the normal to the edge s' drawn outwards. The double integral on the right-hand side contributes a term to the principal equation, and the line integral contributes terms to the boundary conditions. The line integral admits of further transformation by means of the relations

$$\frac{\partial w}{\partial x}=\frac{\partial w}{\partial\nu}\cos(x,\nu)-\frac{\partial w}{\partial s'}\cos(y,\nu),$$

$$\int\cos(x,\nu)\cos(y,\nu)\frac{\partial\psi}{\partial r}\frac{\partial w}{\partial s'}ds'=-\int\frac{\partial}{\partial s'}\left\{\cos(x,\nu)\cos(y,\nu)\frac{\partial\psi}{\partial r}\right\}wds'.$$

It becomes

$$\int \cos^2(x,\nu)\frac{\partial\psi}{\partial r}\frac{\partial w}{\partial\nu}ds'$$

$$+\int\left[\frac{\partial}{\partial s'}\left\{\cos(x,\nu)\cos(y,\nu)\frac{\partial\psi}{\partial r}\right\}-\cos(x,\nu)\frac{\partial}{\partial x}\left(\frac{\partial\psi}{\partial r}\right)\right]w\,ds'.$$

In forming the first term within the square brackets we then use the relations

$$\frac{\partial}{\partial s'}\cos(x,\nu)=-\frac{1}{\rho'}\cos(y,\nu),\ \frac{\partial}{\partial s'}\cos(y,\nu)=\frac{1}{\rho'}\cos(x,\nu),$$

$$\frac{\partial}{\partial s'}\frac{\partial\psi}{\partial r}=-\cos(y,\nu)\frac{\partial}{\partial x}\frac{\partial\psi}{\partial r}+\cos(x,\nu)\frac{\partial}{\partial y}\frac{\partial\psi}{\partial r},$$

where ρ' denotes the radius of curvature of the curve s'.

The second variation.

The necessity of freeing the calculus of variations from dependence upon the notion of infinitely small quantities was realized by Lagrange, and the process of discarding such quantities was partially carried out by him in his *Théorie des fonctions analytiques* (1797). In accordance with the interpretation of differentials which he made in that treatise, he interpreted the variation of an integral, as expressed by means of his symbol δ, as the first term, or the sum of the terms of the first order, in the development in series of the complete expression for the change that is made in the value of the integral when small finite changes are made in the variables. The quantity which had been regarded as the variation of the integral came to be regarded as the first variation, and the discrimination between maxima and minima came to be regarded as requiring the investigation of the second variation. The first step in this theory had been taken by A. M. Legendre in 1786.

In the case of an integral of the form

$$\int_{x_0}^{x_1}F(x,y,y')dx$$

Legendre defined the second variation as the integral

$$\int_{x_0}^{x_1}\frac{1}{2}\left\{\frac{\partial^2F}{\partial y^2}(\delta y)^2+2\frac{\partial^2F}{\partial y\partial y'}\delta y\delta y'+\frac{\partial^2F}{\partial y'^2}(\delta y')^2\right\}dx.$$

To this expression he added the term $\left[\frac{1}{2}a(\delta y)^2\right]_{x_0}^{x_1}$, which vanishes identically because δy vanishes at $x=x_0$ and at $x=x_1$. He took a to satisfy the equation

$$\frac{\partial^2F}{\partial y'^2}\left(\frac{\partial^2F}{\partial y^2}+\frac{da}{dx}\right)=\left(\frac{\partial^2F}{\partial y\partial y'}+a\right)^2,$$

and thus transformed the expression for the second variation to

$$\int_{x_0}^{x_1}\frac{\partial^2F}{\partial y'^2}(\delta y'+m\delta y)^2dx,$$

where

$$m\frac{\partial^2F}{\partial y'^2}=\frac{\partial^2F}{\partial y\partial y'}+a.$$

Legendre's condition.

From this investigation Legendre deduced a new condition for the existence of an extremum. It is necessary, not only that the variation should vanish, but also that the second variation should be one-signed. In the case of the First Problem Legendre concluded that this cannot happen unless $\partial^2F/\partial y'^2$ has the same sign at all points of the stationary curve between the end points, and that the sign must be + for a minimum and − for a maximum. In the application of the perametric method the function which has been denoted by f_1 takes the place of $\partial^2F/\partial y'^2$.

Jacobi.

The transformation of the second variations of integrals of various types into forms in which their signs can be determined by inspection subsequently became one of the leading problems of the calculus of variations. This result came about chiefly through the publication in 1837 of a memoir by C. G. J. Jacobi. He transformed Legendre's equation for the auxiliary function a into a linear differential equation of the second order by the substitution

$$\frac{\partial^2F}{\partial y\partial y'}+a=-\frac{\partial^2F}{\partial y'^2}\frac{1}{w}\frac{dw}{dx},$$

and he pointed out that Legendre's transformation of the second variation cannot be effected if the function w vanishes between the limits of integration. He pointed out further, that if the stationary curves of the integral are given by an equation of the form

$$y=\phi(x,a,b),$$

where a, b are arbitrary constants, the complete primitive of the equation for w is of the form

$$w=A\frac{\partial\phi}{\partial a}+B\frac{\partial\phi}{\partial b},$$

where A, B are new arbitrary constants. Jacobi stated these propositions without proof, and the proof of them, and the extension of the results to more general problems, became the object of numerous investigations. These investigations were, for the most part, and for a long time, occupied almost exclusively with analytical developments; and the geometrical interpretation which Jacobi had given, and which he afterwards emphasized in his *Vorlesungen über Dynamik*, was neglected until rather recent times. According to this interpretation, the stationary curves which start from a point (x_0, y_0) have an envelope; and the integral of F, taken along such a curve, cannot be an extremum if the point (ξ_0, η_0) where the curve touches the envelope lies on the arc between the end points. Pairs of points such as (x_0, y_0) and (ξ_0, η_0) were afterwards called *conjugate points* by Weierstrass. The proof that the integral cannot be an extremum if the arc of the curve between the fixed end points contains a pair of conjugate points was first published by G. Erdmann (1878).

Conjugate points.

Examples of conjugate points are afforded by antipodal points on a sphere, the conjugate foci of geometrical optics, the kinetic foci of analytical dynamics. If the terminal points are a pair of conjugate points, the integral is not in general an extremum; but there is an exceptional case, of which a suitably chosen arc of the equator of an oblate spheroid may serve as an example. In the problem of the catenoid a pair of conjugate points on any of the catenaries, which are the stationary curves of the problem, is such that the tangents to the catenary at the two points A and A′ meet on the axis of revolution (fig. 2). When both the end points of the required curve move on fixed guiding curves C_0, C_1, a stationary curve C, joining a point A_0 of C_0 to a point A_1 of C_1, cannot yield an extremum unless it is cut transversely by C_0 at A_0 and by C_1 at A_1. The envelope of stationary curves which set out from C_0 towards C_1, and are cut transversely by C_0 at points near A_0, meets C at a point D_0; and the envelope of stationary curves which proceed from C_0 to C_1, and are cut transversely by C_1 at points near A_1, meets C at a point D_1. The curve C, drawn from A_0 to A_1, cannot yield an extremum if D_0 or D_1 lies between A_0 and A_1, or if D_0 lies between A_1 and D_1. These results are due to G. A. Bliss (1903). A simple example is afforded by the shortest line on a sphere drawn from one small circle to another. In fig. 3 D_0 is that pole of the small circle A_0B_0 which occurs first on great circles cutting A_0B_0 at right angles, and proceeding towards A_1B_1; D_1 is that pole of the small circle A_1B_1 which occurs first on great circles cutting A_1B_1 at right angles, and drawn from points of A_0B_0 towards A_1B_1. The arc A_0A_1 is the required shortest line, and it is distinguished from B_0B_1 by the above criterion.

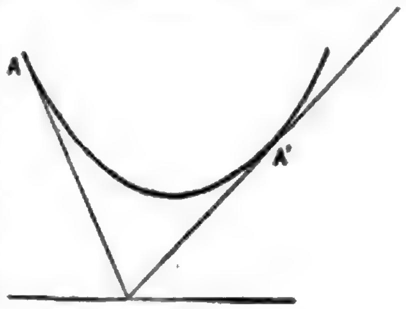


FIG. 2.

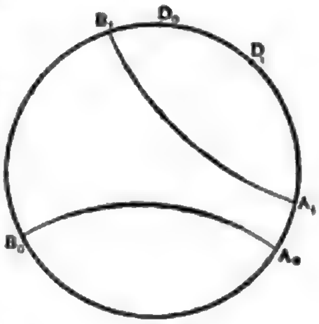


FIG. 3.

Sources of Weierstrass's theory.

Jacobi's introduction of conjugate points is one of the germs from which the modern theory of the calculus of variations has sprung. Another is a remark made by Legendre (1786) in regard to the solution of Newton's problem of the solid of least resistance. This problem requires that a curve be found for which the integral

$$\int yy'^3(1+y'^2)^{-1}dy$$

should be a minimum. The stationary curves are given by the equation

$$yy'^3(1+y'^2)^{-2}=\text{const.},$$

a result equivalent to Newton's solution of the problem; but Legendre observed that, if the integral is taken along a broken line, consisting of two straight lines equally inclined to the axis of x in opposite senses, the integral can be made as small as we please by sufficiently diminishing the angle of inclination. Legendre's remark amounts to admitting a variation of Newton's curve, which is not a weak variation. Variations which are not weak are such that, while the points of a curve are but slightly displaced, the tangents undergo large changes of direction. They are distinguished as *strong variations*. A general theory of strong variations in connexion with the First Problem, and of the conditions which are sufficient to secure that the integral taken along a stationary curve may be an extremum, was given by Weierstrass in lectures. He delivered courses of lectures on the calculus of variations in several years between 1865 and 1889, and his chief discoveries in the subject seem to have been included in the course for 1879. Through these lectures his theory became known to some students and teachers in Europe and America, and there have been published a few treatises and memoirs devoted to the exposition of his ideas.

Necessary conditions.

In the First Problem the following conditions are known to be necessary for an extremum. I. The path of integration must be a stationary curve. II. The expression $\partial^2F/\partial y'^2$, or the expression denoted by f_1 in the application of the parametric method, must not change sign at any point of this curve between the end points. III. The arc of the curve between the end points must not contain a pair of conjugate points. All these results are obtained by using weak variations. Additional results, relating to strong as well as weak variations, are obtained by a method which permits of the expression of the variation of an integral as a line integral taken along the varied curve. Let A, B be the end points, and let the stationary curve AB be drawn. If the end points A, B are not a pair of conjugate points, and if the point conjugate to A does not lie on the arc AB, then we may find a point A′, on the backward continuation of the stationary curve BA beyond A, so near to A that the point conjugate to A′ lies on the forward continuation of the arc AB beyond B. This being the case, it is possible to delimit an area of finite breadth, so that the arc AB of the stationary curve joining A, B lies entirely within the area, and no two stationary curves drawn through A′ intersect within the area. Through any point of such an area it is possible to draw one, and only one, stationary curve which passes through A′. This family of stationary curves is said to constitute a *field* of stationary curves about the curve AB. We suppose that such a field exists, and that the varied curve AQPB lies entirely within the delimited area. The variation of the integral $\int F(x, y, y')dx$ is identical with the line integral of F taken round a contour consisting of the varied curve AQPB and the stationary curve AB, in the sense AQPBA. The line integral may, as usual, be replaced by the sum of line integrals taken round a series of cells, the external boundaries of the set of cells being identical with the given contour, and the internal boundaries of adjacent cells being traversed twice in opposite senses. We may choose a suitable set of cells as follows. Let Q, P be points on the varied curve, and let A′Q, A′P be the stationary curves of the field which pass through Q, P. Let P follow Q in the sense AQPB in which the varied curve is described. Then the contour consisting of the stationary curve A′Q, from A′ to Q, the varied curve QP, from Q to P, and the stationary curve A′P, from P to A′, is the boundary of a cell (fig. 4). Let us denote the integral of F taken along a stationary curve by round brackets, thus (A′Q), and the integral of F taken along any other curve by square brackets, thus [PQ]. If the varied curve is divided into a number of arcs such as QP we have the result

Field of stationary curves.

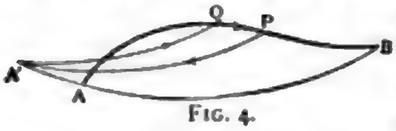


Fig. 4.

General expression for variation of an integral.

$$[AQPB]-(AB)=\Sigma\{(A'Q)+[QP]-(A'P)\},$$

and the right-hand member can be expressed as a line integral taken along the varied curve AQPB.

To effect this transformation we seek an approximate expression for the term $(A'Q)+[QP]-(A'P)$ when Q, P are near together. Let Δs denote the arc QP, and ψ the angle which the tangent at P to the varied curve, in the sense from A to B, makes with the axis of x (fig. 5). Also let ϕ be the angle which the tangent at P to the stationary curve A′P, in the sense from A′ to P, makes with the axis of x. We evaluate $(A'Q)-(A'P)$ approximately by means of a result which we obtained in connexion with the problem of variable limits. Observing that the angle here denoted by ψ is equivalent to the angle formerly denoted by $\pi+\omega$ (cf. fig. 1), while $\tan\phi$ is equivalent to the quantity formerly denoted by y', we obtain the approximate equation

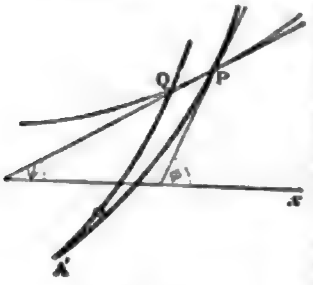


Fig. 5.

$$(A'Q)-(A'P)=-\Delta s\,.\cos\psi\left\{F(x,y,p)+(\tan\psi-p)\frac{\partial F}{\partial p}\right\}_{p=\tan\phi}$$

which is correct to the first order in Δs. Also we have

$$[QP]=\Delta s\,.\cos\psi F(x,y,\tan\psi)$$

correctly to the same order. Hence we find that, correctly to the first order in Δs,

$$(A'Q)+[QP]-(A'P)=E(x,y,\tan\phi,\tan\psi)\Delta s,$$

where

$$E(x,y,\tan\phi,\tan\psi)$$
$$=\cos\psi\left\{F(x,y,\tan\psi)-F(x,y,p)-(\tan\psi-p)\frac{\partial F}{\partial p}\right\}_{p=\tan\phi}.$$

When the parametric method is used the function E takes the form

$$\left(\lambda\frac{\partial f}{\partial \dot{x}}+\mu\frac{\partial f}{\partial \dot{y}}\right)_{\dot{x}=\lambda,\,\dot{y}=\mu}-\left(\lambda\frac{\partial f}{\partial \dot{x}}+\mu\frac{\partial f}{\partial \dot{y}}\right)_{\dot{x}=l,\,\dot{y}=m}$$

where λ, μ are the direction cosines of the tangent at P to the curve AQPB, in the sense from A to B, and l, m are the direction cosines of the tangent at P to the stationary curve A′P, in the sense from A′ to P.

The function E, here introduced, has been called Weierstrass's *excess function*. We learn that the variation of the integral, that is to say, the excess of the integral of F taken along the varied curve above the integral of F taken along the original curve, is expressible as the line integral $\int E ds$ taken along the varied curve. We can therefore state a *sufficient* (but not necessary) condition for the existence of an extremum in the form:—When the integral is taken along a stationary curve, and there is no pair of conjugate points on the arc of the curve terminated by the given end points, the integral is certainly an extremum if the excess function has the same sign at all points of a finite area containing the whole of this arc within it. Further, we may specialize the excess function by identifying A′ with A, and calculating the function for a point P on the arc AB of the stationary curve AB, and an arbitrary direction of the tangent at P to the varied curve. This process is equivalent to the introduction of a particular type of strong variation. We may in fact take, as a varied curve, the arc AQ of a neighbouring stationary curve, the straight line QP drawn from Q to a point of the arc AB, and the arc PB of the stationary curve AB (fig. 6). The sign of the variation is then the same as that of the function $E(x, y, \tan\phi, \tan\psi)$, where (x, y) is the point P, ψ is the angle which the straight line QP makes with the axis of x, and ϕ is the angle which the tangent at P to the curve APB makes with the same axis. We thus arrive at a new *necessary* (but not sufficient) condition for the existence of an extremum of the integral $\int F ds$, viz. the specialized excess function, so calculated, must not change sign between A and B.

Weierstrass's excess function.

Sufficient and necessary conditions.

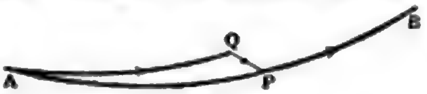


Fig. 6.

The sufficient condition, and the new necessary condition, associated with the excess function, as well as the expression for the variation as $\int E ds$, are due to Weierstrass. In applications to special problems it is generally permissible to identify A′ with A, and to regard QP as straight. The direction of QP must be such that the integral of F taken along it is finite and real. We shall describe such directions as *admissible*. In the statement of the sufficient condition, and the new necessary condition, it is of course understood that the direction specified by ψ is admissible. The excess function generally vanishes if $\psi=\phi$, but it does not change sign. It can be shown without difficulty that, when ψ is very nearly equal to ϕ, the sign of E is the same as that of

Developments connected with the excess function.

$$(\tan\psi-\tan\phi)^2\cos\phi\left(\frac{\partial^2 F}{\partial y'^2}\right)_{y'=\tan\phi}$$

and thus the necessary condition as to the sign of the excess function includes Legendre's condition as to the sign of $\partial^2F/\partial y'^2$.

Weierstrass's conditions have been obtained by D. Hilbert from the observation that, if p is a function of x and y, the integral

$$\int\left\{F(x,y,p)+(y'-p)\left(\frac{\partial F}{\partial y'}\right)_{y'=p}\right\}dx,$$

taken along a curve joining two fixed points, has the same value for all such curves, provided that there is a field of stationary curves, and that p is the gradient at the point (x, y) of that stationary curve of the field which passes through this point.

An instructive example of the excess function, and the conditions connected with it, is afforded by the integral

$$\int y^2y'^{-2}dx \text{ or } \int y^2\dot{x}^3\dot{y}^{-2}d\theta.$$

The first integral of the principal equation is

$$y^2\dot{x}^2\dot{y}^{-2}=\text{const.},$$

and the stationary curves include the axis of x, straight lines parallel to the axis of y, and the family of exponential curves $y=ae^{cx}$. A field of stationary curves is expressed by the equation

Example of the excess function.

$$y=y_0\exp\{c(x-x_0)\},$$

and, as these have no envelope other than the initial point (x_0, y_0), there are no conjugate points. The function f_1 is $6\dot{x}\dot{y}^{-4}$, and this is positive for curves going from the initial point in the positive direction of the axis of x. The value of the excess function is

$$y^2\cos\psi(\cot^2\psi-3\cot^2\phi+2\tan\psi\cot^3\phi).$$

The directions $\psi=0$ and $\psi=\pi$ are inadmissible. On putting $\psi=\frac{1}{2}\pi$ we get $2y^2\cot^3\phi$; and on putting $\psi=\frac{3}{2}\pi$ we get $-2y^2\cot^3\phi$. Hence the integral taken along AQ′PB is greater than that taken along APB, and the integral taken along AQPB is less than that taken along APB, when Q′Q are sufficiently near to P on the ordinate of P (fig. 7). It follows that the integral is neither a maximum nor a minimum.

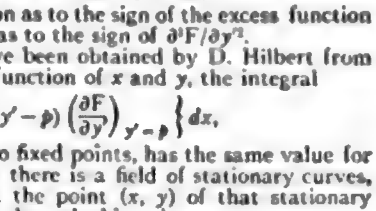


Fig. 7.

It has been proved by Weierstrass that the excess function cannot be one-signed if the function f of the parametric method is a rational function of $\dot{x}$ and $\dot{y}$. This result includes the above example, and the problem of the solid of least resistance, for which, as Legendre had seen, there can be no solution if strong variations are admitted. As another example of the calculation of excess functions, it may be noted that the value of the excess function in the problem of the catenoid is $2y\sin^2\frac{1}{2}(\psi-\phi)$.

Field of stationary curves and transversals.

In general it is not necessary that a field of stationary curves should consist of curves which pass through a fixed point. Any family of stationary curves depending on a single parameter may constitute a field. This remark is of importance in connexion with the adaptation of Weierstrass's results to the problem of variable limits. For the purpose of this adaptation A. Kneser (1900) introduced the family of stationary curves which are cut transversely by an assigned curve. Within the field of these curves we can construct the transversals of the family; that is to say, there is a finite area of the plane, through any point of which there passes one stationary curve of the field and one curve which cuts all the stationary curves of the field transversely. These curves provide a system of curvilinear co-ordinates, in terms of which the value of $\int F dx$, taken along any curve within the area, can be expressed. The value of the integral is the same for all arcs of stationary curves of the field which are intercepted between any two assigned transversals.

Discontinuous solutions.

In the above discussion of the First Problem it has been assumed that the curve which yields an extremum is an arc of a single curve, which must be a stationary curve. It is conceivable that the required curve might be made up of a finite number of arcs of different stationary curves meeting each other at finite angles. It can be shown that such a broken curve cannot yield an extremum unless both the expressions $\partial F/\partial y'$ and $F-y'(\partial F/\partial y')$ are continuous at the corners. In the parametric method $\partial f/\partial \dot{x}$ and $\partial f/\partial \dot{y}$ must be continuous at the corners. This result limits very considerably the possibility of such discontinuous solutions, though it does not exclude them. An example is afforded by the problem of the catenoid. The axis of x and any lines parallel to the axis of y satisfy the principal equation; and the conditions here stated show that the only discontinuous solution of the problem is presented by the broken line ACDB (fig. 8). A broken line like AA′B′B is excluded. Discontinuous solutions have generally been supposed to be of special importance in cases where the required curve is restricted by the condition of not crossing the boundary of a certain limited area. In such cases part of the boundary may have to be taken as part of the curve. Problems of this kind were investigated in detail by J. Steiner and I. Todhunter. In recent times the theory has been much extended by C. Carathéodory.

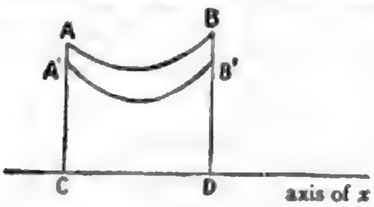


FIG. 8.

Existence-theorems.

In any problem of the calculus of variations the first step is the formation of the principal equation or equations; and the second step is the solution of the equation or equations, in accordance with the assigned terminal or boundary conditions. If this solution cannot be effected, the methods of the calculus fail to answer the question of the existence or non-existence of a solution which would yield a maximum or minimum of the integral under consideration. On the other hand, if the existence of the extremum could be established independently, the existence of a solution of the principal equation, which would also satisfy the boundary conditions, would be proved. The most famous example of such an existence-theorem is Dirichlet's principle, according to which there exists a function V, which satisfies the equation

$$\frac{\partial^2 V}{\partial x^2}+\frac{\partial^2 V}{\partial y^2}+\frac{\partial^2 V}{\partial z^2}=0$$

at all points within a closed surface S, and assumes a given value at each point of S. The differential equation is the principal equation answering to the integral

$$I=\iiint\left\{\left(\frac{\partial V}{\partial x}\right)^2+\left(\frac{\partial V}{\partial y}\right)^2+\left(\frac{\partial V}{\partial z}\right)^2\right\}dx\,dy\,dz$$

taken through the volume within the surface S. The theorem of the existence of V is of importance in all those branches of mathematical physics in which use is made of a potential function, satisfying Laplace's equation; and the two-dimensional form of the theorem is of fundamental importance in the theory of functions of a complex variable. It has been proposed to establish the existence of V by means of the argument that, since I cannot be negative, there must be, among the functions which have the prescribed boundary values, some one which gives to I the smallest possible value. This unsound argument was first exposed by Weierstrass. He observed that precisely the same argument would apply to the integral $\int x^2 y'^2 dx$ taken along a curve from the point $(-1, a)$ to the point $(1, b)$. On the one hand, the principal equation answering to this integral can be solved, and it can be proved that it cannot be satisfied by any function y at all points of the interval $-1<x<1$ if y has different values at the end points. On the other hand, the integral can be made as small as we please by a suitable choice of y. Thus the argument fails to distinguish between a *minimum* and an *inferior limit* (see FUNCTION). In order to prove Dirichlet's principle it becomes necessary to devise a proof that, in the case of the integral I, there cannot be a limit of this kind. This has been effected by Hilbert for the two-dimensional form of the problem.

Dirichlet's principle.

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VARICOSE VEINS (Lat. *varix*, a dilated vein), a condition of the veins which mostly occurs in those parts of the blood stream which are farthest from the heart and occupy a dependent position. Thus they are found in the legs and thighs; in the lowest part of the bowel (piles; see HAEMORRHOIDS), and in the spermatic cord (varicocele). Any condition which hinders the return of blood from the veins is apt to cause their permanent dilatation; thus is explained the occurrence of varicose veins in the leg from the wearing of a tight garter, and of piles as the result of the pressure of an ovarian tumour or of a pregnant uterus, or of disease of the liver.

Sometimes the trouble is begun by a direct injury to the vein, which, by setting up an inflammation, weakens the coats of the vein, which then yield under the pressure of the blood-stream. In the case of varicocele, the dilatation of the veins is probably of developmental origin; many other causes are given, but not one of them appears satisfactory. Examination of a varicose vein shows that it is increased in length as well as in capacity. In some parts of its course the vein has its coats much thickened, but at those places where there is most dilatation the walls are very thin. Veins thus affected give rise to pains and achings, and they are, moreover, liable to attacks of inflammation which end in clotting of the blood (*thrombosis*). This is a dangerous condition, as a sudden or violent movement is apt to cause the detachment of a piece of the clot, which, carried up to the brain or the lung, may cause sudden death. Less serious results of varicose veins are swelling of the parts below (*oedema*), ulceration and abscess.

As regards treatment, the wearing of a well-fitting elastic stocking will prove beneficial in the case of a moderate dilatation of the veins of the leg; the individual must avoid long standing and fatigue. It is well also to have the foot of the bed raised three or four inches, so that during the night the veins may be kept as empty as possible. If the case is more serious, the thinned veins threatening to give way, it will be advisable, provided the dilatations are fairly well localized, and the general condition of the patient permits, to excise the diseased parts, tying the cut ends of the veins, and closing the surface wounds with fine sutures. Should a varicose vein be plugged with clot, it will be advisable to tie it high up where the coats are healthy, and to remove the lower part by dissection. This will render the person safe from the very serious risk of a piece of the clot being carried to the heart, and will also permanently rid him of his trouble. It may be said generally that any operative treatment for varicose veins in the lower extremity is best associated with the application of a ligature upon the large surface vein just before it enters the common femoral vein below the fold of the groin. This operation removes the risk of the downward pressure of blood in the veins whose dilatation has rendered the valves useless.

In the case of a varicose vein being opened by accident or disease, it is quite possible for the individual to bleed to death. The first-aid treatment for the serious haemorrhage should consist in laying the patient on the floor, raising the limb upon the seat of a chair, and fixing a pad over the open vessel by a handkerchief or bandage.

Varicose veins of the spermatic cord (*varicocele*) of the left side are met with in adolescents. The dilatation is, in all probability, of developmental origin, making its appearance at puberty. It is, as a rule, of no serious moment, and, unless present in an extreme degree, had best be treated merely by a suspension bandage. If, however, it is causing real physical distress, it may be treated by excision of an inch or two of the bunch of dilated veins. The presence of varicocele is apt to cause inconvenience or even discomfort to men living in India or the tropics, but the Englishman who intends spending his life in temperate climes will do well to ignore a varicocele. It will become less and less noticeable as time goes on. (E. O.*)

VARIOLITES (Lat. *variola*, smallpox), in petrology, a group of dark green basic igneous rocks which, especially on weathered surfaces, exhibit pale coloured spots that give them a pock-marked appearance. In some conditions these spots weather out prominently; they are grey, pale green, violet or yellowish, while the matrix of the rock is usually dark green. The variolites are related most closely to the basalts or diabases. They are nearly always much decomposed, and, since they are also fine-grained rocks, their original composition may be much obscured by secondary changes. The variolitic spots are rounded in outline and are often about a quarter of an inch in diameter, but may much exceed this size. They have a radiate structure and are sometimes, though not generally, zoned with concentric circles of different appearance and composition. Many authors have compared them with the spherulites of the acid rocks (obsidians and rhyolites), and undoubtedly some kinds of variolite are merely glassy spherulitic varieties of basalt. The tachylyte selvages of the dolerite dikes of the west of Scotland, for example, often contain large brown spherulites which are easily visible in hand specimens. These spherulites consist of very thin divergent fibres, and their nature is often difficult to determine on account of the indefiniteness of the optical characters of minerals in this state. It seems probable, however, that they are mostly felspar embedded in dark brown glass. Small phenocrysts or skeleton crystals of olivine, augite and plagioclase felspar may occur in these tachylytes.

Other variolites are glassy or partly crystalline facies of olivine-free dolerites, occurring as thin dikes or intrusions, or at the margins of dolerite masses. In these the felspars are well crystallized as thin rods, with square or forked ends, radiating outwards from a centre. They are commonly oligoclase, and sometimes assume branching or feathery forms. Some authors would call these "sphaero-crystals" rather than spherulites; they are an intermediate stage between the latter and the stellate groupings of felspar which occur frequently in igneous rocks. In the same rocks augite spherulites occur also, but this mineral forms plumose growths, branching and curved, which spread through the glassy base and do not interfere with the felspar spherulites. They have much resemblance to the feathery ice crystals which form on window-panes. Occasionally olivine-dolerites have a coarsely spherulitic structure with long rods of plagioclase felspar converging to a point; one example of these rocks from Skye contains variolites over three inches in diameter.

Another group of variolites includes the most famous rock of this type, which comes from the Durance, in France. Pebbles of this were well known to collectors for a long time before they were traced to their source at Mont Genèvre. They were proved to belong to a diabasic rock which shows well-marked "pillow-structure" or "spheroidal jointing." Each pillow has a marginal portion which is variolitic, but towards the centre of the block-shaped masses the structure becomes coarse and groups of radiate felspars make their appearance. It is doubtful whether the variolite is an intrusive rock or a lava flow. Many of these pillow lavas (or spilites) occur in the Devonian rocks of Germany, and often they have variolitic facies which seem to belong to the same group as the rock of the Durance. Their spherulites are very often oligoclase felspar or decomposition products after a felspathic mineral. In other cases they consist of chlorite or pale green amphibole, both of which may be secondary after pyroxene. The ground mass is very fine grained and is filled with chlorite, epidote, leucoxene, and other secondary minerals. There is much reason to believe that it was originally in large measure vitreous but has suffered devitrifaction. Sometimes little steam cavities occur and may serve as a nucleus from which the variolite has grown. The radiate structure of the varioles is often nearly obliterated in these much-decomposed rocks, in fact it may never have been very perfect. Variolites are found also in several parts of the Swiss Alps at Jatluga on Lake Onega, in Anglesey, the Lleyn district and Fishguard in Wales, in Cornwall, and in more than one place in Ireland.

Finally, there is a group of spotted rocks formerly known to French petrographers as the *variolites du Drac* from the locality in which they are found, but they have been proved to be merely vesicular, rotten diabases, with steam cavities filled with white calcite and other secondary minerals. (J. S. F.)

VARISCITE, a native hydrous aluminium phosphate, $AlPO_4 \cdot 2H_2O$, named by A. Breithaupt, in 1837, in consequence of its occurrence in the Saxon Voigtland (Variscia). It is a green mineral generally occurring as an incrustation or in nodules. A compact nodular variety was discovered about 1894 in Cedar Valley, near Old Camp Floyd, Utah, and was described by Dr G. F. Kunz as utahlite. Its beautiful apple-green colour has led to its use, when cut and polished, as an ornamental stone. The term utahlite must be distinguished from utahite, the name given by A. Arzruni to a basic ferric sulphate, $3(FeO)_2SO_4 \cdot 4H_2O$, from Utah.

VARLEY, CORNELIUS (1781–1873), English water-colour painter, a younger brother of John Varley (*q.v.*), was born at Hackney, London, on the 21st of November 1781. He was educated by his uncle, a philosophical instrument maker, and under him acquired a knowledge of the natural sciences; but about 1800 he joined his brother in a tour through Wales, and began the study of art. He was soon engaged in teaching drawing. From 1803 till 1859 he was an occasional exhibitor in the Royal Academy; and he also contributed regularly to the displays of the Water-Colour Society, of which, in 1803, he was one of the founders, and of which he continued a member till 1821. His works consist mainly of carefully finished classical subjects, with architecture and figures. He published a series of etchings of "Boats and other Craft on the River Thames," and during his life as an artist he continued deeply interested in scientific pursuits. For his improvements in the camera lucida, the camera obscura and the microscope he received the Isis gold medal of the Society of Arts; and at the International

Exhibition of 1851 he gained a medal for his invention of the graphic telescope. He died at Hampstead on the 2nd of October 1873.

VARLEY, JOHN (1778–1842), English water-colour painter, was born at Hackney, London, on the 17th of August 1778. His father, a man of scientific attainments and tutor in the family of Lord Stanhope, discouraged his leanings towards art, and placed him under a silversmith. But on his parent's death Varley escaped from this uncongenial employment, and, after working with a portrait painter, engaged himself at the age of sixteen to an architectural draughtsman, who took him on a provincial tour to sketch the principal buildings in the towns they visited. His spare hours were employed in sketching from nature, and in the evenings he was permitted, like Turner and Girtin, to study in the house of Dr Munro. In 1798 he exhibited his first work, a "View of Peterborough Cathedral," in the Royal Academy. In 1799 he visited North Wales, and in its wild mountain scenery found the subjects best suited to his brush. He returned to the same district in 1800, and again in 1802, and the impressions then received powerfully influenced the whole course of his art. In 1804 he became a foundation member of the Water-Colour Society, and contributed over forty works to its first exhibition. He had married in the previous year; and, in order to provide for the wants of an increasing family, he was obliged to produce for the dealers much work of a slight and commonplace character. He also taught drawing, and some of his pupils, such as John Linnell and William Hunt, afterwards became celebrated. He was a firm believer in astrology, skilful in casting horoscopes; and some curious instances were related of the truth of his predictions. It was at his house that his friend William Blake sketched his celebrated "Visionary Heads." Varley died at London on the 17th of November 1842.

Varley's landscapes are graceful and solemn in feeling, and simple and broad in treatment, being worked with a full brush and pure fresh transparent tints, usually without any admixture of body-colour. Though his works are rather mannered and conventional, they are well considered and excellent in composition. Some of his earlier water-colours, including his "Views of the Thames," were painted upon the spot, and possess greater individuality than his later productions, which are mainly compositions of mountain and lake scenery, produced without direct reference to nature. Among his literary works are *Zodiacal Physiology* (1828); *Observations on Colour and Sketching from Nature* (1830); *A Practical Treatise on Perspective, and Principles of Landscape Design for Young Artists.*

VARNA, a fortress, seaport, departmental capital and episcopal city of Bulgaria; on the Bay of Varna, an inlet of the Black Sea, in 43° 12′ N. and 27° 56′ E. Pop. (1906) 37,155. Varna is built on the hilly north shore of the bay, overlooking the estuary of the river Devna or Pravadi, which flows seaward through a magnificent valley surrounded by mountains. It is the eastern terminus of the Varna-Rustchuk railway, opened in 1867, and is connected with all parts of the kingdom by branches of this line. The so-called "Varna quadrilateral," which has played an important part in Bulgarian military history, consists of the fortresses of Varna, Shumla, Rustchuk and Silistria (*q.v.*). Varna is the third city of the kingdom in population, after Sofia and Philippopolis, and ranks with Burgas as one of the two principal seaports. Its deep and capacious bay is sheltered from northerly and north-easterly winds, and the construction of modern harbour works has greatly increased the facilities for trade. The principal exports are cattle and dairy produce, grain, lamb and goat skins, and cloth (*shayak*); the imports include coal, iron and machinery, textiles, petroleum and chemicals. In 1907 the port was entered by 869 ships of 926,449 tons, the largest number of vessels being Bulgarian and the greatest tonnage Austro-Hungarian. Wine is largely produced in the department, and in the city there are breweries, distilleries, tanneries and cloth factories; cotton-spinning was introduced by a British firm. There is a large and commercially important colony of Greeks; the Jews, Turks and gipsies are also numerous. Much of the city has been constructed since 1878, and the barracks, post office, college for girls and National Bank are handsome modern buildings. Near Varna is the summer palace of the king of Bulgaria.

Varna has been identified with the ancient Milesian colony of *Odessus* on the coast of Moesia Inferior. It figures largely in the history of more recent times, and close by was fought in 1444 the battle in which Murad II. slew Wladislaus III. of Poland and Hungary, and routed his forces commanded by Hunyadi János. Varna was occupied in 1828 by the Russians, in 1854 by the allies, who here organized the invasion of the Crimea, and in 1877 by the Egyptian troops summoned to the defence of Turkey against the Russians. By the treaty of Berlin (1878) it was ceded to Bulgaria. It has long been the seat of a Greek metropolitan and since 1870 of a Bulgarian bishop.

VARNHAGEN VON ENSE, KARL AUGUST (1785–1858), German biographer, was born at Düsseldorf on the 21st of February 1785. He studied medicine at Berlin, but devoted more attention to philosophy and literature, which he afterwards studied more thoroughly at Halle and Tübingen. He began his literary career in 1804 as joint-editor with Adelbert von Chamisso (*q.v.*) of a *Musenalmanach*. In 1809 he joined the Austrian army, and was wounded at the battle of Wagram. Soon afterwards he accompanied his superior officer, Prince Bentheim, to Paris, where he carried on his studies. In 1812 he entered the Prussian civil service at Berlin, but in the following year resumed his military career, this time as a captain in the Russian army. He accompanied Tettenborn, as adjutant, to Hamburg and Paris, and his experiences were recorded in his *Geschichte der Hamburger Ereignisse* (London, 1813), and his *Geschichte der Kriegszüge des Generals von Tettenborn* (1815). At Paris he entered the diplomatic service of Prussia, and in 1814 acted under Hardenberg at the congress of Vienna. He also accompanied Hardenberg to Paris in 1815. He was resident minister for some time at Karlsruhe, but was recalled in 1819, after which, with the title of "Geheimer Legationsrat," he lived chiefly at Berlin. He had no fixed official appointment, but was often employed in important political business. In 1814 he married Rahel Antonie Friederike, originally called Levin, afterwards Robert, and sister of the poet, Ludwig Robert (1778–1832). She was born in 1771 at Berlin, where she died in 1833. By birth she was a Jewess; but before her marriage she made profession of Christianity. Although she never wrote anything for publication, she was a woman of remarkable intellectual qualities, and exercised a powerful influence on many men of high ability. Her husband, who was devotedly attached to her, found in her sympathy and encouragement one of the chief sources of his inspiration as a writer. After her death he published a selection from her papers, and afterwards much of her correspondence was printed. Varnhagen von Ense never fully recovered from the shock caused by her death. He himself died suddenly in Berlin on the 10th of October 1858.

He made some reputation as an imaginative and critical writer, but he is famous chiefly as a biographer. He possessed a remarkable power of grouping facts so as to bring out their essential significance, and his style is distinguished for its strength, grace and purity. Among his principal works are *Goethe in den Zeugnissen der Mitlebenden* (1824); *Biographische Denkmale* (5 vols., 1824–30; 3rd ed., 1872); and biographies of General von Seydlitz (1834), Sophia Charlotte, queen of Prussia (1837), Field-Marshal Schwerin (1841), Field-Marshal Keith (1844), and General Bülow von Dennewitz (1853). His *Denkwürdigkeiten und vermischte Schriften* appeared in 9 vols. in 1843–59, the two last volumes appearing after his death. His niece, Ludmilla Assing, between 1860 and 1867, edited several volumes of his correspondence with eminent men, and his *Tagebücher* (14 vols., 1861–70). *Blätter aus der preussischen Geschichte* appeared in 5 vols. (1868–69); his correspondence with Rahel in 6 vols. (1874–75); and with Carlyle (1892). His selected writings appeared in 19 vols. in 1871–76. There is also an extensive literature dealing with Rahel Varnhagen von Ense; see especially her husband's *Rahel, ein Buch des Andenkens* (3 vols., 1834); *Aus Rahels Herzensleben* (1877); E. Schmidt-Weissenfels, *Rahel und ihre Zeit* (1857); *Briefwechsel zwischen Karoline von Humboldt, Rahel und Varnhagen von Ense* (1896); O. Berdrow, *Rahel Varnhagen* (1900).

VARNISH, a liquid consisting of a gum or resin dissolved in alcohol (spirit varnish) or an oil (oil varnish), which on application to wooden and other surfaces improves their appearance and permanency (see PAINTER-WORK).

VARRO, MARCUS TERENTIUS (116–27 B.C.), Roman polymath and man of letters, was born at Reate in the Sabine country. Here he imbibed in his earlier years a good measure of the hardy simplicity and strong seriousness which the later Romans attributed to the men of the early republic—characteristics which were supposed to linger in the Sabine land after they had fled from the rest of Italy. The chief teacher of Varro was L. Aelius Stilo, the first systematic student, critic and teacher of Latin philology and literature, and of the antiquities of Rome and Italy. Varro also studied at Athens, especially under the philosopher Antiochus of Ascalon, whose aim it was to lead back the Academic school from the scepticism of Arcesilaus and Carneades to the tenets of the early Platonists, as he understood them. He was really a stoicizing Platonist; and this has led to the error of supposing Varro to have been a professed Stoic. The influence of Antiochus is clearly to be seen in many remains of Varro's writings. The political career of Varro seems to have been late and slow; but he arrived at the praetorship, after having been tribune of the people, quaestor and curule aedile. In politics and war he followed Pompey's lead; but it is probable that he was discontented with the course on which his leader entered when the first triumvirate was formed, and he may thus have lost his chance of rising to the consulate. He actually ridiculed the coalition in a work entitled the *Three-Headed Monster* (*Τρικάρανος* in the Greek of Appian). He did not, however, refuse to join the commission of twenty by whom the great agrarian scheme of Caesar for the resettlement of Capua and Campania was carried into execution (59 B.C.). Despite the difference between them in politics, Varro and Caesar had literary tastes in common, and were friends in private life. Under Pompey Varro saw much active service: he was attached to Pompey as pro-quaestor, probably during the war against Sertorius in Spain. We next find him, as legate, in command of a fleet which kept the seas between Delos and Sicily, while Pompey was suppressing the pirates, and he even won the "naval crown," a coveted reward of personal prowess. A little later he was legate during the last Mithradatic war. In the conflict between Caesar and the Pompeian party Varro was more than once actively engaged. In his *Civil War* (ii. 17–20) Caesar tells how Varro, when legate in Spain along with Afranius and Petreius, lost his two legions without striking a blow, because the whole region where he was quartered joined the enemy. Caesar curiously intimates that, though Varro did his best for Pompey from a sense of duty, his heart was really with the other leader. Nevertheless he proceeded to Epirus before the battle of Pharsalia, and awaited the result at Dyrrachium in the company of Cicero and Cato. Like Cicero, Varro received harsh treatment from Mark Antony after the Pompeian defeat. Some of his property was actually plundered, but restored at the bidding of Caesar, to whom Varro in gratitude immediately dedicated one of his most important writings. The dictator employed the scholar in aiding him to collect and arrange great stores of Greek and Latin literature for the vast public library which he intended to found. We have glimpses of Varro at this time in the *Letters* of Cicero. He appears as harsh and severe, and a poor stylist. The formation of the second triumvirate again plunged Varro into danger. Antony took possession anew of the property he had been compelled to surrender, and inserted Varro's name on the list of the proscribed. His friends, however, afforded him protection. He was able to make peace with the triumvirs, but sacrificed his property and much of his beloved library. He was permitted to spend in quiet study and in writing the last fifteen years of his life. He is said to have died (27 B.C.) almost pen in hand.

Varro was not surpassed in the compass of his writings by any ancient, not even by any one of the later Greek philosophers, to some of whom tradition ascribes a fabulous number of separate works. In a passage quoted by Gellius, Varro himself, when over seventy years of age, estimated the number of "books" he had written at 490; but "book" here means, not merely such a work as was not subdivided into portions, but also a portion of a subdivided work. For example, the *Menippean Satires* numbered 150, and are all counted separately in Varro's estimate. Jerome made or copied a catalogue of Varro's works which has come down to us in a mutilated form. From this and from other extant materials Ritschl has set down the number of the distinct literary works at 74 and the number of separate "books" at about 620. The later years of the author's life were therefore even more fruitful than the earlier. The complete catalogue may be roughly arranged under three heads—(1) belles lettres, (2) history and antiquities, (3) technical treatises on philosophy, law, grammar, mathematics, philology and other subjects.

The first of these three classes no doubt mainly belonged to Varro's earlier life. In poetry he seems to have attempted nothing that was very elaborate, and little of a serious character. His genius tended naturally in the direction of burlesque and satire. In belles lettres he showed himself throughout, both in matter and form, the pupil and admirer of Lucilius, after whom he wrote satires. One poetical work probably consisted of short pieces in the style of the more satirical poems of Catullus. It is doubtful whether, as has often been supposed, Varro wrote a philosophical poem somewhat in the style of Lucretius; if so, it should rather be classed with the prose technical treatises. One curious production was an essay in popular illustrated literature, which was almost unique in ancient times. Its title was *Imagines*, and it consisted of 700 prose biographies of Greek and Roman celebrities, with a metrical *elogium* for each, accompanied in each case by a portrait. But the lighter works of Varro have perished almost to the last line, with the exception of numerous fragments of the *Menippean Satires*. The Menippus whom Varro imitated lived in the first half of the 3rd century B.C., and was born a Phoenician slave. He became a Cynic philosopher, and is a figure familiar to readers of Lucian. He flouted life and all philosophies but the Cynic in light compositions, partly in prose and partly in verse. A careful study of the fragments does not justify Mommsen's glowing account. That the remains exhibit variety and fertility, that there are in them numerous happy strokes of humour and satire, and many felicitous phrases and descriptions, is true, but the art is on the whole heavy, awkward and forced, and the style rudely archaic and untasteful. The Latin is frequently as rough and uncouth as that of Lucilius. No doubt Varro contemned the Hellenizing innovations by which the hard and rude Latin of his youth was transformed into the polished literary language of the late republican and the Augustan age. The titles of the *Menippean Satires* are very diverse. Sometimes personal names are chosen, and they range from the gods and demigods to the slaves, from Hercules to Marcipor. Frequently a popular proverb or catchword in Greek or Latin supplies the designation: thus we have as titles "I've got You" (*Ἔχω σε*); "You don't Know what Evening is to Bring" (*Nescis quid vesper serus vehat*); "Know Thyself" (*Γνῶθι σεαυτόν*). Occasionally the heading indicates that the writer is flying at some social folly, as in "Old Men are Children for the Second Time" (*Δὶς παῖδες οἱ γέροντες*) and in the "Bachelor" (*Caelebs*). In many satires the philosophers were pounded, as in the "Burial of Menippus" and "Concerning the Sects" (*Περὶ αἱρέσεων*). Each composition seems to have been a genuine medley or *lanx satura*: any topic might be introduced which struck the author's fancy at the moment. There are many allusions to persons and events of the day, but political bitterness seems to have been commonly avoided. The whole tone of the writer is that of a *laudator temporis acti*, who can but scoff at all that has come into fashion in his own day. From the numerous citations in later authors it is clear that the *Menippean Satires* were the most popular of Varro's writings. Not very unlike the *Menippean Satires* were the *Libri Logistorici*, or satirical and practical expositions, possibly in dialogue form, of some theme most commonly taken from philosophy on its ethical side. A few fragments in this style have come down to us and a number of titles. These are twofold: that is to say, a personal name is followed by words indicating the subject-matter, as *Marius de Fortuna*, from which the contents may easily be guessed, and *Sisenna de Historia*, most likely a dialogue in which the old annalist of the name was the chief speaker, and discoursed of the principles on which history should be written. Among the lighter and more popular works may be mentioned twenty-two books of *Orations* (probably never spoken), some funeral eulogies (*Laudationes*), some "exhortations" (*Suasiones*), conceivably of a political character, and an account of the author's own life.

The second section of Varro's works, those on history and antiquities, form to the present day the basis on which a large part of our knowledge of the earlier Roman history, and in particular of Roman constitutional history, ultimately rests. These writings were used as a quarry by the compilers and dilettanti of later times, such as Pliny, Plutarch, Gellius, Festus, Macrobius, and by Christian champions like Tertullian, Arnobius and Augustine, who did not disdain to seek in heathen literature the means of defending their faith. These men have saved for us a few remains from the great wreck made by time. Judging from what has been casually preserved, if any considerable portion of Varro's labours as antiquarian and historian were to be now discovered, scholars might find themselves compelled to reconstruct the earlier history of the Roman republic from its very foundations. Varro's greatest predecessor in this field of inquiry, the man who turned over the virgin soil, was Cato the Censor. His example, however, seems to have remained unfruitful till the time of Varro's master, Lucius Aelius Stilo Praeconinus. From his age to the decay of Roman civilization there were never altogether wanting men devoted to the study of their nation's past; but none ever pursued the task with the advantages of Varro's comprehensive learning, his indefatigable industry and his reverent yet discriminating regard for the men and the institutions of the earlier ages. The greatest work of this class was that on *Antiquities*, divided into forty-one books. Of these the first twenty-five were entitled the *Antiquities of Human Things* (*Antiquitates Rerum Humanarum*), while the remaining sixteen were designated the *Antiquities of Things Divine* (*Antiquitates Rerum Divinarum*). The book was the fruit of Varro's later years, in which he gathered together the material laboriously amassed through the period of an ordinary lifetime. The second division of the work was dedicated to Caesar as supreme pontiff. The design was as far-reaching as that of the *Natural History* of Pliny. The general heads of the exposition in the secular portion of the book were four—(1) "who the men are who act (*qui agant*), (2) the places in which they act (*ubi*), (3) the times at which they act (*quando*), (4) the results of their action (*quid agant*)." In the portion relating to divine affairs there were divisions parallel to these four, with a fifth, which dealt with the gods in whose honour action in divine affairs is taken. Our knowledge of this great book is to a large extent derived from the works of the early Christian writers, and especially from Augustine's *De Civitate Dei*. These writers naturally quote in the main from the religious section. It is a great misfortune that no similar series of citations from the secular part of the *Antiquitates* has come down to us. Most of the other historical and antiquarian writings of Varro were special elaborations of topics which he could not treat with sufficient fulness and minuteness in the larger book. The treatise on the *Genealogy of the Roman People* dealt mainly with the relation of Roman chronology to the chronology of Greece and the East. Dates were assigned even to mythological occurrences, because Varro believed in the theory of Euhemerus, that all the beings worshipped as gods had once lived as men. To Varro's researches are mainly due the traditional dates assigned to the era of the kings and to that of the early republic. Minor writings of the same class were the *De Vita Populi Romani*, apparently a kind of history of Roman civilization; the *De Familiis Trojanis*, an account of the families who "came over" with Aeneas; the *Aetia* (Αἴτια), an explanation of the origin of Roman customs, on which Plutarch drew largely in his *Quaestiones Romanae*; a *Tribuum Liber*, used by Festus; and the constitutional handbook written for the instruction of Pompey when he became consul. Nor must the labour expended by Varro in the study of literary history be forgotten. His activity in this direction, as in others, took a wide range. One of his greatest achievements was to fix the canon of the genuine plays of Plautus. The "Varronian plays" were the twenty which have come down to us, along with one which has been lost.

The third class of treatises, which we have called technical, was also numerous and very varied. Philosophy, grammar, the history and theory of language, rhetoric, law, arithmetic, astronomy, geometry, mensuration, agriculture, naval tactics, were all represented. The only works of this kind which have come down to our days are the *De Lingua Latina* (in part) and the *De Re Rustica*. The former originally comprised twenty-five books, three of which (the three succeeding the first) are dedicated to a P. Septimius who had served with the author in Spain, and the last twenty-one to Cicero. The whole work was divided into three main sections, the first dealing with the origin of Latin words, the second with their inflexions and other modifications, the third with syntax. The books still preserved (somewhat imperfectly) are those from the fifth to the tenth inclusive. The Latin style is harsh, rugged and far from lucid. As Mommsen remarks, the clauses of the sentences are often arranged on the thread of the relative pronoun like thrushes on a string. The arrangement of the subject-matter, while pretending to much precision, is often far from logical. The fifth, sixth and seventh books give Varro's views on the etymology of Latin words. The principles he applies are those which he had learned from the philosophers of the Stoic school—Chrysippus, Antipater and others. The study of language as it existed in Varro's day was thoroughly dominated by Stoic influences. Varro's etymologies could be only a priori guesses, but he was well aware of their character, and very clearly states at the outset of the fifth book the hindrances that barred the way to sound knowledge. He was thoroughly alive to the importance of not arguing merely from the forms and meanings of words as they existed in his day, and was fully conscious that language and its mechanism should be studied historically. The books from the eighth to the tenth inclusive are devoted to the inflections of words and their other modifications. These Varro classes all under the head of "declinatio," which implies a swerving aside from a type. Thus *Herculi* from *Hercules* and *manubria* from *manus* are equally regarded as examples of *declinatio*. Varro adopts a compromise between the two opposing schools of grammarians, those who held that nature intended the *declinationes* of all words of the same class to proceed uniformly (which uniformity was called *analogia*) and those who deemed that nature aimed at irregularity (*anomalia*). The matter is treated with considerable confusion of thought. But the *facts* incidentally cited concerning old Latin, and the statements of what had been written and thought about language by Varro's predecessors, are of extreme value to the student of Latin. The other extant prose work, the *De Re Rustica*, is in three books, each of which is in the form of a dialogue, the circumstances and in the main the interlocutors being different for each. The dramatic introductions and a few of the interludes are bright and interesting, and the Latin style, though still awkward and unpolished, is far superior to that of the *De Lingua Latina*.

AUTHORITIES.—The fragments of the different treatises have been partially collected in many separate publications of recent date. The best editions of the *De Lingua Latina* are those by C. O. Müller and by L. Spengel (re-edited by his son in 1885). The most recent and best recension of the *De Re Rustica* is that of Keil (Leipzig, 1884). Of modern scholars Ritschl has deserved best of Varro. Several papers in his *Opuscula* treat of the nature of Varro's works which have not come down to us. The work of G. Boissier, *Étude sur la vie et les ouvrages de M. T. Varron* (1861), though superficial, is still useful; but a comprehensive work on Varro, on the present level of scholarship, is greatly needed. (J. S. R.)

VARRO, PUBLIUS TERENTIUS, surnamed ATACINUS (*c.* 82–36 B.C.), Latin poet, was born near the river Atax in Gallia Narbonensis. He was perhaps the first Roman born beyond the Alps who attained eminence in literature. He seems to have taken at first Ennius and Lucilius as his models, and wrote an epic, entitled *Bellum Sequanicum*, eulogizing the exploits of Caesar in Gaul and Britain, and also *Satires*, of which Horace (*Satires*, i. 10) speaks slightingly. Accordingly to Jerome, Varro did not begin to study Greek literature until his thirty-fifth year. The last ten years of his life were given up to the imitation of Greek poets of the Alexandrian school. Quintilian (*Instit.* x. 1, 87), who describes him as a "translator," speaks of him in qualified terms of praise. Although not vigorous enough to excel in the historical epic or in the serious work of the Roman *satura*, Varro yet possessed in considerable measure the lighter gifts which we admire in Catullus.

His chief poem of the later period was the *Argonautae*, closely modelled on the epic of Apollonius Rhodius. The age was prolific of epics, both historical and mythological, and that of Varro seems to have held a high rank among them. It is highly spoken of by Ovid (*Am.* i. 15, 21, *A.A.* iii. 335, *Tristia*, ii. 439) and Statius (*Silvae*, ii. 7, 77), and Propertius (ii. 34, 85) awards equal praise to his erotic elegies. Varro was also the author of a *Cosmographia*, or *Chorographia*, a geographical poem imitated from the Greek of Eratosthenes or of Alexander of Ephesus, surnamed Lychnus; and of an *Ephemeris*, a hexameter poem on weather-signs after Aratus, from which Virgil has borrowed. Fragments in A. Riese's edition of the fragments of the *Menippean Satires* of Varro of Reate; see also monographs by F. Wullner (1829) and R. Unger (1861).

VARTHEMA (BARTHEMA, VERTOMANNUS, &c.), **LUDOVICO DI,** of Bologna (fl. 1502–1510), Italian traveller and writer. He was perhaps a soldier before beginning his distant journeys, which he undertook apparently from a passion for adventure, novelty and the fame which (then especially) attended successful exploration. He left Europe near the end of 1502; early in 1503 he reached Alexandria and ascended the Nile to Cairo. From Egypt he sailed to Beirut and thence travelled to Tripoli, Aleppo and Damascus, where he managed to get himself enrolled, under the name of Yunas (Jonah), in the Mameluke garrison—doubtless after adopting Islam. From Damascus he made the pilgrimage to Mecca and Medina as one of the Mameluke escort of the Hajj caravan (April–June 1503); he describes the sacred cities of Islam and the chief pilgrim sites and ceremonies with remarkable accuracy, almost all his details being confirmed by later writers. With the view of reaching India, he embarked at Jidda, the port of Mecca, and sailed down the Red Sea and through the Straits of Bab-el-Mandeb to Aden, where he was arrested and imprisoned as a Christian spy. He gained his liberty—after imprisonment both at Aden and Radaa—through the partiality of one of the sultanas of Yemen, made an extensive tour in south-west Arabia (visiting Sana, &c.), and took ship at Aden for the Persian Gulf and India. On the way he touched at Zaila and Berbera in Somaliland; he then (early in 1504?) ran across to the Indian port of Diu in Gujarat, afterwards famous as a Portuguese fortress. From Diu he sailed up the Gulf of Cambay to Gogo, and thence turning back towards the Persian Gulf made Julfar (just within the entrance of the gulf), Muscat and Ormuz. From Ormuz he seems to have journeyed across Persia to Herat, returning thence south-west to Shiraz, where he entered into partnership with a Persian merchant, who accompanied him during nearly all his travels in South Asia. After an unsuccessful attempt to reach Samarkand, the two returned to Shiraz, came down to Ormuz, and took ship for India. From the mouth of the Indus Varthema coasted down the whole west coast of India, touching at Cambay and Chaul; at Goa, whence he made an excursion inland to Bijapur; at Cannanore, from which he again struck into the interior to visit Vijayanagar on the Tungabudra; and at Calicut (1505?), where he stops to describe the society, manners and customs of Malabar, as well as the topography and trade of the city, the court and government of its sovereign (the Zamorin), its justice, religion, navigation and military organization. Nowhere do Varthema's accuracy and observing power show themselves more strikingly. Passing on by the "backwater of Cochin," and calling at Kulam (Quilon), he rounded Cape Comorin, and passed over to Ceylon (1506?). Though his stay here was brief (at Colombo?), he learnt a good deal about the island, from which he sailed to Pulicat, slightly north of Madras, then subject to Vijayanagar. Thence he crossed over to Tenasserim in the Malay Peninsula, to Banghella, perhaps near Chittagong, at the head of the Bay of Bengal, and to Pegu, in the company of his Persian friend and of two Chinese Christians (Nestorians?) whom he met at Banghella. After some successful trading with the king of Pegu, Varthema and his party sailed on to Malacca, crossed over to Pider (Pedir) in Sumatra, and thence proceeded to Bandan (Banda) and Monoch (one of the Moluccas), the farthest eastward points reached by the Italian traveller. From the Moluccas he returned westward, touched at Borneo, and there chartered a vessel for Java, the "largest of islands," as his Christian companions reckoned it. He notes the use of compass and chart by the native captain on the transit from Bornei to Giava, and preserves a curious, more than half-mythical, reference to supposed Far Southern lands. From Java he crossed over to Malacca, where he and his Persian ally parted from the Chinese Christians; from Malacca he returned to the Coromandel coast, and from Negapatam (?) in Coromandel he voyaged back, round Cape Comorin, to Kulam and Calicut. Varthema was now anxious to resume Christianity and return to Europe; after some time he succeeded in deserting to the Portuguese garrison at Cannanore (early in 1506?). He fought for the Portuguese in various engagements, and was knighted by the viceroy Francisco d'Almeida, the navigator Tristan da Cunha being his "sponsor." For a year and a half he acted as Portuguese factor at Cochin, and on the 6th of December 1507 (?) he finally left India for Europe by the Cape route. Sailing from Cannanore, Varthema apparently struck Africa about Malindi, and (probably) coasting by Mombasa and Kilwa arrived at Mozambique, where he notices the Portuguese fortress then building, and describes with his usual accuracy the negroes of the mainland. Beyond the Cape of Good Hope he encountered furious storms, but arrived safely in Lisbon after sighting St Helena and Ascension, and touching at the Azores. In Portugal the king received him cordially, kept him some days at court "to learn about India," and confirmed the knighthood conferred by d'Almeida. His narrative finally brings him to Rome, where he takes leave of the reader. As Richard Burton says (*Pilgrimage to . . . Meccah*, 1855, vol. ii. p. 352): "For correctness of observation and readiness of wit" Varthema "stands in the foremost rank of the old Oriental travellers." In Arabia and in the Indian archipelago east of Java he is (for Europe and Christendom) a real discoverer. Even where passing over ground traversed by earlier European explorers, his keen intelligence frequently adds valuable original notes on peoples, manners, customs, laws, religions, products, trade, methods of war, &c.

Varthema's work (*Itinerario de Ludouico de Varthema Bolognese . . .*) was first published in Italian at Rome in 1510 (*ad instãtia de Lodouico de Henricus da Corneto Vicẽtino*). Other Italian editions appeared at Rome, 1517, at Venice, 1518, 1535, 1563, 1589, &c., at Milan, 1519, 1523, 1525, &c. Latin translations appeared at Milan, 1511 (by Archangelus Madrignanus); and at Nuremberg, 1610 (Frankfort, 1611); as well as in the *Novus Orbis* of Simon Grynaeus (Basel, 1532). German versions came out at Augsburg, 1515 (Strassburg, 1516); at Strassburg, by Michael Herr, in his *New Welt*, from Grynaeus, 1534; at Leipzig, by Hieronymus Megiserus, 1610 (and 1615), &c. A Spanish translation was issued at Seville, 1520 (from the Latin), and a French at Lyons, 1556. Dutch versions were printed at Antwerp, 1563 (from Grynaeus), at Utrecht, 1615 (from the Leipzig German of 1610), and again at Utrecht, 1655. The first English translation was of 1576–1577 (in Richard Eden's *History of Travayle*); an extract from Varthema was inserted in Samuel Purchas's *Pilgrimage* (London, 1625–1626); and in 1863 appeared the Hakluyt Society edition by J. W. Jones and G. P. Badger (*Travels of Ludovico di Varthema*, London). (C. R. B.)

VARUNA, in early Hindu mythology, the greatest, with Indra, of the gods of the Rig Veda. He is invoked with his double Mitra in some dozen hymns. As contrasted with Indra the war god, Varuna is the lord of the natural laws, the upholder of the physical and moral order of the universe. His power is limitless, his anger at wrong-doing unassuageable, and he is omniscient. He makes the sunshine, the wind is his breath; river valleys are hollowed out at his command. Unlike Indra, Varuna has no myths related of him. In the later Vedic period he is specially connected with the nocturnal heavens. Ultimately in post-Vedic mythology he becomes the Hindu Neptune. The earlier conception of Varuna is singularly similar to that of Ahuramazda of the Avesta. The name Varuna may be Indo-European, identifiable, some believe, with the Greek οὐρανός (Uranus), and ultimately referable to a root *var*, "to cover," Varuna thus meaning "the Encompasser." Among Varuna's aliases are Jalapati, "Lord of Water," and Amburaja, "King of Water."

See A. A. Macdonell, *Vedic Mythology* (Strassburg, 1897).

VASA, or NIKOLAISTAD, in the grand duchy of Finland, capital of the province of Vasa, on the east coast of the Gulf of Bothnia, 327 m. by rail north-west of Helsingfors. Pop. (1904) 18,028. It has two classical lyceums for boys and three for girls, a school of navigation, and a large number of primary schools. There is a shipyard and a considerable export trade. Vasa was founded on the coast of the Gulf of Bothnia in 1606, but after the great fire of 1852, as the sea had already receded for a considerable distance, the town was rebuilt nearer to the shore and received the official name of Nikolaistad. The population of the province (1904) was 295,187.

VASARI, GIORGIO (1511–1571), Italian painter and architect, whose main distinction, however, rests on his valuable history of Italian art, was born at Arezzo on the 30th of July 1511. At a very early age he became a pupil of Guglielmo da Marsiglia, a very skilful painter of stained glass, to whom he was recommended by his own kinsman, the painter Luca Signorelli. At the age of sixteen he went to Florence, where he studied under Michelangelo and Andrea del Sarto, aided by the patronage of the Medici princes. In 1529 he visited Rome and studied the works of Raphael and others of his school. The paintings of Vasari were much admired by the rapidly degenerating taste of the 16th century; but they possess the smallest amount of merit, being in the main feeble parodies of the powerful works of Michelangelo. Vasari was largely employed in Florence, Rome, Naples, Arezzo and other places. Many of his pictures still exist, the most important being the wall and ceiling paintings in the great hall of the Palazzo Vecchio in Florence, and his frescoes on the cupola of the cathedral, which, however, were not completed at the time of his death. As an architect he was perhaps more successful: the loggia of the Uffizi by the Arno, and the long passage connecting it with the Pitti Palace, are his chief works. Unhappily he did much to injure the fine medieval churches of S. Maria Novella and Santa Croce, from both of which he removed the original rood-screen and loft, and remodelled the retro-choir in the degraded taste of his time. Vasari enjoyed a very high repute during his lifetime and amassed a considerable fortune. He built himself in 1547 a fine house in Arezzo, and spent much labour in decorating its walls and vaults with paintings. He was elected one of the municipal council or priori of his native town, and finally rose to the supreme office of gonfaloniere. He died at Florence on the 27th of June 1571.

Personally Vasari was a man of upright character, free from vanity, and always ready to appreciate the works of others: in spite of the narrow and meretricious taste of his time, he expresses a warm admiration of the works of such men as Cimabue and Giotto, which is very remarkable. As an art historian of his country he must always occupy the highest rank. His great work was first published in 1550, and afterwards partly rewritten and enlarged in 1568, bearing the title *Delle Vite de' più eccellenti pittori, scultori, ed architettori.* It was dedicated to Cosimo de' Medici, and was printed at Florence by the Giunti; it is a small quarto illustrated with many good woodcut portraits. This *editio princeps* of the complete work is usually bound in three volumes, and also contains a very valuable treatise on the technical methods employed in all branches of the arts, entitled *Le Tre Arti del disegno, cioè architettura, pittura, e scoltura.* His biographies are written in a very pleasant style, interspersed with amusing stories. With a few exceptions Vasari's judgment is acute and unbiased. And though modern criticism—with all the new materials opened up by research—has done valuable work in upsetting a good many of his traditional accounts and attributions, the result is a tendency very often to underestimate Vasari's accuracy and to multiply hypotheses of a rather speculative character. The work in any case remains a classic, however it may be supplemented by the more critical research of modern days.

Vasari gives a sketch of his own biography at the end of his *Vite*, and adds further details about himself and his family in his lives of Lazzaro Vasari and Francesco Salviati. The best edition of Vasari's works is that published at Florence by Milanesi (1878–1882), which embodies the valuable notes in the earlier edition by Le Monnier (1846); another, by Venturi, was begun in 1896. The *Lives* has been translated into French, German and English (by Mrs Foster, London, 1850).

VASCULAR SYSTEM. I. ANATOMY.—The circulatory or blood vascular apparatus consists of the central pump or heart, the arteries leading from it to the tissues, the capillaries, through the walls of which the blood can give and receive substances to and from the tissues of the whole body, and the veins, which return the blood to the heart. As an accessory to the venous system, the lymphatics, which open finally into the great veins, help in returning some of the constituents of the blood. Separate articles are devoted to the *heart*, *arteries*, *veins* and *lymphatic* system, and it only remains here to deal with the capillaries.

The *blood capillaries* form a close network of thin-walled tubules from $\frac{1}{3000}$ to $\frac{1}{2000}$ of an inch in diameter, permeating, with a few exceptions, the whole of the body, and varying somewhat in the closeness of its meshwork in different parts. In the smallest capillaries, in which the arteries end and from which the veins begin, the walls are formed only of somewhat oval endothelial cells, each containing an oval nucleus and joined to its adjacent cells by a serrated edge, in the interstices of which is a small amount of intercellular cement, easily demonstrated by staining the preparation with nitrate of silver. Here and there the cement substance is more plentiful, and these spots when small are known as *stigmata*, when large as *stomata*. As the capillaries approach the arteries on the one hand and the veins on the other they blend and become larger, and a delicate connective tissue sheath outside the endothelium appears, so that the transition from the capillaries into the arterioles and venules is almost imperceptible; indeed, the difference between a large artery or vein and a capillary, apart from size, is practically the amplification and differentiation of its connective tissue sheath.

Embryology.—The first appearance of a vascular system is outside the body of the embryo in the wall of the yolk sac, that is to say, in the mesoderm or the middle one of the three embryonic layers. The process is a very early one and in the chick is seen to begin at the end of the first day of incubation. The first occurrence is a network made up of solid cords of cells forming in certain places solid cell masses called the *blood islands of Pander*. The central cells of these islands divide by karyokinesis and gradually float away into the vessels which are now being formed by fluid from the exterior, finding its way into the centre of the cell cords and pressing the peripheral cells flat to form the endothelial lining. These free cells from the blood islands are known as *erythroblasts* and are the primitive corpuscles of the foetal blood. They have a large reticular nucleus and at first are colourless though haemoglobin gradually develops within them and the blood becomes red (see BLOOD). The erythroblasts continue to multiply by karyokinesis in early foetal life, especially in the liver, spleen, bone marrow and lymphatic glands, though later on their formation only occurs in the red bone marrow. In most of the erythroblasts the nucleus soon becomes contracted, and the cell is then known as a *normoblast*, while ultimately the general view is that the nucleus disappears by extrusion from the cell and the non-nucleated red blood plates or *erythrocytes* remain. The leucocytes or white blood corpuscles appear later than the red, and are probably formed from lymphoid tissue in various parts of the body. The blood vessels thus formed in the so-called vascular area gradually travel along the vitelline stalk into the body of the embryo, and two vessels larger than the rest are formed one on each side of the stalk. These are the vitelline veins, which, as they pass towards the caudal end of the embryo, become the two primitive aortae, and these fuse later on to form the heart. After the inversion of the pericardial region and formation of the head fold (see COELOM AND SEROUS MEMBRANES) the front of the developing heart becomes the back, and the vitelline veins now enter it from behind. It must be understood that most of our knowledge of the early history of the blood vessels is derived from the study of lower mammals and birds, and that this is being gradually checked by observations on human embryos and on those of other primates. It seems probable that in these mammals, owing to the small size of the yolk sac, the vessels of the embryo establish an early communication with those of the chorion before the vitelline veins are formed (see Quain's *Anatomy*, vol. i., London, 1908). The later stages of the embryology of the vascular system are sketched in the articles on Heart, Arteries, Veins and Lymphatic System (*q.v.*). (F. G. P.)

II. HISTORY OF DISCOVERY

Galen.

Galen, following Erasistratus (*ob.* 280 B.C.) and Aristotle, clearly distinguished arteries from veins, and was the first to overthrow the old theory of Erasistratus that the arteries contained air. According to him, the vein arose from the liver in two great trunks, the *vena porta* and *vena cava*. The first was formed by the union of all the abdominal veins, which absorbed the chyle prepared in the stomach and intestines, and carried it to the liver, where it was converted into blood. The vena cava arose in the liver, divided into two branches, one ascending through the diaphragm to the heart, furnishing the proper veins of this organ; there it received the *vena azygos*, and entered the right ventricle, along with a large trunk from the lungs, evidently the pulmonary artery. The vena azygos was the *superior vena cava*, the great vein which carries the venous blood from the head and upper extremities into the right auricle. The descending branch of the great trunk supposed to originate in the liver was the *inferior vena cava*, below the junction of the hepatic vein. The arteries arose from the left side of the heart by two trunks, one having thin walls (the pulmonary veins), the other having thick walls (the aorta). The first was supposed to carry blood to the lungs, and the second to carry blood to the body. The heart consisted of two ventricles, communicating by pores in the septum; the lungs were parenchymatous organs communicating with the heart by the pulmonary veins. The blood-making organ, the liver, separates from the blood subtle vapours, the *natural spirits*, which, carried to the heart, mix with the air introduced by respiration, and thus form the *vital spirits*; these, in turn carried to the brain, are elaborated into *animal spirits*, which are distributed to all parts of the body by the nerves.[1] Such were the views of Galen, taught until early in the 16th century.

Vesalius.

Jacobus Berengarius of Carpi (*ob.* 1530) investigated the structure of the valves of the heart. Andreas Vesale or Vesalius (1514–1564) contributed largely to anatomical knowledge, especially to the anatomy of the circulatory organs. He determined the position of the heart in the chest;

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[1] See Burggraeve's *Histoire de l'anatomie* (Paris, 1880).

he studied its structure, pointing out the fibrous rings at the bases of the ventricles; he showed that its wall consists of layers of fibres connected with the fibrous rings; and he described these layers as being of three kinds—straight or vertical, oblique, and circular or transverse. From the disposition of the fibres he reasoned as to the mechanism of the contraction and relaxation of the heart. He supposed that the relaxation, or diastole, was accounted for principally by the longitudinal fibres contracting so as to draw the apex towards the base, and thus cause the sides to bulge out; whilst the contraction, or systole, was due to contraction of the transverse or oblique fibres. He showed that the pores of Galen, in the septum between the ventricles, did not exist, so that there could be no communication between the right and left sides of the heart, except by the pulmonary circulation. He also investigated minutely the internal structure of the heart, describing the valves, the *columnae carneae* and the *musculi papillares*. He described the mechanism of the valves with much accuracy. He had, however, no conception either of a systemic or of a pulmonary circulation. To him the heart was a reservoir from which the blood ebbed and flowed, and there were two kinds of blood, arterial and venous, having different circulations and serving different purposes in the body. Vesalius was not only a great anatomist: he was a great teacher; and his pupils carried on the work in the spirit of their master. Prominent among them was Gabriel Fallopius (1523–1562), who studied the anastomoses of the blood vessels, without the art of injection, which was invented by Frederick Ruysch (1638–1731) more than a century later. Another pupil was Columbus (Matthieu Reald Columbo, *ob.* 1560), first a prosector in the anatomical rooms of Vesalius and afterwards his successor in the chair of anatomy in Padua; his name has been mentioned as that of one who anticipated Harvey in the discovery of the circulation of the blood. A study of his writings clearly shows that he had no true knowledge of the circulation, but only a glimpse of how the blood passed from the right to the left side of the heart. In his work there is evidently a sketch of the pulmonary circulation, although it is clear that he did not understand the mechanism of the valves, as Vesalius did. As regards the systemic circulation, there is the notion simply of an oscillation of the blood from the heart to the body and from the body to the heart. Further, he upholds the view of Galen, that all the veins originate in the liver; and he even denies the muscular structure of the heart.[1]

Columbus.

Servetus.

In 1553 Michael Servetus (1511–1553), a pupil or junior fellow-student of Vesalius, in his *Christianismi Restitutio*, described accurately the pulmonary circulation.[2] Servetus perceived the course of the circulation from the right to the left side of the heart through the lungs, and he also recognized that the change from venous into arterial blood took place in the lungs and not in the left ventricle Not so much the recognition of the pulmonary circulation, as that had been made previously by Columbus, but the discovery of the respiratory changes in the lungs constitutes Servetus's claim to be a pioneer in physiological science.

Andrea Cesalpino (1519–1603), a great naturalist of this period, also made important contributions towards the discovery of the circulation, and in Italy he is regarded as the real discoverer[3] Cesalpino knew the pulmonary circulation. Further, he was the first to use the term "circulation," and he went far to demonstrate the systemic circulation. He experimentally proved that, when a vein is tied, it fills below and not above the ligature. The following passage from his *Quaestiones Medicae* (lib. v. cap. 4, fol. 125), quoted by Gamgee, shows his views:—

Cesalpino.

> "The lungs, therefore, drawing the warm blood from the right ventricle of the heart through a vein like an artery, and returning it by anastomosis to the venal artery (pulmonary vein), which tends towards the left ventricle of the heart, and air, being in the meantime transmitted through the channels of the aspera arteria (trachea and bronchial tubes), which are extended near the venal artery, yet not communicating with the aperture as Galen thought, tempers with a touch only. This circulation of the blood (*huic sanguinis circulationi*) from the right ventricle of the heart through the lungs into the left ventricle of the same exactly agrees with what appears from dissection. For there are two receptacles ending in the right ventricle and two in the left. But of the two only one intromits; the other lets out, the membranes (valves) being constituted accordingly."

Still Cesalpino clung to the old idea of there being an efflux and reflux of blood to and from the heart, and he had confused notions as to the veins conveying nutritive matter, whilst the arteries carried the vital spirits to the tissues. He does not even appear to have thought of the heart as a contractive and propulsive organ, and attributed the dilatation to "an effervescence of the spirit," whilst the contraction—or, as he termed it, the "collapse"—was due to the appropriation by the heart of nutritive matter. Whilst he imagined a communication between the termination of the arteries and the commencement of the veins, he does not appear to have thought of a direct flow of blood from the one to the other. Thus he cannot be regarded as the true discoverer of the circulation of the blood. More recently Ercolani has put forward claims on behalf of Carlo Ruini as being the true discoverer. Ruini published the first edition of his anatomical writings in 1598, the year William Harvey entered at Padua as a medical student. This claim has been carefully investigated by Gamgee, who has come to the conclusion that it cannot be maintained.[4]

Discovery of circulation of blood.

The anatomy of the heart was examined, described and figured by Bartolomeo Eustacheo (*c.* 1500–1574) and by Julius Caesar Aranzi or Arantius (*c.* 1530–1589), whose name is associated with the fibro-cartilaginous thickenings on the free edge of the semilunar valves (*corpora Arantii*). Hieronymus Fabricius of Acquapendente (1537–1619), the immediate predecessor and teacher of Harvey, made the important step of describing the valves in the veins; but he thought they had a subsidiary office in connexion with the collateral circulation, supposing that they diverted the blood into branches near the valves; thus he missed seeing the importance of the anatomical and experimental facts gathered by himself. At the time when Harvey arose the general notions as to the circulation may be briefly summed up as follows: the blood ebbed and flowed to and from the heart in the arteries and veins; from the right side at least a portion of it passed to the left side through the vessels in the lungs, where it was mixed with air; and, lastly, there were two kinds of blood—the venous, formed originally in the liver, and thence passing to the heart, from which it went out to the periphery by the veins and returned by those to the heart; and the arterial, containing "spirits" produced by the mixing of the blood and the air in the lungs—sent out from the heart to the body and returning to the heart by the same vessels. The pulmonary circulation was understood so far, but its relation to the systemic circulation was unknown. The action of the heart, also, as a propulsive organ was not recognized. It was not until 1628 that Harvey announced his views to the world by publishing his treatise *De Motu Cordis et Sanguinis*. His conclusions are given in the following celebrated passage:—

Harvey.

> "And now I may be allowed to give in brief my view of the circulation of the blood, and to propose it for general adoption. Since all things, both argument and ocular demonstration, show that the blood passes through the lungs and heart by the auricles and

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[1] An interesting account of the views of the precursors of Harvey will be found in Willis's edition of the *Works* of Harvey, published by the Sydenham Society. Compare also P. Flourens, *Histoire de la decouverte de la circulation du sang* (Paris, 1854), and Professor R. Owen, *Experimental Physiology, its Benefits to Mankind, with an Address on Unveiling the Statue of W. Harvey, at Folkestone, 6th August 1881.*.

[2] See Willis, *Servetus and Calvin* (London, 1877).

[3] A learned and critical series of articles by Sampson Gamgee in the *Lancet*, in 1876, gives an excellent account of the controversy as to whether Cesalpino or Harvey was the true discoverer of the circulation; see also the Harveian oration for 1882 by George Johnston (*Lancet*, July 1882), and Professor G. M. Humphry, *Journ. Anat. and Phys.*, October 1882.

[4] Gamgee, "Third Historical Fragment," in *Lancet*, 1876.

ventricles, and is sent for distribution to all parts of the body, where it makes its way into the veins and pores of the flesh, and then flows by the veins from the circumference on every side to the centre, from lesser to the greater veins, and is by them finally discharged into the vena cava and right auricle of the heart, and this in such a quantity, or in such a flux and reflux, thither by the arteries, hither by the veins, as cannot possibly be supplied by the ingestor, and is much greater than can be required for mere purposes of nutrition, it is absolutely necessary to conclude that the blood in the animal body is impelled in a *circle*, and is in a state of ceaseless motion, that this is the act or function which the heart performs by means of its pulse, and that it is the sole and only end of the motion and contraction of the heart" (bk. x. ch. xiv. p. 68).

Capillary circulation.

Opposed to Caspar Hofmann of Nuremberg (1571–1623), Veslingius (Vesling) of Padua (1598–1649), and J. Riolanus the younger, this new theory was supported by Roger Drake, a young Englishman, who chose it for the subject of a graduation thesis at Leiden in 1637, by Werner Rolfinck of Jena (1599–1673), and especially by Descartes, and quickly gained the ascendant; and its author had the satisfaction of seeing it confirmed by the discovery of the capillary circulation, and universally adopted. The circulation in the capillaries between the arteries and the veins was discovered by Marcellus Malpighi (1628–1694) of Bologna in 1661. He saw it first in the lungs and the mesentery of a frog, and the discovery was announced in the second of two letters, *Epistola de Pulmonibus*, addressed to Borelli, and dated 1661.[1] Malpighi actually showed the capillary circulation to the astonished eyes of Harvey. Anthony van Leeuwenhoek (1632–1723) in 1673 repeated Malpighi's observations, and studied the capillary circulation in a bat's wing, the tail of a tadpole and the tail of a fish. William Molyneux studied the circulation in the lungs of a water newt in 1683.[2]

Transfer of blood.

The idea that the same blood was propelled through the body in a circuit suggested that life might be sustained by renewing the blood in the event of some of it being lost. About 1660 Lower, a London physician (died 1691), succeeded in transferring the blood of one animal directly from its blood vessels into those of another animal. This was first done by passing a "quill" or a "small crooked pipe of silver or brass" from the carotid artery of one dog to the jugular vein of another.[3] This experiment was repeated and modified by Sir Edmund King (1629–1709), Thomas Coxe (1615–1685), Gayant and Denys with such success as to warrant the operation being performed on man, and accordingly it was carried out by Lower and King on the 23rd of November 1667, when blood from the arteries of a sheep was directly introduced into the veins of a man.[4] It would appear that the operation had previously been performed with success in Paris.

Force of heart and velocity of blood.

Borelli.

Keill.

Hales.

Thomas Young.

The doctrine of the circulation being accepted, physiologists next directed their attention to the force of the heart, the pressure of the blood in the vessels, its velocity, and the phenomena of the pulse wave. Giovanni Alphonso Borelli (1608–1679) investigated the circulation during the lifetime of Harvey. He early conceived the design of applying mathematical principles to the explanation of animal functions; and, although he fell into many errors, he must be regarded as the founder of animal mechanics. In his *De Motu Animalium* (1680–85) he stated his theory of the circulation in eighty propositions, and in prop. lxxiii., founding on a supposed relation between the bulk and the strength of muscular fibre as found in the ventricles, erroneously concluded that the force of the heart was equal to the pressure of a weight of 180,000 lb. He also recognized and figured the spiral arrangement of fibres in the ventricles. The question was further investigated by James Keill, a Scottish physician (1673–1719), who in his *Account of Animal Secretion, the Quantity of Blood in the Human Body, and Muscular Motion* (1708) attempted to estimate the velocity of blood in the aorta, and gave it at 52 ft. per minute. Then, allowing for the resistance of the vessels, he showed that the velocity diminishes towards the smaller vessels, and arrived at the amazing conclusion that in the smallest vessels it travels at the rate of ½ in. in 278 days,—a good example of the extravagant errors made by the mathematical physiologists of the period. Keill further described the hydraulic phenomena of the circulation in papers communicated to the Royal Society and collected in his *Essays on Several Parts of the Animal Oeconomy* (1717). In these essays, by estimating the quantity of blood thrown out of the heart by each contraction, and the diameter of the aortic orifice, he calculated the velocity of the blood. He stated (pp. 84, 87) that the blood sent into the aorta with each contraction would form a cylinder 8 in. (2 oz.) in length and be driven along with a velocity of 156 ft. per minute. Estimating then the resistances to be overcome in the vessels, he found the force of the heart to be "little above 16 oz.,"—a remarkable difference from the computation of Borelli. Keill's method was ingenious, and is of historical interest as being the first attempt to obtain quantitative results; but it failed to obtain true results, because the data on which he based his calculations were inaccurate. These calculations attracted the attention not only of the anatomico-physiologists, such as Haller, but also of some of the physicists of the time, notably of Jurin and D. Bernoulli. Jurin (died 1750) gave the force of the left ventricle at 9 lb 1 oz., and that of the right ventricle at 6 lb 3 oz. He also stated with remarkable clearness, considering that he reasoned on the subject as a physicist, without depending on experimental data gathered by himself, the influence on the pulse induced by variations in the power of the heart or in the resistance to be overcome.[5] The experimental investigation of the problem was supplied by Stephen Hales (1677–1761), rector of Teddington in Middlesex, who in 1708 devised the method of estimating the force of the heart by inserting a tube into a large artery and observing the height to which the blood was impelled into it. Hales is the true founder of the modern experimental method in physiology. He observed in a horse that the blood rose in the vertical tube, which he had connected with the crural artery, to the height of 8 ft. 3 in. perpendicular above the level of the left ventricle of the heart. But it did not attain its full height at once: it rushed up about half-way in an instant, and afterwards gradually at each pulse 12, 8, 6, 4, 2, and sometimes 1 in. When it was at its full height, it would rise and fall at and after each pulse 2, 3 or 4 in.; and sometimes it would fall 12 or 14 in., and have there for a time the same vibrations up and down at and after each pulse as it had when it was at its full height, to which it would rise again after forty or fifty pulses.[6] He then estimated the capacity of the left ventricle by a method of employing waxen casts, and, after many such experiments and measurements in the horse, ox, sheep, fallow deer and dog, he calculated that the force of the left ventricle in man is about equal to that of a column of blood 7½ ft. high, weighing 51½ lb, or, in other words, that the pressure the left ventricle has to overcome is equal to the pressure of that weight. When we contrast the enormous estimate of Borelli (180,000 lb) with the under-estimate of Keill (16 oz.), and when we know that the estimate of Stephen Hales (1677–1761), as corroborated by recent investigations by means of elaborate scientific appliances, is very near the truth, we recognize the far higher service rendered to science by careful and judicious experiment than by speculations, however ingenious. With the exception of some calculations by Dan Bernoulli (1700–1782) in 1748, there was no great contribution to haemadynamics till 1808, when two remarkable papers appeared from Thomas Young (1773–1829). In the first, entitled "Hydraulic Investigations," which appeared in the *Phil Trans.*, he investigated the friction and discharge of fluids running in pipes and the velocity of rivers, the resistance occasioned by flexures in pipes and rivers, the propagation of an impulse through an elastic tube, and some of the phenomena of pulsations. This paper was preparatory to the second, "On the Functions of the Heart and Arteries,"—the Croonian lecture for 1808—in which he showed more clearly than had hitherto been done (1) that the blood pressure gradually diminishes from the heart to the periphery; (2) that the velocity of the blood becomes less as it passes from the greater to the smaller vessels; (3) that the resistance is chiefly in the smaller vessels, and that the elasticity of the coats of the great arteries comes into play in overcoming this resistance in the interval between systoles; and (4) that the contractile coats do not act as propulsive agents, but assist in regulating the distribution of blood.[1]

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[1] See his *Opera Omnia*, vol. i. p. 328.

[2] Lowthorp, *Abridgement of Trans. Roy. Soc.*, 5th ed. vol. iii. p. 230.

[3] Ibid. p. 231.

[4] Ibid. p. 226.

[5] Jones, *Abridgement of Phil. Trans.* (3d ed., 1749), vol. v. p. 223. See also for an account of the criticisms of D. Bernoulli the elder and others, Haller's *Elementa Physiologiae*, vol. i. p. 448.

[6] Hales, *Statical Essays, containing Haemastatics*, &c. (1733), vol. ii. p. 1

Use of instruments.

The next epoch of physiological investigation is characterized by the introduction of instruments for accurate measurement, and the graphic method of registering phenomena, now so largely used in science.[2] In 1825 appeared E. and Wilhelm Weber's (1804–1891) *Wellenlehre*, and in 1838 Ernest Weber's (1795–1878) *Ad Notat. Anatom. et Physiolog.* i., both of which contain an exposition of E. H. Weber's *schema* of the circulation, a scheme which presents a true and consistent theory. In 1826 Jean Louis Marie Poiseuille invented the haemadynamometer.[3] This was adapted with a marker to a recording cylinder by Ludwig in 1847, so as to form the instrument named by Alfred Volkmann (1801–1877) the kymograph. Volkmann devised the haemadromometer for measuring the velocity of the blood in 1850; for the same purpose Vierordt constructed the haematachometer in 1858; Chauveau and Pierre Lortet (1792–1868) first used their haemadromograph in 1860; and lastly, Ludwig and Dogiel obtained the best results as regards velocity by the "stream-clock" in 1867. As regards the pulse, the first sphygmograph was constructed by Karl Vierordt (1818–1884) in 1856; and Étienne Marey's form, of which there are now many modifications, appeared in 1860. In 1861 Jean Chauveau (b. 1827) and Marey obtained tracings of the variations of pressure in the heart cavities (see below), by an experiment which is of great historical importance. During the past twenty-five years vast accumulations of facts have been made through the instruments of precision above alluded to, so that the conditions of the circulation, as a problem in hydrodynamics, have been thoroughly investigated. Since 1845, when the brothers Weber discovered the inhibitory action of the vagus, and 1858, when Claude Bernard (1813–1878) formulated his researches showing the existence of a vaso-motor system of nerves, much knowledge has been acquired as to the relations of the nervous to the circulatory system. The Webers, John Reid (1816–1895), Claude Bernard and Carl Ludwig (1809–1849) may be regarded as masters in physiology equal in standing to those whose researches have been more especially alluded to in this historical sketch. The Webers took the first step towards recognizing the great principle of inhibitory action; John Reid showed how to investigate the functions of nerves by his classical research on the eighth pair of cranial nerves; Claude Bernard developed the fundamental conception of vaso-motor nerves; and Ludwig showed how this conception, whilst it certainly made the hydraulic problems of the circulation infinitely more complicated than they were even to the scientific imagination of Thomas Young, accounted for some of the phenomena and indicated at all events the solidarity of the arrangements in the living being. Further, Ludwig and his pupils used the evidence supplied by some of the phenomena of the circulation to explain even more obscure phenomena of the nervous system, and they taught pharmacologists how to study in a scientific manner the physiological action of drugs. (J. G. M.)

III. Physiology

The general principles of the circulation.

The unicellular animal immersed in water absorbs nutritive matter and oxygen, and excretes waste materials with its whole surface. Owing to the small mass of the protozoa the metabolic products can penetrate throughout the whole. With the evolution of the multicellular organs of the metazoa and the division of physiological labour a circulatory mechanism became of immediate need. A double-layered animal like the common water polype Hydra can exist, it is true, without such a mechanism, but communities of polypes, such as the sponges, form channels for the circulation of water. With the development of the three-layered animal the coelom or body cavity arose by the splitting of the mesoderm, and it was in this body cavity that the evolution of the circulatory system took place, an evolution which finally became perfected in the higher members of the metazoa into a closed vascular system filled with red blood. The evolution of the red matter, haemoglobin, as a special carrier of oxygen was necessitated by the increasing mass and muscular activity of the higher animal, in comparison with the size of the oxygen-absorbing surface—the gill or lung. The blood vascular system of the invertebrata such as the Arthropoda and Insecta, is not generally a closed system, but consists of a pulsatile heart whence proceed arteries which open into lacunar spaces forming part of the coelom. The lacunae exist between the organs and tissues of the body, and the blood from these spaces is returned to a venous sinus whence the heart draws its supply through valved openings. The movements of the animal help to return the blood from the tissue spaces to the heart, while the heart by its rhythmic contraction drives the blood into the arteries. Somewhere in the course of this system are placed the gills and renal organs, and it appears to be a matter of indifference whether the gills be placed on the arterial or venous side of the system, both arrangements being found in different types. In some types (mussel, earthworm), the whole blood passes through the renal organs at each circulation, in others (crayfish) only parts. In the earthworm the vascular system is closed, the arteries and veins being connected by capillaries in place of lacunae. The movement of tissue juices may be maintained by physico-chemical forces alone, *e.g.* by the forces of osmosis and adsorption, as is seen in the movements of sap in the vascular bundles of plants, in the streaming of protoplasm in the plant cell and in the marvellous rhythmic to-and-fro movements of the richly granular juice contained in the veins of the spreading protoplasmic sheet of myxomycetes. Such agencies come into play in the lacunar or capillary part of the circulation of the metazoa and are assisted by the movements of the body wall and of the alimentary organs. The evolution of a special pumping organ, the heart, associated with the aeration of the body fluids in the gills, led to the perfection of the efficient system of circulation which is found in the vertebrata.

The blood is to be regarded as alive in as strict a sense as any other component of the living body. It is a tissue consisting of mobile elements—the blood corpuscles—and a plasma—a colloidal albuminous fluid which is analogous to the more solid intercellular material of other tissues. The primary sources of its elements are the blood-forming organs—the bone marrow, the haemolymph and lymphatic glands and other lymphatic tissue, and the spleen. It circulates as the middleman between the tissues, conveying from the alimentary canal the products of digestion—sugar, fat, amino-acids and salts; oxygen from the lungs; carbonic acid, urea and other waste products of the tissues to the lungs and kidneys; internal secretions from one organ to another; and acts not only as a carrier, but deals with the material remitted to it on the way. One other function of the blood, a most important one, must not be omitted, that of defence against the invasion of bacteria and their toxins, and other parasites.

The blood is contained in a continuous system of vessels; *arteries* lead from the heart and divide into a multitude of

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[1] See *Miscellaneous Works*, ed. Peacock (2 vols., London, 1855).

[2] See Marey, *La Méthode graph. dans les sc. expér.* (Paris, 1878).

[3] Magendie's *Journal*, vol. viii. p. 272.

The course of the circulation in mammals.

capillary vessels, and these lead into the *veins* which finally pass back to the heart. The heart is to be regarded as a double organ, each half consisting of an *auricle* and a *ventricle*. The right half contains dark venous blood which has been returned from the body and is sent to the lungs: the left heart contains the bright oxygenated blood which has been returned from the lungs and is distributed to the body. There are thus two circulations—the one *pulmonary*, from the right side of the heart to the pulmonary artery and thence to the capillaries of the lungs and to the left heart by the pulmonary veins—the other *systemic*, from the left side of the heart, by the aorta, to the arteries and capillaries of the body tissues and organs, whence the blood returns by the veins to the right side of the heart.

A schematic representation is given of the circulatory system in the accompanying diagram. The venous blood flows into the right auricle (RA) from the superior vena cava and the inferior vena cava. The right ventricle (RV) drives through the lungs the blood received from the right auricle. The right auriculo-ventricular valve, or tricuspid, and the pulmonary semilunar valve are represented directing the flow of blood in this direction. From the pulmonary capillaries the blood returns by the pulmonary veins (PV) into the left auricle (LA), and so through the left auriculo-ventricular or mitral valve into the left ventricle (LV). By the left ventricle the blood is driven through the aortic semilunar valve, and is distributed to the systemic arteries, and so to the capillaries of the various organs and back to the veins. The muscular wall of the auricles and that of the right ventricle are much thinner than that of the left ventricle. This is so, because the energy required of the left ventricle must exceed that of the right ventricle, inasmuch as the resistance in the systemic system exceeds that in the pulmonary circuit.

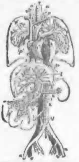

FIG. 1.—General Course of Circulation and some of the Principal Vessels. H', right ventricle; H, left ventricle; A, A, A, aorta; *h*, part of left auricle; P, pulmonary artery, going to lungs; P, pulmonary veins; *v*, ascending or lower vena cava; *e*, trachea or wind-pipe; *p*, *p'*, bronchial tubes; *a'*, *a*, right and left carotid arteries; *v*, *v'*, veins from root of neck (internal jugular and subclavian), joining to form descending or upper vena cava; *i*, hepatic artery *l*, hepatic vein; I, superior mesenteric artery, going to mesentery and bowels; L, portal vein, going to liver; *k'*, renal artery; *k*, renal vein; V, inferior vena cava, splitting into the two iliac veins, *v*, *v*.

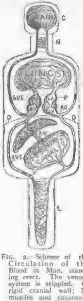

FIG. 2.—Scheme of the Circulation of the Blood in Man, standing erect. The venous system is stippled. C, rigid cranial wall; N, muscles and cutaneous wall of neck; T, thoracic wall; A, muscular and cutaneous wall of abdomen; D, diaphragm; L, muscles and cutaneous wall of limbs; P, pericardium; AO, aorta; S. V. C, I. V. C, venae cavae; P.V, portal vein; V, valves in veins of neck, or legs; RA, LA, right and left auricles; RV, LV, right and left ventricles.

The heart fills with venous blood during its expansion or *diastole*, and forces the blood into the arteries during its contraction or *systole*. The large arteries are of less capacity than the corresponding veins, and their walls are essentially extensile and elastic. The pulmonary arteries are especially extensile structures. The small arteries and *arterioles* are essentially muscular tubes and can vary considerably in diameter. The arterioles open into the capillaries, and these are so numerous that each organ may be regarded as a sponge full of blood. The skeletal muscles and the muscular walls of the viscera at each contraction express the blood within them, and materially influence the circulation. The whole muscular system, as well as the heart, must therefore be regarded as a pump to the vascular system. The capillary wall is composed of a single layer of flattened cells, separating the blood within from the tissues without. Through this layer, which is of extraordinary tenuity, there takes place an exchange of material between the blood and the tissues, an exchange which depends on the physico-chemical conditions which characterize the living state of the cells. The phenomena of adsorption and osmosis come into play here, but the conditions still await complete elucidation. The veins are of larger calibre than the corresponding arteries, and have tough and inextensile walls. Their walls are muscular, and contract on local stimulation. The veins are not, as a rule, distended with blood to their full potential capacity. The latter is so great that the whole blood of the body can collect within the veins.

The heart and lungs are placed within the thoracic cavity (T), the floor of which is formed by the muscular diaphragm (D); the heart is itself enclosed in a tough inextensile bag, *the pericardium* (P), the function of which is to check over-dilatation of the heart. The pericardium bears to the muscular wall of the heart the same relation as the leather case of a football does to the bag within. In particular, it prevents over-distension of the heart during muscular efforts.

The abdominal organs and blood vessels are encompassed by the muscular wall of the abdomen (A), and may be regarded as enclosed in a sphere of muscle. Above is the dome of the diaphragm (T), and below the basin-like levator ani, closing the outlet of the pelvis; in front are the recti muscles, behind the quadrati lumborum and the spine; while the oblique and transverse muscles complete the wall at either side. The brain is enclosed in a rigid and unyielding box of bone—*the cranium*, while the limbs are encompassed by the extensile and, in health, taut and elastic skin.

The heart's energy is spent in maintaining a pressure of blood in the elastic arteries, and by the difference of pressure in the arteries and veins the blood is kept flowing through the capillaries into the veins. The movements of the body and particularly of respiration help to return the blood from the capillaries and veins back to the heart, valves being set in the veins to direct the blood in this direction. The blood is a viscous fluid and its viscosity varies; it is propelled by a heart which varies both in rate and energy; it circulates through a system of muscular and elastic arteries and veins, which varies in capacity and may alter in elasticity. The width of bed through which it flows varies greatly at different parts of the circuit, and the resistance offered to the moving blood is very much greater in the capillary-sized vessels than in the large arteries and veins. The blood continually varies, both in quantity and in quality, as it effects exchanges through the capillary walls with the tissues. The problems of the circulation are thus far from simple. They resolve themselves mainly into a consideration of (1) the physiology of the heart; (2) the physical characters of the circulation; (3) the control of the heart and vessels by the nervous system.

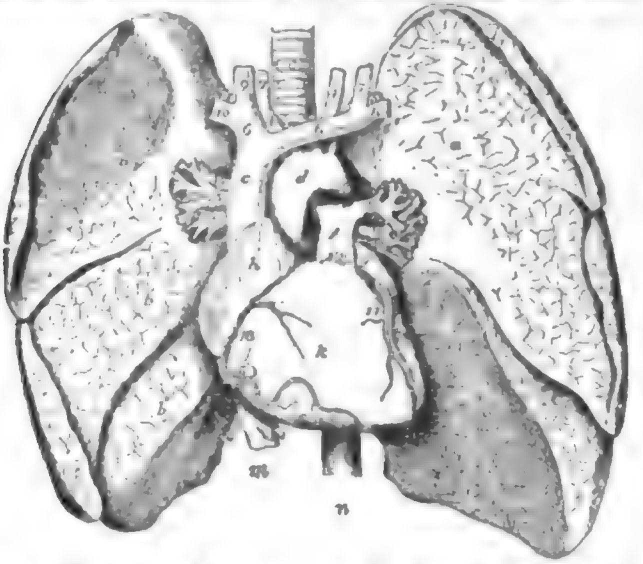

Fig. 3.—The Thoracic Viscera. In this diagram the lungs are turned to the side, and the pericardium removed to display the heart. *a*, upper, *a′*, lower lobe of left lung; *b*, upper, *b′*, middle, *b″*, lower lobe of right lung; *c*, trachea; *d*, arch of aorta; *e*, superior vena cava; *f*, pulmonary artery; *g*, left, and *h*, right auricle; *k*, right, and *l*, left ventricle; *m*, inferior vena cava; *n*, descending aorta; 1, innominate artery; 2, right, and 4, left common carotid artery; 3, right, and 5, left subclavian artery; 6, 6, right and left innominate vein; 7 and 9, left and right internal jugular veins; 8 and 10, left and right subclavian veins; 11, 12, 13, left pulmonary artery, bronchus and vein; 14, 15, 16, right pulmonary bronchus, artery and vein; 17 and 18, left and right coronary arteries.

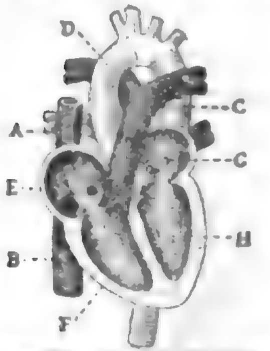

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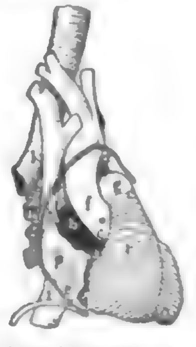
Fig. 4.—Diagram of Chambers of Heart and Large Vessels.

A, Vena cava, superior.
B, Vena cava, inferior.
C, Pulmonary artery.
D, Aorta.
E, Right auricle.
F, Right ventricle.
G, Left auricle, into which open the four pulmonary veins.
H, Left ventricle.

The arrows point the course of the blood.



A. Keith, in *Journal of Anatomy and Physiology*.

Fig. 5.—Showing the Attachments of the Heart. *a*, *a*, auricular base of ventricle; *c*, *c*, aortic base of ventricles; *d*, *d*, arterial mesocardium; *e*, *e*, venous mesocardium; *f*, ascending aorta; *g*, pulmonary aorta; *h*, superior vena cava; *i*, inferior vena cava, perforating diaphragm and pericardium; *l*, *m*, *n*, structures at the root of the lung—bronchus, pulmonary artery, and pulmonary veins; *o*, vortex at apex; *p*, pectinate musculature of right auricle; *r*, superficial musculature of right ventricle.

The Action of the Heart.

The permanent position and general arrangements of the heart are described in a separate article, and it is only necessary here to allude to certain points of physiological importance. The substance of the heart is composed of a special kind of muscular tissue which must be regarded as a syncytium in which no distinct and separate cells occur. a complex plexus of branching and anastomosing fibres, forming one functional whole. The fibres are nucleated, have a cross-striated structure and are surrounded by delicate connective tissue sheaths. The cross-striations are due to the primitive fibrils which as in skeletal muscle are differentiated into alternate doubly and singly refracting substances. These fibrils are embedded in a granular nucleated sarcoplasm. Between the bundles of fibres are thin layers of connective tissue containing closely spun networks of capillaries. The muscle of the auricles consists of a circular layer common to both and a deeper layer separate for each chamber. The auriculo-ventricular ring consists of connective tissue surrounding the auriculo-ventricular orifices and separating the auricular from the ventricular muscle with the exception of an important band, the *auriculo-ventricular bundle*. The superficial fibres of the ventricles appear to have origin in the auriculo-ventricular ring, to wind about the heart spirally and to end in the tendons of the papillary muscles or pass up to the ring again on the inner surface of the heart. The middle layers consist of bundles of fibres running more or less circularly round the ventricles.

The greater part of the heart lies free in the pericardial sac. The pericardium is reflected from the wall of the sac on to the wall of the heart and attaches the heart at the point where the venae cavae and aorta leave the sac. This part of the pericardium gives a fixation point to the auricles, for it is attached to the roots of the lungs and thereby to the thoracic wall, to the diaphragm and to the structures at the root of the neck. On opening the chest the normal fulcra for the movements of the auricles are lost, and this renders it difficult to record the exact movements of the heart. The attached part of the heart is called the *base*, and the venous part of the base is the beginning and the arterial part the end of the tube, coiled on itself, from which in the embryo the heart develops. The longitudinal and circular muscle fibres of the ventricles are antagonists. The circular fibres by their contraction tend to lengthen the apex-base diameter, the longitudinal fibres resist this and the two together wring the blood out of the heart. The apex is maintained as a fixed point by this antagonistic action, and thus the longitudinal fibres are enabled to expand the auricles by pulling down the floor of these chambers. This action is important, as it contributes to the filling of the auricles simultaneously with the emptying of the ventricles. Tracings of the jugular pulse give evidence of such action.

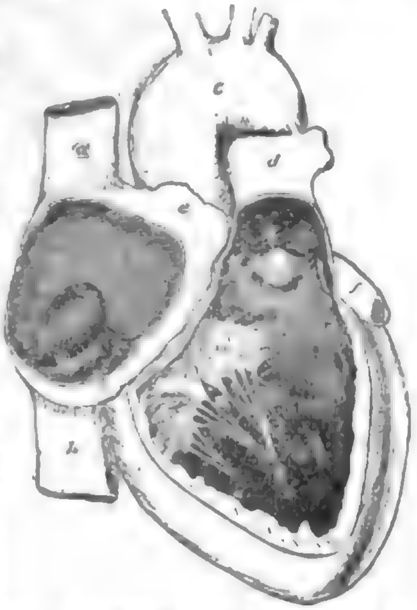


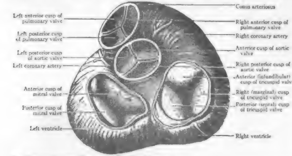
Fig. 6.—Cavities of the Right Side of the Heart. *a*, superior, and *b*, inferior vena cava; *c*, arch of aorta; *d*, pulmonary artery; *e*, right, and *f*, left auricular appendage; *g*, fossa ovalis; *h*, Eustachian valve; *k*, mouth of coronary vein; *l*, *m*, *n*, cusps of the tricuspid valve; *o*, *o*, papillary muscles; *p*, semilunar valve; *q*, corpus Arantii; *r*, lunula.

In the case of the auricles the longitudinal musculi pectinati not only help the circular fibres to expel the blood, but draw up the base of the ventricle to meet its load of blood. Thus the base of the ventricular part (or floor of the auricles) is pulled up during auricular systole, and down during ventricular systole. The posterior and upper borders of the left auricle lie against the unyielding structures of the posterior mediastinum, the pulmonary artery and bronchi, the floor and anterior part in contact with the base of the ventricle and ascending aorta respectively. The latter parts alone are free to move during systole. Thus the left ventricular base is drawn up and the aorta back on auricular systole (A. Keith).

The valves of the heart.

As regards the valves of the heart—(1) the tricuspid guards the right auriculo-ventricular opening, and consists of three flaps of fibrous tissue, covered, like all the internal surfaces of the heart, with the smooth shining membrane, the endocardium. The flaps are continuous at their base, forming an annular membrane surrounding the opening. The bicuspid or mitral consists of two cusps and guards the left auriculo-ventricular opening. The under surface and free edge of each cusp of these valves are attached by chordae tendinae to two papillary muscles; these are pillars of muscle which rise up from the inner surface of the ventricles.

The edges of these valves which come into opposition are exceedingly thin and delicate, while the outer parts which bear the full systolic pressure of the blood, are tough. The cardiac muscle, by its contraction, limits the size of the auriculo-ventricular orifices and so maintains the competency of the valves. It is the papillary muscles and chordae tendineae which pull down the diaphragm formed by the closed valves (the floor of the auricles), thus expanding the auricles and enabling the valvular as well as the muscular parts of the wall of the ventricles to approach together and wring out the blood. The thin, moist, film-like edges of the valves of the heart come into perfect apposition and prevent all leakage, while the fibrous parts give strength and support. The ventricles are never completely emptied, for some blood remains in contact with the auriculo-ventricular valves up to the end of systole and ensures their closure. Incompetency of the valves may arise when the right heart is greatly dilated. The aortic and pulmonary valves consist of three semilunar, pocket-shaped cusps. A fibrous nodule is placed centrally in the free edge of each cusp, whence numerous tendinous fibres radiate to the attached borders of the cusp. The rest of the free edges which come into apposition are thin and delicate. Opposite the cusps are bulgings of the aortic walls—the sinuses of Valsalva. From the anterior one arises the right coronary artery and from the left posterior, the left coronary artery, these vessels supply the substance of the heart with blood. Eddies formed in the sinuses during the period of systolic output bring the semilunar valves into apposition, so that they close without noise or jar at the moment when the intraventricular becomes less than the aortic pressure. The auriculo-ventricular valves are likewise floated up by eddies, and brought into apposition at the moment the intraventricular pressure surmounts that in the auricles.


Left anterior cusp of pulmonary valve
Left posterior cusp of pulmonary valve
Left posterior cusp of aortic valve
Left coronary artery
Anterior cusp of mitral valve
Posterior cusp of mitral valve
Left ventricle
Conus arteriosus
Right anterior cusp of pulmonary valve
Right coronary artery
Anterior cusp of aortic valve
Right posterior cusp of aortic valve
Anterior (infundibular) cusp of tricuspid valve
Right (marginal) cusp of tricuspid valve
Posterior (septal) cusp of tricuspid valve
Right ventricle

From Young and Robinson, Cunningham's *Text-Book of Anatomy*.

FIG. 7.—The Bases of the Ventricles of the Heart, showing the auriculo-ventricular, aortic and pulmonary orifices and their valves.

The heart in size is about equal to the closed fist of a man. The average weight of the heart in the new-born baby is about 24 grms., in the adult 300 grms. The percentage which the heart weight bears to the whole body weight is 0·76 in the new-born and 0·46 in the adult. While the whole body increases in weight 21-fold, the heart increases only 12·74-fold (Vierordt, Karl, 1818–1884). The average weight of the male and female heart is almost the same.

The average volume of the whole heart is about 270 c.c. The capacity, estimated by filling the heart with wax, is for each auricle about 100–150 c.c., and 150–230 c.c. for each ventricle. There are considerable sources of error in such measurements. The muscle of the left ventricle is about 1·6 cm. in thickness, and of the right ventricle 0·5 cm. The left ventricle has twice the muscular mass of the right. The circumference of the left auriculo-ventricular orifice is about 14·0 cm.; of the right, about 12·5 cm.; of the aortic orifice, 8·0 cm.; of the pulmonary orifice, 9·0 cm. The average diameter of the vena cava superior is about 23 mm.; of the vena cava inferior, 34 mm.; of each of the four pulmonary veins about 13–14 mm.; of the pulmonary artery, 28 mm.; of the aorta, 32 mm.

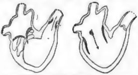


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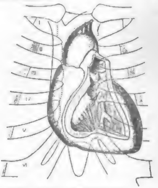
FIG. 8.—Position of the Valves of the Heart in Systole and Diastole.

Modes of examining the living heart.

The physiologist or physician has many means at his disposal of examining the heart's action. By palpation with the hand over the region of the heart, its stroke, the *cardiac impulse*, can be felt. By *auscultation* with the ear directly, or with use of the stethoscope the sounds of the heart can be heard. By *percussion* the anatomical limits of the organ can be defined. The cardiac impulse can be recorded by tambour methods of registration, the heart sounds by means of the microphone and capillary electrometer, while the volume and movements of the heart can be studied with the help of the Röntgen rays

The cardiac impulse.

The impulse is caused by the sudden hardening of the muscular mass of the ventricles against the wall of the thorax. It is synchronous with the beginning of systole. The position at which the impulse is felt varies with changing posture of the body, as different parts of the thorax come in turn in contact with the ventricle. In the supine position it is usually to be felt in the fifth intercostal space 3½ inches from the midsternal line. The chest wall is driven out by the systole only where the heart muscle touches it; at other places it is slightly drawn in. This indrawing is attributed to the expulsion of the blood out of the thorax by the left ventricle. The thorax is a closed cavity and the vacuum therein produced by systolic output into the arteries of the head, limbs and abdomen is filled by (1) the drawing of air into the lungs, (2) the drawing of venous blood into the great veins and right auricle, (3) the slight indrawing of the chest wall. The impulse is recorded by placing a small cup, or receiving tambour, over the spot where it is most evident, and connecting the inside of the cup by a tube to a recording tambour. The cup can be closed by a rubber dam, or an air-tight junction can be effected by pressing it upon the skin. The stroke of the heart is transmitted as a wave of compression to the air within the system of tambours. The recording tambour is brought to write on a drum, moved by clockwork, and covered with a paper smoked with lamp-black. From the record so obtained we can obtain information as to the time relations of the heart-beat, but no accurate information as to its energy or amount of contraction.



From Young and Robinson, Cunningham's *Text-Book of Anatomy*.

FIG. 9.—The Relation of the Heart to the Anterior Wall of the Thorax.

I, II, III, IV, V, VI, the upper six costal cartilages.

Movements of the heart.

The movements of the heart consist of a series of contractions which succeed each other with a certain rhythm. The period of contraction is called the *systole* and that of relaxation the *diastole*. The two auricles contract and relax synchronously, and these movements are followed by the synchronous contraction and relaxation of the ventricles. Finally, there is a short period when the whole heart is in diastole. The whole series of movements is known as the *cardiac* *cycle.* Taking 75 as the average number of heart-beats per minute, each cardiac cycle will occupy ·8 seconds. Of this period

auricular systole occupies	·1	second
auricular diastole occupies	·7	,,
ventricular systole occupies	·3	,,
ventricular diastole occupies	·5	,,

In 1861 Chauveau and Marey obtained direct records of the heart of a horse, and determined the sequence and duration of the events happening in the heart, and measured the endo-cardiac pressure by an instrument termed the cardiac sound. The sound—a two-way tube—was pushed down the jugular vein until the orifice of one tube lay in the right ventricle and of the other in the right auricle. The tubes were connected with recording tambours which wrote on a moving drum covered with smoked paper.

Another tambour was used to record the cardiac impulse. The tracings so obtained (fig. 10) teach us the following facts: (1) The auricular contraction is less sudden than the ventricular, and lasts only a very short time, as indicated by the line *ab*. The ventricle, on the other hand, contracts suddenly and forcibly and remains contracted a considerable time, as shown by the line *c′d′* and by the flat top to the curve which succeeds *d′*. (2) The auricular movement precedes the ventricular, and the latter coincides with the impulse of the apex against the wall of the chest. (3) The contraction of the auricle influences the pressure in the ventricle as shown by the small rise *a′b′*, and that of the ventricle influences the pressure in the auricle somewhat as shown by the waves *cd*. Much labour has been spent in the contrivance of rapidly acting spring pressure gauges, freed as far as possible from inertia, in order to investigate more exactly the changes of intracardiac pressure, which were first described by Chauveau and Marey. As the intraventricular pressure may rise 150 mm. of mercury in one-tenth of a second, it is no easy matter to contrive an instrument which will respond as rapidly and yet yield an accurate result without overshooting the mark. The final result of a most careful inquiry is the confirmation in almost every point of Chauveau and Marey's pressure curves. Karl Hürthle's differential manometer has proved to be an instrument of great value and precision. A double-bored tube cannula is introduced so that one tube reaches the right auricle and the other the right ventricle. In observations on the left side of the heart, one tube is placed in the left ventricle and the other in the aorta, and each of these tubes is brought into connexion with a tambour. The two tambours are placed one on either side of the fulcrum of a lever. This lever works against a light spring, which in its turn sets in motion a writing-style. The style records the pressure changes on a drum covered with smoked paper. By this means there can be recorded the exact moment at which the auricular pressure exceeds that in the ventricle, that is to say, the moment when the auriculo-ventricular valves open; likewise the moment when the ventricular pressure becomes greater than that in the auricles, and the auriculo-ventricular valves shut. Similarly, there can be recorded the moment when the intraventricular pressure exceeds that in the aorta and the semilunar valves open, and the moment at which the diastole of the ventricle begins, when the aortic pressure becomes the greater, and the semilunar valves shut. The smoothness with which the heart works is shown by the fact that neither the opening nor the closing of the valves is marked by any peak or point on the pressure curves.

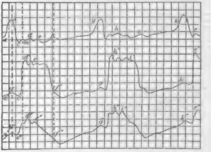
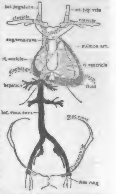


FIG. 10.—Tracings from the Heart of a Horse, by Chauveau and Marey. The upper tracing is from the right auricle, the middle from the right ventricle, and the lowest from the apex of the heart. The horizontal lines represent time, and the vertical amount of pressure. The vertical dotted lines mark coincident points in the three movements. The breadth of one of the small squares represents one-tenth of a second.

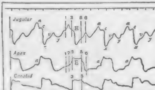
The absence of a mechanism for preventing regurgitation of blood from the auricles of birds and mammals is remarkable, for in fishes, amphibia and reptiles this is effected by valves guarding the sino-auricular junction. In the warm-blooded vertebrata with the appearance of the diaphragm the sinus becomes merged into the right auricle, and the venous cistern formed by the superior and inferior venae cavae, the innominate, iliac, hepatic and renal veins takes the place of the sinus. Six pairs of valves prevent regurgitation from this cistern, viz. those placed in the common femoral, the sub-clavian and jugular veins. The cistern when filled holds some 400 c.c. of blood; in the liver there is some 500 c.c. of blood, and this can be expressed into the cistern by abdominal pressure; in the portal venous system, when distended, another 500 c.c. may be held, which can be expressed through the liver into the cistern. A large volume of blood is thus at the disposal of the heart for it to draw on during diastole. Respiration by the aspirating action of the thorax sucks this blood into the heart, while the inspiratory descent of the diaphragm squeezes the abdominal contents and forces blood from the liver and cistern into the heart. These forces take the place of the sinus and are far more efficient. The intra-abdominal pressure may be raised on bending or straining till it becomes equivalent to the pressure of a column of mercury 80–100 mm. high (Keith). Under such conditions the pericardium prevents the right side of the heart being over-distended with venous blood.



A. Keith, in *Journal of Anatomy and Physiology*.

FIG. 11.—Diagram of the Venous Cistern from which the Heart is filled. The abdominal or infra-diaphragmatic part of the cistern is indicated in black; the thoracic or supra-diaphragmatic is stippled.

With these facts in view, we can now describe the complete course of a cardiac cycle. We will start at the moment when the blood is pouring from the venae cavae and pulmonary veins into the two auricles. The auricles are relaxed and their cavities open into the ventricles by the funnel-shaped apertures formed by the dependent segments of the tricuspid and mitral valves. The blood passes freely through these apertures into the ventricles. The small positive pressure which is always present in the venous cistern (aided by the respiratory forces) is at this time filling the right heart, while the positive pressure in the pulmonary veins is filling the left heart. The auricular systole now takes place. The circular muscle bands compress the blood out of the auricles into the ventricles, while the longitudinal bands aid in this and pull up the base of the ventricles to meet the load of blood. As the contraction starts from the mouths of the venae cavae, and sweeps towards the ventricles, there can



From *Diseases of the Heart*, by James Mackenzie, M.D., by permission.

FIG. 12.—Tracings of the Jugular Pulse Apex Beat, Carotid and Radial Pulses. The perpendicular lines represent the time of the following events:—1, the beginning of the auricular systole; 2, the beginning of ventricular systole; 3, the appearance of the pulse in the carotid; 4, the appearance of the pulse in the radial; 5, the closing of the semilunar valves; 6, the opening of the tricuspid valves.

occur but little regurgitation of blood into the venous cistern, but the cessation of flow into the auricle during its systole does produce a slight rise of pressure in the cistern, as is shown by tracings taken from the jugular pulse. The function of the auricles is to rapidly complete the filling of the ventricles.

The auriculo-ventricular valves are floated up and brought into apposition by eddies set up in the blood which streams into the ventricles, and close without noise or jar at the moment when the intra-ventricular pressure exceeds in the least that in the auricles. The systole of the ventricles immediately following that of the auricles closes the auriculo-ventricular valves, and as the intra-ventricular pressure rises above that in the pulmonary artery and aorta respectively the semilunar valves open and the blood is expelled; these elastic vessels are in their turn expanded by the expulsive force of the heart so as to receive the blood. The papillary muscles, by contracting synchronously with the muscular wall of the ventricles, pull down and flatten the dome-like diaphragm formed by the closed auriculo-ventricular valves, thus shortening the longitudinal diameter of the ventricles, while at the same time they enlarge the auricles and so help to fill these cavities. The outflow of blood from the ventricles is rapid at first. It becomes slower as the big arteries become distended and the pressure of blood rises within them, and ceases finally when the pressure becomes equal to that in the ventricles. As the outflow diminishes the semilunar pockets are filled by eddies of blood, and their thin edges are brought nearer and nearer, until finally they come into apposition. The closure is effected without jar or noise at the moment when the outflow ceases and the ventricles begin to expand. The heart, as a good pump should, works with the least possible jar. During the contraction of the ventricles blood has been pouring from the veins into the auricles, and directly the ventricular systole ceases the auriculo-ventricular valves open, and the blood begins to fill the expanding ventricular cavities. For a brief moment the ventricles remain dilated and at rest, then the auricles contract again, and the cycle of changes, once more, is repeated. During the first period of ventricular systole—the period of rising tension—all the valves are closed and the ventricle is getting up pressure. This period has been measured and is found to occupy ·02″—·04″. The second period is that of systolic output, and lasts about ·2″, that is, from the moment when the semilunar valves open to the moment when they close. The upstroke of the pulse curve taken in the aorta, or in the carotid artery in man, can be taken as marking the moment when the semilunar valves open, while the dicrotic notch on the pulse curve marks their closure. The second sound of the heart occurs immediately after their closure, and can be used to mark the time of this event on the impulse curve.

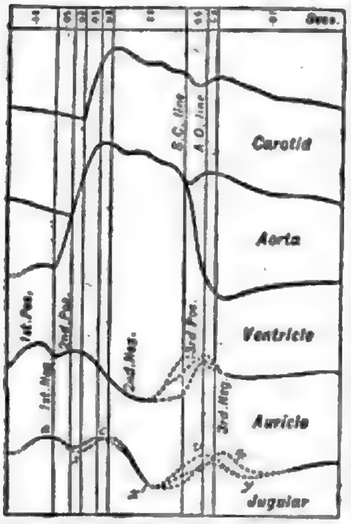


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FIG 13.—Diagrammatic representation of the Cardiac Cycle and of the Carotid and Jugular Pulses in relation to standard movements. The scale of abscissae is 1 mm. to $\frac{1}{100}$ sec. S.C. = semilunar valve closure; A. O. = auriculo-ventricular valves open. The broken lines indicate those portions of the respective curves over which there is doubt or controversy.

The intra-ventricular pressure curve may rise or fall during the output period according to the state of the peripheral resistance. If the carotid pulse be recorded synchronously with the impulse curve, the time relations can be determined for the human heart. The beginning of the upstroke of the impulse curve marks the beginning of systole, that of the pulse curve marks the opening of the semilunar valves, and the dicrotic notch, which precedes the dicrotic wave, marks the closure of these valves and the end of the output. The first sound of the heart is synchronous with the upstroke of the impulse curve. The maximal systolic pressure exerted by the heart varies with the degree of diastolic filling and with the obstruction to outflow. The heart responds to the latter by a greater output of energy, and this it does with little loss in rapidity of action. The total fluid pressure to which the wall of the heart is submitted rapidly increases as the radii of curvature become greater. Hence the greater energy required of a dilated heart, its tendency to hypertrophy and liability to fail. By its reserve power the heart may throw out three or even six times the volume of the normal output per minute, and may maintain its output when the aortic pressure is twice its normal value.

The maximal and minimal pressures have been accurately recorded in the heart by a manometer fitted with a valve arranged so that either only a rise or a fall of pressure is recorded. In the right ventricle of the dog the maximal pressures recorded equalled 35–62 mm. of mercury, in the left ventricle 114–135 mm., in the auricles 2–20 mm. (Michael Jäger, 1795–1838). A negative pressure, of considerable amount but of very fleeting duration, sometimes occurs in the ventricles at the beginning of diastole. This is produced by the elastic rebound of the fleshy columns of the inner wall of the heart, which become pressed together as the blood is wrung out of the ventricular cavities. The entry of the first few drops of blood from the auricles abolishes this negative pressure, and it has no important influence on the filling of the heart.

The sounds of the heart.

When the ear is applied over the cardiac region of the chest, or a stethoscope is employed, two sounds are heard, the first, heard most intensely over the apex, is a duller and longer sound than the second, which is shorter and sharper and is heard best over the base of the heart. The syllables *lub, dupp* express fairly well the characters of the two sounds, and the accent is on lub when the stethoscope is over the apex, thus—lúb-dupp—lúb-dupp—lúb-dupp, and on the second sound when over the base, thus—lub-dúpp—lub-dúpp—lub-dúpp. The sounds of the heart have been successfully recorded by means of the microphone. Hürthle inserted the microphone in the primary circuit of an E. Du Bois-Reymond induction coil, and placed the nerve of a frog-muscle preparation in the secondary circuit. The muscle, being attached to a lever, recorded its contraction on a revolving drum at the moment when the sound of the heart reached the microphone and closed the primary circuit. A capillary electrometer can be inserted in place of the frog-muscle indicator, and the movements of the electrometer photographed on a sensitized plate moved by clockwork (Willem Einthoven). Each sound gives rise to a succession of vibrations of the mercury meniscus of the capillary electrometer. The first sound is formed of many component tones derived from the sudden tension, and consequent vibration, of the ventricular muscle, and of the auriculo-ventricular valves with their chordae tendineae. The first sound can be resolved by a trained musical ear into two tones, one deep and the other high. The deeper tone alone is heard on the contraction of the excised and bloodless heart, while the higher tone is produced by throwing the auriculo-ventricular valves into tension (John Berry Haycraft). In the cold-blooded animal, such as the turtle, the heart muscle does not become tense rapidly enough to produce a sound (Allen). This sound is not produced by fluid friction as the blood rushes through the arterial orifices, for the velocity of outflow is too small to produce in this way any noise. Nor is it produced by sudden opening of the semilunar valves, for these open quietly and without jar at the moment when the intra-ventricular pressure rises above that in the aorta.

The second sound of the heart is produced by the tension of the semilunar valves in the aorta and pulmonary artery at the moment when the ventricles pass into diastole. These valves close without any jar or shock so soon as the arterial pressures rise to the slightest degree above that in the ventricles. In the next moment the ventricles dilate, and the valves, no longer supported on one side, become taut. The elastic vibrations of the walls of the distended arteries probably share in the production of this sound.

When the sounds and the impulse are recorded together the record shows that the first sound begins about 0·01 sec. before the cardiagram marks the beginning of systole, and for the first 0·06 sec. of its duration this sound is heard only over the apex. Over the base of the heart the first sound is heard just at the time when the semilunar valves open and the output begins. The first sound ceases before the ventricular contraction is over, for it is the sudden tension, not the continuance of contraction, that causes it. The beginning of the second sound marks the sudden tension of the semilunar valves which immediately follows their closure.

For practical purposes it is important to bear in mind what is happening in the heart whilst one listens to its sounds. During the first sound we have (1) contraction of the ventricles, closure of the auriculo-ventricular valves and impulse of the apex against the chest; (2) rushing of the blood into the aortic and pulmonary artery, and filling of the auricles. With the second sound we have closure of the semilunar valves from the elastic recoil of the aorta and pulmonary artery, relaxation of the ventricular walls, opening of the auriculo-ventricular valves so as to allow the passage of blood from auricle to ventricle, and diminished pressure of apex against chest wall. With the long pause there are (1) gradual refilling of the ventricle from the auricle, and (2) contraction of the auricle so as to entirely fill the ventricle. The sound of the tricuspid valve is heard loudest at the junction of the lower right costal cartilages with the sternum, of the mitral over the apex beat, of the aortic semilunar valves in the direction of the aorta where it comes nearest to the surface at the second right costal cartilage, and of the valves of the pulmonary orifice over the third left costal cartilage, to the left and external to the margin of the sternum. The sounds are changed in character by valvular lesion or muscular weakness of the heart, and afford important signs to the physician. Murmurs are produced by eddies setting some part of the membranous walls or valve flaps in vibration.

If a stethoscope be placed over a large artery, a murmur will be heard, caused by the blood rushing through the vessel narrowed by the pressure of the instrument. The fluid escapes into a wider portion of the vessel beyond the point of pressure, and the sound is caused by the eddies set up there throwing the membranous wall of the vessel into vibration. Such a sound is heard over an aneurism. The placental bruit heard during pregnancy is a sound of this kind, arising from pressure on the uterine arteries. In cases of insufficient aortic valves a double blowing murmur may be heard, the first being due to the rush of blood into the vessel, and the second to the regurgitation of the blood back into the ventricle. These murmurs are produced by eddies of blood setting the membranous parts into vibration.

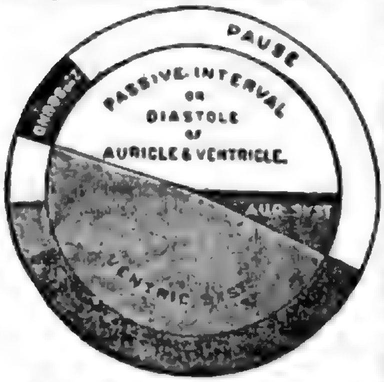


FIG. 14.—Scheme of a Cardiac Cycle. The inner circle shows what events occur in the heart, and the outer the relation of the sounds and silences to these events.

Occasionally a murmur is produced by the displacement of air in the bronchial vessels by the beat of the heart, and may simulate the murmur of aortic incompetence. By placing a stethoscope over the jugular vein on the right above the collar bone a murmur is heard, the *bruit de diable*, particularly if the subject turn his head to the left. This is held to be due to the vibration of the blood in the jugular vein rushing from the dilated to the contracted part. It is more marked during auricular diastole and during inspiration.

The nutrition of the heart.

The work of the heart.

In the lower vertebrates, as the frog, the heart is directly nourished by the blood which fills the cavities in its sponge-like structure. In the warm-blooded vertebrates there is a special arrangement of coronary vessels. The two coronary arteries (right and left) originate at the root of the aorta from the sinuses of Valsalva. Their branches penetrate the muscular substance and end in a rich plexus of capillaries. From these arise the radicles of the coronary veins which open into the right auricle by the coronary sinus and other small veins. These openings are valved. The heart in contracting exerts a greater pressure than that of the coronary arteries, and so arrests the flow in these during the height of systole, and squeezes the blood within the coronary capillaries and veins on into the right auricle. On diastole the coronary system fills again. Sudden occlusion of any large part of the coronary arteries produces irregular and inco-ordinate contractions, followed by daath of the heart. Gradual occlusion of the coronary arteries by degenerative changes in advanced life is one of the causes of the distressing form of cardiac distress known as angina pectoris. The work of the left ventricle is calculated by the formula $W = VP + mv^2$, where V = volume of blood in c.c. expelled per beat, P = mean pressure in aorta, m = mass of the blood expelled on systole, and v = the velocity imparted to it. The volume of the output has been determined directly by inserting the stromuhr in the ascending aorta (Robert Adolf Tigerstedt), and indirectly by determining (1) how much oxygen is absorbed per minute, (2) the difference in the oxygen content of the arterial and venous blood, (3) the number of heart beats. If 1000 c.c. of oxygen are absorbed from the air breathed in a minute, and the arterial blood contains 10% more oxygen than the venous, it is clear that 100×100 c.c. of blood must have passed through the lungs in that time, and if the heart beat 100 times, the output for each beat would be 100 c.c. From the determinations made on animals the output is calculated for man to be 60–100 c.c. The velocity of the output can be calculated if the volume of the output is known, the duration of the period of output, and the diameter of the aorta. The pressure is measured with a manometer. The velocity is much greater at the orifice than in the aorta, for the blood can flow from the aorta during the whole cardiac cycle, while the whole of it must escape through the orifice into the aorta during the period of output. The work spent on maintaining the velocity is not, however, more than $\frac{1}{11}$ of the whole and is generally neglected in the calculation. The output is not greater than 60–100 c.c. (3 oz.) (Tigerstedt, Nathan Zuntz), and the mean arterial pressure in a healthy man, determined by the sphygmometer, is not more than 110 mm. of mercury (L. Hill). The work of the right heart can be reckoned to be ¼ that of the left, for the pressure in the pulmonary artery does not exceed 30 mm. The total work of the heart during the day may be taken as equal to 20,000 kilogr.-metres, and this would be equivalent to 50 calories out of the total 2500 calories which a man takes in as food. A labourer does about 150,000 kilogrm.-metres of external work a day. The work of the heart is increased two or three times over during severe muscular labour. It has been estimated that the heart requires per diem, to maintain its energy, an amount of solid food (water-free) equal to the weight of solids in the heart itself, *i.e.* about 60 grms. of sugar or proteid. 30 c.c. of blood must be circulated per minute through the coronary arteries of a dog to maintain the vigour of the heart.

The artificial circulation of the heart.

The use of oxygen per grm. of weight per minute is high for the heart. Thus for the whole body of the dog there was used ·017 c.c. per grm. per min., for the heart ·045–·083, and for the active secretory glands ·07–1·0 (Barcroft and Dixon). It has long been known that the heart of frog or tortoise can be kept beating normally for hours after removal from the body, if it is provided with an artificial circulation of blood or a suitable solution of salts. Sydney Ringer worked out the necessary ingredients of this solution to be

Sodium chloride	0·7 %
Potassium „	0·03 %
Calcium „	0·025 %

The excised mammalian heart can be kept beating in the same way provided the nutritive fluid is oxygenated and the heart kept at body temperature. A solution containing one-third defibrinated blood and two-thirds Ringer's salt solution is most suitable. A mammalian heart thus was restored to activity 7 days after death. The beat of the heart of a child was restored 20 hours after death from pneumonia. The excised heart of a cat was kept beating for 4 days. The heart of a monkey was restored after freezing the body of the animal. The nerves of the excised heart retain their action for some time if the nutritive fluid is immediately circulated through the coronary arteries. Thus the heart's action can be conveniently studied when taken from the body of a mammal.

The cause of the heart beat.

The cause of the heart beat has naturally been one ot thé most continued objects of inquiry, and the point of view shifts with each advance of our experimental methods, and the wider extension of the inquiry throughout the animal world. H. Allen in 1757 was the first to announce that the activity of the heart is not dependent on its connexion with the nervous system. The excised heart, properly fed, continues to beat. The heart of a dog continued to work effectively and the animal to keep in health for months after division of all the nerves passing to the heart. The heart, it is true, is controlled and influenced constantly by the nervous system—attuned to the general needs of the body—but this control is not essential to life. The above dog, when exercised, became fatigued quickly, owing to the lack of the nervous control of the heart. When in 1848 Robert Remak discovered that groups of nerve cells are contained in the heart of the frog, the causation of the beat was attributed to the activity of these ganglia.

Confirmation of this view was found in the experiment of Hermann Stannius which demonstrates that the apex of the heart ceases to beat rhythmically if physiologically separated from the rest of the heart by ligature or momentary application of a clamp. The sinus, on the other hand, which contains ganglion cells, continues its beat as before when separated. Further experiment has shown that the beat of the heart cannot be ascribed to the rhythmic activity of the ganglion cells, which in the mammalian heart lie scattered in the base of the heart, in the neighbourhood of the venous opening and in the auriculo-ventricular groove. That this is so is shown by the fact that every strip of heart muscle, whether free of ganglion cell or not, is capable of rhythmic activity under suitable conditions (Walter Gaskell, 1847–   , Theodor Wilhelm Engelmann, Alfred Wm. Porter). The inherent power of rhythmic contraction is most clearly seen in the embryonic heart, for the pulsation of the chick's heart became visible by the 24th to 48th hour of incubation, while the migration of the ganglion cells into the heart from the sympathetic system does not take place until the sixth day (His.). The heart muscle is pervaded by a network of nerve fibrils, and the supporters of the neurogenic theory have had to fall back upon this network as the cause of the beat. The "myogenic" theorists place the causation in the muscle itself.

The pulsating "umbrella" of the jelly-fish is formed of a network of nerve fibril and contractile elements, and this can be excited to contract by irritating any one of the sensory endings of the nervous network which are situated on the edge of the "umbrella." In the manifestation of a "refractory period" the "umbrella" behaves like the heart. Against this view we may cite the experiment of Julius Bernstein (1839), who clamped off the apex of the frog's heart to destroy the physiological continuity, kept the animal alive till the nerve network had degenerated and then found the apex could be mechanically excited to contract. Moreover, skeletal muscle-fibres can be thrown into rhythmic contraction by the application of a suitable solution of salts (Wilhelm Biedermann, 1854), and it is probable that heart muscle is excited to rhythmic activity by such means. At any rate the beat is profoundly affected by varying slightly the nature and percentage of salts supplied in the nutritive fluid. Carlson has recorded experiments upon the heart of the horseshoe crab (*Limulus*) which show that its beat at any rate depends on the integrity of the median nerve (and its ganglion cells) which runs down the heart. On the other hand, Gaskell has shown that any small bridge of heart muscle left connecting the auricle and ventricle of the tortoise heart will transmit the wave of contraction, while if the nerve passing from sinus to ventricle be left, and the muscular connexions entirely severed, no wave passes. In contradistinction to cross-striated muscle, the structural unit of the heart is not also a functional unit, for the heart-cells are, from the earliest stage of development, joined together by branches into networks and bands so as to form one functional whole, and hence excitation of any one part leads to the contraction of the whole. The first part to begin to functionate in the embryo is the venous end, and the waves of contraction passing thence spread over the developing ventricular segment. The muscle-cells of the ventricles are thicker, less sarcoplasmic and more clearly striated than the auricular muscle, which is more embryonic in structure. The contraction lasts longer in the ventricular than in the auricular muscle, while the automatic rhythm not only persists longer in the auricles, but is of greater frequency, as is clearly seen when the cavities of the heart are divided from each other. The venous orifices of the heart are least sensitive to injury, beat longest after death, and are the first to recover after arrest. Owing to the more powerful automatism of the venous extremity, the contraction normally proceeds thence, and passing as a peristaltic wave over the auricles and ventricles, finally reached the arterial orifices. This peristaltic form of contraction is invariable in all periods of development and in all hearts, both of invertebrate and vertebrate animals. The peristalsis may, with difficulty, be artificially reversed by the application of a powerful rhythmic stimulus to the ventricular end. Antiperistalsis does not, however, take place easily, because the comparatively slow excitatory process in the ventricle has little effect on the auricular muscle. The latter, by initiating more rapid contraction-waves, over-dominates the former. The frequency of the whole heart is accelerated by warming the auricles, while the period of systole is alone shortened on warming the ventricles.

The sequence in the beat of the three chambers of the heart is attributed by Gaskell to the delay that occurs in the excitatory wave passing through the muscular connexions in the sino-auricular and auriculo-ventricular junctions. He showed that such delay could be imitated by moderately clamping a strip of heart muscle; the compressed part transmitted the wave less readily, so that the part above and below the clamp contracted in sequence.

In the mammalian heart there has recently been discovered a remarkable remnant of primitive fibres persisting in the neighbourhood of the venous orifices (representing the sinus). These fibres are in close connexion with the vagus and sympathetic nerves, and form the sino-auricular node of A. Keith and Martin Flack. If this node is squeezed by a clamp, it prevents the effect of excitation of the vagus reaching the heart. The auricle and ventricles of the mammalian heart are connected through the septum by a remarkable bundle of muscle fibres which is believed to convey the excitatory wave from the one cavity to the other. The root of this auriculo-ventricular bundle lies in the right auricle, the main part is buried in the interventricular septum; its branches and twigs are distributed to all parts of either ventricle; the papillary muscles and fleshy columns, in particular, receive a direct supply. The muscle fibres are of a peculiar type, known as the cells of Purkinje. By this bundle it is believed every part of the ventricle is brought into synchronous contraction. To its degeneration has been ascribed certain cases of disturbed cardiac rhythm, when the ventricle no longer follows the sequence of auricle. The evidence of such degeneration is, at present, not convincing.

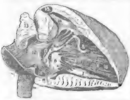


FIG. 15.—The Right Auricle and Ventricle of a Calf's Heart, exposed to show the course and connexions of the auriculo-ventricular bundle. 1, central cartilage exposed by dissection; 2, the main bundle; 3, auricular fibres from which the main bundle arises; 4, right septal division; 5, moderator band; 6, a cusp of the tricuspid valve; 7, posterior group of the musculi papillaries; 8, orifice of the coronary sinus; 9, above orifice of the inferior vena cava (10); 11, orifice of the superior vena cava; 12, septal wall of the right auricle; 13, appendix of the right auricle; 14, septal wall of the infundibulum; 15, beginning of the pulmonary artery; 16, apex of the right ventricle. (After A. Keith, in *Journal of Anatomy and Physiology*.)

The electrical change of the heart.

The contraction of the heart, like that of other muscle, is accompanied by an electrical change. The part in contraction is at different potential to the part at rest. Thus an electrical wave accompanies the wave of contraction. This has been studied by means of the capillary, or the string, electrometer (Sir John Scott Burdon-Sanderson and Page, Einthoven, Gotch). The photographic records obtained with these instruments afford us a most beautiful method of recording the rhythm of normal and abnormal hearts in man, for they can be obtained by connecting the right hand and left foot of a patient with the instrument. Einthoven, by making use of the telephone wires, recorded in his laboratory the electrical changes of the hearts of patients seated in a hospital 2 m. away.

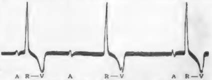


FIG. 16.—Electrical Changes of Heart. A, diphasic variation of auricle; R—V, diphasic variation of ventricle. R = base negative; V = apex negative to base. After auricular contraction the ventricular is delayed—an example of arhythmia. (Einthoven.) The string galvanometer is the best method for elucidating disorders of cardiac rhythm.

The heart during the period of systole is refractive to artificial excitation, but its susceptibility returns with diastole. The force and amplitude of any cardiac contraction depend on the previous activity of the heart and on such physical conditions as the degree of diastolic filling, the resistance to systolic outflow, temperature, &c., but are independent of the strength of the artificial stimulus so long as the latter is efficient. Owing to the refractory period, the slow rate of contraction and the independence of the amplitude of contraction on the strength of stimulus, the heart under ordinary conditions cannot be thrown, by rapidly repeated excitation, into a complete state of tetanic spasm. The refractory period can be shortened by heat (40° C.), or by calcium and sodium salts until tetanus is obtainable. The cardiac muscle is rich in sarcoplasm, and on this depends its power of slow, sustained contraction. The heart-muscle, besides rhythmically contracting, possesses "tone," and this tone varies with the conditions of metabolism, temperature, &c. Chloroform, for example, produces a soft dilated, strychnine, adrenalin or ammonia a tonically contracted heart. The mammalian heart ceases to beat at temperatures below 7° C. and above 44° C., and passes into "heat rigor" at 45° C.

The Cardiac Nerves.—In 1845 the brothers Weber made the astonishing discovery that the vagus nerve, when excited, slowed or even arrested the action of the heart. This was the first proof of the existence of inhibitory nerves. The cardiac inhibitory nerves have since been found in all classes of vertebrates and in many invertebrates. Some years later v. Beyeld (1862) and Moses and Il'ya Cyon (1843–) discovered the existence of nerve fibres which, when excited, augmented and accelerated the beat of the heart. These nerves arise from 1–5 thoracic anterior spinal nerve roots and have their "cell stations" in the first thoracic and inferior cervical ganglia, whence they pass to the heart partly in company with the cardiac branches of the vagus, and partly as separate twigs. The vagus cardiac fibres arise by the middle of the lowermost group of vagus roots, and have their cell-stations in the ganglion cells of the heart. These ganglion cells lie chiefly in the sub-pericardial tissue in the posterior wall of the auricles between and around the orifices of the venae cavae and pulmonary veins and between the aorta and pulmonary artery. The minute structure of these ganglia and the terminations of the nerves have been studied particularly by Dogiel. The inhibitory fibres arise from a centre in the spinal bulb which is in tonic action and constantly bridles the heart's action. When the vagi are divided the frequency of the heart increases and the blood pressure rises. The vagus centre is reflexly excited by the inhalation of chloroform, ammonia or other vapour irritant to the air passages, also by the want of oxygen in the blood in asphyxia. It may be excited by irritation of the abdominal nerves, *e.g.* a blow on the abdomen, and by increased pressure in the cerebral vessels. The acceleratory and augmenting fibres

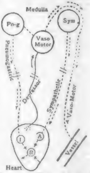
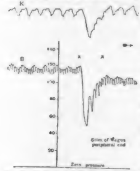


FIG. 17.—The origins of pneumogastric and vaso-motor systems are in medulla, that of the sympathetic in upper portion of cord. The arrows indicate direction of nerve currents. In the heart R represents a reflex centre, I an inhibitory centre and A an accelerating centre.

likewise have their centre in the spinal bulb, and are in tonic action, antagonizing more or less the action of the vagal centre. The vagus nerve works directly on the cardiac muscle, and produces some change (signalized by a positive variation in the electrical state of the heart) which results in a depression of the excitability, the conductivity, the force and the frequency of the heart. After the vagal arrest the heart beats more forcibly, owing, it is thought, to the greater accumulation of contractile material during the period of rest. The converse of all these effects occurs on stimulation of the accelerator nerves. Excitation of these nerves may excite to renewed efforts an excised heart which has just ceased to beat after withdrawal of the supply of nutritive solution. Hence it is thought by some that the accelerator nerves tonically exert a sustaining influence on the heart.



From Howell's *Text-Book of Physiology*, by permission of W. B. Saunders Co.

Fig. 18.—B, arterial blood pressure. K, record of volume of kidney. Inhibition of heart on faradizing vagus nerve.

The alkaloid atropin paralyses the vagal nerve endings in the heart, while nicotine paralyses the ganglion cells. Muscarin obtained from poisonous fungi slows and finally arrests the heart. Adrenalin, the active principle of the medulla of the supra-renal glands, augments its power. Chloroform depresses it and in poisonous dose throws the heart into paralytic dilatation. A great many of the cardiac vagal fibres convey impulse to the spinal bulb (centripetal), and reflexly influence the heart frequency, the breathing and the tonus of the blood vessels. In particular certain fibres, termed *depressor* (discovered by Ludwig and Cyon, 1866), cause dilatation of the arterioles and a fall of arterial pressure by inhibiting the tonic action of the vaso-motor centre in the spinal bulb. The depressor fibres arise from the root of the aorta, and over-distension of this part excites them, as evidenced not only by the above effect, but also by the electrical variation (action current) which has been observed passing up the depressor nerve. Sensory impressions originating in the heart do not as a rule enter into consciousness. They are carried by the cardiac nerves to the sympathetic ganglia, and thence to the upper thoracic region of the spinal cord, where they come into relation with the sensory nerves from the pectoral region, upper limb, shoulder, neck and head. The impressions are not felt in the heart, but referred to these sensory cutaneous nerves. Thus cardiac pain is felt in the chest wall and upper limbs and particularly on the left side. The function of the cardiac nerves is to co-ordinate the beat of the heart with the needs of the body and to co-ordinate the functions of other organs with the needs of the heart. For example, an undue rise of arterial pressure, induced, let us say, by compression of the abdomen, excites the centre of the vagus and produces slowing of the heart and a consequent lowering of arterial pressure. The heart of a mammal, however, continues to functionate after a section of all the branches of the cardiac plexus has been made, so that the nervous control and co-ordination of the heart are not absolutely essential to the continuance of life.

Certain physical factors concerning the circulation.

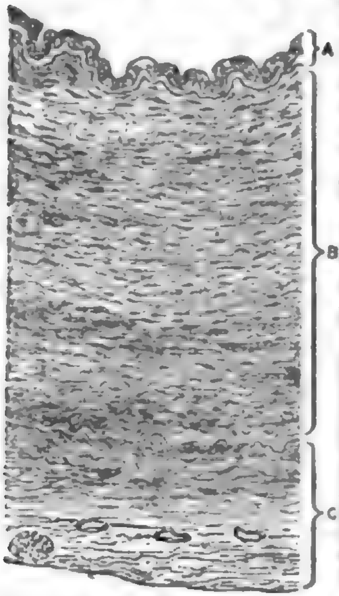
Water flowing through a tube from a constant head of pressure encounters a resistance occasioned by the friction of the moving water particles against each other and against the stationary layer that wets the wall of the tube. Part of the potential energy of the head of pressure is spent in endowing the fluid with kinetic energy, the greater part in overcoming this resistance is rubbed down into heat. The narrower the tube is made, the greater the friction, until finally the flow ceases, the total energy being then insufficient to overcome the resistance.

The resistance may be measured at any point in the tube by inserting a side tube in the vertical position. The water rises to a certain height in the side tube, indicating the head of pressure spent in overcoming the resistance between the point of measurement and the orifice. If the lower end of the side tube is bent thus ⅃ and inserted so that its orifice faces the stream, the water will rise higher than it did in the first case. The extra rise indicates the head of pressure spent in maintaining the velocity of flow. Such a method has been used to measure the velocity of flow in the vascular system (Napoleon Cybulski). When a stream of water is transmitted intermittently by the frequent strokes of a pump through a long elastic rubber tube, the fluid does not issue in jets as it would in the case of a rigid tube, but flows out continuously. The elastic tube is distended by the force of the pump, and its elasticity maintains the outflow between the strokes. The continuous outflow here depends on the elasticity of the tube and the resistance to flow.

In the vascular system an area of vessels of capillary size is placed between the large arteries and veins. This area opposes a great resistance to flow. The arteries also are extensile elastic tubes. The effect of the peripheral resistance, as it is called, is to raise the pressure on the arterial side and lower it on the venous. The resistance to flow is situated chiefly, not in the capillaries, but in the small arteries, where the velocity is high; for "skin friction"—that is, the friction of the moving concentric layers of blood against one another and against the layer which wets the wall of these blood vessels is proportional to the surface area and to the viscosity of the blood—is nearly proportional to the square of the velocity of flow, and is inversely proportional to the sectional area of the vessels. Owing to the resistance to the capillary outflow, the large arteries are expanded by each systolic output of the heart, and the elasticity of their walls comes into play, causing the outflow to continue during the succeeding diastole of the heart. The conditions are such that the intermittent flow from the heart is converted into a continuous flow through the capillaries. If the arteries were rigid tubes, it would be necessary for the heart to force on the whole column of blood at one and the same time; but, owing to the elasticity of these vessels, the heart is saved from such a prolonged and jarring strain, and can pass into diastolic rest, leaving the elasticity of the distended arteries to maintain the flow. As a result of disease, the elastic tissue may degenerate and the arteries become rigid. Besides the saving of heart-strain, there are other advantages in the elasticity of the arteries. It has been found that an intermittently acting pump maintains a greater outflow through an elastic than through a rigid tube; that is to say, if the tubes be of equal bore. The four chief factors which co-operate in producing the conditions of pressure and velocity in the vascular system are—(1) the heart-beat, (2) the peripheral resistance, (3) the elasticity of the arteries, (4) the quantity of blood in the system. Suppose the body to be in the horizontal position and the vascular system to be brought to rest by, say, excitation of the vagus nerve and arrest of the heart. A sufficiency of blood to distend it collects within the venous cistern. The arterial system, owing to its elasticity and contractility, empties. If the heart now begin to beat, blood is taken from the venous system and is driven into the arterial system. The arteries receive more blood than can escape through the capillary vessels, and the arterial side of the system becomes distended, until equilibrium is reached, and as much blood escapes into the venous side per unit of time as is delivered by the heart. The flow in the capillaries and veins has now become a constant one and if the side pressure be measured it will be found to fall from the arteries to the capillaries, and from the capillaries to the venae cavae. In the large arteries there is a large side pressure which rises and falls with the pulses of the heart. The pulse waves spread out over a wider and wider area as the arteries branch. They finally die away in the arterioles. An increase or decrease in the energy of the heart-beat will increase or decrease respectively the velocity of flow and pressure of the blood. An increase or decrease in the total width of the arterioles respectively will lessen or raise the resistance; increase or decrease the velocity; lower or raise the blood pressure. A loss of blood, other conditions remaining the same, would cause a decrease in pressure and velocity. As a matter of fact, such a loss is compensated for by the adjustability of the vascular system. Tissue lymph passes from the tissues into the blood, and the blood vessels of the limbs and abdomen constrict, and thus the pressure is kept up, and an efficient circulation maintained through the brain, lungs and coronary vessels of the heart.

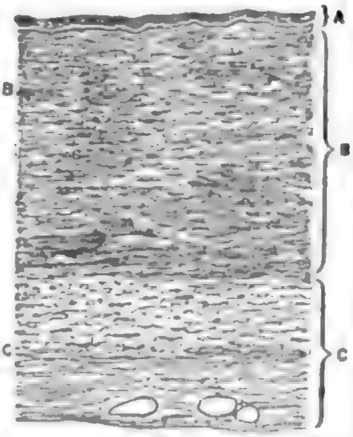
Structure of the blood vessels.

The whole vascular system is lined within by a layer of flattened cells, the *endothelium*; each cell is exceedingly thin and cemented to its fellows by a wavy border of an interstitial protoplasmic substance. The endothelium affords a smooth surface along which the blood can flow with ease. Outside it there exists in the arteries and veins a middle and an external coat. The middle coat varies greatly in thickness and contains most of the non-striated muscle-cells, which in the smaller arteries and arterioles form a particularly well developed band. In the larger arteries (fig. 19) a great deal of yellow elastic tissue, together with some white, fibrous tissue, pervades the middle coat. At the inner and outer border of this coat the elastic fibres fuse to form an internal and external fenestrated membrane. This coat endows the arteries with extensibility, elasticity and contractility. The outside coat consists mostly of white fibrous tissue and not only protects the arteries, but by its rigidity prevents over-distension. In the veins (fig. 20), where the middle coat is somewhat thinner and contains less elastic tissue, the outer coat consists mostly of muscle-fibres. The valves of the veins are formed of fibrous and elastic tissue covered with endothelium. As the arterioles branch into capillaries the muscular and elastic elements become less and less, until in the capillaries themselves there is left only the layer of endothelium, supported by some stellate connective tissue cells The capillaries form networks which accommodate themselves to the structure of the organs, *e.g.* longitudinal networks in muscle, loops in the papillae of the skin, close-meshed networks round the alveoli of glands, cells of liver, &c. In the liver the blood penetrates into the substance of the liver-cells. As the capillaries join together to form the vennules, muscle fibres again appear and coat the walls of the latter. The veins have a greater capacity than the arteries. Blood vessels, the vasa vasorum, supply the walls of the large vessels with nutrition.



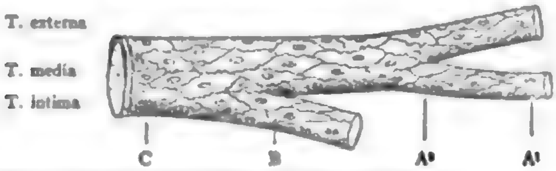
From Young and Robinson, Cunningham's *Text-Book of Anatomy.*

FIG. 19.—Transverse Section through the Wall of a Large Artery. A, tunica intima; B, tunica media; C, tunica externa.



From Young and Robinson, Cunningham's *Text-Book of Anatomy.*

FIG. 20.—Transverse Section of the Wall of a Vein. A, tunica intima; B, tunica media; C, tunica externa.



From Young and Robinson, Cunningham's *Text-Book of Anatomy.*

FIG. 21.—Structure of Blood Vessels (diagrammatic). A^1, capillary—with simple endothelial walls. A^2, larger capillary—with connective tissue sheath, "adventitia capillaris"; B, capillary arteriole—showing muscle cells of middle coat, few and scattered; C, artery—muscular elements of the tunica media forming a continuous layer.

The vaso-motor nerves end in a plexus of fibrils among the muscle-fibres. Ganglion cells occupy the larger nodes of the nerve plexus. The ends of a torn artery retract, coil up within the external coat and prevent haemorrhage. The arteries contract when mechanically irritated and remain contracted for a long time after excision. They tend to contract when submitted to increased blood pressure. The capillaries cannot contract of themselves, but their lumen can be widened or narrowed by the varying contractility or turgidity of the tissues in which they run.

The arteries successfully withstand elastic strain of the pulse 70 times a minute throughout the years of a long life. It has proved possible to stitch divided arteries and veins together so perfectly that the circulation can continue through them. A kidney has thus been successfully transplanted from one dog to another, and has continued to functionate normally.

The elastic coefficients of the several layers of the coat of an artery increase from within out, and thus great strength is obtained with the use of a small amount of material. Over-expansion of the arteries is checked by an external coat of inextensible connective tissue. The elasticity of a healthy artery is almost perfect, while the breaking strain is very great and far above that exerted by the blood pressure. The small arteries and arterioles are essentially muscular tubes, and can, under the influence of the central nervous system, vary considerably in diameter.

The pulse.

By the expulsion of the blood at each systole the walls of the aorta are suddenly distended. From the aorta a wave of distension ripples down the walls of the arteries. This wave of distension is called the pulse. As the pulse is distributed over an ever-widening field its energy is expended and it disappears finally in the arterioles. From a wounded artery the blood flows out in pulses, from a wounded vein continuously. To stop the haemorrhage the ligature must be applied between the wound and the heart in the case of the artery, and between the peripheral parts and the wound in the case of the vein. The pulse travels about 20 times as fast as the blood flows in the arteries (7–8 metres per second). By feeling the pulse we can tell whether the heart-beat is frequent, quick, strong, regular, &c., and whether the wall of the artery is normal and the pressure in the arteries high or low. Frequency expresses the number per minute, quickness the duration of a single beat. The pulse is a most important guide to the physician. The pulse can be registered graphically by means of a sphygmograph. A lever rests on the radial artery and transmits the pulse to a system of levers which magnifies the movement and records it on a smoked surface moved by clockwork.

In such a record, or sphygmograph, the upstroke corresponds to systolic output of the left ventricle, marking the opening of the aortic valves, and the pouring of the blood into the arteries.

The downstroke represents the time during which the blood is flowing out of the arteries into the capillaries. There are subsidiary waves on the downstroke. The chief of these is called the dicrotic wave, the notch preceding which marks the closure of the semilunar valves. The dicrotic wave is caused by the jerk back of the blood towards the heart when the outflow ceases, and is most manifest when the systole is short and sharp and the output of blood from the arterioles rapid, in other words when the heart-beat is strong, the systolic pressure high and the diastolic pressure low. A smaller wave, predicrotic, preceding this occurs during the period of output and sometimes is placed on the ascending limb of the pulse curve. This occurs when the peripheral resistance is great, and the pulse is then termed anacrotic.

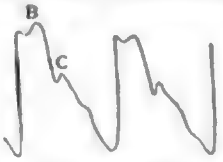


FIG. 22.— Anacrotic Pulse.

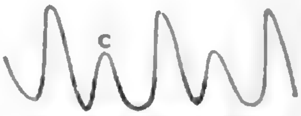
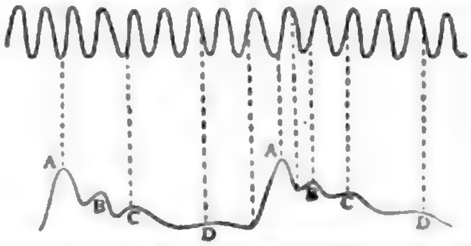


FIG. 23.—Dicrotic Pulse.



FIGS. 22, 23 and 24 from Allchin's *Manual of Medicine*, by permission of Macmillan & Co. Ltd.

FIG. 24.—Normal Pulse, and Time Tracing in $\frac{1}{5}$ sec.

A, Primary wave.	C, Dicrotic wave.
B, Predicrotic wave.	D, Post-dicrotic wave.

The form of these waves is modified by the pressure of application of the sphygmograph, and by instrumental errors; and we have no scale by which we can measure the blood pressure in sphygmograph tracings. To do this another instrument, the sphygmomanometer, is employed.

The pulse may pass through the arterioles and reach the capillaries when the arterioles are dilated or when the capillaries are only filled at each systole, as may be seen in the pink of the nail when the arm is held above the head, and in cases of aortic regurgitation.

A venous pulse may be recorded in the jugular vein; it exhibits oscillations synchronous with auricular and ventricular systole, and affords us important information in certain cases of heart disease. The normal average pulse rate is 72 per minute, in woman about 80; but individual variations from 40–100 have been observed consistent with health. In the newborn the pulse beats on the average 130–140 times a minute; in a one-year-old child 120–130; three years 100; ten years 90; fifteen years 70–75. Active muscular exercise may increase the pulse rate to 130. Nervous excitement, extreme debility and rise of body temperature also increase it markedly. The pulse is more frequent when one stands than when one sits, or lies down, and this is especially so in states of debility. The taking of food, especially hot food, increases it. By placing tambours on, say, the carotid and radial arteries and recording the two pulses synchronously, it has been found that the pulse occurs later, the further the seat of observation is from the heart. The velocity with which the pulse wave travels down the arteries has been determined thus. It is about 7–8 metres per second. The wave length of the pulse is obtained by multiplying the duration of the inflow of blood into the aorta by the velocity of the pulse wave. It is about 3 metres. As the return of venous blood and pulmonary circulation is favoured during inspiration so that the output of the left ventricle during the first part of inspiration is lessened and subsequently increased, the sphygmograph reveals respiratory oscillations; the whole line of the tracing falls during the first part of inspiration and rises subsequently.

The capillary circulation.

The circulation in the capillaries may be studied by placing under the microscope a transparent membrane such as the web of the frog's foot, tail of tadpole, wing of bat, &c. By a special illumination one may see the shadow of the blood corpuscles moving through the retinal vessels of one's own eye, and even calculate the velocity of flow. The diameter of the smaller capillaries is such as to permit the passage of the red blood corpuscles in single file only; their length is about $\frac{1}{50}$th of an inch. The endothelial cells confine the blood from direct contact with the tissue lymph and so prevent its coagulation, but allow and regulate the exchange of material between the blood and lymph. This exchange is regulated by the vital activity of the cells, and does not follow such laws as pertain to filtration and diffusion through dead membranes. There is evidence to show that the cells of the hepatic capillaries are capable of protoplasmic movement and of phagocytosis. The pressure in the capillaries stands in closer relationship to that in the veins than to that in the arteries; for example, a rise of pressure in the venae cavae, other things remaining the same, raises the pressure in the hepatic capillaries to a like amount, while a rise of pressure in the aorta does not, for most of the arterial pressure is spent in overcoming the peripheral resistance. The filling of the capillaries in the skin varies greatly with temperature, posture, &c. When the hand is cold the arterioles are so constricted that blood only passes through the wider and more direct capillaries. As the skin becomes warm it flushes, the arterioles dilating and all the capillary networks becoming filled with blood. Muscular movements express the blood out of the capillaries, as may be seen by the blanching of the skin which occurs on clenching the hand. Raising the hand blanches, and lowering it congests the capillaries. The pressure and velocity in the capillaries thus constantly vary, owing to alterations in hydrostatic pressure, the pressure of the body against external objects, the contraction of the muscles, and the contraction of the arterioles. It is not possible therefore to set any definite figure to the capillary pressure or velocity. In the frog's web, with the foot confined and at rest, the velocity is about 1 mm. per second. We continually make slight movements to counteract the hydrostatic effect and prevent the congestion of blood in the capillaries of lower parts of the body. It is this tendency to congestion which makes it so difficult to stand absolutely motionless for any length of time. The red corpuscles, being the heavier, occupy the axis, and the white corpuscles the peripheral layer of the capillary stream. If an irritant is placed on the membrane it will be observed that the capillaries become wider and crowded with corpuscles, the flow slackening and finally becoming arrested owing to the passing out of the plasma through the damaged capillary wall. The white corpuscles creep out between the endothelial cells into the tissues. Such are the first phenomena of inflammation. After obstruction of an artery collateral pathways are in most parts rapidly formed, for the anastomatic capillaries, stimulated by the increased blood flow, develop into arterioles and arteries.

The flow in the veins.

Numerous anastomoses exist between the veins, so that if the flow of blood be obstructed in one direction it readily finds a passage in another. Muscular movement, alterations of posture and respiratory movements particularly forward the venous circulation. The barber's pole of the barber surgeon was grasped to increase the flow in the old blood-letting days. The valves in the veins allow the blood to be forced only towards the heart. The pressure in the veins varies according to the hydrostatic pressure of the blood column above the point of measurement. In the horizontal position, when this factor is almost eliminated, the pressure in the large veins is about equal to 5-10 mm. of mercury, and even may become negative on taking a deep inspiration. There thus arises the danger of air being sucked into a wounded jugular vein. If air does thus gain entry it may fatally obstruct the circulation.

The venous circulation is impeded by (1) a lessening of heart power, (2) valvular defects, such as incompetence or narrowing of the orifice which they guard, (3) obstruction to the filling of the heart, as in cases of pericardial effusion, (4) obstruction of the pulmonary circulation as in coughing, by pleuritic effusion, &c. The results of venous congestion are a less efficient arterial circulation, a dusky appearance of the skin, a fall of cutaneous temperature, and an effusion of fluid into the tissue spaces producing oedema and dropsy. This last effect is not due to increased capillary pressure producing increased transudation as has been supposed, for no such increase in venous and capillary pressure persists under the conditions. It is due to the altered nutrition of the capillary endothelium and the tissues, which results from the deficient circulation.

If for any reason the left ventricle fail to maintain its full systolic output, it ceases to receive the full auricular input, and in consequence the pulmonary vessels congest. This tells back on the right heart, and the right ventricle is unable to empty itself into the congested pulmonary vessels, and this in its turn leads to venous congestion. The final result of any obstruction thus is a pooling of the blood in the venous cistern. Dyspnoea results from cardiac insufficiency. It is excited by the increased venosity of the blood acting on the respiratory centre. Both excess of carbon dioxide and deficiency of oxygen excite this centre. The increased respiratory movements aid the circulation.

Haemorrhage and transfusion.

The venous side of the vascular system, owing to the great size of the veins, has a large potential capacity, while many of the capillaries in each organ are empty and collapsed, except at those periods of vaso-dilatation and hyperaemia which accompany extreme activity of function. The vascular system cannot be regarded as a closed system, for the blood-plasma, whenever the capillary pressure is increased, transudes through the capillary wall into the tissue-spaces and enters the lymphatics. Thus, if fluid be transfused into the circulatory system, it not only collects in the capacious reservoirs of the veins and capillaries—especially in the lungs, liver and abdominal organs—but leaks into the tissue-spaces. Hence the pressure in the vascular system cannot be raised above the normal for any length of time by the injection of even enormous quantities of fluid. The lymphatics of tissue-spaces must be regarded as part of the vascular system. There is a constant give and take between the blood-plasma and the tissue lymph. If the fluid part of the blood be increased, then the capillary transudation becomes greater, and the excess of fluid is excreted from the kidneys and glands of the alimentary canal. If the fluid part of the blood diminish, then fluid passes from the tissue-spaces into the blood, and the sensation of thirst arises, and more drink is taken. The circulation may be greatly aided by the transfusion of salt solution (0·8 %) or blood after severe hemorrhage, or in states of surgical shock. Only the blood of man must be used. The direct giving of blood by connecting the radial artery of a relation to the median vein of a patient has been used as a means of effecting restoration. Blood may be withdrawn from the system slowly to the extent of 4 %, rapidly to the extent of 2 % of the bodyweight, without lowering the arterial pressure, owing to the compensatory contraction of the arterioles and the rapid absorption of fluid from the tissues into the blood. The withdrawal of the tissue-lymph excites extreme thirst and the great need for water which occurs after severe hemorrhage. About 75 % by weight of the tissues, excluding fat and bone, consists of water. The quantity of blood in the body is about $\frac{1}{20}$th of the body weight. That of tissue-lymph is unknown; but it must be considerable, probably greater than that of the blood. The lymphatics drain off the excess of fluid which transudes from the capillaries, and finally return it to the vascular system. The interchange between tissue, blood and lymph depends on the forces of the living cells, which are as yet far from complete elucidation.

The velocity of blood flow.

We may define the velocity of the blood at any point in a vessel as the length of the column of blood flowing by that point in a second. In the case of a tube, supplied by a constant head of pressure, we can divide the tube and measure the outflow per second; knowing the volume of this, and the cross area of the artery, we can determine the length of the column. This kind of experiment cannot be done on the living animal, because the opening of the vessel alters the resistance to flow, and the loss of blood also changes the physiological conditions. To determine the velocity other means must be devised. Ludwig invented an instrument called the stromuhr, consisting of two bulbs mounted on a rotating platform pierced with two holes. One bulb is filled with oil—the other with blood. The bulbs are connected together by a tube at their upper end, and the lower end of the one full of oil is brought over the hole in the platform. The central end of the artery is connected to the same hole and the peripheral end to the other, over which stands the bulb full of blood. The blood being allowed to flow displaces the oil out of the one bulb into the other; directly this happens, the bulbs are rotated and the one full of oil is again brought over the central end of the artery. The number of rotations per minute is counted, and the volume of the bulb being known we obtain the volume of blood that passes through the instrument per minute. In another instrument, the haemodromograph of Chauveau, there is inserted into the artery a ⊥ tube in which hangs a small pendulum; the stem of the pendulum passing through a rubber dam which closes the vertical limb of the tube. The pendulum is deflected by the flow, and the greater the velocity the greater the deflection. The deflection can be recorded by connecting the free end of the pendulum to a tambour arrangement. This instrument allows us to record and measure the variations of velocity during systole and diastole of the heart, but it can only be used in the vessels of large animals. Still other methods have been employed by Cybulski and Stewart. The general relations of the velocity of the blood in the arteries, capillaries and veins is expressed by the curve shown in fig. 26. The velocity in the large arteries may reach 500 mm. per second

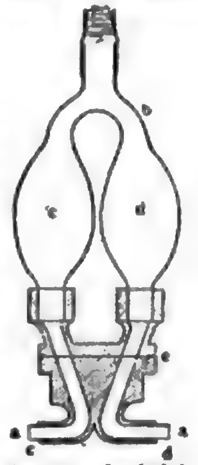


FIG. 25.—Ludwig's Stromuhr.

in systole and fall to 150 mm. in diastole. The smaller the artery the less is this difference and the more uniform the rate of flow.

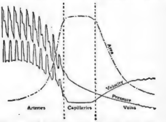


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FIG. 26.—Diagram showing General Relations of the Velocity of the Blood in the Arteries, Capillaries and Veins.

The flow in the large veins is approximately equal to that in the large arteries. In the jugular vein of a dog the mean velocity was found to be 225 mm. and in the carotid 260 mm. per second. The velocity in the capillaries has been measured by direct observation with the microscope. It is very small, *e.g.* 0·5–1 mm. per second. The variation of velocity in different parts of the vascular system is explained by the difference in width of bed through which the stream flows. The vascular system may be compared to a stream which on entering a field is led into a multitude of irrigation channels, the sum of the cross sections of all the channels being far greater than that of the stream. The channels unite together again and leave the field as one stream. If the flow proceeds uniformly for any given unit of time, the same volume must flow through any cross section of the system. Thus the greatest velocity is where the total bed is narrowest, and slowest where the bed widens to the dimensions of a lake.

The time necessary for a complete circulation.

The blood in leaving the heart may take a short circuit through the coronary system of the heart and so back to the right heart, or it may take a long and devious course to the toes and back, or through the intestinal capillaries, portal system and hepatic capillaries. It is obvious, then, that the time any two particles of blood take to complete the circuit may be widely different. Experiments have been made to determine how rapidly any substance, like a poison, which enters the blood may be distributed over the body. A salt such as potassium ferrocyanide is injected into the jugular vein, and the blood collected in successive samples at seconds of time from the opposite jugular vein. These samples are tested for the presence of the salt, or a strong solution of methylene blue is injected into the jugular vein, and the moment determined with a stop-watch when the blue colour appears in the carotid artery.

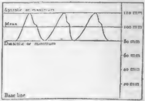
The velocity of flow also can be determined in any organ by injecting salt solution into an artery, and observing, with the aid of a Wheatstone's bridge arrangement, the galvanometric change in electrical resistance which occurs in the corresponding vein when the salt solution reaches it. The moment of injection and that of the alteration in resistance are observed with a stop-watch (Stewart).

It has been determined that the blood travelling fastest can complete the circuit in about the time occupied by 25 to 30 heart-beats, say in 20 to 30 seconds; a result which shows how rapidly methods must be taken to prevent the absorption of poisons—for example, snake-poison. The blood travelling fastest in the pulmonary circuit occupies only about one-fifth of the time spent by that in the systemic circuit. That some of the blood takes a very long time to return to the heart is shown by the long time it takes to wash the vascular system free of blood by the injection of salt solution.

The pressure relation in the vascular system.

That the blood is under different pressure in the various parts of the system has long been known. From a divided artery the blood flows out in forcible spurts, while from a vein it flows out continuously and with little force. It takes very little pressure of the fingers to blanch the capillaries of the skin, but an appreciable amount to obliterate the radial artery.

Stephen Hales (1733) was the first to measure the blood pressure. He inserted a brass tube into the femoral vein of a horse and connected it to a long glass tube held vertically, using the trachea of a goose as a flexible tube, and found the blood rose to the height of 8 ft., oscillated there with each heart-beat, and rose and fell somewhat with inspiration and expiration. In the vein he found the pressure to be only about 12 in. Poiseuille (1828) adapted to the same purpose the mercurial manometer, a U-shaped tube containing mercury, which, being 13·5 times heavier than blood, allowed the manometer to be brought to a convenient height. The introduction of rubber tubing for the connexions made the method of inquiry comparatively simple. The tubing connecting the arterial cannula and the manometer was filled with a suitable fluid to prevent coagulation of the blood; also to prevent more than a trace of blood entering the connexions. A saturated solution of sodium sulphate, or a 1 % solution of sodium citrate, may be employed for this purpose. Ludwig (1847) added a float provided with a writing style to the mercurial manometer, and brought the style to write on a drum covered with smoked paper and driven slowly round by clockwork—a kymograph. By this means tracings of the arterial blood pressure are obtained, and the influence upon the blood pressure of various agents recorded and studied. For the veins a manometer filled with salt solution is used, as mercury is too heavy a fluid to record the far slighter changes of venous pressure. The manometer may be connected with a recording tambour.



From Howell's *Text-Book of Physiology*, by permission of W. B. Saunders Co.

FIG. 27.—Diagram showing Systolic, Mean and Diastolic Pressure.

The arterial blood-pressure record obtained with the mercurial manometer exhibits cardiac and respiratory oscillations as shown in fig. 18. The method gives us a fairly accurate record of the mean pressure, but the mass of the mercury causes such inertia that the instrument is quite unable to faithfully record the systolic and diastolic variations of pressure. To effect this record, delicate spring manometers of rapid action and small inertia have been invented. A mercury manometer provided with maximum and minimum valves has also been employed to indicate the maximal systolic and minimal diastolic pressure. To determine the blood pressure in man, an instrument called the sphygmometer is used. The writer's sphygmometer consists of a rubber bag covered with silk which is filled with air, and connected by a short length of tube to a manometer. This manometer consists of a graduated glass tube, open at one end. A small hole is in the side of the tube near this end. A meniscus of water is introduced up to the side hole—the zero mark on the scale—by placing the open end of the tube in water. The bag is now connected to the gauge so that the side hole is closed by the rubber tube. Covering the rubber bag with the hand and pressing it on the radial artery until the pulse (felt beyond) is obliterated, one reads the height to which the meniscus rises in the manometer, and this gives us the systolic pressure in the artery. The air above the meniscus acts as a spring, converting the instrument into a spring manometer. It is empirically graduated in mm. Hg.

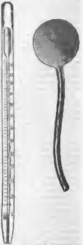


FIG. 28.—Hill's Sphygmometer.

It is very necessary to remember that the blood pressures, taken in different vessels and postures, vary with the hydrostatic pressure of the column of blood above the point of measurement. Thus in the standing posture the arterial pressure in the arteries of the leg is higher than in the arm by the height of the column of blood that separates the two points of measurement. In the horizontal posture the pressure is practically the same in all the big arteries. The pressure in the ascending aorta is kept about the same in all postures, while that of the leg arteries varies widely. The effect of gravity is compensated there by active changes in heart force, splanchnic dilatation, &c. (L. Hill). The systolic pressure of young men, taken in the radial artery with the arm at the same level as the heart, may be taken to be about 110 mm. of Hg. In men of 40–60 years the systolic pressure is often about 140 mm., but in some robust men it is no higher than in youth.

The venous pressure in man may be measured by finding the pressure just required to prevent a cutaneous vein refilling after it has been emptied beyond a valve. There is no accurate method of measuring the capillary pressure. It and the venous pressure constantly vary from nothing to a positive amount with rest or movement of muscles, change of posture, &c.

The arterial pressure is raised during exertion by the more forcible beat of the heart—*e.g.* pressures of 140–190 mm. Hg have been observed immediately after a 3-mile race. It rapidly sinks to a lower level than usual after the exertion is over, *e.g.* 90 mm. Hg, owing to the quieter action of the heart and the persistence of the cutaneous dilatation of the blood vessels which is evoked by the rise of body temperature. The writer has observed in athletes rectal temperatures of 102–105° F. after long races. After meals there is an increase in cardiac force to maintain the flow through the dilated splanchnic vessels. Mental excitement raises the pressure—*e.g.* the writer's pressure may be 110 mm. before and 125 mm. Hg after giving a lecture. The origin of the blood pressure in the arteries is the energy of the heart. The pressure gradient depends on the peripheral resistance. In the arterials the pressure is spent, and little of it reaches the capillaries. The return of the capillary blood to the veins and the pressure in the veins is due partly to the remainder of the cardiac force, but more largely to the contraction of the skeletal muscles and the viscera, to the action of gravity in changes of posture and to the respiratory pump.

The pulmonary circulation.

The pulmonary artery, carrying venous blood, divides and subdivides, and the smallest branches end in a plexus of capillaries on the walls of the air-cells of the lung. From this plexus the blood is drained by the radicles of the four pulmonary veins which open into the left auricle. The pressure in the pulmonary artery is less than one-third the aortic pressure, and the blood takes only one-third of the time to complete the pulmonary circuit that it takes to make the systemic. The four chief factors which influence the pulmonary circulation are: (1) the force and output of the right ventricle; (2) the diastolic filling action of the left auricle and ventricle; (3) the diameter of the pulmonary capillaries, which varies with the respiratory expansion of the lungs; (4) the intrathoracic pressure.

In inspiration the lungs are distended in consequence of the greater positive pressure on the inner surfaces being greater than the negative pressure on their outer pleural surfaces. The negative pressure in the intrathoracic cavity results from the enlargement of the thorax by the inspiratory muscles. When the elastic lungs are distended by a full inspiration they exert an elastic traction amounting to about 15 mm. Hg. The heart and vessels within the thorax are submitted to this traction—that is, to the pressure of the atmosphere minus 15 mm. Hg—while the vascular system of the rest of the body bears the full atmospheric pressure. The thin-walled auricles and veins yield more to this elastic traction than the thick-walled ventricles and arteries. Thus inspiration exerts a suction action, which furthers the filling of the veins and auricles. This action is assisted by the positive pressure exerted by the descending diaphragm on the contents of the abdomen. Blood is thus both pushed and sucked into the heart in increased amount during inspiration.

Experiment has shown that the blood vessels of the lungs when distended are wider than those of collapsed lungs. Suppose an elastic bag having minute tubes in its walls be dilated by blowing into it, the lumina of the tubes will be lessened, and the same occurs in the lungs if they are artificially inflated with air; but if the bag be placed in a glass bottle, and the pressure on its outer surface be diminished by removing air from the space between the bag and the side of the bottle, the bag will distend and the lumina of the tubes be increased. Thus it is evident that inspiration, by increasing the calibre of the pulmonary vessels, draws blood into the lungs, and the movements of the lungs become an effective force in carrying on the pulmonary circulation. It has been estimated that there is about one-twelfth of the whole blood quantum in the lungs during inspiration, and one-fifteenth during expiration. The great degree of distensibility of the pulmonary vessels allows of frequent adjustments being made, so that within wide limits as much blood in a given time will pass through the pulmonary as through the systemic system. The limits of their adjustment may, however, be exceeded during violent muscular exertion. The compressive action of the skeletal muscles returns the blood to the venous cistern, and if more arrives than can be transmitted through the lungs in a given time, the right heart becomes engorged, breathlessness occurs, and signs of venous congestion appear in the flushed face and turgid veins. The weaker the musculature of the heart the more likely is this to occur; hence the breathlessness on exertion which characterizes cardiac affections. The training of an athlete consists largely in developing and adjusting his heart to meet this strain. Similarly the weak heart may be trained and improved by carefully adjusted exercise. Rhythmic compression of the thorax is the proper method of resuscitation from suffocation, for this not only aerates the lungs, but produces a circulation of blood. By compressing the abdomen to fill the heart, and then compressing the thorax to empty it, the valves meanwhile directing the flow, a pressure of blood can be maintained in the aorta even when the heart has ceased to beat, and this if patiently continued may lead to renewal of the heart-beat. There is no certain evidence that the pulmonary arteries are controlled by vaso-motor nerves. In the intact animal it is difficult to determine whether a rise of pressure in the pulmonary artery is induced really by constriction of the pulmonary system, or by changes in the output of the heart; hence different observers have reached conflicting conclusions. In the case of lungs which have been supplied with an artificial circulation and a constant head of pressure to eliminate the action of the heart, no diminution in outflow has been observed in exciting the branches of the vagus or sympathetic nerves which supply the lungs, or by the injection of adrenalin (Sir Benjamin C. Brodie (1783–1862), and Dixon, Burton-Spitz).

The portal circulation.

The portal circulation is peculiar in that the blood passes through two sets of capillaries. Arterial blood is conveyed to the capillary networks of the stomach, spleen, pancreas and intestines by branches of the abdominal aorta. The portal vein is formed by the confluence of the mesenteric veins with the splenic vein, which together drain these capillaries. The portal blood breaks up into a second plexus of capillaries within the substance of the liver. The hepatic veins carry the blood from this plexus into the inferior vena cava. Ligation of the portal vein causes intense congestion of the abdominal vessels, and so distensile are these that they can hold nearly all the blood in the body: thus the arterial pressure quickly falls, and the animal dies just as if it had been bled to death. The portal circulation is largely maintained by the action of the respiratory pump, the peristaltic movements of the intestine and the rhythmic contractions of the spleen; these agencies help to drive the blood through the second set of capillaries in the liver. The systole of the heart may tell back on the liver and cause it to swell, for there are no valves between it and the inferior vena cava. Obstruction in the right heart or pulmonary circulation at once tells back on the liver. The increased respiration which results from muscular exercise greatly furthers the hepatic circulation, while it increases the consumption of food material. Thus exercise relieves the over-fed man. The liver is so vascular and extensile that it may hold one-quarter of the blood in the body.

The cerebral circulation.

The circulation of the brain is somewhat peculiar, since this organ is enclosed in a rigid bony covering. The limbs, glands and viscera can expand considerably when the blood pressure rises, but the expansion of the brain is confined. By the expression of venous blood from the veins and sinuses the brain can receive a larger supply of arterial blood at each pulse. Increase in arterial pressure increases the velocity of flow through the brain, the whole cerebral vascular system behaving like a system of rigid tubes when the limits of expansion have been reached. For as the pressure transmitted directly through the arteries to the capillary veins must always be greater than that transmitted through the elastic wall of the arteries to the brain tissue, the expansion of the arteries cannot obliterate the lumina of the veins. The pressure of the brain against the skull wall is circulatory in origin; in the infant's fontanelle the brain can be felt to pulse with each heart-beat and to expand with expiration. The expiratory impediment to the venous flow produces this expansion. A blood clot on the brain or depressed piece of bone raise the brain pressure by obliterating the capillaries in the compressed area and raising the pressure therein to the arterial pressure. The arterial supply to the brain by the two carotid and two vertebral arteries is so abundant, and so assured by the anastomosis of these vessels in the circle of Willis, that at least two of the arteries in the monkey can be tied without grave effect. Sudden compression of both carotids may render a man unconscious, but will not destroy life, for the centres of respiration, &c., are supplied by the vertebral arteries. The vertebral arteries in their passage to the brain are protected from compression by the cervical vertebrae.

Whether the muscular coat of the cerebral arteries is supplied with vaso-motor nerves is uncertain. Hürthle and others observed a rise of pressure in the peripheral end of the carotid artery on stimulating the cervical sympathetic nerve. The writer found this to be so only when the cervical sympathetic nerve was excited on the same side as the carotid pressure was recorded. If the circle of Willis was constricted, excitation of either nerve ought to have the effect; it is possible that the effect was produced by the vaso-constriction of the extra-cranial branches of the carotid. After establishing an artificial circulation of the brain Wiggins found that adding adrenalin to the nutritive fluid reduced the outflow, and it is supposed that adrenalin acts by stimulating the ends of the vaso-motor nerves, rather than by stimulating the muscular coats of the arteries. The veins of the pia and dura mater have no middle muscular coat and no valves. The venous blood emerges from the skull in man mainly through the opening of the lateral sinuses into the internal jugular vein; there are communications between the cavernous sinuses and the ophthalmic veins of the facial system, and with the venous plexuses of the spinal cord. The points of emergence of the veins are well protected from closure by compression. The brain can regulate its own blood supply by means of the cardiac and vaso-motor centres. Deficient supply to these centres excites increased frequency of the heart and constriction of the arteries, especially those of the great splanchnic area. Cerebral excitement has the same effect, so that the active brain is assured of a greater blood supply (Bayliss and L. Hill).

The circulation during muscular activity.

In each unit of time the same quantity of blood must, on the average, flow through the lesser and greater circuit, for otherwise the circulation would not continue. Likewise, the average velocity at any part of the vascular system must be inversely proportional to the total cross-section at that part. In other words, where the bed is wider, the stream is slower; the total sectional area of the capillaries is roughly estimated to be 700 times greater than that of the aorta or venae cavae. Any general change in velocity at any section of this circuit tells both backwards and forwards on the velocity in all other sections, for the average velocity in the arteries, veins and capillaries, these vessels being taken respectively as a whole, depends always on the relative areas of their total cross-sections.

The vascular system is especially constructed so that considerable changes of pressure may be brought about in the arterial section, without any (or scarcely any) alteration of the pressures in the venous or pulmonary sections of the circulatory system. A high-pressure main (the arteries) runs to all the organs, and this is supplied with taps; for by means of the vaso-motor nerves which control the diameter of the arterioles, the stream can be turned on here or there, and any part flushed with the blood, while the supply to the remaining parts is kept under control. Normally, the sum of the resistances which at any moment opposes the outflow through the capillaries is maintained at the same value, for the vascular system is so coordinated by the nervous system that dilatation of the arterioles in any one organ is compensated for by constriction in another. Thus the arterial pressure remains constant, except at times of great activity. The great splanchnic area of arterioles acts as "the resistance box" of the arterial system. By the constriction of these arterioles during mental or muscular activity the blood current is switched off the abdominal organs on to the brain and muscles, while by dilating during rest and digestion they produce the contrary effect. The constriction of the splanchnic vessels does not sensibly diminish the capacity of the total vascular system, for the veins possess little elasticity. Thus variations of arterial pressure, brought about by constriction or dilatation of the arterial system, produce little or no effect on the pressure in the great veins or pulmonary circuit. The contraction of the abdominal muscles, on the other hand, greatly influences the diastolic or filling pressure of the heart. It is obviously of the utmost importance that the heart should not be over-dilated by an increased filling pressure during the period of diastole.

When a man strains to lift a heavy weight he closes the glottis, and by contracting the muscles which are attached to the thorax raises the intrathoracic pressure. The rise of intrathoracic pressure aids the pericardium in supporting the heart, and prevents over-dilatation by resisting the increase in venous blood pressure. This increase results from the powerful and sustained contraction of the abdominal and other skeletal muscles. In the diagram already given it is clear that the contraction of T will counteract the contraction of A. At the same time the rise of intrathoracic pressure supports the lungs, and prevents the blood, driven out from the veins, from congesting within the pulmonary vessels. Over-dilatation both of the heart and lungs being thus prevented, the blood expressed from the abdomen is driven through the lungs into the left ventricle, and so into the arteries. So long as the general and intense muscular spasms continue, there is increased resistance to the outflow of the blood through the capillaries both of the abdominal viscera and the limbs. The arterial pressure rises, therefore, and the flow of blood to the central nervous system is increased. The rise of the intrathoracic and intra-abdominal pressures, and the sustained contraction of the skeletal muscles, alike hinder the return of venous blood from the capillaries to the heart, and, owing to this, the face and limbs become congested until the veins stand out as knotted cords. It is obvious that at this stage the total capacity of the vascular system is greatly diminished, and the pressure in all parts of the system is raised. It is during such a muscular effort that a degenerated vessel in the brain is prone to rupture and occasion apoplexy. The venous obstruction quickly leads to diminished diastolic filling of the heart, and to such a decreased velocity of blood flow that the effort is terminated by the lack of oxygen in the brain. During any violent exercise, such as running, the skeletal muscles alternately contract and expand, and the full flood of the circulation flows through the locomotor organs. The stroke of the heart is then both more energetic and more frequent, and the blood circulates with increased velocity. Under these conditions the filling of the heart is maintained by the pumping action of the skeletal and respiratory muscles. The abdominal wall is tonically contracted, and the reserve of blood is driven from the splanchnic vessels to fill the dilated vessels of the locomotor organs. The thorax is tonically elevated and the thoracic cavity enlarged, so that the pulmonary vessels are dilated. At each respiration the pressure within the thoracic cavity becomes less than that of the atmosphere, and the blood is aspirated from the veins into the right side of the heart and lungs; conversely, at each expiration the thoracic pressure increases, and the blood is expressed from the lungs into the left side of the heart. While the respiratory pump at all times renders important aid to the circulation of the blood, its action becomes of supreme importance during such an exercise as running. The runner pants for breath, and this not only increases the intake of oxygen, but maintains the diastolic filling of the heart. It is of the utmost importance that man should grasp the fact that the circulation of the blood depends not only on the heart, but on the vigour of the respiration and the activity of the skeletal muscles. Muscular exercise is for this reason a *sine quâ non* for the maintenance of vigorous mental and bodily health. Under the influence of the muscular system comes not only the blood but the lymph. The lymphatics form a subsidiary system of small valved vessels, and drain the tissues of the excess of lymph, which transudes from the capillaries of the organs during functional activity, or in consequence of venous obstruction. The larger lymphatics open into the veins at the root of the neck. It is chiefly by the compressive action of the skeletal and visceral muscles, and the aspirating action of the respiratory pump, that the lymph is propelled onwards. It must be borne in mind that the descent of the diaphragm during inspiration compresses the abdominal organs, and thus aids the aspirating action of the thorax in furthering the return to the heart both of venous blood and of lymph.

Influence of posture on the circulation.

The circulation remains efficient not only in the horizontal but also in the erect position, and just as much so when a man, like a gymnast, is ceaselessly shifting the position of his body. Yet in a man standing six feet the hydrostatic pressure of a column of blood reaching from the vertex to the soles of the feet is equal to 14 cm. of mercury. The blood, owing to its weight, continually presses downwards, and under the influence of gravity would sink if the veins and capillaries of the lower parts were sufficiently extensile to contain it. Such is actually the case in the snake or eel, for the heart empties so soon as one of these animals is immobilized in the vertical posture. This does not occur in an eel or snake immersed in water, for the hydrostatic pressure of the column of water outside balances that of the blood within. During the evolution of man there have been developed special mechanisms by which the determination of the blood to the lower parts is prevented, and the assumption of the erect posture rendered possible. The pericardium is suspended above by the deep cervical fascia, while below it is attached to the central tendon of the diaphragm. Almost all displacement of the heart is thus prevented. The pericardium supports the right heart when the weight of a long column of venous blood suddenly bears upon it, as, for example, when a man stands on his head. The abdominal viscera are slung upwards to the spine, while below they are supported by the pelvic basin and the wall of the abdomen, the muscles of which are arranged so as to act as a natural waist-band. In tame hutch rabbits, with large patulous abdomens, death may result in from 15 to 30 minutes if the animals are suspended and immobilized in the erect posture, for the circulation through the brain ceases and the heart soon becomes emptied of blood. If, however, the capacious veins of the abdomen be confined by an abdominal bandage, no such result occurs. Man is naturally provided with an efficient abdominal belt, although this in many is rendered toneless by neglect of exercise and gross or indolent living. The splanchnic arterioles are maintained in tonic contraction by the vaso-motor centre, and thus the flow of blood to the abdominal viscera is confined within due limits. The veins of the limbs are broken into short segments by valves, and these support the weight of the blood in the erect posture. The brain is confined within the rigid wall of the skull, and by this wall are the cerebral vessels supported and confined when the pressure is increased by the head-down posture. Every contraction of the skeletal muscles compresses the veins of the body and limbs, for these are confined beneath the taut and elastic skin. The pressure of the body against external objects has a like result. Guided by the valves of the veins, the blood is by such means continually driven upwards into the venae cavae. If the reader hangs one arm motionless, until the veins at the back of the hand become congested, and then either elevates the limb or forcibly clenches the fist, he will recognize the enormous influence which muscular exercise, and continual change of posture, has on the return of blood to the heart. It becomes wearisome and soon impossible for a man to stand motionless. When a man is crucified—that is to say, immobilized in the erect posture—the blood slowly sinks to the most dependent parts, oedema and thirst result, and finally death from cerebral anaemia ensues. In man, standing erect, the heart is situated above its chief reservoir—the abdominal veins. The blood is raised by the action of the respiratory movements, which act both as a suction and as a force pump, for the blood is not only aspirated into the right ventricle by the expansion of the thoracic cavity, but is expressed from the abdomen by the descent of the diaphragm. When a man faints from fear, his muscular system is relaxed and respiration inhibited. The blood in consequence sinks into the abdomen, the face blanches and the heart fails to fill. He is resuscitated either by compression of the abdomen, or by being placed in the head-down posture. To prevent faintness and drive the blood-stream to his brain and muscles, a soldier tightens his belt before entering into action. Similarly, men and women with lax abdominal wall and toneless muscles take refuge in the wearing of abdominal belts, and find comfort in prolonged immersion in baths. It would be more rational if they practised rope-hauling, and, like fishermen, hardened their abdominal muscles.

Foetal.

In the mature foetus the fluid brought from the placenta by the umbilical vein is partly conveyed at once to the vena cava ascendens by means of the *ductus venosus* and partly flows through two trunks that unite with the portal vein, returning the blood from the intestines into the substance of the liver, thence to be carried back to the vena cava by the hepatic vein. Having thus been transmitted through the placenta and the liver, the blood that enters the vena cava is purely arterial in character; but, being mixed in the vessels with the venous blood returned from the trunk and lower extremities, it loses this character in some degree by the time that it reaches the heart. In the right auricle, which it then enters, it would also be mixed with the venous blood brought down from the head and upper extremities by the descending vena cava were it not that a provision exists to impede (if it does not entirely prevent) any further admixture. This consists in the arrangement of the Eustachian valve, which directs the arterial current (that flows upwards through the ascending vena cava) into the left side of the heart, through the foramen ovale—an opening in the septum between the auricles—whilst it directs the venous current (that is being returned by the superior vena cava) into the right ventricle. When the ventricles contract, the arterial blood contained in the left is propelled into the ascending aorta, and supplies the branches that proceed to the head and upper extremities before it undergoes any further admixture, whilst the venous blood contained in the right ventricle is forced into the pulmonary artery, and thence through the *ductus arteriosus*—branching off from the pulmonary artery before it passes to the two lungs—into the descending aorta, mingling with the arterial currents which that vessel previously conveyed, and thus supplying the trunk and lower extremities with a mixed fluid. A portion of this is conveyed by the umbilical arteries to the placenta, in which it undergoes the renovating influence of the maternal blood, and from which it is returned in a state of purity. In consequence of this arrangement the head and upper extremities are supplied with pure blood returning from the placenta, whilst the rest of the body receives blood which is partly venous. This is probably the explanation of the fact that the head and upper extremities are most developed, and from their weight occupy the inferior position in the uterus. At birth the course of the circulation undergoes changes. As soon as the lungs are distended by the first inspiration, a portion of the blood of the pulmonary artery is diverted into them and undergoes aeration; and, as this portion increases with the full activity of the lungs, the ductus arteriosus gradually shrinks, and its cavity finally becomes obliterated. At the same time the foramen ovale is closed by a valvular fold, and thus the direct communication between the two auricles is cut off. When these changes have been accomplished, the circulation, which was before carried on upon the plan of that of the higher reptiles, becomes that of the complete warm-blooded animal, all the blood which has been returned in a venous state to the right side of the heart being transmitted through the lungs before it can reach the left side or be propelled from its arterial trunks. After birth the umbilical arteries shrink and close up and become the lateral ligaments of the bladder, while their upper parts remain as the superior vesical arteries. The umbilical vein becomes the ligamentum teres. The ductus venosus also shrinks and finally is closed. The foramen ovale is also closed, and the ductus arteriosus shrivels and becomes the ligamentum arteriosum.

The vaso-motor nerves.

The blood vessels are supplied with constrictor and dilator nerve fibres which regulate the size of the vascular bed and the distribution of the blood to the various organs. The arteries may be compared to a high pressure main supplying a town. By means of the vaso-motor nerves the arterioles (the house taps) can be opened or closed and the current switched on to or off any organ according to its functional needs. If all the arterioles be dilated at one and the same time, the aortic pressure falls, and the blood taking the pathways of least resistance, gravitates to the most dependent parts of the vascular system, just as if all the taps in a town were opened at once the pressure in the main would fail, and only the taps in the lower parts of the town would receive a supply. The discovery of the vaso-motor nerves is due to Claude Bernard (185:). He discovered that by section of the cervical sympathetic nerve he could make the ear of a rabbit flush, while by stimulation of this nerve he could make it blanch. Claude Bernard had the good fortune to make the further discovery that stimulation of certain nerves, such as the chorda tympani supplying the salivary gland, produces an active dilatation of the blood vessels. The vaso-constrictor fibres issue in the anterior spinal roots, from the second thoracic to the second lumbar root, and pass to the sympathetic chain of ganglia. The fibres are of small diameter, and probably arise from cells situated in the lateral horn of the grey matter of the spinal cord. They each have a cell station in one other ganglion and proceed as post-ganglionic fibres to the cervical sympathetic, to the mesenteric nerves and to the nerves of the limbs. Nicotine paralyses ganglion cells, and by applying this test to the various ganglia the cell stations of the vaso-constrictor fibres supplying each organ have been mapped out. The vaso-dilator fibres have not so restricted an origin, for they issue in the efferent roots in all parts of the neural axis. The two kinds of nerves, although antagonistic in action, end in the same terminal plexus which surrounds the vessels. The presence of vaso-dilator fibres in the common nerve trunks is masked, on excitation, by the overpowering action of the vaso-constrictor nerves. The latter are, however, more rapidly fatigued than the former, and by this and other means the presence of vaso-dilator fibres can be demonstrated in almost all parts of the body. The nervi-erigentes to the penis and the chorda tympani supplying the salivary glands are the most striking examples of vaso-dilator nerves. The vaso-dilator nerves for the limbs issue in the posterior spinal roots (Bayliss). The posterior roots contain the afferent nerves (touch, pain, &c.). Excitation of these fibres causes reflexly a rise of blood pressure directly, a vaso-dilatation of the part the nerves supply. Thus it is assured that the irritated or injured part receives immediately a greater supply of blood. The vaso-motor centre exerts a tonic influence over the calibre of the arterial and portal systems.

Much labour has been done since to determine the origin and exact distribution of the vaso-motor nerves to the various organs, and the reflex conditions under which they come normally into action, and, as the fruit, our knowledge of these inquiries has come to a condition of considerable exactness. This knowledge is of great practical importance to the physician, and it is worth noting that it has been obtained entirely by experiment on living but anaesthetized animals. No dissections of the dead animal could have informed us of the vaso-motor nerves. Vaso-motor effects can be studied by (1) inspection of the flushing or blanching of an organ; (2) measuring the venous outflow; (3) recording the pressure in the artery going to and the vein leaving the organ; (4) observations on the volume of an organ. To make these observations, the organ is enclosed in a suitable air-tight box or plethysmograph, an opening being contrived for the vessels of the organ to pass through so that the circulation may continue. The box is filled with air or water and is connected with a recording tambour (see fig. 18).

The chief effects of vaso-constriction are an increased resistance and lessened flow through the organ, diminished volume and tension of the organ, the venous blood issues from it darker in colour and the pressure rises in the artery and falls in the vein of the organ, and its temperature sinks. Lastly, if a large area be constricted the general arterial pressure rises.

The centre is situated in the spinal bulb beneath the middle of the floor of the fourth ventricle. The tone of the vascular system is not disturbed when the great brain and mid brain is destroyed as far as the region of the pons Varolii, but as soon as the spinal bulb is injured or destroyed the arterial pressure falls very greatly, and the animal passes into the condition of surgical shock if kept alive by artificial respiration. Painting the floor of the fourth ventricle with a local anaesthetic, *e.g.* cocaine, has the same lowering effect on the blood pressure. Division of the cervical spinal cord or of the splanchnic nerves lowers the blood pressure greatly. The one lesion cuts off the whole body, the other the abdominal organs from the tonic influence of the centre. The fall of pressure is due almost entirely to the pooling of the blood in the portal veins and vena cava inforior. On the other hand, electrical excitation of the lower end of the divided cord or splanchnic nerves raises the pressure by restoring the vascular tone. If an animal be kept alive after division of the spinal cord in the lower cervical region, as it may be, for the phrenics, the chief motor nerves of respiration, come off above this region, it is found that the vascular tone after a time becomes restored and the condition of shock passes away. By no second section of the spinal cord can the general condition of shock be reproduced, but a total obstruction of the cord once more causes a general loss of the vascular tone. From the experimental result, so obtained, it is argued that subsidiary vaso-motor centres exist in the spinal cord, and there is evidence to show that these centres may be excited reflexly. After the lumbar cord has been destroyed the tone of the vessels of the lower limbs is recovered in the course of a few days. In this case the recovery is attributed to the ganglionic and nervous structures which are intercalated between the spinal cord and the muscular walls of the blood vessels. There are thus three mechanisms of control, the bulbar centre influenced particularly by the visual, auditory and vestibular nerves, the spinal centres and the peripheral ganglionic structures.

The vaso-motor centre is reflexly excited by the afferent nerves, and its ever-varying tonic action is made up of the balance of the "pressor" and "depressor" influences which thus reach it, and from the quality of the blood which circulates through it. Pressor effects, *i.e.* those causing increased constriction and rise of arterial pressure, may be produced by stimulating the central end of almost any afferent nerve, and especially that of a cutaneous nerve. Depressor effects are always obtained by stimulating the depressor nerve, and may be obtained by stimulating the afferent nerves under special conditions. That these reflex vaso-motor effects frequently occur is shown by the blush of shame, the blanching of the face by fear, the blanching of the skin by exposure to cold and the flushing which is produced by heat. The rabbit's ear blanches if its feet are put into cold water. The vaso-motor mechanism is one of the most important of those mechanisms which control the body heat. Stimulation of the nasal mucous membrane causes flushing of the vessels of the head, constriction elsewhere and a rise of arterial pressure. Food in the mouth, or even the sight or smell of food, cause dilatation of the vessels of the salivary gland. The mucous membrane of the air passages flush and secrete more actively when a draught of cold air strikes the skin. Ice placed on the abdomen constricts not only the vessels in the skin but those in the kidney. Many other examples might be given of the control which the vaso-motor system exerts, but the above are sufficient to suggest the influence which the physician can bring to bear on the blood supply of the various organs.

Discussion has taken place as to whether depressor reflexes are brought about by lessening of the vaso-constrictor tone or by excitation of vaso-dilator nerves. Proof of an undoubtable character seems to have been produced that after division of the vaso-constrictor nerves dilatation of a limb can be brought about reflexly by stimulating the depressor nerve, and in this case the effect must be produced by active excitation of the vaso-dilator nerves.

Under certain unusual conditions, *e.g.* deficient supply of oxygen, the vaso-motor centre exhibits rhythmical variations in tonicity which make themselves visible as rhythmical rises and falls of arterial pressure of slow tempo. A waxing and waning of respiration (Cheyne-Stokes breathing) frequently accompanies these waves. Such are observed in sleep, especially in children and in hibernating animals.

BIBLIOGRAPHY.—References to all the authoritative papers up to 1892 on the circulation of the blood will be found in Tigerstedt's *Lehrbuch der Physiologie des Kreislaufs*, and up to 1905–1908 in the articles on the circulation published in Nagel's *Handbuch der Physiologie des Menschen*, viz. "Allgemeine Physiologie des Herzens, Die Innervation der Kreislaufsorgane," by F. B. Hofmann, "Die Mechanik der Kreislaufsorgane," by O. Frank. An elementary introduction to the subject will be found in Leonard Hill's *Manual of Physiology*, and a more extensive treatment of it in the same author's article on the "Mechanism of the Circulation," and Gaskell's article on the "Heart" in Schäfer's *Text-Book of Physiology*, or in one of the larger text-books of physiology, such as that of Howell, Stewart Halliburton or Starling. (L. E. H.)

IV. PATHOLOGY OF THE VASCULAR SYSTEM

On account of its intimate relations with every part of the body, the circulation is prone to disturbances arising from a great series of causes. Some of these produce effects which may be regarded as functional—mere changes in metabolism, whose disturbances react upon the rest of the body; others give rise to definite structural alterations. In considering the pathology of the circulation, it is useful to divide it into that of the heart, that of the blood vessels and that of the blood.

The heart.

The heart is liable to changes in the pericardium, malformations, changes in the myocardium, changes in the endocardium, valvular lesions and functional disorders.

(1) *The pericardium* may become the seat of morbid changes in various cardiac enlargements, it may become stretched or distended; but the most common and important of the changes is an inflammatory one, *i.e. pericarditis*. This may arise by way of the blood stream, as in rheumatism, scarlatina and other infective diseases, or by way of the lymph stream. The micro-organisms chiefly responsible for the production of pericarditis are the pneumococcus, the different varieties of streptococci and staphylococci, the bacillus tuberculosis, the bacillus coli, and sometimes the gonococcus. In the acute form of the disease the shining serous membrane becomes first dull and lustreless, the blood vessels engorged and an exudation of serum takes place; then fibrin is deposited both on the visceral and parietal layers. When the fluid is insufficient to keep the surfaces apart, the separation at each diastole gives rise to the well-known "friction rub." Sometimes the amount of exudation pent up in the pericardial sac is so great as to necessitate its being drawn off. The fluid may be serous or sero-fibrinous, or may be haemorrhagic, or have undergone a putrefactive change. An effusion of serous fluid into the pericardial sac causes considerable embarrassment to the course of the blood, by rendering the negative pressure, normally present in the sac, positive. The reason for the interference with the circulation brought about by this alteration of pressure is that the auricles are by compression rendered incapable of accommodating the blood-return from the veins. Analogous effects are produced by pressure upon the heart from without, whether by aneurysm or tumour, and pleural effusion or pneumothorax, affecting the viscera from without. In pericarditis it has further to be remembered that the effect of the process itself upon the muscle fibres lying beneath the membrane is to cause a softening of texture and weakening of function, whereby the driving power of the heart is diminished. In obliteration of the pericardium, again, the presence of the adhesions between these two layers leads to interference with the contraction of the myocardium, whereby its functions are interfered with. Acute ventricular dilatation may be associated with pericarditis particularly when the latter is of rheumatic origin and is the result of the myocardial softening referred to. Pericardial effusions usually undergo absorption, but various adhesions, and thickenings known as "white spots," may remain. Effusions other than inflammatory are found in the pericardium, *i.e. hydropericardium*, a dropsical accumulation, may be mistaken for an inflammatory one. It occurs in scarlatina, Bright's disease, as part of a general dropsy, or occasionally from some mechanical difficulty interfering with the local circulation. When the fluid is abundant, it may produce the effects noticed under the inflammatory effusion, and the pericardium may become soddened and its endothelium degenerated. *Haemopericardium*, or blood in the pericardium, may occur apart from the amount that may be mixed with inflammatory effusions. It is associated with foreign bodies penetrating from the oesophagus, rupture of an aneurysm, or occasionally associated with scurvy and purpura. Gas and air may sometimes distend the pericardium. It is also liable to new growths, which are usually secondary in character, and tuberculosis and hydatids are sometimes found.

(2) *Malformations.*—We are ignorant of the causes which lead to imperfect development of the heart. Many of its malformations are of purely pathological interest, but others, such as deficiencies of the intraventricular septum, non-closure of the foramen ovale, patency of the ductus arteriosus, or malformations of the valves, produce a series of secondary effects resultant on the deficient aeration of the blood and sluggishness of the circulation and of venous congestion. The train of symptoms is similar to those mentioned below under acquired valvular lesions, but dropsy is very rare.

(3) *The Myocardium.*—The coverings of the heart muscle cannot long be diseased without affecting the contractile substance itself. Any morbid changes in the lung tissues which impede the circulation through them, and more particularly emphysema, lead to change in the substance of the right ventricle, while morbid changes in the systemic arteries lead to changes in the left ventricle. In *hypertrophy* we have an increase of substance. Tangl found by direct measurement that the muscle cells are increased in diameter. The hypertrophy may be due to increased work thrown upon the muscle, as in athletics (idiopathic hypertrophy), or may be compensatory, when the muscle is trying to overcome a circulatory defect, as in valvular stenosis or regurgitation. Hypertrophy, when within physiological limits, is to be considered as a means of adaptation. When occurring in pathological circumstances, it must be regarded as a method of compensation. Every structure and every function in a healthy body has greater or lesser reserve of energy. In healthy conditions the ordinary demands made upon various organs are far below their possible responses, and if these be excessive in extent or duration, the organs adapt themselves to the conditions imposed on them. In abnormal circumstances the process of hypertrophy is brought about by the power which the structures have of responding to the demands made upon them; and so long as the process is adequate, all disturbances may be averted. As an example of such readjustment may be cited the fact that in chronic renal cirrhosis, with increased thickness of the middle tunic of the arteries, there is hypertrophy of the left ventricle.

Dilatation of the heart is due to the inability of the heart muscle to expel the contents of its cavities. It may occur from temporary overstress or in the failing compensation of valvular disease, or may accompany pathological changes in the muscle such as myocarditis or one of the degenerations.

From the presence of toxic substances in the blood (whether introduced from without or arising within the body) the cells of the cardiac muscle fibres are apt to undergo what is termed *cloudy swelling*—the simplest form of degenerative process. The cells become larger and duller, with a granular appearance, and the nuclei are less distinct. As a result of interference with nutrition, whether by simple diminution or perverted processes, *fatty degeneration* ensues. It may be associated, but is not necessarily connected, with adipose accumulation and encroachment commonly termed infiltration. In true fatty degeneration the muscle cells have part of their protoplasm converted into adipose tissue. The fibres become granular, and the cells lose their definition, while the nuclei are obscure.

The myocardium undergoes both acute and chronic reaction changes. In the former there is enlargement of the nuclei, with proliferation but without karyokinesis. The muscle cells become swollen and lose their striation, while they are softer in texture and altered in outline. The intermuscular tissues are swollen, and may be invaded by leucocytes; this may end in abscess formation or in the production of newly formed fibrous tissue. Chronic processes affecting the myocardium give rise to a large amount of fibrosis, and the newly formed fibrous tissue separates and compresses the areas of muscle fibres, giving rise to what is commonly known as chronic interstitial myocarditis.

Restitution or recovery may occur to a varying extent in almost all of the disease-processes which have been considered, but it has to be kept in view that in certain of the degenerative affections there is little if any possibility of getting rid of the results of the process, which in the reactive changes terminating in the formation of much fibrous tissue, or its conversion into adipose or calcareous material, the same holds true. Many of the changes, which are no doubt in their essence conservative, lead to far-reaching consequences, by their interference with nutritive possibilities.

Diseased conditions of the myocardium are frequently associated with atheromatous degenerations of the coronary arteries, and angina pectoris is said to depend upon such state of malnutrition.

The causes which operate by means of the myocardium are almost invariably of a secondary character. The various degenerations already detailed, and the different forms of myocarditis, as well as simple debility of the muscle, are all examples of changes due to general or local disturbance. All processes which directly or indirectly interfere with the energy of the walls of the heart produce twofold effects, by diminishing the aspiratory or suction-pump action during diastole, and by lessening its expulsive or force-pump action during systole. The immediate result upon the heart itself of such disturbances is dilatation of that cavity immediately affected. This may occur under perfectly healthy conditions. In these, however, the dilatation is evanescent, while in the circumstances now under consideration it is permanent, and, although compensated, it leads to persistent dilatation. Upon the blood vessels the result, whether on account of diminished aspiratory or propulsive energy, is that the amount of blood in the arterial system is decreased, while it is increased in the venous. It is not a necessary consequence that because there is less blood in the arteries the arterial pressure will be diminished, or the venous pressure increased because the veins contain more than their normal amount of blood, seeing that the blood pressure depends upon many different factors. It is a fact, nevertheless, that in consequence of the alteration in the relative amount of blood in the arteries and veins there is a considerable disturbance of blood pressure. Gravitation may overcome the contractile and elastic factors, and several consequences arise from the resulting venous engorgement. From transudation, oedema of the dependent parts of the body and the serous membranes occurs. From the sluggish nature of the current, the blood absorbs too much carbonic acid and loses too much oxygen, hence cyanosis is the result. On account, also, of the slowness of the circulation, there is a longer period for radiation of heat, and the superficial parts of the body accordingly become cold.

The engorgement of internal organs leads to distinct changes in them. The solid viscera, such as the liver, the spleen, the kidney and the lung, become enlarged and hyperaemic, and if the disturbance be continued, cyanotic atrophy ensues. Change in structure, with loss of function, takes place from blocking of the vessels by blood-clot, whether due to coagulation on the spot, or by the conveyance thither of clots formed elsewhere; a cirrhotic termination also is not infrequent, although there is still some doubt whether in this latter condition other concomitant causes have not at the same time been operative. The brain, although suffering less from hyperaemia, is subject to disturbance of the circulation through it, while it is a common seat of embolic and thrombotic processes. The heart itself, lastly, suffers in consequence of the disturbed circulation through it, and by undergoing venous stasis, with weakening of its walls and increase of its fibrous tissue, it completes the final link in a vicious circle. Effusion into the serous sacs, such as the pleura, the pericardium and the peritoneum, leads to great disturbance of the viscera with which they are connected. The mucous membranes, both respiratory and digestive, become the seat of catarrhal changes in consequence of the backward pressure and impure blood.

(4) *Changes in the Endocardium.*—In *endocarditis*, or inflammation of the lining membrane of the heart, that portion of the membrane which covers the valves is invariably affected first. Two varieties of endocarditis are described, simple and infective or ulcerative, but it is difficult to separate them pathologically. Both result from poisoning of the membrane by micro-organisms and their toxins; the main difference seems to lie in the variety of micro-organism present. Simple endocarditis may be associated with a variety of diseases, acute rheumatism and scarlet fever being the most frequent. In many fatal cases of chorea associated with endocarditis the micrococcus rheumaticus has been found in the endocardium, while the streptococci present in tonsilitis have produced endocarditis in animals. The membrane covering the valves loses its smoothness, granulations or elevations forming on the free edges; then the endothelium proliferates and is destroyed and fibrin becomes deposited, producing what is termed a "vegetation." In the lower layers of this vegetation micro-organisms can be demonstrated. Finally, portions of the vegetations may be broken off and carried as emboli in the blood stream, or two valves may become glued together, narrowing the opening and producing stenosis, or the deformed valves may be unable to close properly and regurgitation takes place. Thus the lesions of valvular disease are produced. In infective or ulcerative endocarditis, occurring in conjunction with such diseases as pyaemia, septicaemia, smallpox and pneumonia, pyogenic micrococci are carried into the blood stream, and purulent deposits take place around the valves. In this case, however, the emboli are septic, and when carried to distant tissues produce there ulceration and pus-formation. Numerous abscesses may occur in the wall of the heart muscle itself.

(5) *Valvular Lesions.*—All the valves of the heart are not equally liable to disease; those most frequently affected are the aortic and mitral valves. We have seen how the lesions of the valves are brought about. A valvular lesion may act in two ways: it may impede the onward flow of the blood by narrowing the orifice, or the mal-closure of the valves may allow a reflux of blood. Either of these processes may occur at any of the valvular orifices of the heart. Obstruction is usually complicated by some regurgitation as well, though the converse does not hold good. An increase of the quantity of blood in the auricles, particularly the left, has a less marked effect on the heart itself than an increase in the contents of the ventricles, owing to the left auricle being in continuity with the pulmonary system; whereas if the amount of blood in the left ventricle be doubled the ventricle must dilate in order to accommodate it. The reserve power of the heart is called upon to meet the dilatation, the muscular tissues becoming hypertrophied and a more powerful systole is produced. As the left is the chief ventricle to undergo this change, the apex of the heart becomes displaced downwards. Similar changes take place in the right ventricle in pulmonary stenosis or tricuspid incompetency. Changes in the right ventricle other than primary valvular disease of the right side of the heart are frequently preceded by mitral incompetence, and are due to extra pressure being thrown upon the pulmonary semilunar valves by the pressure in the overfull pulmonary system. In mitral regurgitation the accumulation of blood in the right auricular cavity leads to its dilatation and an engorgement of the pulmonary vessels, pulmonary oedema and induration of the lung, which in turn affects the right heart. Should compensatory hypertrophy of the right ventricle fail to be established, we get the general venous congestion, dropsy and sequence before alluded to.

(6) ***Functional Cardiac Disorders.***—Cardiac rhythm may be modified in several ways; there may be variation in either the length or the strength of the beat, or the beats may not be asynchronous. In palpitation or *tachycardia* its frequency is increased. This increase depends upon the inhibition of the action of the cardio-inhibitory centre, impulses passing to it from the stomach (as in dyspepsia) or from other organs. Tachycardia is also produced by toxic action, as in diphtheria and Graves's disease. In *bradycardia* the frequency is diminished. It may be due to toxins or to degenerative changes. Intermittence may simulate bradycardia, though the actual rate of the beat is not lessened; but the weak beats fail to reach the periphery. Various irregularities may take place, dependent upon perverted nerve action. It is considered that the intrinsic nerve elements play a large part in these, and in some forms of disease the irregularity is of myocardial origin.

The blood vessels.

The blood vessels possess the properties of contractility and elasticity in different degrees. Their contractility is characterized by great tonicity considerable rhythmic action and little or no rapidity of contraction. Their elasticity stores up energy in a potential condition, and this may be liberated in kinetic form as required. The vessels are supported in various degrees by the different tissues in which they are found. In the more solid viscera they are strongly supported, as in the liver and kidney, while in those which are less dense, as in the case of the brain and the lungs, they are not so well sustained.

In many conditions the contractility and elasticity of the blood vessels become diminished according as they may be involved in various pathological processes—purulent, tuberculous or syphilitic. Chronic toxic conditions lead to numerous degenerations, such as fatty degeneration or *hyaline degeneration* of muscle fibre, apparently as the effect of coagulative processes. The tissues assume a somewhat glassy appearance, with a distinct tendency towards segmentation. *Calcareous infiltration* is brought about by the deposition of lime salts in tissues which have previously undergone fatty or fibroid changes; it particularly affects the arteries in senile affections. In consequence of many toxic agencies as part of a senile change, and as the effect of long-continued stress, the blood vessels undergo a loss of their normal properties. This is compensated by the growth of an excessive amount of fibrous tissue, leading to various forms of *arterial sclerosis*, of which the best known are *endarteritis obliterans*, which affects the smaller arteries and is due to a toxic irritant and may occur at any age, and *endarteritis deformans* (*atheroma*), which affects the larger arteries during middle age, and is usually due to mechanical irritation. As the result of these fibrous changes there is interference with the blood current, since the vessels become unyielding yet frangible, instead of distensile and elastic, tubes. The sclerotic changes lead, moreover, to dilatation of blood vessels, as well as to the formation of definite aneurysms. They also pave the way for coagulation of blood within them, *i.e.* thrombosis, while in certain situations, more particularly in the brain and in the kidney, rupture is apt to take place. Upon the heart also these changes bring about far-reaching effects. Dilatation, accompanied by hypertrophy, is a certain result of generalized arterial degeneration, while changes in the coronary arteries lead to some of the definite results in the walls of the heart which have already been considered.

Veins are subject also to mechanical and toxic effects. The pressure of abdominal tumours, the effects of the weight of a column of blood on a long vein, constipation or obstruction to the venous return may cause dilatations or varicosity. The dilatation thins the walls of the veins and the valves become incompetent; the dilated vessel then becomes twisted and the surrounding tissues thickened by the growth of fibrous tissue. The thinned walls may rupture, and, owing to the loss of the valves, extensive haemorrhages may take place. Thrombosis may follow the slowing of the blood current, and phleboliths are produced by the deposit of lime salts in it. *Phlebitis* is an acute inflammation of a vein. Apart from injury it usually follows invasion by a septic thrombus, as in the well-known *phlegmasia alba dolens*, when an infective clot from the uterine sinuses reaches the iliac veins. The pathology of the blood itself is treated under BLOOD.

VASE (through Fr. from Lat. *vas*, a vessel, pl. *vasa*, of which the singular *vasum* is rarely found; the ultimate root is probably *was-*, to cover, seen in Lat. *vestis*, clothing, Eng. "vest," Gr. *ἐσθής*, and also in "wear," of garments), a vessel, particularly one of ornamental form or decoration; the term is often confined to such vessels which are uncovered and with two handles, and whose height is great in proportion to their width. It is the general term applied to the decorative pottery of the ancient Greeks and Romans, of whatever shape (see CERAMICS).

VASELINE, or mineral jelly, the *Paraffinum molle* of the British Pharmacopoeia, a commercial product of petroleum which is largely employed in pharmacy, both alone and as a vehicle for the external application of medicinal agents, especially when local action rather than absorption is desired, and as a protective coating for metallic surfaces. "Vaseline" is a registered proprietary name (coined from the German *Wasser*, water, the Greek ἔλαιον, oil, and the termination *-ine*), and is strictly applicable only to the material manufactured by one company (the Chesebrough Manufacturing Company), but it is commonly applied in a generic sense. As met with in commerce, vaseline is a semi-solid mixture of hydrocarbons, having a melting-point usually ranging from a little below to a few degrees above 100° F. It is colourless, or of a pale yellow colour, translucent, fluorescent, amorphous and devoid of taste and smell. It does not oxidize on exposure to the air, and is not readily acted on by chemical reagents. It is soluble in chloroform, benzene, carbon bisulphide and oil of turpentine. It also dissolves in warm ether and in hot alcohol, but separates from the latter in flakes on cooling.

The process employed by the Chesebrough Manufacturing Company in the manufacture of vaseline is said to consist essentially in the careful distillation of selected crude petroleum, vacuum-stills being used to minimize dissociation, and filtration of the residue through granular animal charcoal. The filters are either steam-jacketed, or are placed in rooms heated to 120° F., or higher. The first runnings from the filters are colourless, and when they become coloured to a certain extent they are collected for use as a lubricant under the name of "filtered cylinder oil." (B. R.)

VASILKOV, a town of Russia, in the government of Kiev, 23 m. by rail S.W. of the city of Kiev. Pop. 18,000, chiefly agricultural. Vasilkov was founded in the 10th century, but laid waste during the Mongol invasion of 1239–42. In 1320 it was taken by the Lithuanians, and later by the Poles, under whom it remained until 1686, when it was annexed to Russia.

VASLUI, the capital of the department of Vaslui, Rumania; on a hill at the confluence of the Bêrlad and Vaslui rivers, and on the railway from Jassy to Galatz. Pop. (1900) 13,405. There are a fine old church and ruins of a palace built in 1471 by Stephen the Great. The chief trade is in corn, wine, cattle and timber. A fair is held yearly on the first ten days of September.

VASSAL (Fr. *vassal*, *vassaut*, *vassault*, &c.), the tenant and follower of a feudal lord (see FEUDALISM). The etymology of the word has been a matter of considerable dispute. The late Henri de Tourville, in his *Histoire de la formation particulariste*, maintained that vassal is derived from the German *Gast*, a guest, meaning an outsider to whom a portion of a free domain was assigned in return for rent and certain fixed services. This derivation has a somewhat fantastic air, and seems to have been framed to suit an hypothesis. The commonly accepted etymology is from the Breton *gwas*, Welsh *gwas*, a lad or a servant. As the word in its Latin form *vassus* was at first uniformly employed in the sense of slave, this explanation is the more acceptable of the two. If it is correct we may say that "vassal" was analogous in origin to the name of "boy" given to a coloured servant by Europeans in Asia and Africa. The word gained in dignity under the Frankish empire through the *vassi dominici*, *i.e.* servants of the royal household, great officers of state, who were sent on extraordinary missions into the provinces, to act as assessors to the counts in the courts, or generally to settle any questions in the interests of the central power. Sometimes they were sent to organize and govern a march, sometimes they were rewarded with benefices, and as, with the growth of feudalism, these developed into hereditary fiefs, the word *vassus* or *vassallus* was naturally retained as implying the relation to the king as overlord, and was extended to the holders of all fiefs whether capital or mediate. As feudal independence increased, the word vassal lost every vestige of its original servile sense, and, since it had come to imply a purely military relation, acquired rather the meaning of "free warrior." Thus in medieval French poetry *vasselage* is commonly used in the sense of "prowess in arms," or generally of any knightly qualities. In this sense it also became acclimatized in England, and "vassal" came to be used as equivalent to free-born, soldierly, valiant and loyal, in which sense it is commonly used in medieval poetry. In countries which were not feudally organized—in Castile, for instance—vassal meant simply subject, and during the revolutionary period acquired a distinctly offensive significance as being equivalent to slave. The diminutive form *vasseletus*, for the son of a vassal, after strange fortunes returned to something of its original sense of "household servant" in the modern "valet" (*q.v.*) (see also VAVASSOR).

See *Dictionnaire de l'ancienne langue française* (Paris, 1895), for numerous examples of the use of the word vassal; also Du Cange, *Glossarium*, *s.* "Vassus."

VASSAR COLLEGE, a non-sectarian institution for the higher education of women, about 2 m. E. of Poughkeepsie, New York, U.S.A. It was incorporated in 1861 as Vassar Female College (which was changed to Vassar College in 1867), and was named in honour of its founder,[1] Matthew Vassar, who transferred to a board of trustees of his own selection about $400,000 (increased by his will to twice that amount) and the tract of about 200 acres of land upon which the college was built. Building began in June 1861, and the institution was opened on the 20th of September 1865, with John Howard Raymond[2] (1814–1878) as president, and Hannah W. Lyman (1816–1871) as lady principal; it had a faculty of eight professors and twenty instructors and teachers, and an enrolment of 353 pupils. The first graduating class was that of 1867, and comprised four members, to whom were given temporary certificates stating that they were "entitled to be admitted to the *First Degree of Liberal Arts*," as the propriety of awarding the degree of "bachelor" to women was questioned at that time; in 1868 these certificates were replaced by diplomas bestowing the degree of A.B. The present equipment includes more than twenty buildings, and the campus has an area of about 400 acres. The college confers the baccalaureate degree in arts (A.B.) upon the completion of the regular course of four years, and a second degree in arts (A.M.) upon Bachelors of Arts of Vassar or any approved college who have completed (by examination and thesis) a course of advanced non-professional study. In 1909–10 there were about ninety professors and instructors and 1040 students. The college had in 1909 total productive funds of about $1,360,000, yielding an income of about $600,000. James Monroe Taylor (b. 1848), a graduate of the university of Rochester and of Rochester Theological Seminary, became president of the college in 1886.

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[1] Matthew Vassar (1791–1868) was born at East Dereham, Tuddenham parish, Norfolk, England, on the 29th of April 1791, son of a Baptist who emigrated to the United States in 1796, settled 3 m. E. of Poughkeepsie in 1797 and in 1801 established a brewery there. The brewery was burned in 1811, and Matthew took up the business and in 1812 established an "ale and oyster saloon" and a brewery, from which he became wealthy. He was a prominent member of the Baptist church. He got the idea of founding a college for women from his niece, Lydia Booth, a school teacher. He died on the 23rd of June 1868 while reading his farewell report to the Board of Trustees. His nephew, MATTHEW VASSAR, Jun. (1809–1881), was born in Poughkeepsie, became manager of his uncle's brewery, was a member of the Board of Trustees of Vassar College, and its treasurer until his death, gave in all about $500,000 to the institution, and with his brother, John Guy Vassar (1811–1888), also one of the trustees and a benefactor of the college, gave to the college the Vassar Brothers' Laboratory.

[2] Raymond graduated at Union College in 1832; studied law and then (at Hamilton, N.Y.) theology; in 1839–49 taught rhetoric and English literature at Madison (now Colgate) University, at Hamilton, N.Y.; was professor of belles-lettres at Rochester University in 1850–56; and organized the Brooklyn Polytechnic Institute in 1856–65.

See Benson J. Lossing's *Vassar College and its Founder* (New York, 1867) and Frances A. Wood's *Earliest Years at Vassar* (Poughkeepsie, N.Y., 1909).

VASTO (anc. *Histonium*), a fortified town of the Abruzzi, Italy, in the province of Chieti, situated high on an olive-clad slope, about a mile from the Adriatic, 32 m. direct S.E. by E. of Chieti and 131 m. by rail from Ancona, 525 ft. above sea-level. Pop. (1901), 10,090 (town); 15,542 (commune). It is surrounded by medieval walls, and commands fine views extending to the Tremiti Islands and Monte Gargano. The churches of S. Pietro and S. Giuseppe have Gothic façades. There is a medieval castle. The municipal buildings contain a collection of Roman antiquities and inscriptions. There are manufactures of earthenware, woollen cloth and silk; but the inhabitants are chiefly employed in the culture of the olive and in fishing.

The ancient *Histonium* was a town of the Frentani, and an Oscan inscription of the period of its independence speaks of censors there, probably officers of the whole community of the Frentani (see R. S. Conway, *Italian Dialects*, i. 208, Cambridge, 1897). Though hardly mentioned in history, it was a flourishing municipal town under the Roman Empire, as is shown by the numerous inscriptions found there. One of these mentions its Capitolium or temple of Jupiter, Juno and Minerva. It lay on the line of the ancient road which prolonged the Via Flaminia to the S.E., and reached the coast here after having passed through Anxanum (Lanciano). It was, and still is, subject to severe earthquakes. (T. As.)

VATICAN COUNCIL, THE, of 1869 and 1870, the last ecumenical council of the Roman Catholic Church, and the most important event in her historical development since the Tridentine synod. The preliminaries were surrounded by the closest secrecy. As early as the end of the year 1864, Pius IX. had commissioned the cardinals resident in Rome to tender him their opinions as to the advisability of a council. The majority pronounced in favour of the scheme, dissentient voices being rare. After March 1865 the convocation of the council was no longer in doubt. Thirty-six carefully selected bishops of diverse nationalities were privately interrogated with regard to the tasks which, in their estimation, should be assigned to the prospective assembly. Some of them proposed, *inter alia*, that the doctrine of papal infallibility should be elevated to the rank of a dogma. In public, however, Pius IX. made no mention of his design till the 26th of June 1867, when Catholic bishops from every country were congregated round him in Rome on the occasion of the great centenary of St Peter. On the 29th of June 1868 the bull *Aeterni Patris* convened the council to Rome, the date being fixed for the 8th of December 1869. And since the Roman Catholic Church claims that all baptized persons belong to her, special bulls were issued, with invitations to the bishops of the Oriental Churches, to the Protestants and to the other non-Catholics, none of which groups complied with the request.

The object of the council was long a mystery. The Bull of Convocation was couched in perfectly general terms, and specified no definite tasks—a circumstance which at first ensured a favourable reception for the scheme, as it allowed ample scope to hope and imagination. But, among liberal Catholics, this mood underwent a complete reversal when information began to leak out as to the object of the Curia in convening the council. The first—epoch-making—revelation was given, in February 1869, by an article in the *Civiltà Cattolica*, a periodical conducted under Jesuit auspices. It was there stated, as the view of many Catholics in France, that the council would be of very brief duration, since the majority of its members were in agreement. As a presumptive theme of the deliberations, it mentioned *inter alia* the proclamation of papal infallibility. The whole proceeding was obviously an attempt, from the Jesuit side, to gauge the prevalent opinion with regard to this favourite doctrine of ultramontanism. The repudiation was energetic and unmistakable, especially in Germany. Certain articles on "The Council and the Civiltà," published by Döllinger in the *Allgemeine Zeitung*, worked like a thunderbolt. Unions of the laity, designed to repel the encroachments of ultramontanism, sprang up immediately; and all manner of old ideas for the remodelling of the clergy were broached anew. It must, however, be admitted that counter demonstrations were not lacking. The attitude adopted by the German episcopate well exemplifies the ecclesiastical situation of that period. The bishops tried to allay the excitement by publishing a pastoral letter drawn up in common; but in a written address to the pope they declared against the contemplated definition of infallibility. In France also a violent conflict broke out. Here it was principally the writings of Bishop Maret in Paris (*Du concile général et de la paix religieuse*, 2 vols., 1869), and of Bishop Dupanloup of Orleans, which gave expression to the prevalent unrest, and led to those literary controversies in which Archbishop Manning of Westminster and Dechamps of Mechlin came forward to champion the opposite cause. In Italy the free-thinkers considered the moment opportune for renewing their agitations on a larger scale. They even attempted—though with no success worth the name—to counteract the Vatican Council by a rival council in Naples. That the projected dogma had weighty opponents among the higher clergy of Austria-Hungary, Italy and North America was demonstrated during the progress of the council; but before it met all was quiet in these countries. The credit of inviting the European governments to consider their attitude towards the forthcoming synod belongs to the president of the Bavarian ministry, Prince Chlodwig of Hohenlohe-Schillingsfürst, the future imperial chancellor. In his circular note to the Powers of the 9th of April 1869 he analysed the political import of the doctrine of papal infallibility,[1] and proposed a common course of action. But his overtures met with no response. In view of the strained international situation, none of the Powers approached was willing to take a step which might easily have resulted in a bitter conflict with the Church; and the studied vagueness of the Curia in its official pronouncements on the council enabled them to assume an attitude of reserve and suspension of judgment. France was equally inactive, though it rested with her to decide whether the council could even meet in Rome: for the withdrawal of her troops from the papal state would have been the signal for a patriotic Italy to sweep this last impediment to national unity from the face of the earth.

On none of the previous ecumenical councils did the Roman see exercise so pronounced an influence as on the Vatican. As early as the year 1865 a committee of cardinals had been formed as a "special directive congregation for the affairs of the future general council," a title which was usually abbreviated to that of "Central Commission." Among the earliest preliminaries, a number of distinguished theologians and canonists were retained as *consultors* to the council. In the selection of these the preference for men of ultramontane tendencies was so pronounced—Döllinger, for instance, was not invited—that the influences at work in the convocation of the council were obvious long before its opening. Under the control of the Central Commission were six sub-commissions: (1) for dogma; (2) for matters of ecclesiastical discipline; (3) for the religious orders; (4) for the Oriental Churches and the missions; (5) for the secular policy of the Church;

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[1] The note was drafted by Döllinger (see INFALLIBILITY).

(6) for the ceremonial of the council. The pope nominated the presidents of the council (Cardinals Reisach, de Luca, Bizarri, Bilio and Capalti); also the secretaries and the remaining officials. Again, before the proceedings began, he determined the order of business on his own initiative (*Multiplices inter d. d.* Nov. 27, 1869),—thus precluding the members of the synod from any opportunity of co-operating in the task. In these regulations the right of fixing the subjects for debate was reserved to the pope. The members of the synod, it is true, enjoyed the privilege of proposing motions; but these motions could never reach the stage of discussion, except by the papal sanction. Another fact of great importance was the strict privacy in which the labours of the council were to be conducted, the members being pledged to silence on every point. For their deliberations, two forms of assembly, analogous to those employed at Trent, were instituted: the *congregationes generales* and the *sessiones*. The General Congregations, presided over by cardinals, were employed in considering the *schemata* (drafts) submitted to the synod; and provisory votes—not regarded as binding—were there taken. The sessions witnessed the definitive voting, the results of which were to be immediately promulgated as ecclesiastical law by the pope. The form of this promulgation was, in itself, sufficiently characteristic; for the pope was represented as the real agent, while the acknowledgment of the share of the council was confined to the phrase *sacro approbante concilio*. In contrast to this, we may refer to the synods of Constance and Trent (C. Mirbt, *Quellen u.s.w.*, pp. 155–202, and the articles CONSTANCE, COUNCIL OF, and TRENT, COUNCIL OF). In the event of the drafts submitted by the Curia not being unanimously adopted by the General Congregations, they were to be remitted, together with the objections raised, to special committees chosen from the body of the council. These committees (*congregationes speciales deputationes*), the presidents of which were also nominated by the pope, were four in number: (1) for matters of belief; (2) for questions of ecclesiastical discipline; (3) for the religious orders; (4) for affairs of the Oriental Churches. The whole proceedings took place in the church of St Peter, the south transept of which had been prepared especially for the purpose. That the acoustic properties of the structure were unequal to the demands made upon them was obvious from the first day, and occasioned numerous complaints.

On the 8th of December the first session met, and the council was solemnly opened by Pius IX. From beginning to end it was dominated by the "Infallibility" problem. At the elections to the committees the fact was already obvious; for the leaders of the synodal majority in favour of the dogma took excellent care that no one should be chosen who was known to lean toward the opposite side. The order of procedure excited considerable dissatisfaction in many; and a series of petitions, with alternative suggestions, was submitted to the pope, but without success. The very first transactions of the council gave proof that numerous bishops held the theory that their convocation implied the duty of serious and united work, and that they were by no means inclined to yield a perfunctory assent to the papal propositions, which—in part at least—stood in urgent need of emendation. The Curia awoke to this unpleasant fact during the discussion upon the first draft laid before the council,—the schema *De Fide*,—and some perplexity was the result; for on the 8th of December the second session had already been announced for the 6th of January. Since the consideration of the *schema* could not possibly be completed by that date, and since it was now futile to hope that the doctrine of infallibility would be carried by acclamation, and without debate, in that session,—Archbishop Darboy informing Cardinal de Luca that, in this event, a hundred bishops would leave Rome at once,—the second session, on the 6th of January, was reduced to a mere formality, the delegates again declaring their allegiance to the *Professio Fidei Tridentinae*, to which they had already pledged themselves at ordination. On the 10th of January the schema *De Fide* was referred to the committee "for matters of belief," to receive further revision.

From the 10th of January to the 22nd of February 1870 the council was occupied with proposals concerning ecclesiastical discipline and with questions of church life. On this occasion it became evident that the synod was not blind to the necessity for many and various reforms. Even the College of Cardinals and the Curia did not escape. Complaint was made, for instance, that the papal chair and the Roman Congregations were filled almost exclusively by Italians; while the control of the Church was too much centralized in Rome. Again, the treatment of impediments to marriages, of licences and of the scales of charges, was submitted to criticism. The fact was elicited that the resolutions of provincial synods, when transmitted to Rome for approbation, were there subjected to arbitrary changes, so that the contents no longer corresponded with those to which the bishops had affixed their signatures. Even the desire for national assemblies and for ecumenical councils, held at regular intervals, found expression. The delicate subject of the compulsory celibacy of the clergy was also discussed; the notorious defects of the Roman Breviary were considered, and a long debate ensued with regard to the policy of drawing up a short catechism for the whole of Catholic Christendom. Even the proposals which led to these declarations of opinion—many of which were neither anticipated nor desired—were not accepted by the council, but returned for revision to the respective committees.

That matters progressed slowly was undeniable. It was the third month, and not one of the proposals under consideration had been despatched. That this unexpected delay was a natural sequel to the character of the proposals themselves was a fact which the Curia declined to recognize. Consequently, as that body could rely upon a complacent majority, it resolved to proclaim a new order of procedure, by means of which it would be possible to end these unwelcome discussions and quicken the pace of the council. By the papal decree of the 20th of February the influence of the committees was increased; the majority was allowed to cut short a debate by accepting a motion for its closure; a plurality of votes was declared sufficient to carry a proposal; and the voting itself was modified by the institution of a "conditional affirmative" (*placet iuxta modum*) in addition to the regular affirmative and negative (*placet* and *non placet*). Since neither the presidents nor the majority of the council could well be expected to employ the extensive powers thus placed at their disposal with much consideration for the rights of the minority, protests by the weaker party against the new regulations were handed in to the pope, but to no effect.

The main object, however, of this alteration in procedure was to ensure that if the council could not be induced to accept the doctrine of infallibility by acclamation, it should at least do so by resolution. From the first the general interest was almost exclusively concentrated on this question, which divided the members of the synod into two hostile camps. The adherents of the contemplated dogma—among whom Archbishop Manning of Westminster and Bishop Senestrey of Regensburg admittedly held the leading position—circulated petitions to the pope requesting the introduction of a proposal to meet their views; and, as a result of their efforts, the signatures of 480 bishops were obtained. This manœuvre aroused the other side. Petitions to the opposite effect were now similarly distributed, and signed by 136 bishops. On the 9th of February the committee of examination—as was only to be expected—resolved to recommend the pope to grant the wishes of the majority. The remarkable feature of the situation created by these agitations was not that the majority of members declared in favour of the dogmatization of infallibility—that was a foregone conclusion in view of the strides made by ultramontanism in the Roman Catholic Church—but that so many could be found with courage enough to withstand the aspiration to which Pius IX. had given open expression on every possible occasion. The weight of their opposition was accentuated by the fact that the finest intellects and the ablest theologians of Catholicism were included in their ranks. The presence of striking personalities, whose devotion to the Church was beyond question, —Archbishop Scherr of Munich, Melchers of Cologne, Bishop

Ketteler of Mainz, Bishop Hefele of Rottenburg, Cardinal Schwarzenberg of Prague, Cardinal Rauscher of Vienna, Archbishop Haynald of Kalossa, Bishop Strossmayer of Sirmium, Archbishop Darboy of Paris, Bishop Dupanloup of Orleans, to say nothing of the others,—assured this group an influence which, in spite of itself, the opposing faction was bound to feel. If the minority indeed had formed one compact phalanx, the council might possibly have taken a different course; but this it was not, and the fatal truth could not be concealed from the pope and his advisers. The bond which united its members was not a repudiation of the doctrine of infallibility itself, but simply a common sentiment that its elevation to the rank of dogma was inopportune *at the time*. Some—possibly many—may have entertained serious doubts with regard to that doctrine; but, if such was the case, they succeeded in repressing and disciplining their suspicions, and the greatest anxiety was shown to avoid the least attempt at founding their resistance on a dogmatic basis. And here the weakness of the opposition is at once manifest; it lacked a clear and positive goal.

In outside circles the proceedings at Rome were followed with strained attention, and the battle round the question of infallibility was waged with equal violence in France and Germany. In the one country public interest was focused on the writings of Gratry, the former Oratorian; in the other on the trenchant attacks of Döllinger. In England, Newman protested against the dogma. The progress of the council was marked by a plethora of controversial literature with which it was almost impossible to keep pace; articles and pamphlets were poured forth in increasing volume month after month, and even yet no classified collection of them is extant. Among them all, none exceeded in influence the *Römische Briefe*, first published in the Augsburg *Allgemeine Zeitung*, which gave a regular account of the most intimate transactions of the council, and maintained a high reputation for accuracy in spite of all attempts to discredit their authenticity. Important service in disseminating information among widely extended circles was done by the brochure *Ce qui se passe au concile* (May 1870), which revealed a number of proceedings never intended for publicity.

Among the secret propositions submitted to the council by the Curia was the schema *De Ecclesia Christi*, which was distributed to the members on the 21st of January. This contained fifteen sections, in which were defined the nature of the Church, the position of the pope in the Church, and, more especially, the relationship between the Church and the State. In case the harmony between these two magnitudes is disturbed, the responsibility lies with the State, because it thereby disregards the rights and duties of the Church (cap. 13). The divine law is binding on temporal sovereigns, but the administration of that law is a question which can only be decided by the supreme doctrinal authority of the Church (cap. 14). In addition to the education of youth, the Church demands absolute freedom in the training of its clergy and the abrogation of all restrictions on the religious orders, &c. Thus the superiority of Church to State was here enunciated in the same drastic terms as in the *Syllabus* of Pius IX. (1864)—a declaration of war against the modern political and social order, which in its day provoked the unanimous condemnation of public opinion. When, in spite of the injunction of secrecy, the schema became known outside Rome, its genuineness was at first impugned; but as soon as the authenticity of the text was established beyond the possibility of doubt, this attempt to dogmatize the principles of the notorious *Syllabus* excited the most general indignation, even in the strongholds of Catholicism—France and Austria. It almost appeared as if both governments, incensed by these encroachments on the sphere of the State, were at last bent upon bringing pressure to bear on the future deliberations of the council; but the international situation enabled the Curia to persist in its attitude of strict negation towards the despatches of Count Beust and Count Daru. On political grounds Napoleon was not inclined to employ any form of coercion against the synod; Bismarck maintained a like reserve; and although Lord Acton influenced Gladstone in the contrary direction, Lord Clarendon followed Odo Russell, his *chargé d'affaires* in Rome, who was himself adroitly kept in hand by Manning. Thus the danger that the attitude of the secular powers might imperil the liberties of the council was averted for the second time.

From the 22nd of February to the 18th of March no meetings of the General Congregations took place, on account of structural alterations in the *aula* itself. During this interval all uncertainty as to whether the question of infallibility would actually be broached was dispelled. On the 6th of March a supplementary article to section 11 of the schema *De Ecclesia*, dealing with the primacy of the Roman see, was transmitted to the members, and in it the much disputed doctrine received formal expression. But before the animated discussions which centred round this problem could begin, it was imperative to conclude the debate on the schema *De Doctrina Catholica*. From the deputation "for matters of faith" it returned to the *plenum* in a considerably modified form, and there it occupied the attention of the assembly for a full month, beginning with the 18th of March. Even in this later stage it frequently gave rise to trenchant criticism; but the greatest sensation was created by a speech of Bishop Strossmayer, who took exception to the terms of the proposal on the ground that it described Protestantism as the fountain-head of naturalism and as an unclean thing (*pestis*). There followed a dramatic scene: the orator was interrupted by the president and compelled by the outcries of the indignant fathers to quit the tribune. Nevertheless, Strossmayer by his courageous protest succeeded in modifying the objectionable clauses. The bishops of the minority were still dissatisfied with several passages in the *schema*, but, desirous of concentrating their whole available force in opposition to the next proposal, they suppressed their doubts; and the result was that, on the 24th of April, in the third public session, the *Constitutio dogmatica de Fide Catholica*[1] was adopted unanimously and immediately confirmed by the pope.

Meanwhile, the elaboration of the all-important business of the council had been quietly proceeding. Influenced by the alarming number of amendments to the schema *De Ecclesia*, and anxious above all to ensure an early acceptance for the dogma of infallibility, the deputation abandoned the idea of subjecting the entire doctrine of the Church to debate, and resolved to eliminate everything save the one question of papal authority, and to submit this to the council alone. That this procedure directly challenged criticism was obvious enough, and, within the synod, several speakers drew attention to the capriciousness of a method which required them to consider the infallibility of the pope before the nature of the Church herself had been defined. The event, however, justified the wire-pullers of the council in their policy, for the path they chose obviated the danger that the discussion might lose itself in a maze of generalities. It is impossible to give a short and, at the same time, an adequate account of the debate: lengthy disquisitions were the order of the day, and the disputants did not scruple to indulge in verbose repetition of arguments worn threadbare by their predecessors. A pleasant impression is left by the great candour of the opposition speakers, who, in the course of the next few weeks, made every point against the doctrine which in their position it was possible to make. In the general debate, begun on the 13th of May, Bishop Hefele of Rottenburg, author of the well-known *Konziliengeschichte*, criticized the dogma from the standpoint of history, adducing the fact that Pope Honorius I. had been condemned by the sixth ecumenical council as a heretic (680). Others were of opinion that the doctrine implied a radical change in the constitution of the Church: one speaker even characterized it as sacrilege. The contention that the dogma was necessitated by the welfare of the Church, or justified by contemporary conditions, met with repeated and energetic repudiation. The champions of infallibility were, indeed, confronted with no slight task:—to establish their theory by Holy Writ and tradition, and to defend it against the arguments of history.

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[1] Mirbt. *Quellen*, 371–77.

But to them it was no hypothesis waiting to be verified, but an already existing truth, the possession of which no extraneous attacks could for a moment affect. On the 3rd of June the general debate was closed, and forty prospective orators compulsorily silenced.

In the special debate, which dealt with the proposal in detail, every important declaration with regard to the pope was impugned by one party and upheld by the other. The main assault was naturally directed upon the fourth section, "concerning the doctrinal authority of the pope," and Archbishop Guidi of Bologna, in particular, incurred the resentment of the majority through his outspoken utterances on the subject. Immediately after the session he was summoned to the Vatican, and, on defending his attitude by an appeal to tradition, received from Pius IX. the celebrated answer, "I am the tradition." From the beginning of July onwards it became increasingly evident that the council was on the verge of exhaustion: the great heat was positively dangerous to members accustomed to a colder climate, and the opinion gained ground that the spokesmen of both parties had sufficiently elucidated their views for the benefit of the conclave. Many delegates who had announced their intention of speaking relinquished the privilege, and on the 13th of July it was found possible to conclude the debate. On that day the voting in the 85th General Congregation, on the whole schema, showed that, out of 601 members present, 451 had voted *placet*, 88 *non placet* and 62 *placet iuxta modum*. That the number of prelates who rejected the *placet* would amount to 150 had not been expected. The question was now: Could the doctrine of infallibility be raised to dogmatic rank when it was repudiated by so formidable a minority? At the height of the crisis several leaders of the opposition attempted, by a direct appeal to the pope, to secure a modification in the terms of the dogma, which might enable them to give their assent. On the evening of the 15th of July six bishops were accorded an audience with Pius IX., in which they preferred their modest requests. Ketteler threw himself at the feet of the pope and implored him to restore peace to the Church by a little act of compliance. The touching scene appeared to have made some impression on Pius IX.; but, after the deputation had left, opposing influences gained the ascendant, and the result was simply that the clauses on which everything hinged received an addition the reverse of conciliatory (General Congregation, 16th July). The bishops who had hitherto formed the recalcitrant minority were now face to face with the final decision. On the one hand was their loyalty to the pope, allied with the desire to avoid any demonstration calculated to impair the prestige of the Church; on the other, their conviction that the very doctrine which the council was about to proclaim as dogma was a gigantic error. There was but one way out of the *impasse*,—to leave Rome before the deciding session,—and on the 16th of July the pope met their wishes and accorded the leave of absence previously withheld. A section of the dissentient bishops reiterated their views in a letter to Pius IX., and agreed to direct their subsequent actions in common,—a compact which was not observed. On the 18th of July, in the fourth public session, the dogma was accepted by 535 dignitaries of the Church, and at once promulgated by the pope; only two members repeated their *non placet*, and these submitted in the same session. The council continued its labours for a few more weeks, but its main achievement was over, and the remainder of its time was occupied with affairs of secondary importance. When, coincident with the outbreak of the Franco-German War, the papal state collapsed, the pope availed himself of the altered situation, and prorogued the council by the bull *Postquam Dei munere* (October 20). The Italian government at once protested against his statement that the liberties of the council would be prejudiced by the incorporation of Rome into the kingdom of Italy.

The resolutions of the Vatican Council entirely revolutionized the position of the pope within the Church. He is first accredited with "complete and supreme jurisdictionary authority over the whole Church, not simply in matters of faith and morality, but also in matters touching the discipline and governance of the Church; and this authority is a regular and immediate authority, extending over each and every Church and over each and every pastor and believer" (*Sessio* iv. cap. 3, *fin.*; Mirbt, *Quellen*, p. 380). These words conceded to the pope a universal episcopate in the entire Church, in virtue of which he may, at any time, in any diocese, exercise the functions of the regular bishop: the individual bishop forfeited the independence which he had formerly enjoyed, and the episcopate as a whole was dispossessed of that position which, in preceding centuries, had enabled it to champion the true welfare of the Church against a decadent papacy. Nor was this all: it is laid down "as a dogma revealed by God, that the Roman pontiff, when he speaks *ex cathedra*,—that is to say, when, in virtue of his supreme apostolical authority, and in the exercise of his office as pastor and instructor of all Christians, he pronounces any doctrine touching faith or morality to be binding on the whole Church,—is, by reason of the divine assistance promised to him in the person of St Peter, endowed with that infallibility which, according to the will of the Redeemer, is vouchsafed to the Church when she desires to fix a doctrine of faith or morality; and that consequently all such decisions of the Roman pontiff are *per se* immutable and independent of the subsequent assent of the Church. But if any man,—which Heaven forefend!" proceeds the document, "shall venture to deny this definition, let him be accursed!" (*Sessio* iv. cap. 4; Mirbt, *Quellen*, p. 381). These clauses contain the doctrine of papal infallibility, and make the recognition of that doctrine incumbent on all Catholic Christians. But how are we to recognize whether the decision of the pope is given "in the exercise of his doctrinal office," or not? No criterion is assigned, and no authentic interpretation has been accorded from the chair of St Peter. Thus great uncertainty prevails with regard to utterances *ex cathedra*; and the result has been that every papal declaration has tended to be invested with the halo of infallibility. Again, the dogma implies a fundamental change in the position of the ecumenical councils, which, in conjunction with the papacy, had till then been supposed to constitute the representation of the Roman Catholic Church. By the *Vaticanum* they lost every vestige of actual, independent authority, for their function of defining the doctrine of the Church now passed to the pope; and, though in the future they may still be convened, their indispensability is a thing of the past. They have ceased to form a constituent organ of the Church, and are sunk to the level of a decorative or consultative assembly. Thus the decrees of the council possess a double significance; they have not only erected the papacy into the sole tribunal for questions of belief, but have at the same time radically transformed the constitution of the Church. The two factors which previously served to check the papal ambition have been shorn of their strength, and the papacy has attained the status of an absolute monarchy. The concurrent loss of the papal states, so far from enfeebling this new absolutism, tended, in spite of the protests of the Curia, to increase its strength, for its position now became unassailable, and it was enabled to concentrate its energies on a purely international policy to a greater extent than formerly.

The bishops, who, on the council, had impugned the doctrine of papal infallibility, submitted without exception to the promulgated dogma. Confronted with the alternative of either seceding from the Church or adopting a theory which they had previously attacked, they resorted to the "sacrifice of reason," many with bleeding hearts; many, as it would seem, without any pangs of conscience. But though they submitted they failed to carry with them the whole of the theologians and laymen who had ranged themselves at their side in the battle against the dogma; and after the conclusion of the council a new Church was formed, which, in contrast with the *fin de siècle* Catholicism which, by the Vatican Synod, had cut itself loose from the traditions of the past, was termed Old Catholic (see the special article).

In the sphere of politics also the *Vaticanum* was attended by important results. The secular governments could not remain indifferent to the prospect that the proclamation of papal infallibility would invest the *dicta* of the medieval popes, as to the relationship between Church and State, with the character of inspired doctrinal decisions, and confer dogmatic authority on the principles enunciated in the *Syllabus* of Pius IX. Nor was the fear of these and similar consequences diminished by the proceedings of the council itself. The result was that on the 30th of July 1870, Austria annulled the Concordat arranged with the Curia in 1855. In Prussia the so-called *Kulturkampf* broke out immediately afterwards, and in France the synod so accentuated the power of ultramontanism, that, in late years, the republic has taken effectual steps to curb it by revoking the Concordat of 1801 and completely separating the Church from the State.

The antecedent history of the council was long; its subsequent history is a chapter which has not yet been closed. That the dogma was carefully prepared beforehand, mainly by the Society of Jesus, is a demonstrable and demonstrated fact, notwithstanding the denials emanating from writers belonging to the society.

The general position of Roman Catholicism was consolidated by the Vatican Council in more respects than one; for not only did it promote the centralization of government in Rome, but the process of unification soon made further progress, and the attempts to control the intellectual and spiritual life of the Church have now assumed dimensions which, a few decades ago, would have been regarded as anachronistic. On the other hand, however, a counter-movement can be traced in all countries with a predominant Catholic population,—the so-called Reformed Catholicism, which may wear a different aspect in different districts and different strata of society, but is everywhere distinguished by the same fundamental aspiration towards increased liberty. Thus the victory gained by ultramontane influences within the Church—a victory for which the *Vaticanum* was largely responsible—closes one period of development, but a second has already begun, the keynote of which is the search for a *modus vivendi* between this Vatican system and the Catholicism which is rooted in the intellectual life of the modern world.

BIBLIOGRAPHY.—A résumé of the literature bearing on the history of this council is given by C. Mirbt in the *Realencyclopädie*, vol. xx. 445 seq. (ed. 3, Leipzig, 1908). The two most detailed accounts are: J. Friedrich, *Geschichte des Vatikanischen Konzils* (3 vols., Bonn, 1877, 1883, 1887); and Th. Granderath, S.J., *Geschichte des Vatikanischen Konzils* (ed. K. Kirch, 3 vols., Freiburg im Breisgau, 1903–6). The last-mentioned work represents the Jesuitico-Curial standpoint (cf. C. Mirbt, "Die Geschichtschreibung des Vatikanischen Konzils," *Historische Zeitschrift*, Band 101, 1908, pp. 529–600). The most important collections of the *acta* are: *Collectio Lacensis*, tome vii. (Freiburg, 1890); E. Friedberg, *Sammlung der Aktenstücke zum ersten Vatikanischen Konzil* (Tübingen, 1872); J. Friedrich, *Documenta ad illustrandum Concilium Vaticanum* (Nordlingen, 1871); A. v. Roskovany, *Romanus Pontifex*, tomes 7–16, Suppl. 7–10 (Nitriae, 1871–79). For the dogmatic resolutions see also C. Mirbt, *Quellen zur Geschichte des Papsttums* (ed. 2, Tübingen, 1901), pp. 371–82. For the internal history of the councils one of the main sources is Quirinus, *Römische Briefe vom Konzil* (Munich, 1870). Also, J. Friedrich, *Tagebuch während des Vatikanischen Konzils* (Nördlingen, 1871); Lord Acton, *Zur Geschichte des Vatikanischen Konziles* (Munich, 1871, Eng. in *Hist. Essays*, 1907); J. Fessler, *Das Vatikanische Concilium* (Vienna, 1871); Manning, *The True Story of the Vatican Council* (London, 1877); E. Ollivier, *L'Église et l'état au concile du Vatican* (2 vols., Paris, 1879); Purcell, *Life of Cardinal Manning* (2 vols., London, 1896). Cecconi's great work, *La Storia del Concilio ecumenico Vaticano* (4 vols., Rome, 1873–79), is incomplete. For criticism of the council, see Janus, *Der Papst und das Konzil* (Leipzig, 1869), revised by J. Friedrich under the title *J. v. Döllinger, Das Papsttum* (Munich, 1892). Also, Gladstone's *Vatican Decrees and Vaticanism* (London, 1874). (C. M.)

VATKE, JOHANN KARL WILHELM (1806–1882), German Protestant theologian, was born at Behndorf, near Magdeburg, on the 14th of March 1806. After acting as *Privatdozent* in Berlin, he was appointed in 1837 professor extraordinarius. Vatke was one of the founders of the newer Hexateuch criticism. In the same year in which David Strauss published his *Life of Jesus*, Vatke issued his book, *Die Religion des Alten Testaments nach den kanonischen Büchern entwickelt*, which contained the seeds of a revolution in the ideas held about the Old Testament. Since, however, his book was too philosophical to be popular, the author's theories were practically unnoticed for a generation, and the new ideas are now associated especially with the names of A. Kuenen and J. Wellhausen (*qq.v.*). He died on the 18th of April 1882.

His other works include: *Die menschliche Freiheit in ihrem Verhältniss zur Sünde und zur göttlichen Gnade* (1841), *Historisch-kritische Einleitung in das Alte Testament* (1886), and *Religionsphilosophie* (1888). See O. Pfleiderer, *Development of Theology* (1890), and T. K. Cheyne, *Founders of Old Testament Criticism* (1893).

VATTEL, EMERIC (EMER) **DE** (1714–1767) Swiss jurist, the son of a Protestant minister, was born at Couvet, in the principality of Neuchâtel, on the 25th of April 1714. He studied at Basel and Geneva. During his early years his favourite pursuit was philosophy; and, having carefully examined the works of G. W. Leibnitz and C. Wolff, he published in 1741 a defence of Leibnitz's system against J. P. de Crousaz. In the same year Vattel, who was born a subject of the king of Prussia, repaired to Berlin in the hope of obtaining some public employment from Frederick II., but was disappointed in his expectation. Two years later he proceeded to Dresden, where he experienced a very favourable reception from Count Brühl, the minister of Saxony. In 1746 he obtained from the elector, Augustus III., the title of councillor of embassy, accompanied with a pension, and was sent to Bern in the capacity of the elector's minister. His diplomatic functions did not occupy his whole time, and much of his leisure was devoted to literature and jurisprudence. Among other works he published *Loisirs philosophiques* (1747) and *Mélanges de littérature, de morale, et de politique* (1757). But his reputation chiefly rests on his *Droit des gens, ou Principes de la loi naturelle appliqués à la conduite et aux affaires des nations et des souverains* (Neuchâtel, 1758). During the same year he was recalled from Switzerland, to be employed in the cabinet of Dresden, and was soon afterwards honoured with the title of privy councillor. His labours now became so intense as to exhaust his strength, and his health broke down. After a period of rest he returned to Dresden in 1766; but his renewed exertions soon produced a relapse, and he made another excursion to Neuchâtel, where he died on the 28th of December 1767. His last work was entitled *Questions de droit naturel, ou Observations sur le traité du droit de la nature, par Wolff* (Bern, 1762).

Vattel's *Droit des gens*, which is founded on the works of Wolff, had in its day a great success, in truth, greater than it deserved. His principal and only merit consists in his having rendered the ideas of that author accessible to the political and diplomatic world. The *Droit des gens* passed through many editions, and was translated into various languages (English in 1760).

VAUBAN, SÉBASTIEN LE PRESTRE DE (1633–1707), marshal of France, the most celebrated of military engineers (see FORTIFICATION), was born at Saint-Léger-Vauban (Yonne). At the age of ten he was left an orphan in very poor circumstances, and his boyhood and youth were spent amongst the peasantry of his native place. A fortunate event brought him under the care of the Carmelite prior of Sémur, who undertook his education, and the grounding in mathematics, science and geometry which he thus received was of the highest value in his subsequent career. At the age of seventeen Vauban joined the regiment of Condé in the war of the Fronde. His gallant conduct won him within a year the offer of a commission, which he declined on account of poverty. Condé then employed him to assist in the fortification of Clermont-en-Argonne. Soon afterwards he was taken prisoner by the royal troops; but though a rebel he was well treated, and the kindness of Mazarin converted the young engineer into a devoted servant of the king. He was employed in the siege of St Ménéhould (which he had helped to storm as a Frondeur) and won a lieutenancy in the regiment of Burgundy, and at Stenay he was twice wounded. Soon afterwards he besieged and took his own first fortress, Clermont; and in May 1655 he received his commission as an *ingénieur du roi*, having served his apprenticeship under the Chevalier de Clerville, one of the foremost engineers of the time. Between that year and the peace of 1659 he had taken part in or directed ten sieges with distinction, had been several times wounded, and was rewarded by the king with the free gift of a company in the famous Picardy regiment. About this time he married a cousin, Jeanne d'Aulnay. After the peace Vauban was put in charge of the construction of several important defences, amongst other places at Dunkirk, where his work continued until the year before his death. On the renewal of war in 1662 he conducted, under the eyes of the king, the sieges of Douai, Tournai and Lille. At Lille he so distinguished himself that he received a lieutenancy in the guard (ranking as a colonelcy).

The peace of Aix-la-Chapelle confirmed France in the possession of new fortresses, which Vauban now improved or rebuilt. Hitherto the characteristic features of his method of fortification had not been developed, and the systems of preceding engineers were faithfully followed. Colbert and Louvois were profoundly interested in the work, and it was at the request of the latter that the engineer drew up in 1669 his *Mémoire pour servir à l'instruction dans la conduite des sièges* (this, with a memorandum on the defence of fortresses by another hand, was published at Leiden in 1740). On the renewal of war Vauban again conducted the most important sieges (Rheinbergen and Nijmwegen 1672, Maestricht and Trier 1673, Besançon 1674). In the latter year he also supervised the only defence in which he ever took part, that of Oudenarde. This was followed by the reduction of Dinant, Huy and Limburg. At this time he wrote for the commandants of Verdun and Le Quesnoy, valuable *Instructions pour la défense* (MS. Dépôt des Fortifications, Paris; see also Quincy, *Art de la guerre*, Paris, 1740). In 1676 he was made *maréchal de camp*. He took Condé, Bouchain and other places in that year, Valenciennes and Cambrai in 1677, Ghent and Ypres in 1678.

It was at this time that Vauban synthesized the methods of attacking strong places, on which his claim to renown as an engineer rests far more than on his systems of fortification. The introduction of a systematic approach by parallels (said to have been suggested by the practice of the Turks at Candia in 1668) dates from the siege of Maëstricht, and in principle remains to this day the standard method of attacking a fortress. The peace of Nijmwegen gave more territory to France, and more fortresses had to be adapted. Vauban was named *commissaire-général des fortifications* on the death of De Clerville, and wrote in 1679 a memorandum on the places of the new frontier, from which it appears that from Dunkirk to Dinant France possessed fifteen fortresses and forts, with thirteen more in second line. Most of these had been rebuilt by Vauban, and further acquisitions, notably Strassburg (1681), involved him in unceasing work. At Saarlouis for the first time appeared Vauban's "first system" of fortification, which remained the accepted standard till comparatively recent times. He never hesitated to retain what was of advantage in the methods of his predecessors, which he had hitherto followed, and it was in practice rather than in theory, that he surpassed them. In 1682 his "second system," which introduced modifications of the first designed to prolong the resistance of the fortress, began to appear; and about the same time he wrote a practical manual entitled *Le Directeur-Général des fortifications* (Hague, 1683–85). Having now attained the rank of lieut.-general, he took the field once more, and captured Courtrai in 1683, and Luxemburg in the following year. The unexpected strength of certain towers designed by the Spanish engineer Louvigni (fl. 1673) at Luxemburg suggested the tower-bastions which are the peculiar feature of Vauban's second system (see Augoyat, *Mémoires inédits du Ml. de Vauban*, Paris, 1841) which was put into execution at Belfort in the same year (Provost du Vernois, *De la fortification depuis Vauban*, Paris, 1861). In 1687 he chose Landau as the chief place of arms of Lower Alsace, and lavished on the place all the resources of his art. But side by side with this development grew up the far more important scheme of attack. He instituted a company of miners, and the elaborate experiments carried out under his supervision resulted in the establishment of all the necessary formulae for military mining (*Traité des mines*, Paris, 1740 and 1799; Hague, 1744); while at the siege of Ath in 1697, having in the meanwhile taken part in more sieges, notably that of Namur in 1692 (defended by the great Dutch engineer Coehoorn), he employed ricochet fire for the first time as the principal means of breaking down the defence. He had indeed already used it with effect at Philipsburg in 1688 and at Namur, but the jealousy of the artillery at outside interference had hindered the full use of this remarkable invention, which with his other improvements rendered the success of the attack almost certain. After the peace of Ryswick Vauban rebuilt or improved other fortresses, and finally New Breisach, fortified on his "third system"—which was in fact a modification of the second and was called by Vauban himself *système de Landau perfectionné*. His last siege was that of Old Breisach in 1703, when he reduced the place in a fortnight. On the 14th of January of that year Vauban had been made a marshal of France, a rank too exalted for the technical direction of sieges, and his active career came to an end with his promotion. Soon afterwards appeared his *Traité de l'attaque des places*, a revised and amplified edition of the older memoir of 1669, which contains the methods of the fully developed Vauban attack, the main features of which are the parallels, ricochet fire and the attack of the defending personnel by vertical fire (ed. Augoyat, Paris, 1829).

But Louis XIV. was now thrown on the defensive, and the war of the Spanish Succession saw the gradual wane of Vauban's influence, as his fortresses were taken and retaken. The various captures of Landau, his *chef-d'œuvre*, caused him to be regarded with disfavour, for it was not realized that the greatness of his services was rather in the attack than in the defence. In the darkness of defeat he turned his attention to the defence; but his work *De la défense des places* (ed. by General Valazé, Paris, 1829) is of far less worth than the *Attaque*, and his far-seeing ideas on entrenched camps (*Traité des fortifications de campagne*) were coldly received, though therein may be found the elements of the "detached forts" system now universal in Europe. The close of his life, saddened by the consciousness of waning influence and by failing health, he devoted largely to the arrangement of the voluminous manuscripts (*Mes oisivetés*) which contained his reflections on war, administration, finance, agriculture and the like. In 1689 he had had the courage to make a representation to the king in favour of the republication of the Edict of Nantes, and in 1698 he wrote his *Projet d'une dix$^{me.}$ royale* (see *Economistes financières du XVIIIe siècle*, Paris, 1851), a remarkable work foreshadowing the principles of the French Revolution. Vauban was deeply impressed with the deplorable condition of the peasantry, whose labour he regarded as the main foundation of all wealth, and protested in particular against the unequal incidence of taxation and the exemptions and privileges of the upper classes. His *dix$^{me.}$ royale*, a tax to be impartially applied to all classes, was a tenth of all agricultural produce payable in kind, and a tenth of money chargeable on manufacturers and merchants. This work was published in 1707, and instantly suppressed by order of the king. The marshal died heart-broken at the failure of his efforts a few days after the publication of the order (March 30, 1707). At the Revolution his remains were scattered, but in 1808 his heart was found and deposited by order of Napoleon in the church of the Invalides.

Vauban's attention was closely engaged, not only in general military matters, but in political and financial reform and the inland navigation of France. He carried out the rearmament of the French infantry with flint-lock muskets and the socket bayonet. The order of St Louis was suggested by him, and lastly may be mentioned the fortress-models which he constructed, most of which are in the Invalides at Paris, and some in the Berlin Zeughaus. The actual total of his work as an engineer is worth recording. He conducted forty sieges and took part in more than three hundred combats, while his skill and experience were employed on the construction or rebuilding of more than 160 fortresses of all kinds. *Mes oisivetés* long remained unpublished, and of the twelve volumes of manuscript seven are lost. The remainder were published in Paris, 1841–45, in an abridged form, and of the five manuscript volumes three are in public hands, and two belong to the families of two famous engineers, Augoyat and Haxo. At the Hague (1737–1742) appeared, dedicated to Frederick of Prussia, De Hondt's edition of *De l'attaque et défense*, &c., and of this work an improved edition appeared subsequently. But the first satisfactory editions are those of Augoyat and Valazé mentioned above.

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VAUCLUSE, a department of south-eastern France, formed in 1793 out of the countship of Venaissin, the principality of Orange, and a part of Provence, and bounded by Drôme on the N., Basses-Alpes on the E., Bouches-du-Rhône (from which it is separated by the Durance) on the S., and Gard and Ardèche (from which it is separated by the Rhone) on the W. It has also an enclave, the canton of Valréas, in the department of Drôme. Pop. (1906) 239,178. Area, 1381 sq. m. The western third of Vaucluse belongs to the Rhone valley, and consists of the rich and fertile plains of Orange, Carpentras and Cavaillon. To the east, with a general west-south-west direction and parallel to one another, are the steep barren ranges of Ventoux, Vaucluse and Lubéron, consisting of limestones and sandstones. The first-mentioned, which is the most northerly, has a maximum elevation of 6273 ft.; the culminating peak, on which is a meteorological observatory, is isolated and majestic. The Vaucluse chain does not rise above 4075 ft. The most southerly range, that of Lubéron (3691 ft.), is rich in palaeontological remains of extant mammals (the lion, gazelle, wild boar, &c.). The Rhone is joined on the left by the Aygues, the Sorgue (rising in Petrarch's celebrated fountain of Vaucluse, which has given its name to the department), and the impetuous Durance. The Sorgue has an important tributary in the Ouvèze and the Durance in the Coulon (or Calavon). These and other streams feed the numerous irrigation canals (Canal de Pierrelatte, Canal de Carpentras, &c.) to which is largely due the success of the farmers and market-gardeners of the department. The climate is that of the Mediterranean region. The valley of the Rhone suffers from the mistral, a cold and violent wind from N.N.W.; but the other valleys are sheltered by the mountains, and produce the oleander, pomegranate, olive, jujube, fig, and other southern trees and shrubs. The mean annual temperature is 55° F. at Orange and 58° at Avignon; the extremes of temperature are 5° and 105° F. Snow is rare. The south wind, which is frequent in summer, brings rain. The average annual rainfall is 29 in. in the hill region and 22 in the plains.

Wheat, potatoes, and oats are the most important crops; sugar-beet, sorghum, millet, ramie, early vegetables and fruits, among which may be mentioned the melons of Cavaillon, are also cultivated, and to these must be added the vine, olive and mulberry. The truffles of the regions of Apt and Carpentras, and the fragrant herbs of the Ventoux range, are renowned. Sheep are the principal live-stock, and mules are also numerous. Lignite and sulphur are mined; rich deposits of gypsum, fire-clay, ochre, &c., are worked. Montmirail has mineral springs of some repute. The industrial establishments include silk mills, silk-spinning factories, oil mills, flour mills, paper mills, wool-spinning factories, confectionery establishments, manufactories of pottery, earthenware, bricks, mosaics, tinned provisions, chemicals, candles, soap and hats, breweries, puddling works, iron and copper foundries, cabinet workshops, blast furnaces, sawmills, edge-tool workshops and nursery gardens. Coarse cloth, carpets, blankets, and ready-made clothes are also produced. The department is served by the Paris-Lyon-Méditerranée railway, and the Rhone is navigable for 40 m. within it. It is divided into 4 arrondissements (Avignon, Apt, Carpentras and Orange), 22 cantons and 150 communes. Avignon, the capital, is the seat of an archbishop. The department belongs to the region of the XV. army corps and to the *académie* (educational circumscription) of Aix, and has its appeal court at Nîmes.

Avignon, Apt, Carpentras, Cavaillon, Orange and Vaison, the most noteworthy towns, are treated separately, and the interesting abbey of Senanque, of Romanesque architecture. Other places of interest are Gordes, with a town hall of Renaissance architecture; Pernes, which has a church of the 11th century and medieval fortifications; La Tour d'Aigues, with fine ruins of the Renaissance château of the barons of Central Bonnieux, near which there is a bridge of the 2nd or 3rd century over the Calavon; Venasque, of Gallo-Roman or even earlier origin, with a baptistery of the 8th or 9th century; and Le Thor, with a fine church in the Provençal Romanesque style.

VAUD (Ger. *Waadt*), one of the cantons of south-western Switzerland. Its total area is 1255·2 sq. m. (thus ranking after the Grisons, Bern and the Valais), of which 1056·7 sq. m. are reckoned as "productive" (forests covering 320·1 sq. m. and vineyards 24·9 sq. m., this last region being more extensive than in any other canton). Of the rest, 160½ sq. m. are occupied by the portions of various lakes partly in the canton (Geneva, 123⅓ sq. m.; Neuchâtel, 33 sq. m.; and Morat, 3⅓ sq. m.) and 4·3 by glaciers, the loftiest point in the canton being the Diablerets (10,650 ft.). The canton is of very irregular shape, as it owes its artificial existence solely to historical causes. It includes practically the whole northern shore of the Lake of Geneva, while it stretches from the "Alpes Vaudoises" and Bex, on the S.E., to the Jura and the French frontier, on the N.W. A long narrow tongue extending past Payerne (Peterlingen) to the Lake of Neuchâtel is just disconnected with the Avenches region that forms an "enclave" in the canton of Fribourg, while in the canton of Vaud, Fribourg holds the two "enclaves" of Vuissens and Surpierre. A small stretch of the right bank of the Rhone (from Bex to the Lake of Geneva) is within the canton, while various short streams flow down into the Lake of Geneva. But the more northerly portion of the canton, beyond the Jorat range, to the north of Lausanne, and in particular the valley of the Broye, belongs to the Aar, and so to the Rhine basin. The canton is thus hilly rather than mountainous, save at its south-eastern extremity. It is well supplied with railways, including that along the northern shore of the Lake of Geneva, while from Bex through Vallorbes runs the main Simplon line towards Paris. There are also numerous "regional" or small-gauge railways, as well as mountain lines from Montreux past Glion up the Rochers de Naye, and from Vevey up the Mont Pèlerin, not to speak of that ("Montreux-Oberland" line) direct to the head of the Sarine valley and so by the Simme valley to the Lake of Thun. In 1900 the population was 281,279, of whom 243,463 were French-speaking, 24,372 German-speaking, and 10,667 Italian-speaking, while 242,811 were Protestants (Calvinists, whether of the larger *église nationale* or of the smaller *église libre*, founded in 1847), 36,980 Romanists, and 1076 Jews. Agriculture is the main occupation of the inhabitants: the land is much subdivided and very highly cultivated.

The vineyards give employment to great numbers of people. Much more white wine is produced than red wine. The best white wines of the canton are Yvorne (near Aigle) and La Côte (west of Lausanne), while the vineyard of Lavaux (east of Lausanne) produces both red and white wine. There is not very much industry in the canton, though at Ste Croix in the Jura watches and musical boxes are made, while at Payerne tobacco is grown. Many foreigners reside in the canton, partly for reasons of health, partly on account of the educational advantages that it offers. They chiefly favour Lausanne, Vevey and the collection of hamlets known as

"Montreux," as well as Châteaux d'Oex, in the upper Sarine valley. Lausanne (*q.v.*) is the political capital of the canton. Next in point of population comes the "agglomeration" known as Montreux (*q.v.*), with 14,144, and Vevey (*q.v.*), with 11,781. Other important villages or small towns are Yverdon (7985 inhab.), Ste Croix (5905 inhab.), Payerne (5224 inhab.), Nyon (4882 inhab.), Morges (4421 inhab.), Aigle (3897 inhab.), and Château d'Oex (3025 inhab.). In educational matters the canton holds a high place. The academy of Lausanne dates from 1537, and was raised to the rank of a university in 1890; and there are a very large number of schools and educational establishments at Morges, Lausanne, Vevey, and elsewhere. Pestalozzi's celebrated institution flourished at Yverdon from 1806 to 1825. Among the remarkable historical spots in the canton are Avenches (the chief Roman settlement in Helvetia), Grandson (*q.v.*) (scene of the famous battle in 1476 against Charles the Bold), and the castle of Chillon (where Bonivard, the prior of St Victor at Geneva, was imprisoned from 1530 to 1536 for defending the freedom of Geneva against the duke of Savoy).

The canton is divided into 19 administrative districts, which comprise 388 communes. The cantonal constitution dates from 1885. The government consists of a *Grand Conseil*, or great council (one member to every 300 electors or fraction over 150), for legislative and a *conseil d'état*, or council of state, of seven members (chosen by the *Grand Conseil*) for executive purposes. In both cases the term of office is four years. Six thousand citizens can compel consideration of any project by the legislature ("initiative," first in 1845), and the *referendum* exists in its "facultative" form, if demanded by 6000 citizens, and also in case of expenditure (not included in the budget) of over half a million francs. The two members of the Federal *Ständerath* are named by the *Grand Conseil*, while the fourteen members of the Federal *Nationalrath* are chosen by a popular vote. Capital punishment was abolished in 1874.

The early history of the main part of the territories comprised in the present canton is identical with that of south-west Switzerland generally. The Romans conquered (58 B.C.) the Celtic Helvetii and so thoroughly colonized the land that it has remained a Romance-speaking district, despite conquests by the Burgundians (5th century) and Franks (532) and the incursions of the Saracens (10th century). It formed part of the empire of Charlemagne, and of the kingdom of Transjurane Burgundy (888–1032), the memory of "good queen Bertha," wife of King Rudolph II., being still held in high honour. After the extinction of the house of Zähringen (1218) the counts of Savoy gradually won the larger part of it, especially in the days of Peter II., "le petit Charlemagne" (d. 1268). The bishop of Lausanne (to which place the see had probably been transferred from Aventicum by Marius the Chronicler at the end of the 6th century), however, still maintained the temporal power given to him by the king of Burgundy, and in 1125 had become a prince of the empire. (We must be careful to distinguish between the present canton of Vaud and the old medieval Pays de Vaud: the districts forming the present canton very nearly correspond to the Pays Romand.) Late in the 15th century Bern began to acquire lands to the south from the dukes of Savoy, and it was out of those conquests that the canton was formed in 1798. In 1475 she seized Aigle and (in concert with Fribourg) Échallens and Grandson as well as Orbe (the latter held of the county of Burgundy). Vaud had been occupied by Bern for a time (1475–1476), but the final conquest did not take place till 1536, when both Savoyard Vaud and the bishopric of Lausanne (including Lausanne and Avenches) were overrun and annexed by Bern (formally ceded in 1564), who added to them (1555) Château d'Oex, as her share of the domains of the debt-laden count of the Gruyère in the division of the spoil she made with Fribourg. Bern in 1526 sent Guillaume Farel, a preacher from Dauphiné, to carry out the Reformation at Aigle, and after 1536 the new religion was imposed by force of arms and the bishop's residence moved to Fribourg (permanently from 1663). Thus the whole land became Protestant, save the district of Échallens. Vaud was ruled very harshly by bailiffs from Bern. In 1588 a plot of some nobles to hand it over to Savoy was crushed, and in 1723 the enthusiastic idealist Davel lost his life in an attempt to raise it to the rank of a canton. Political feeling was therefore much excited by the outbreak of the French Revolution, and a Vaudois, F. C. de la Harpe, an exile and a patriot, persuaded the Directory in Paris to march on Vaud in virtue of alleged rights conferred by a treaty of 1565. The French troops were received enthusiastically, and the "Lemanic republic" was proclaimed (January 1798), succeeded by the short-lived Rhodanic republic, till in March 1798 the canton of Léman was formed as a district of the Helvetic republic. This corresponded precisely with the present canton minus Avenches and Payerne, which were given to the canton of Vaud (set up in 1803). The new canton was thus made up of the Bernese conquests of 1475, 1475–76, 1536 and 1555. The constitutions of 1803 and 1814 favoured the towns and wealthy men, so that an agitation went on for a radical change, which was effected in the constitution of 1831. Originally acting as a mediator, Vaud finally joined the anti-Jesuit movement (especially after the radicals came into power in 1845), opposed the Sonderbund, and accepted the new federal constitution of 1848, of which Druey of Vaud was one of the two drafters. From 1839 to 1846 the canton was distracted by religious struggles, owing to the attempt of the radicals to turn the church into a simple department of state, a struggle which ended in the splitting off (1847) of the "free church." The cantonal feeling in Vaud is very strong, and was the main cause of the failure of the project of revising the federal constitution in 1872, though that of 1874 was accepted. In 1879 Vaud was one of the three cantons which voted (though in vain) against a grant in aid of the St Gotthard railway. In 1882 the radicals obtained a great majority, and in 1885 the constitution of 1861 was revised.

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(W. A. B. C.)

VAUDEVILLE, a term now generally given to a musical drama of a light, humorous or comic description interspersed with songs and dances. In English usage "vaudeville" is practically synonymous with what is more generally known as "musical comedy," but in America it is applied also to a music-hall variety entertainment. This modern sense is developed from the French *vaudeville* of the 18th century, a popular form of light dramatic composition, consisting of pantomime, dances, songs and dialogue, written in couplets. It is generally accepted that the word is to be identified with *vau-de-vire*, the name given to the convivial songs of the 15th century. This name originated with a literary association known as the "*Compagnons Gallois*," *i.e.* "boon companions" or "gay comrades" in the valley of the Vire and Virène in Normandy. The most famous of the authors of these songs was Olivier Basselin (*q.v.*). When in the 17th century the term had become applied to topical, satiric verses current in the towns, it was corrupted into its present form, either from *à vau le ville*, or *voix de ville*.

VAUGELAS, CLAUDE FAVRE, SEIGNEUR DE, BARON DE PÉROGES (1595–1650), French grammarian and man of letters, was born at Meximieu, department of Ain, on the 6th of January 1595. He became gentleman-in-waiting to Gaston d'Orléans, and continued faithful to this prince in his disgrace, although his fidelity cost him a pension from the crown on which he was largely dependent. His thorough knowledge of the French language and the correctness of his speech won for him a place among the original academicians. On the representation of his colleagues his pension was restored so that he might have leisure to pursue his admirable *Remarques sur la langue française*

(1647). In this work he maintained that words and expressions were to be judged by the current usage of the best society, of which, as an habitué of the Hôtel de Rambouillet, Vaugelas was a competent judge. He shares with Malherbe the credit of having purified French diction. His book fixed the current usage, and the classical writers of the 17th century regulated their practice by it. Protests against the academical doctrine were not lacking. Scipion Dupleix in his *Liberté de la langue française dans sa pureté* (1651) pleaded for the richer and freer language of the 16th century, and François de la Mothe le Vayer took a similar standpoint in his *Lettres à Gabriel Naudé touchant les Remarques sur la langue française.* Towards the end of his life Vaugelas became tutor to the sons of Thomas Francis of Savoy, prince of Carignan. He died in Paris in February 1650. His translation from Quintus Curtius, *La Vie d'Alexandre* (posthumously published in 1653) deserves notice as an application of the author's own rules.

BIBLIOGRAPHY.—See *Remarques sur la langue française*, edited with a key by V. Conrart, and introductory notes by A. Chassang (Paris, 1880). The principles of Vaugelas's judgments are explained in the *Études critiques* (7ᵉ série) of M. Brunetière, who regards the name of Vaugelas as a symbol of all that was done in the first half of the 16th century to perfect and purify the French language. See also F. Brunot in the *Histoire de la langue et littérature française* of Petit de Julleville.

VAUGHAN, CHARLES JOHN (1816–1897), English scholar and divine, was educated at Rugby and Cambridge, where he was bracketed senior classic with Lord Lyttelton in 1838. In 1839 he was elected fellow of Trinity College, Cambridge, and for a short time studied law. He took orders, however, in 1841, and became vicar of St Martin's, Leicester. Three years later he was elected headmaster of Harrow. He resigned the headmastership in 1859 and accepted the bishopric of Rochester, but afterwards withdrew his acceptance. In 1880 he was appointed vicar of Doncaster. He was appointed master of the Temple in 1869, and dean of Llandaff in 1879. In 1894 he was elected president of University College, Cardiff, in recognition of the prominent part he took in its foundation. Vaughan was a well-known Broad Churchman, an eloquent preacher and an able writer on theological subjects, his numerous works including lectures, commentaries and sermons; he was joint-author with the Rev. John Llewelyn Davies (b. 1826)—also a well-known Cambridge scholar and Broad Churchman—of a well-known translation of Plato's *Republic.*

VAUGHAN, HENRY (1622–1695), called the "Silurist," English poet and mystic, was born of an ancient Welsh family at Newton St Briget near Scethrog by Usk, Brecknockshire, on the 17th of April 1622. His grandfather, Thomas Vaughan, was the son of Charles Vaughan of Tretower Castle, and had acquired the farm of Newton by marriage. From 1632 to 1638 he and his twin brother Thomas, noticed below, were privately educated by the Rev. Matthew Herbert, rector of Llangattock, to whom they both addressed Latin verses expressing their gratitude. Anthony à Wood, who is the main authority for Vaughan's biography, says that Henry was entered at Jesus College, Oxford, in 1638, but no corroboration of the statement is forthcoming, although Thomas Vaughan's matriculation is entered, nor does Henry Vaughan ever allude to residence at the university.[1] He was sent to London to study law, but turning his attention to medicine, he became a physician, and settled first at Brecon and later at Scethrog to the practice of his art. He was regarded, says Wood, as an "ingenious person, but proud and humorous." It seems likely that he fought on the king's side in the Welsh campaign of 1645, and was present at the battle of Rowton Heath. In 1646 appeared *Poems, with the Tenth Satyre of Juvenal Englished*, by Henry Vaughan, Gent. The poems in this volume are chiefly addressed to "Amoret," and the last is on Priory Grove, the home of the "matchless Orinda," Mrs Katharine Philips. A second volume of secular verse, *Olor Iscanus*, which takes its name from the opening verses addressed to the Isca (Usk), was published by a friend, probably Thomas Vaughan, without the author's consent, in 1651. The book includes three prose translations from Latin versions of Plutarch and Maximus of Tyre, and one in praise of a country life from Guevara. The preface is dated 1647, and the reason for Vaughan's reluctance to print the book is to be sought in the preface to *Silex Scintillans: or Sacred Poems and Pious Ejaculations* (1650). There he says: "The first that with any effectual success attempted a diversion of this foul and overflowing stream (of profane poetry) was the blessed man, Mr George Herbert, whose holy life and verse gained many pious converts, of whom I am the least." He further expresses his debt in "The Match," when he says that his own "fierce, wild blood . . . is still tam'd by those bright fires which thee inflam'd." His debt to Herbert extended to the form of his poetry and sometimes to the actual expressions used in it, and a long list of parallel passages has been adduced. His other works are *The Mount of Olives: or Solitary Devotions*, with a translation, *Man in Glory*, from the Latin of Anselm (1652); *Flores Solitudinis* (1654), consisting of two prose translations from Nierembergius, one from St Eucherius, and a life of Paulinus, bishop of Nola; *Hermetical Physick*, translated from the *Naturae Sanctuarium* of Henricus Nollius; *Thalia Rediviva; The Pass-Times and Diversions of a Country Muse* (1678), which includes some of his brother's poems. Henry Vaughan died at Scethrog on the 23rd of April 1695, and was buried in the churchyard of Llansantffraed.

As a poet Vaughan comes latest in the so-called "metaphysical" school of the 17th century. He is a disciple of Donne, but follows him mainly as he saw him reflected in George Herbert. He analyses his experiences, amatory and sacred, with excessive ingenuity, striking out, every now and then, through his extreme intensity of feeling and his close observation of nature, lines and phrases of marvellous felicity. He is of imagination all compact, and is happiest when he abandons himself most completely to his vision. It is, as Canon H. C. Beeching has said, "undoubtedly the mystical element in Vaughan's writing by which he takes rank as a poet . . . it is easy to see that he has a passion for Nature for her own sake, that he has observed her moods; that indeed the world is to him no less than a veil of the eternal spirit, whose presence may be felt in any, even the smallest part." In this imaginative outlook on Nature he no doubt exercised great influence on Wordsworth, who is known to have possessed a copy of his poems, and it is difficult to avoid seeing in "The Retreat" the germ of the later poet's "Ode on Intimations of Immortality." By this poem, with "The World," mainly because of its magnificent opening stanza, "Beyond the Veil," and "Peace," he is best known to the ordinary reader.

The complete works of Henry Vaughan were edited for the Fuller Worthies Library by Dr A. B. Grosart in 1871. The *Poems of Henry Vaughan, Silurist*, were edited in 1896 by Mr E. K. Chambers, with an introduction by Canon H. C. Beeching, for the Muses' Library.

VAUGHAN, HERBERT (1832–1903), cardinal and archbishop of Westminster, was born at Gloucester on the 15th of April 1832, the eldest son of lieutenant-colonel John Francis Vaughan, head of an old Roman Catholic family, the Vaughans of Courtfield, Herefordshire. His mother, a daughter of John Rolls of The Hendre, Monmouthshire, was intensely religious; and all the daughters of the family entered convents, while six of the eight sons took priest's orders, three of them rising to the episcopate, Roger becoming archbishop of Sydney, and John bishop of Sebastopolis. Herbert spent six years at Stonyhurst, and was then sent to study with the Benedictines at Downside, near Bath, and subsequently at the Jesuit school of Brugelette, Belgium, which was afterwards removed to Paris. In 1851 he went to Rome. After two years of study at the Accademia dei nobili ecclesiastici, where he became a friend and disciple of Manning, he took priest's orders at Lucca in 1854. On his return to England he became for a period vice-president of St Edmund's College, Ware, at that time the chief seminary for candidates for the priesthood in the south of England. Since childhood he had been filled with zeal for foreign missions, and he conceived the determination to found a great English missionary college to fit young priests for the work of evangelizing the heathen. With this object he made a great begging expedition to America in 1863, from which he returned with £11,000. St Joseph's Foreign Missionary College, Mill Hill Park, London, was opened in 1869. Vaughan also became proprietor of the *Tablet*, and used its columns vigorously for propagandist purposes. In 1872 he was consecrated bishop of Salford, and in 1892 succeeded Manning as archbishop of Westminster, receiving the cardinal's hat in 1893. Vaughan was a man of very different type from his predecessor; he had none of Manning's intellectual *finesse* or his ardour in social reform, but he was an ecclesiastic of remarkably fine presence and aristocratic leanings, *intransigeant* in theological policy, and in personal character simply devout.

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[1] Two poems in the *Eucharistica Oxoniensia* (1641) are signed "H. Vaughan, Jes. Coll.," but are probably by a contemporary of the same name, noticed by Wood. See Mr E. K. Chambers's biographical note in vol. ii. of Vaughan's *Works.*

It was his most cherished ambition to see before he died an adequate Roman Catholic cathedral in Westminster, and he laboured untiringly to secure subscriptions, with the result that its foundation stone was laid in 1895, and that when he died, on the 19th of June 1903, the building was so far complete that a Requiem Mass was said there over his body before it was removed to its resting-place at Mill Hill Park.

See the *Life of Cardinal Vaughan*, by J. G. Snead Cox (2 vols., London, 1910).

VAUGHAN, THOMAS (1622–1666), English alchemist and mystic, was the younger twin brother of Henry Vaughan, the "Silurist." He matriculated from Jesus College, Oxford, in 1638, took his B.A. degree in 1642, and became fellow of his college. He remained for some years at Oxford, but also held the living of his native parish of Llansantfread from 1640 till 1649, when he was ejected, under the Act for the Propagation of the Gospel in Wales, upon charges of drunkenness, immorality and bearing arms for the king. Subsequently he lived at his brother's farm of Newton and in various parts of London, and studied alchemy and kindred subjects. He married in 1651 and lost his wife in 1658. After the Restoration he found a patron in Sir Robert Murray, with whom he fled from London to Oxford during the plague of 1665. He appears to have had some employment of state, but he continued his favourite studies and actually died of the fumes of mercury at the house of Samuel Kem at Albury on the 27th of February 1666. Vaughan regarded himself as a philosopher of nature, and although he certainly sought the universal solvent, his published writings deal rather with magic and mysticism than with technical alchemy. They also contain much controversy with Henry More the Platonist. Vaughan was called a Rosicrucian, but denied the imputation. He wrote or translated *Anthroposophia Theomagica* (1650); *Anima Magica Abscondita* (1650); *Magia Adamica* and *Coelum Terrae* (1650); *The Man-Mouse taken in a Trap* (1650); *The Second Wash; or the Moor Scoured once more* (1651); *Lumen de Lumine* and *Aphorisimi Magici Eugeniani* (1651); *The Fame and Confession of the Fraternity of R.C.* (1652); *Aula Lucis* (1652); *Euphrates* (1655); *Nollius' Chymist's Key* (1657); *A Brief Natural History* (1669). Most of these pamphlets appeared under the pseudonym of Eugenius Philalethes. Vaughan was probably, although it is by no means certain, *not* the famous adept known as Eirenaeus Philalethes, who was alleged to have found the philosopher's stone in America, and to whom the *Introitus Apertus in Occlusum Regis Palatium* (1667) and other writings are ascribed. In 1896 Vaughan was the subject of an amazing mystification in the *Mémoires d'une ex-Palladiste*. These formed part of certain alleged revelations as to the practice of devil-worship by the initiates of freemasonry. The author, whose name was given as Diana Vaughan, claimed to be a descendant of Thomas and to possess family papers which showed amongst other marvels that he had made a pact with Lucifer, and had helped to found freemasonry as a Satanic society. The inventors of the hoax, which took in many eminent Catholic ecclesiastics, were some unscrupulous Paris journalists.

The Magical Writings of Thomas Vaughan were edited by Mr A. E. Waite in 1888. His miscellaneous Latin and English verses are included in vol. ii. of Dr A. B. Grosart's Fuller Worthies Library edition of the *Works* of Henry Vaughan (1871). A manuscript book of his, with alchemical and autobiographical jottings made between 1658 and 1662, forms *Brit. Mus. Sloane MS.* 1741. Biographical data are in Mr E. K. Chambers's Muses Library edition of the *Poems* of Henry Vaughan (1896), together with an account and criticism of the *Mémoires d'une ex-Palladiste*. These fabrications were also discussed by Mr A. E. Waite, *Devil-Worship in France* (1896), and finally exposed by M. Gaston Méry, *La Vérité sur Diana Vaughan*.

(E. K. C.)

VAUGHAN, WILLIAM (1577–1641), English author and colonial pioneer, son of Walter Vaughan (d. 1598), was born at Golden Grove, Carmarthenshire, his father's estate, in 1577. He was descended from an ancient prince of Powys. His brother, John Vaughan (1572–1634), became 1st earl of Carbery; and another brother, General Sir Henry or Harry Vaughan (1587–1659), was a well-known royalist leader. William was educated at Jesus College, Oxford, and took the degree of LL.D. at Vienna. In 1616 he bought a grant of land in the south coast of Newfoundland, to which he sent two batches of settlers. In 1622 he visited the settlement, which he called Cambriol, and returned to England in 1625. Vaughan apparently paid another visit to his colony, but his plans for its prosperity were foiled by the severe winters. He died at his house of Torcoed, Carmarthenshire, in August 1641.

His chief work is *The Golden Grove* (1600), a general guide to morals, politics and literature, in which the manners of the time are severely criticized, plays being denounced as folly and wickedness. The section in praise of poetry borrows much from earlier writers on the subject. *The Golden Fleece . . . transported from Cambriol Colchis . . . by Orpheus jun., alias Will Vaughan*, which contains information about Newfoundland, is the most interesting of his other works.

VAULT [1] (Fr. *voute*, Ital. *volta*, Ger. *Gewölbe*), in architecture, the term given to the covering over of a space with stone or brick in arched form, the component parts of which exert a thrust and necessitate a counter resistance. In the case of vaults built under the level of the ground, the latter gave all that was required, but, when raised aloft, various expedients had to be employed, such as great thickness of walls in the case of barrel or continuous vaults, and cross walls or buttresses when intersecting vaults were employed. The simplest kind of vault is that known as the barrel, wagon or tunnel vault, which is generally semicircular in section, and may be regarded as a continuous arch, the length of which is in excess of its diameter; like the arch (*q.v.*), the same provision is required as regards its temporary support whilst the voussoirs constituting one of its rings are being placed in position, for until the upper voussoir, or keystone, is introduced it is not self-supporting. At the present day, when timber of all kinds is easily procurable, this temporary support is given by centring, consisting of a framed truss with semicircular or segmental head, which carries the voussoirs until the ring of the whole arch is completed and is then, with a barrel vault, shifted on to support other rings; in early times, and particularly in Chaldaea and Egypt, where timber was scarce, other means of support had to be contrived, and it would seem that it was only in Roman times that centring was regularly employed.

The earliest example known of a vault is that found under the Chaldaean ziggurat at Nippur in Babylonia, ascribed to about 4000 B.C., which was built of burnt bricks cemented with clay mortar. The earliest tunnel vaults in Egypt are those at Requaqnah and Denderah, *c.* 3500 B.C.; these were built in unburnt brick in three rings over passages descending to tombs: in these cases, as the span of the vault was only 6 ft., the bricks constituting the voussoirs were laid flatwise, and adhered sufficiently to those behind to enable the ring to be completed without other support; in the granaries built by Ramessu II., still in part existing behind the Ramesseum, at Thebes, the span was 12 ft., and another system was employed; the lower part of

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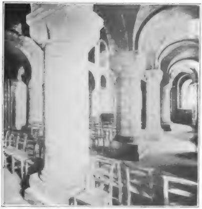
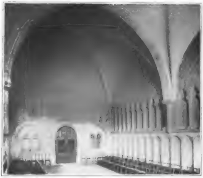
[1] For the form of safe so called see SAFES.



Photo, Valentine & Sons.

Fig. 13.—Intersecting Groined Vaulting. Early Example. St. John's Chapel, Tower of London.



Photo, Valentine & Sons.

Fig. 14.—Intersecting Ribbed Vaulting Late Example. Chapter House, Bristol Cathedral.

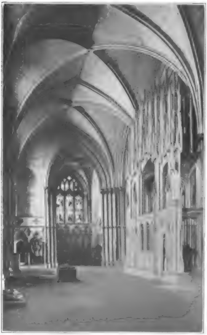


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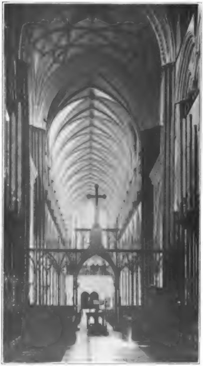
Fig. 15.—Early English Vaulting. Winchester Cathedral, Waynfleet's Chantry.



Photo, F. Frith & Co. Ltd.

Fig. 16.—Early English Lierne Vaulting. Tower of Salisbury Cathedral.

VAULT

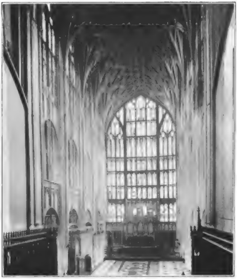


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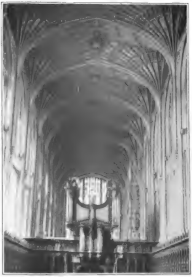
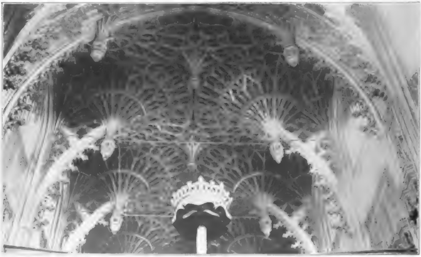
Fig. 17.—Decorated or Lierne Vaulting. Choir of Gloucester Cathedral. (See also Plate VIII., Fig. 82, Architecture.)



Photo, G. W. Wilson & Co.

Fig. 18.—Fan Vaulting. King's College Chapel, Cambridge.



Photo, G. W. Wilson & Co.

Fig. 19.—Fan Vaulting. Henry VII. Chapel, Westminster.

the arch was built in horizontal courses, up to about one-third of the height, and the rings above were inclined back at a slight angle, so that the bricks of each ring, laid flatwise, adhered till the ring was completed, no centring of any kind being required; the vault thus formed was elliptic in section, arising from the method of its construction. A similar system of construction was employed for the vault over the great hall at Ctesiphon, where the material employed was burnt bricks or tiles of great dimensions, cemented with mortar; but the span was close upon 83 ft., and the thickness of the vault was nearly 5 ft. at the top, there being four rings of brickwork. It is probable that the great vaults of the Assyrian palaces were constructed in the same way, but with unburnt bricks dried only in the sun: one of the drains discovered by Layard at Nimrud was built in rings sloping backwards. From the fact that each Assyrian monarch on his accession to the throne commenced his reign by the erection of a palace, it is probable that, owing to the ephemeral construction of these great vaults, half a century was the term of their existence. This may also account for the fact that no domed structures exist of the type shown in one of the bas reliefs from Nimrud (fig. 1); the tradition of their erection, however, would seem to have been handed down to their successors in Mesopotamia, viz. to the Sassanians, who in their palaces at Serbistan and Firuzabad built domes of similar form to those shown in the Nimrud sculptures, the chief difference being that, constructed in rubble stone and cemented with mortar, they still exist, though probably abandoned on the Mahommedan invasion in the 7th century.

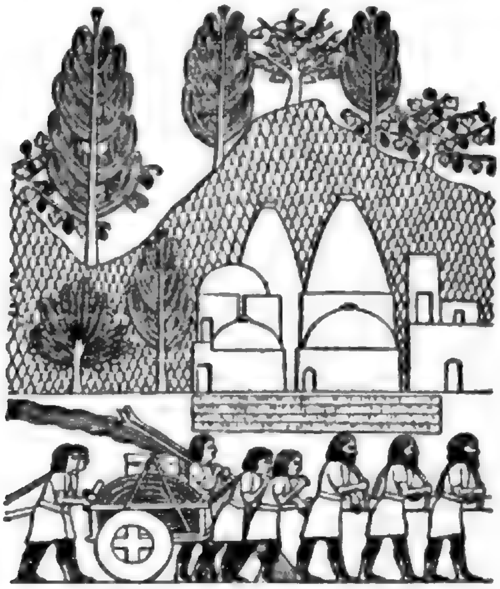


Fig. 1.

In all the instances above quoted in Chaldaea and Egypt the bricks, whether burnt or sun-dried, were of the description to which the term "tile" would now be given; the dimensions varied from 18 or 20 in. to 10 in., being generally square and about 4 to 2 in. thick, and they were not shaped as voussoirs, the connecting medium being thicker at the top than at the bottom. The earliest Egyptian examples of regular voussoirs in stone belong to the XXVIth Dynasty (*c.* 650 B.C.) in the additions made then to the temple of Medinet-Abou, and here it is probable that centring of some kind was provided, as the vaults are built in rings, so that the same centring could be shifted on after the completion of each ring. The earliest example of regularly shaped voussoirs, and of about the same date, is found in the *cloaca* at Graviscae in Etruria, with a span of about 14 ft., the voussoirs of which are from 5 to 6 ft. long. The *cloaca maxima* in Rome, built by Tarquin (603 B.C.) to drain the marshy ground between the Palatine and the Capitoline Hills, was according to Commendatore Boni vaulted over in the 1st century B.C., the vault being over 800 ft. long, 10 ft. in span, with three concentric rings of voussoirs.

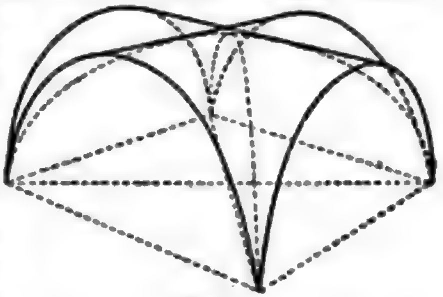


Fig. 2.

So far, all the vaults mentioned have been barrel vaults, which, when not built underground, required continuous walls of great thickness to resist their thrust; the earliest example of the next variety, the intersecting barrel vault, is said to be over a small hall at Pergamum, in Asia Minor, but its first employment over halls of great dimensions is due to the Romans. When two semicircular barrel vaults of the same diameter cross one another (fig. 2) their intersection (a true ellipse) is known as a groin, down which the thrust of the vault is carried to the cross walls; if a series of two or more barrel vaults intersect one another, the weight is carried on to the piers at their intersection and the thrust is transmitted to the outer cross walls; thus in the Roman reservoir at Baiae, known as the *piscina mirabilis*, a series of five aisles with semicircular barrel vaults are intersected by twelve cross aisles, the vaults being carried on 48 piers and thick external walls. The width of these aisles being only about 13 ft. there was no great difficulty in the construction of these vaults, but in the Roman Thermae the tepidarium had a span of 80 ft., more than twice that of an English cathedral, so that its construction both from the statical and economical point of view was of the greatest importance. The researches of M. Choisy (*L'Art de bâtir chez les Romains*), based on a minute examination of those portions of the vaults which still remain *in situ*, have shown that, on a comparatively slight centring, consisting of trusses placed about 10 ft. apart and covered with planks laid from truss to truss, were laid—to begin with—two layers of the Roman brick (measuring nearly 2 ft. square and 2 in. thick); on these and on the trusses transverse rings of brick were built with longitudinal ties at intervals; on the brick layers and embedding the rings and cross ties concrete was thrown in horizontal layers, the haunches being filled in solid, and the surface sloped on either side and covered over with a tile roof of low pitch laid direct on the concrete. The rings relieved the centring from the weight imposed, and the two layers of bricks carried the concrete till it had set. As the walls carrying these vaults were also built in concrete with occasional bond courses of brick, the whole structure was homogeneous. One of the important ingredients of the mortar was a volcanic deposit found near Rome, known as pozzolana, which, when the concrete had set, not only made the concrete as solid as the rock itself, but to a certain extent neutralized the thrust of the vaults, which formed shells equivalent to that of a metal lid, the Romans, however, do not seem to have recognized the extraordinary value of this pozzolana mixture, for they otherwise provided amply for the counteracting of any thrust which might exist by the erection of cross walls and buttresses. In the tepidaria of the Thermae and in the basilica of Constantine, in order to bring the thrust well within the walls, the main barrel vault of the hall was brought forward on each side and rested on detached columns, which constituted the principal architectural decoration. In cases where the cross vaults intersecting were not of the same span as those of the main vault, the arches were either stilted so that their soffits might be of the same height, or they formed smaller intersections in the lower part of the vault; in both of these cases, however, the intersections or groins were twisted, for which it was very difficult to form a centring, and, moreover, they were of disagreeable effect: though every attempt was made to mask this in the decoration of the vault by panels and reliefs modelled in stucco.

The widest hall vaulted by the Romans was that of the throne room in the palace of Diocletian on the Palatine Hill, and this had the enormous span of 100 ft., its thrust being counteracted by other halls on either side with buttresses outside. In provincial towns and in other parts of the Roman Empire, where the material pozzolana was not procurable, the Romans had to trust to their mortar as a cementing medium, but this, though excellent of its kind, was not of sufficient cohesive strength to allow of the erection of vaults of more than about 40 ft. span, which were generally built in rubble masonry. There still exist in Asia Minor and Syria some vaulted halls, generally attached to thermae, which are carried on walls of great thickness. There were many varieties of the Roman vault, whether continuous or intersected, such as those employed over the corridors on the Colosseum and the theatre of Marcellus, but in these cases the springing of the vault was above the summit of the arches of the main front, so that there was no intersection; on the other hand, over the corridors were either elliptical or semicircular, or over the staircases rising vaults, all of which were more difficult to construct; there were also numerous solutions of vault over circular halls, of which that of the Pantheon was the most important example, having a diameter of 142 ft., and over the hemicycles, which were sometimes of great size; that known as Canopus in Hadrian's villa at Tivoli had a diameter of 75 ft., and was vaulted over with a series of ribs, between which were alternating rampant flat and semicircular webs and cells; in the same villa and in Rome were octagonal halls with various other combinations of vault. Another type of vault not yet referred to is that of the Tabularium arcade where the cloister vault was employed. Fig. 3 compared with fig. 2 will show the difference; in the former the angles of intersection are inset, and in the latter they are groins with projecting angles at the base, which die away at the summit.

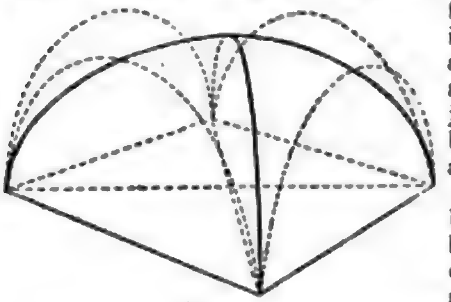


FIG. 3.

The vault of the basilica, commenced by Diocletian and completed by Constantine, was the last great work carried out by the Romans, and two centuries pass before the next important development is found in the church of Sta Sophia at Constantinople. It is probable that the realization of the great advance in the science of vaulting shown in this church owed something to the eastern tradition of dome vaulting seen in the Assyrian domes, which are known to us only by the representations in the bas-relief from Nimrud (fig. 1), because in the great water cisterns in Constantinople, known as the Yeri Batan Serai (the underground palace) and Bin bir-derek (cistern with a thousand and one columns), both built by Constantine, we find the intersecting groin vaults of the Romans already replaced by small cupolas or domes. These domes, however, are of small dimensions when compared with that projected and carried out by Justinian in Sta Sophia. Previous to this the greatest dome was that of the Pantheon at Rome, but this was carried on an immense wall 20 ft. thick, and with the exception of small niches or recesses in the thickness of the wall could not be extended, so that Justinian apparently instructed his architect to provide an immense hemicycle or apse at the eastern end, a similar apse at the western end, and great arches on either side, the walls under which would be pierced with windows.

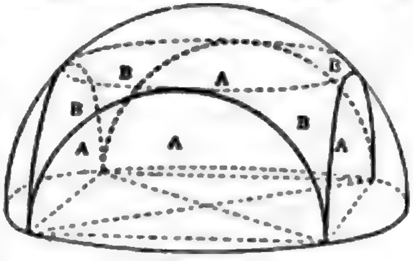


FIG. 4.

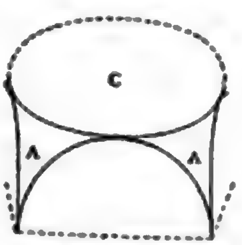


FIG. 5.—AA, pendentive.

The diagram (fig. 4) shows the outlines of the solution of the problem. If a hemispherical dome is cut by four vertical planes, the intersection gives four semicircular arches; if cut in addition by a horizontal plane tangent to the top of these arches, it describes a circle; that portion of the sphere which is below this circle and between the arches, forming a spherical spandril, is the pendentive (fig. 5), and its radius is equal to the diagonal of the square on which the four arches rest. Having obtained a circle for the base of the dome, it is not necessary that the upper portion of the dome should spring from the same level as the arches, or that its domical surface should be a continuation of that of the pendentive. The first and second dome of Sta Sophia apparently fell down, so that Justinian determined to raise it, possibly to give greater lightness to the structure, but mainly in order to obtain increased light for the interior of the church. This was effected by piercing it with forty windows—the effect of which was of an extraordinary nature, as the light streaming through these windows gave to the dome the appearance of being suspended in the air. The pendentive which carried the dome rested on four great arches, the thrust of those crossing the church being counteracted by immense buttresses which traversed the aisles, and the other two partly by smaller arches in the apse, the thrust being carried to the outer walls, and to a certain extent by the side walls which were built under the arches. From the description given by Procopius we gather that the centring employed for the great arches consisted of a wall erected to support them during their erection. The construction of the pendentives is not known, but it is surmised that to the top of the pendentives they were built in horizontal courses of brick, projecting one over the other, the projecting angles being cut off afterwards and covered with stucco in which the mosaics were embedded; this was the method employed in the erection of the Perigordian domes, to which we shell return; these, however, were of less diameter than those of Sta Sophia, being only about 40 to 60 ft. instead of 107 ft. The apotheosis of Byzantine architecture, in fact, was reached in Sta Sophia, for although it formed the model on which all subsequent Byzantine churches were based, so far as their plan was concerned, no domes approaching the former in dimensions were even attempted. The principal difference in some later examples is that which took place in the form of the pendentive on which the dome was carried. Instead of the spherical spandril of Sta Sophia, large niches were formed in the angles, as in the mosque of Damascus, which was built by Byzantine workmen for the Sherif al Walid in A.D. 705; these gave an octagonal base on which the hemispherical dome rested (fig. 6); or again, as in the Sassanian palaces of Serbistan and Firuzabad of the 4th and 5th century of our era, when a series of concentric arch rings, projecting one in front of the other, were built, giving also an octagonal base; each of these pendentives is known as a squinch.

There is one other remarkable vault, also built by Justinian, in the church of S. Sergius and Bacchus in Constantinople. The central area of this church was octagonal on plan, and the dome is divided into sixteen compartments; of these eight consist of broad flat bands rising from the centre of each of the walls, and the alternate eight are concave cells over the angles of the octagon, which externally and internally give to the roof the appearance of an umbrella.

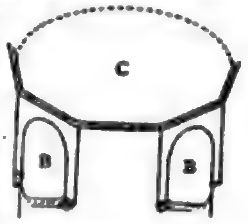


FIG. 6.—BB, niche or squinch pendentive.

Although the dome constitutes the principal characteristic of the Byzantine church, throughout Asia Minor are numerous examples in which the naves are vaulted with the semicircular barrel vault, and this is the type of vault found throughout the south of France in the 11th and 12th centuries, the only change being the occasional substitution of the pointed barrel vault, adopted not only on account of its exerting a less thrust, but because, as pointed out by Fergusson (vol. ii. p. 46), the roofing tiles were laid directly on the vault and a less amount of filling in at the top was required. The continuous thrust of the barrel vault in these cases was met either by semicircular or pointed barrel vaults on the aisles, which had only half the span of the nave; of this there is an interesting example in the chapel of St John in the Tower of London—and sometimes by half-barrel vaults. The great thickness of the walls, however, required in such constructions would seem to have led to another solution of the problem of roofing over churches with incombustible material, viz. that which is found throughout Perigord and La Charente, where a series of domes carried on pendentives covered over the nave, the chief peculiarities of these domes being the fact that the arches carrying them form part of the pendentives, which are all built in horizontal courses.

The intersecting and groined vault of the Romans was employed in the early Christian churches in Rome, but only over the aisles, which were comparatively of small span, but in these there was a tendency to raise the centres of these vaults, which became slightly domical; in all these cases centring was employed.

Reference has been made to the twisting of the groins in Roman work, where the intersecting barrel vaults were not of the same diameter; their construction must at all times have been somewhat difficult, but where the barrel vaulting was carried round over the choir aisle and was intersected, as in St Bartholomew's, Smithfield, by semicones, instead of cylinders, it became worse and the groins more complicated; this would seem to have led to a change of system, and to the introduction of a new feature, which completely revolutionized the construction of the vault. Hitherto the intersecting features were geometrical surfaces, of which the diagonal groins were the intersections, elliptical in form, generally weak in construction and often twisting (Plate I. fig. 13). The medieval builder reversed the process, and set up the diagonal ribs first, which were utilized as permanent centres, and on these he carried his vault or web, which henceforward took its shape from the ribs. Instead of the elliptical curve which was given by the intersection of two semicircular barrel vaults, or cylinders, he employed the semicircular arch for the diagonal ribs; this, however, raised the centre of the square bay vaulted above the level of the transverse arches and of the wall ribs, and thus gave the appearance of a dome to the vault, such as may be seen in the nave of Sant' Ambrogio, Milan. To meet this, at first the transverse and wall ribs were stilted, or the upper part of their arches was raised, as in the Abbaye-aux-Hommes at Caen, and the abbey of Lessay, in Normandy. The problem was ultimately solved by the introduction of the pointed arch for the transverse and wall ribs—the pointed arch had long been known and employed, on account of its much greater strength and of the less thrust it exerted on the walls. When employed for the ribs of a vault, however narrow the span might be, by adopting a pointed arch, its summit could be made to range in height with the diagonal rib; and, moreover, when utilized for the ribs of the annular vault, as in the aisle round the apsidal termination of the choir, it was not necessary that the half ribs on the outer side should be in the same plane as those of the inner side; for when the opposite ribs met in the centre of the annular vault, the thrust was equally transmitted from one to the other, and being already a broken arch the change of its direction was not noticeable.

The first introduction of the pointed arch rib would seem to have taken place in the choir aisles of the abbey of St Denis, near Paris, built by the Abbé Suger in 1135, and it was in the church at Vezelay (1140) that it was extended to the square bay of the porch. Before entering into the question of the web or stone shell of the vault carried on the ribs, the earlier development of the great vaults which were thrown over the naves of a cathedral, or church, before the introduction of the pointed arch rib, shall here be noted. As has been pointed out, the aisles had already in the early Christian churches been covered over with groined vaults, the only advance made in the later developments being the introduction of transverse ribs[1] dividing the bays into square compartments; but when in the 12th century the first attempts were made to vault over the naves, another difficulty presented itself, because the latter were twice the width of the aisles, so that it became necessary to include two bays of the aisles to form one square bay in the nave. This was an immense space to vault over, and, moreover, it followed that every alternate pier served no purpose, so far as the support of the nave vault was concerned, and this would seem to have suggested an alternative, viz. to provide a supplementary rib across the church and between the transverse ribs. This resulted in what is known as a sexpartite, or six-celled vault, of which one of the earliest examples is found in the Abbaye-aux-Hommes (S. Étienne) at Caen. This church, built by William the Conqueror, was originally constructed to carry a timber roof only, but nearly a century later the upper part of the nave walls were partly rebuilt, in order that it might be covered with a vault. The immense size, however, of the square vault over the nave necessitated some additional support, so that an intermediate rib was thrown across the church, dividing the square compartment into six cells, and called the sexpartite vault (fig. 7); this was adopted in the cathedrals of Sens (1170), Laon (1195), Noyon (1190), Paris (1223-35), and Bourges (1250). The intermediate rib, however, had the disadvantage of partially obscuring one side of the clerestory windows, and it threw unequal weights on the alternate piers, so that in the cathedral of Soissons (1205) a quadripartite (fig. 8) or four-celled vault was introduced, the width of each bay being half the span of the nave, and corresponding therefore with the aisle piers. To this there are some exceptions, in Sant' Ambrogio, Milan, and San Michele, Pavia (the original vault), and in the cathedrals of Spires, Mainz and Worms, where the quadripartite vaults are nearly square, the intermediate piers of the aisles being of much smaller dimensions. In England sexpartite vaults exist at Canterbury (1175) (set out by William of Sens), Rochester (1200), Lincoln (1215), Durham (east transept), and St Faith's chapel, Westminster Abbey.

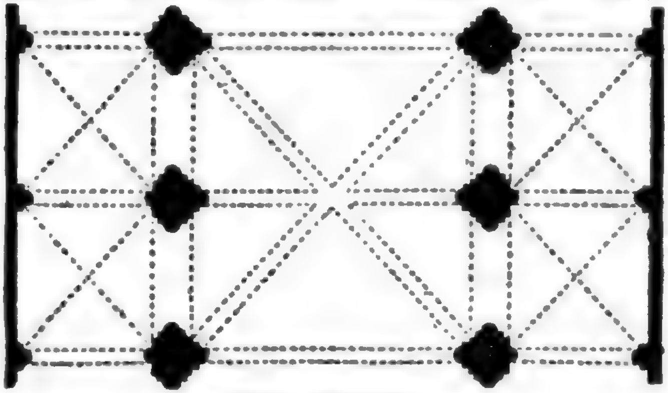


FIG. 7.—Sexpartite.

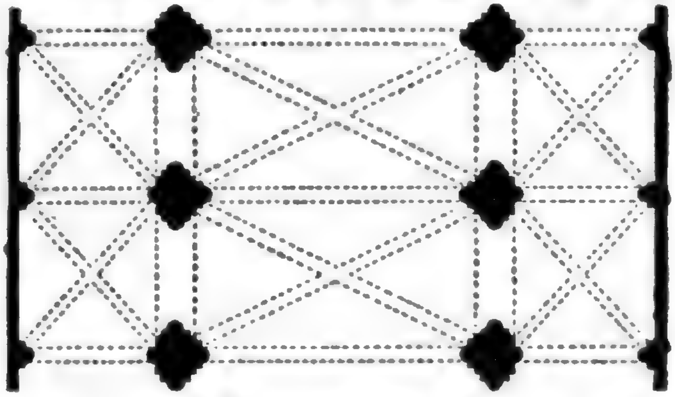


FIG. 8.—Quadripartite.

In the earlier stage of rib vaulting, the arched ribs consisted of independent or separate voussoirs down to the springing; the difficulty, however, of working the ribs separately led to two other important changes: (1) the lower part of the transverse diagonal and wall ribs were all worked out of one stone; and (2) the lower courses were all made horizontal, constituting what is known as the tas-de-charge (*q.v.*) or solid springer. Fig. 9 is a diagram made by Professor Willis taken from the south transept of Westminster Abbey. The horizontal courses rise to N. or about half the height of the vault, but the ribs are freed from one another from the point M. The tas-de-charge, or solid springer, had two advantages: (1) it enabled the stone courses to run straight through the wall, so as to bond the whole together much better; and (2) it lessened the span of the vault, which then required a centring of smaller dimensions. As soon as the ribs were completed, the web or stone shell of the vault was laid on them. In some English work, as may be seen in fig. 9, each course of stone was of uniform height from one side to the other; but, as the diagonal rib was longer than either the transverse or wall rib, the courses dipped towards the former, and at the apex of the vault were cut to fit one another. At an early period, in consequence of the great span of the vault and the very slight rise or curvature of the web, it was thought better to simplify the construction of the web by introducing intermediate ribs between the wall rib and the diagonal rib and between the diagonal and the transverse ribs; and in order to meet the thrust of these intermediate ribs a ridge rib was required, and the prolongation of this rib to the wall rib hid the junction of the web at the summit, which was not always very sightly, and constituted the ridge rib. In France, on the other hand, the web courses were always laid horizontally, and they are therefore of unequal height, increasing towards the diagonal rib. Each course also was given a slight rise in the centre, so as to increase its strength; this enabled the French masons to dispense with the intermediate rib, which was not introduced by them till the 15th century, and then more as a decorative than a constructive feature, as the domical form given to the French web rendered unnecessary the ridge rib, which, with some few exceptions, exists only in England. In both English and French vaulting centring was rarely required for the building of the web, a template (Fr. *cerce*) being employed to support the stones of each ring until it was complete. In Italy, Germany and Spain the French method of building the web was adopted, with horizontal courses and a domical form. Sometimes, in the case of comparatively narrow compartments, and more especially in clerestories, the wall rib was stilted, and this caused a peculiar twisting of the web, as may be seen in fig. 9, where the springing of the wall rib is at K: to these twisted surfaces the term "ploughshare vaulting" is given.

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[1] Transverse ribs under the vaulting surfaces had been employed from very early times by the Romans, and utilized as permanent stone centrings for their vaults; perhaps the earliest examples are those in the corridor of the Tabularium in Rome, which is divided into square bays, each vaulted with a cloister dome. Transverse ribs are also found in the Roman Piscinae and in the Nymphaeum at Nîmes; they were not introduced by the Romanesque masons till the 11th century.

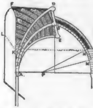

FIG. 9.—AB, springing of transverse and diagonal ribs; P, centre of the same; DE, longitudinal ridge rib; DF, intersection of webs; M, top of solid springer; KN, starting level of web; LK, springing of wall rib; EBD, bosses at intersection of ribs.

One of the earliest examples of the introduction of the intermediate rib is found in the nave of Lincoln Cathedral, and there the ridge rib is not carried to the wall rib. It was soon found, however, that the construction of the web was much facilitated by additional ribs, and consequently there was a tendency to increase their number, so that in the nave of Exeter Cathedral three intermediate ribs were provided between the wall rib and the diagonal rib. In order to mask the junction of the various ribs, their intersections were ornamented with richly carved bosses, and this practice increased on the introduction of another short rib, known as the lierne, a term in France given to the ridge rib. Lierne ribs in English vaults are short ribs crossing between the main ribs, and were employed chiefly as decorative features, as, for instance, in the stellar vault (see Plate I. fig. 16), one of the best examples of which exists in the vault of the oriel window of Crosby Hall, London. The tendency to increase the number of ribs led to singular results in some cases, as in the choir of Gloucester (see Plate II. fig. 17), where the ordinary diagonal ribs become mere ornamental mouldings on the surface of an intersected pointed barrel vault, and again in the cloisters, where the introduction of the fan vault, forming a concave-sided conoid, returned to the principles of the Roman geometrical vault. This is further shown in the construction of these fan vaults, for although in the earliest examples each of the ribs above the tas-de-charge was an independent feature, eventually it was found easier to carve them and the web out of the solid stone, so that the rib and web were purely decorative and had no constructional or independent functions.

The fan vault would seem to have owed its origin to the employment of centrings of one curve for all the ribs, instead of having separate centrings for the transverse, diagonal wall and intermediate ribs; it was facilitated also by the introduction of the four-centred arch, because the lower portion of the arch formed part of the fan, or conoid, and the upper part could be extended at pleasure with a greater radius across the vault. The simplest version is that found in the cloisters of Gloucester Cathedral, where the fans meet one another at the summit, so that there are only small compartments between the fans to be filled up. In later examples, as in King's College chapel, Cambridge (see Plate II. fig. 18), on account of the great dimensions of the vault, it was found necessary to introduce transverse ribs, which were required to give greater strength. Similar transverse ribs are found in Henry VII.'s chapel (see Plate II. fig. 19) and in the divinity schools at Oxford, where a new development presented itself. One of the defects of the fan vault at Gloucester is the appearance it gives of being half sunk in the wall; to remedy this, in the two buildings just quoted, the complete conoid is detached and treated as a pendant.

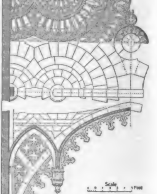

FIG. 10.

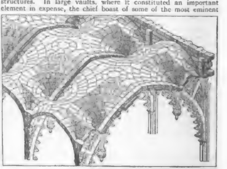

FIG. 11.

One of the most interesting examples of the fan vault is that over the staircase leading to the hall of Christ Church, Oxford, and here the complete conoid is displayed in its centre carried on a central column. This vault, not built until 1640, is an exceptional example of the long continuance of traditional workmanship, probably in Oxford transmitted in consequence of the late vaulting of the entrance gateways to the colleges. Fan vaulting is peculiar to England, the only example approaching it in France being the pendant of the Lady chapel at Caudebec, in Normandy. In France, Germany and Spain the multiplication of ribs in the 15th century led to decorative vaults of various kinds, but with some singular modifications. Thus in Germany, recognizing that the rib was no longer a necessary constructive feature, they cut it off abruptly, leaving a stump only; in France, on the other hand, they gave still more importance to the rib, by making it of greater depth, piercing it with tracery and hanging pendants from it, and the web became a horizontal stone paving laid on the top of these decorated vertical webs. This is the characteristic of the great Renaissance work in France and Spain; but it soon gave way to Italian influence, when the construction of vaults reverted to the geometrical surfaces of the Romans, without, however, always that economy in centring to which they had attached so much importance, and more especially in small structures. In large vaults, where it constituted an important element in expense, the chief boast of some of the most eminent architects has been that centring was dispensed with, as in the case of the dome at Florence, built by Brunelleschi, and Ferguson cites as an example the great dome of the church at

Mousta in Malta, erected in the first half of the 19th century, which was built entirely without centring of any kind. Fig. 10 is a plan and section of the vault of Henry VII.'s chapel and fig 11 a perspective view, in which it will be seen that the transverse rib thrown across the chapel carries the pendant, the weight of the latter probably preventing a rise in the haunches.

There are two other ribbed vaults in India which form no part of the development of European vaults, but are too remarkable to be passed over; one carries the central dome of the Jumma Musjid at Bijapur (A.D. 1559), and the other is the tomb of Mahommed (A.D. 1626–1660) in the same town. The vault of the latter was constructed over a hall 135 ft. square, to carry a hemispherical dome. The ribs, instead of being carried across the angles only, thus giving an octagonal base for the dome, are carried across to the further pier of the octagon (fig. 12) and consequently intersect one another, reducing the central opening to 97 ft. in diameter, and, by the weight of the masonry they carry, serving as counterpoise to the thrust of the dome, which is set back so as to leave a passage about 12 ft. wide round the interior. The internal diameter of the dome is 124 ft., its height 175 ft. and the ribs struck from four centres have their springing 57 ft. from the floor of the hall. The Jumma Musjid dome was of smaller dimensions, on a square of 70 ft. with a diameter of 57 ft., and was carried on piers only instead of immensely thick walls as in the tomb; but any thrust which might exist was counteracted by its transmission across aisles to the outer wall.

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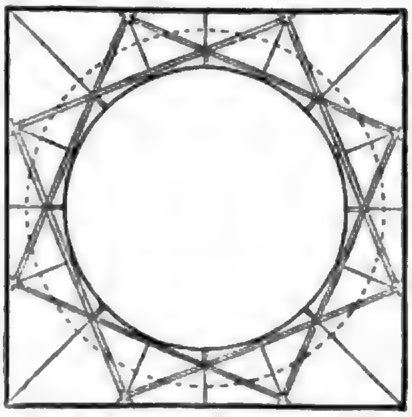

FIG. 12.—Plan of Bijapur Dome.

VAUQUELIN, LOUIS NICOLAS (1763–1829), French chemist, was born at Saint-André-d'Hebertot in Normandy on the 16th of May 1763. His first acquaintance with chemistry was gained as laboratory boy to an apothecary in Rouen (1777–1779), and after various vicissitudes he obtained an introduction to A. F. Fourcroy, in whose laboratory he was an assistant from 1783–1791. At first his work appeared as that of his master and patron, then in their joint-names; but in 1790 he began to publish on his own authority, and between that year and 1833 his name is associated with 376 papers. Most of these were simple records of patient and laborious analytical operations, and it is perhaps surprising that among all the substances he analysed he only detected two new elements—beryllium (1798) in beryl and chromium (1797) in a red lead ore from Siberia. Either together or successively he held the offices of inspector of mines, professor at the School of Mines and at the Polytechnic School, assayer of gold and silver articles, professor of chemistry in the *Collège de France* and at the *Jardin des Plantes*, member of the Council of Industry and Commerce, commissioner on the pharmacy laws, and finally professor of chemistry to the Medical Faculty, to which he succeeded on Fourcroy's death in 1809. His lectures, which were supplemented with practical laboratory teaching, were attended by many chemists who subsequently attained distinction. He died at his birthplace on the 14th of November 1829.

VAUQUELIN DE LA FRESNAYE, JEAN (1536–1608), French poet, was born at the château of La Fresnaye, near Falaise in Normandy, in 1536. He studied the humanities at Paris and law at Poitiers and Bourges. He fought in the civil wars under Marshal Matignon and was wounded at the siege of Saint-Lô (1574). Most of his life was spent at Caen, where he was president, and he died there in 1608. La Fresnaye was a disciple of Ronsard, but, while praising the reforms of the Pléiade, he laid stress on the continuity of French literary history. He was a student of the trouvères and the old chroniclers, and desired to see French poetry set on a national basis. These views he expounded in an *Art poétique*, begun at the desire of Henry III. in 1574, but not published until 1605.

His *Foresteries* appeared in 1555; his *Diverses poésies*, including the *Art poétique*, the *Satyres françoises*, addressed to various distinguished contemporaries, and the *Idylles*, with some epigrams and sonnets, appeared in 1605. Among his political writings may be noted *Pour la monarchie du royaume contre la division* (1569).

The *Art poétique* was edited by G. Pellissier in 1885. It is summarized for English readers in vol. ii. of Mr George Saintsbury's *History of Criticism*. A notice of the poet by J. Travers is prefixed to an edition of the *Œuvres diverses* (Caen, 1872).

VAUVENARGUES, LUC DE CLAPIERS, MARQUIS DE (1715–1747), French moralist and miscellaneous writer, was born at Aix in Provence on the 6th of August 1715. His family was poor though noble; he was educated at the collège of Aix, where he learned little—neither Latin nor Greek—but by means of a translation acquired a great admiration for Plutarch. He entered the army as sub-lieutenant in the king's regiment, and served for more than ten years, taking part in the Italian campaign of Marshal Villars in 1733, and in the disastrous expedition to Bohemia in support of Frederick the Great's designs on Silesia, in which the French were abandoned by their ally. Vauvenargues took part in Marshal Belle-Isle's winter retreat from Prague. On this occasion his legs were frozen, and though he spent a long time in hospital at Nancy he never completely recovered. He was present at the battle of Dettingen, and on his return to France was garrisoned at Arras. His military career was now at an end. He had long been desired by the marquis of Mirabeau, author of *L'Ami des hommes*, and father of the statesman, to turn to literature, but poverty prevented him from going to Paris as his friend wished. He wished to enter the diplomatic service, and made applications to the ministers and to the king himself. These efforts were unsuccessful, but Vauvenargues was on the point of securing his appointment through the intervention of Voltaire when an attack of smallpox completed the ruin of his health and rendered diplomatic employment out of the question. Voltaire then asked him to submit to him his ideas of the difference between Racine and Corneille. The acquaintance thus begun ripened into real and lasting friendship. Vauvenargues removed to Paris in 1745, and lived there in the closest retirement, seeing but few friends, of whom Marmontel and Voltaire were the chief. Among his correspondents was the archaeologist Fauris de Saint-Vincens. Vauvenargues published in 1746 an *Introduction à la connaissance de l'esprit humain*, with certain *Réflexions* and *Maximes* appended. He died in Paris on the 28th of May 1747.

The bulk of Vauvenargues's work is very small, but its interest is very considerable. In the *Introduction*, in the *Réflexions* and in the minor fragments, it consists, in fact, of detached and somewhat desultory thoughts on questions of moral philosophy and of literary criticism. Sainte-Beuve has mildly said that as a literary critic Vauvenargues "shows inexperience." His literary criticism is indeed limited to a repetition in crude form of the stock ideas of his time. Thus he exaggerates immensely the value of Racine and Boileau, but depreciates Corneille and even Molière. As a writer he stands far higher. His style is indeed, according to strict academic judgment, somewhat incorrect, and his few excursions into rhetoric have the artificial and affected character which mars so much 18th-century work. His strength, however, is not really in any way that of a man of letters, but that of a moralist. He did not adopt the complete *philosophe* attitude; in his letters, at any rate, he poses as "neutral" between the religious and the anti-religious school. In some of his maxims about politics there is also traceable the hollow and confused jargon about tyrants and liberty which did so much to bring about the struggles of the Revolution. It is in morals proper, in the discussion and application of general principles of conduct, that Vauvenargues shines. He is not an exact psychologist, much less a rigorous metaphysician. His terminology is popular and loose, and he hardly attempts the co-ordination of his ideas into any system. His real strength is in a department which the French have always cultivated with greater success than any other modern people—the expression in more or less epigrammatic language of the results of acute observation of human conduct and motives, for which he had found ample leisure in his campaigns. The chief distinction between Vauvenargues and his great predecessor La Rochefoucauld is that Vauvenargues, unlike La Rochefoucauld, thinks nobly of man, and is altogether inclined rather to the Stoic than to the Epicurean theory. He has indeed been called a modern Stoic, and, allowing for the vagueness of all such phrases, there is much to be said for the description.

An edition of the *Œuvres* of Vauvenargues, slightly enlarged, appeared in the year of his death. There were some subsequent editions, superseded by that of M. Gilbert (2 vols., 1857), which contains some correspondence, some *Dialogues of the Dead*, "characters" in imitation of Theophrastus and La Bruyère, and numerous short pieces of criticism and moralizing. The best comments on Vauvenargues, besides those contained in Gilbert's edition, are to be found in four essays by Sainte-Beuve in *Causeries du lundi*, vols. iii. and xiv., and in Villemain's *Tableau de la littérature française au XVIII*^{me} *siècle*.

See also M. Paléologue, *Vauvenargues* (1890); and *Selections from . . . La Bruyère and Vauvenargues*, with memoir and notes by Miss Elizabeth Lee (1903).

VAUX, CALVERT (1824–1895), American architect and landscape gardener, was born in London on the 24th of December 1824. He was educated at Merchant Taylors' School and in the office of Lewis N. Cottingham (1787–1847). In 1850 he went to America and became A. J. Downing's architectural partner. In 1856 and 1866 Vaux was associated with F. L. Olmsted in the plans for the improvement of various parks. He designed the Belvidere in Central Park, New York, and built a number of country houses in Newport, besides many town houses and public institutions.

VAUX OF HARROWDEN, THOMAS VAUX, 2ND BARON (1510–1556), English poet, eldest son of Nicholas Vaux, 1st Baron Vaux, was born in 1510. In 1527 he accompanied Cardinal Wolsey on his embassy to France; he attended Henry VIII. to Calais and Boulogne in 1532; in 1531 he took his seat in the House of Lords, and was made Knight of the Bath at the coronation of Anne Boleyn. He was captain of the Isle of Jersey until 1536. He married Elizabeth Cheney, and died in October 1556. Sketches of Vaux and his wife by Holbein are at Windsor, and a finished portrait of Lady Vaux is at Hampton Court. Two of his poems were included in the *Songes and Sonettes of Surrey* (Tottel's *Miscellany*, 1557). They are "The assault of Cupid upon the fort where the lover's hart lay wounded, and how he was taken," and the "Dittye . . . representinge the Image of Deathe," which the gravedigger in Shakespeare's *Hamlet* misquotes. Thirteen pieces in the *Paradise of Dainty Devices* (1576) are signed by him. These are reprinted in Dr A. B. Grosart's *Miscellanies of the Fuller Worthies Library* (vol. iv., 1872).

VAUXHALL, a district on the south bank of the river Thames, in London, England, included in the metropolitan borough of Lambeth. The manor was held by Falkes de Breauté (whence the name, Falkes Hall) in the time of John and Henry III. About 1661 public gardens were laid out here, known as the New Spring Garden, and later as Spring Gardens, but more familiar under the title of Vauxhall Gardens. They soon became the favourite fashionable resort of the metropolis; but as a place of general entertainment they underwent great development from 1732 under the management of Jonathan Tyers (d. 1767) and his sons Thomas and Jonathan. In 1822, with the approval of George IV., who frequented the gardens before his accession, the epithet Royal was added to their title. By the middle of the 19th century, however, Vauxhall had lost its high reputation; in 1859 the gardens were finally closed, and the site was quickly built over.

VAVASSOR (Med. Lat. *valvassor*, *vasvassor*; Fr. *vavassour*, *vavassor*, *vasseur*, &c.), in its most general sense a mediate vassal, *i.e.* one holding a fief under a vassal. The word was, however, applied at various times to the most diverse ranks in the feudal hierarchy, being used practically as the synonym of vassal. Thus tenants-in-chief of the crown are described by the Emperor Conrad (*Lex Langob.* lib. iii. tit. 8, § 4) as *valvassores majores* as distinguished from mediate tenants, *valvassores minores*. Gradually the term without qualification was found convenient for describing sub-vassals, tenants-in-chief being called *capitanei* or *barones* (see BARON). Its implication, however, still varied in different places and times. Bracton (lib. i. cap. 8, § 2) ranks the *magnates seu valvassores* between barons and knights; for him they are "men of great dignity," and in this order they are found in a charter of Henry II. (1166). But in the *regestum* of Philip Augustus (fol. 158) we find that five vavassors are reckoned as the equivalent of one knight. Finally, Du Cange quotes two charters, one of 1187, another of 1349, in which vavassors are clearly distinguished from nobles.

The derivation of the word vavassor is very obscure. The fanciful interpretation of Bracton, *vas sortitum ad valetudinem* (a vessel chosen to honour), may be at once rejected. Others would derive it from *vassi ad valvas* (at the folding-doors, *valvae*), *i.e.* servants of the royal antechamber. Du Cange, with more justice, regards it merely as an obscure variant of *vassus*. (W. A. P.)

VAYGACH (variously Waigats, Waigatch, &c.), an island off the Arctic coast of Russia, between it and Novaya Zemlya, bounded S. by the narrow Yugor Strait, and N. by that of Kara. It is roughly oblong in form; its length from S.E. to N.W. is 70 m., and its greatest breadth 28. Its greatest elevation scarcely exceeds 300 ft. For the most part it consists of tundra, with frequent marshes and small lakes. Slight rocky ridges run generally along its length, and the coast has low cliffs in places. The island consists in the main of limestone, and its elevation above the sea is geologically recent. Raised beaches are frequently to be traced. The rocks are heavily scored by ice, but this was probably marine ice, not that of glaciers. Grasses, mosses and Arctic flowering plants are abundant, but there are no trees excepting occasional dwarf willows. Foxes and lemmings are met with, but whereas animals are few, birds are very numerous; a variety of ducks, waders, &c., frequent the marshes and lakes. The island is visited periodically by a few Samoyedes; they formerly considered it sacred, and some of their sacrificial piles, consisting of drift-wood, deer's horns and the skulls of bears and deer, have been observed by travellers. In spite of their conversion to Christianity, the Samoyedes still regard these piles with superstition. The origin of the name Vaygach is as dubious as its orthography; it has been held to be Dutch (*waaien*, to blow, and *gat*, a strait, hence "windy strait") or Russian, in which case it is probably a surname.

Comparatively little was known of the interior of the island until Mr F. G. Jackson made the circuit of it on foot in 1893 (see his *Great Frozen Land*, London, 1895; also H. J. Pearson, *Beyond Petsora Eastward*, London, 1899).

VECTOR ANALYSIS, in mathematics, the calculus of vectors. The position of a point B relative to another point A is specified by means of the straight line drawn from A to B. It may equally well be specified by any equal and parallel line drawn in the same sense from (say) C to D, since the position of D relative to C is the same as that of B relative to A. A straight line conceived in this way as having a definite length, direction and sense, but no definite location in space, is called a *vector*. It may be denoted by $\overrightarrow{AB}$ (or $\overrightarrow{CD}$), or (when no confusion is likely to arise) simply by **AB**. Thus a vector may be used to specify a displacement of translation (without rotation) of a rigid body. Again, a force acting on a particle, the velocity or momentum of a particle, the state of electric or magnetic polarization at a particular point of a medium, are examples of physical entities which are naturally represented by vectors.

The quantities, on the other hand, with which we are familiar in ordinary arithmetical algebra, and which have merely magnitude and sign, without any intrinsic reference to direction, are distinguished as *scalars*, since they are completely specified by their position on the proper scale of measurement. The mass of a body, the pressure of a gas, the charge of an electrified conductor, are instances of scalar magnitudes. It is convenient to emphasize this distinction by a difference of notation; thus scalar quantities may be denoted by italic type, vectors (when they are represented by single symbols) by "black" or "Clarendon" type.

There are certain combinations of vectors with one another, and with scalars, which have important geometrical or physical significance. Various systems of "vector analysis" have been devised for the purpose of dealing methodically with these; we shall here confine ourselves to the one which is at present in most general use. Any such calculus must of course begin with definitions of the fundamental symbols and operations; these are in the first instance quite arbitrary conventions, but it is convenient so to frame them that the analogy with the processes of ordinary algebra may as far as possible be maintained.

As already explained, two vectors which are represented by equal and parallel straight lines drawn in the same sense are regarded as identical. Again, the product of a scalar m into a vector **A** is naturally defined as the vector whose direction is the same as that of **A**, but whose length is to that of **A** in the ratio m, the sense (moreover) being the same as that of **A** or the reverse, according as m is positive or negative. We denote it by $m\mathbf{A}$. The particular case where $m=-1$ is denoted by $-\mathbf{A}$, so that a change of sign simply reverses the sense of a vector.

As regards combinations of two vectors, we have in the first place the one suggested by composition of displacements in kinematics, or of forces or couples in statics. Thus if a rigid body receive in succession two translations represented by $\overrightarrow{AB}$ and $\overrightarrow{BC}$, the final result is equivalent to the translation represented by $\overrightarrow{AC}$. It is convenient, therefore, to regard $\overrightarrow{AC}$ as in a sense the "geometric sum" of $\overrightarrow{AB}$ and $\overrightarrow{BC}$, and to write

$$\overrightarrow{AB}+\overrightarrow{BC}=\overrightarrow{AC}.$$

This constitutes the definition of vector *addition*; and it is evident at once from fig. 1 that

$$\overrightarrow{BC}+\overrightarrow{AB}=\overrightarrow{AD}+\overrightarrow{DC}=\overrightarrow{AC}=\overrightarrow{AB}+\overrightarrow{BC}.$$

Hence, **A** and **B** being any two vectors, we have

$$\mathbf{A}+\mathbf{B}=\mathbf{B}+\mathbf{A}, \quad . \quad . \quad . \quad . \quad . \quad (1)$$

i.e. addition of vectors, like ordinary arithmetical addition, is subject to the "commutative law." As regards subtraction, we define $\mathbf{A}-\mathbf{B}$ as the equivalent of $\mathbf{A}+(-\mathbf{B})$; thus in fig. 1, if $\overrightarrow{AB}=\mathbf{A}$, $\overrightarrow{BC}=\mathbf{B}$, we have

$$\mathbf{A}+\mathbf{B}=\overrightarrow{AC},\ \mathbf{A}-\mathbf{B}=\overrightarrow{DB}.$$

When the sum (or difference) of two vectors is to be further dealt with as a single vector, this may be indicated by the use of curved brackets, *e.g.* $(\mathbf{A}+\mathbf{B})$. It is easily seen from a figure that

$$(\mathbf{A}+\mathbf{B})+\mathbf{C}=\mathbf{A}+(\mathbf{B}+\mathbf{C}), \quad . \quad . \quad . \quad . \quad (2)$$

and so on; *i.e.* the "associative law" of addition also holds.

Again, if m be any scalar quantity, we have

$$m(\mathbf{A}+\mathbf{B})=m\mathbf{A}+m\mathbf{B}, \quad . \quad . \quad . \quad . \quad (3)$$

or, in words, the multiplication of a vector sum by a scalar follows the "distributive law." The truth of (3) is obvious on reference to the similar triangles in fig. 2, where

$$\overrightarrow{OP}=\mathbf{A},\ \overrightarrow{PQ}=\mathbf{B},\ OP'=m\mathbf{A},\ P'Q'=m\mathbf{B}.$$

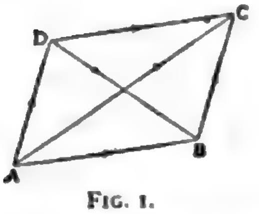

FIG. 1.

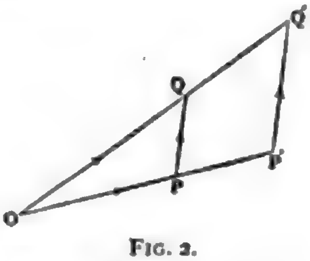

FIG. 2.

It will be noticed that the proofs of (1) and (3) involve the fundamental postulate of the Euclidean geometry.

The definition of "work" in mechanics gives us another important mode of combination of vectors. The product of the absolute magnitudes A, B (say) of two vectors **A**, **B** into the cosine of the angle θ between their directions is called the *scalar product* of the two vectors, and is denoted by **A B** or simply **AB**. Thus

$$\mathbf{AB}=AB\cos\theta=\mathbf{BA}, \quad . \quad . \quad . \quad . \quad (4)$$

so that the "commutative law of multiplication" holds here as in ordinary algebra. The "distributive law" is also valid, for we have

$$\mathbf{A}(\mathbf{B}+\mathbf{C})=\mathbf{AB}+\mathbf{AC}, \quad . \quad . \quad . \quad . \quad (5)$$

the proof of this statement being identical with that of the statical theorem that the sum of the works of two forces in any displacement of a particle is equal to the work of their resultant.

For an illustration of the next mode of combination of vectors we may have recourse to the geometrical theory of the rotation of a rigid body about a fixed point O. As explained under MECHANICS, the state of motion at any instant is specified by a vector $\overrightarrow{OI}$ representing the angular velocity. The instantaneous velocity of any other point P of the body is completely determined by the two vectors $\overrightarrow{OI}$ and $\overrightarrow{OP}$, viz. it is a vector normal to the plane of OI and OP, whose absolute magnitude is OI . OP . sin θ, where θ denotes the inclination of OP to OI, and its sense is that due to a right-handed rotation about OI. A vector derived according to this rule from any two given vectors **A**, **B** is called their *vector product*, and is denoted by $\mathbf{A}\times\mathbf{B}$ or by $[\mathbf{AB}]$. This type of combination is frequent in electro-magnetism; thus if **C** be the current and **B** the magnetic induction, at any point of a conductor, the mechanical force on the latter is represented by the vector $[\mathbf{CB}]$. It will be noticed in the above kinematical example that if the rôles of the two vectors OI, OP were interchanged, the resulting vector would have the same absolute magnitude as before, but its sense would be reversed. Hence

$$[\mathbf{AB}]=-[\mathbf{BA}], \quad . \quad . \quad . \quad . \quad . \quad (6)$$

so that the commutative law does *not* hold with respect to vector products. On the other hand, the distributive law applies, for we have

$$[\mathbf{A}(\mathbf{B}+\mathbf{C})]=[\mathbf{AB}]+[\mathbf{AC}], \quad . \quad . \quad . \quad . \quad (7)$$

as may be proved without difficulty by considering the kinematical interpretation.

Various types of triple products may also present themselves, the most important being the scalar product of two vectors, one of which is itself given as a vector product. Thus $\mathbf{A}[\mathbf{BC}]$ is equal in absolute value to the volume of the parallelepiped constructed on three edges OA, OB, OC drawn from a point O to represent the vectors **A**, **B**, **C** respectively, and it is positive or negative according as the lines OA, OB, OC follow one another in right- or left-handed cyclical order. It follows that

$$\mathbf{A}[\mathbf{BC}]=\mathbf{B}[\mathbf{CA}]=-\mathbf{B}[\mathbf{AC}]=\&c. \quad . \quad . \quad . \quad (8)$$

In order to exhibit the correspondence between the shorthand methods of vector analysis and the more familiar formulae of Cartesian geometry, we take a right-handed system of three mutually perpendicular axes Ox, Oy, Oz, and adopt three fundamental *unit-vectors* i, j, k, having the positive directions of these axes respectively. As regards the scalar products of these unit-vectors, we have, by (4),

$$i^2=j^2=k^2=1,\ jk=kj=ji=0. \quad . \quad . \quad . \quad (9)$$

Any other vector **A** is expressed in terms of its scalar projections A_1, A_2, A_3 on the co-ordinate axes by the formula

$$\mathbf{A}=iA_1+jA_2+kA_3. \quad . \quad . \quad . \quad . \quad . \quad (10)$$

For the scalar product of any two vectors we have

$$\mathbf{AB}=(iA_1+jA_2+kA_3)(iB_1+jB_2+kB_3)=A_1B_1+A_2B_2+A_3B_3, (11)$$

as appears on developing the product and making use of (9). In particular, forming the scalar square of **A** we have

$$A^2=A_1^2+A_2^2+A_3^2, \quad . \quad . \quad . \quad . \quad (12)$$

where A denotes the absolute value of **A**.

Again, the rule for vector products, applied to the fundamental units, gives

$$\left.\begin{array}{c}[i^2]=[j^2]=[k^2]=0,\\ [jk]=-[kj]=i,\ [ki]=-[ik]=j,\ [ij]=-[ji]=k.\end{array}\right\} \quad (13)$$

Hence

$$\begin{aligned}[\mathbf{AB}]&=[(iA_1+jA_2+kA_3)(iB_1+jB_2+kB_3)]\\ &=i(A_2B_3-A_3B_2)+j(A_3B_1-A_1B_3)+k(A_1B_2-A_2B_1)\\ &=-[\mathbf{BA}]. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)\end{aligned}$$

The correspondence with the formulae which occur in the analytical theory of rotations, &c., will be manifest. If we form the scalar product of a third vector **C** into $[\mathbf{AB}]$, we obtain

$$\mathbf{C}[\mathbf{AB}]=\begin{vmatrix}A_1, & B_1, & C_1\\ A_2, & B_2, & C_2\\ A_3, & B_3, & C_3\end{vmatrix} \quad . \quad . \quad . \quad . \quad . \quad (15)$$

in agreement with the geometrical interpretation already given.

In such subjects as hydrodynamics and electricity we are introduced to the notion of scalar and vector *fields*. With every point P of the region under consideration there are associated certain scalars (*e.g.* density, electric or magnetic potential) and vectors (*e.g.* fluid velocity, electric or magnetic force) which are regarded as functions of the position of P. If we treat the partial-differential operators $\partial/\partial x$, $\partial/\partial y$, $\partial/\partial z$, where x, y, z are the co-ordinates of P, as if they were scalar quantities, we are led to some remarkable and significant expressions. Thus if we write

$$\nabla=\left(i\frac{\partial}{\partial x}+j\frac{\partial}{\partial y}+k\frac{\partial}{\partial z}\right). \quad . \quad . \quad . \quad (16)$$

and operate on a scalar function ϕ, we obtain the vector

$$\nabla\phi=i\frac{\partial\phi}{\partial x}+j\frac{\partial\phi}{\partial y}+k\frac{\partial\phi}{\partial z}. \quad . \quad . \quad . \quad . \quad (17)$$

This is called the *gradient* of ϕ and sometimes denoted by "grad ϕ"; its direction is that in which ϕ most rapidly increases, and its magnitude is equal to the corresponding rate of increase. Thus

$$(\nabla\phi)^2=\left(\frac{\partial\phi}{\partial x}\right)^2+\left(\frac{\partial\phi}{\partial y}\right)^2+\left(\frac{\partial\phi}{\partial z}\right)^2. \quad . \quad . \quad . \quad (18)$$

A repetition of the operation ∇ gives

$$\nabla^2\phi=\frac{\partial^2\phi}{\partial x^2}+\frac{\partial^2\phi}{\partial y^2}+\frac{\partial^2\phi}{\partial z^2}. \quad . \quad . \quad . \quad . \quad (19)$$

In the theory of attractions this expression is interpreted as measuring the degree of *attenuation* of the quantity ϕ at P; if we reverse the sign we get the *concentration*, $-\nabla^2\phi$.

Again, if we form the scalar product of the operator ∇ into a vector **A** we have

$$\nabla\mathbf{A}=\left(i\frac{\partial}{\partial x}+j\frac{\partial}{\partial y}+k\frac{\partial}{\partial z}\right)(iA_1+jA_2+kA_3)=\frac{\partial A_1}{\partial x}+\frac{\partial A_2}{\partial y}+\frac{\partial A_3}{\partial z}. \quad (20)$$

If A represent the velocity at any point (x, y, z) of a fluid, the latter expression measures the rate at which fluid is flowing away from the neighbourhood of P. By a generalization of this idea, it is called the *divergence* of **A**, and we write

$$\nabla\mathbf{A}=\text{div }\mathbf{A}. \quad . \quad . \quad . \quad . \quad (21)$$

The vector product $[\nabla\mathbf{A}]$ has also an important significance. We find

$$\begin{aligned}[\nabla\mathbf{A}]&=\left[\left(i\frac{\partial}{\partial x}+j\frac{\partial}{\partial y}+k\frac{\partial}{\partial z}\right)(iA_1+jA_2+kA_3)\right]\\&=i\left(\frac{\partial A_3}{\partial y}-\frac{\partial A_2}{\partial z}\right)+j\left(\frac{\partial A_1}{\partial z}-\frac{\partial A_3}{\partial x}\right)+k\left(\frac{\partial A_2}{\partial x}-\frac{\partial A_1}{\partial y}\right) \quad . \quad (22)\end{aligned}$$

If **A** represent as before the velocity of a fluid, the vector last written will represent the (doubled) angular velocity of a fluid element. Again if A represent the magnetic force at any point of an electro-magnetic field, the vector $[\nabla\mathbf{A}]$ will represent the electric current. In the general case it is called the *curl*, or the *rotation*, of **A**, and we write

$$[\nabla\mathbf{A}]=\text{curl }\mathbf{A},\text{ or rot }\mathbf{A}. \quad . \quad . \quad . \quad (23)$$

These definitions enable us to give a compact form to two important theorems of C. F. Gauss and Sir G. G. Stokes. The former of these may be written

$$\int\text{div }\mathbf{A}\,.\,dV=\int\mathbf{A}n\,dS, \quad . \quad . \quad . \quad (24)$$

where the integration on the left hand includes all the volume-elements dV of a given region, and that on the right includes all the surface-elements dS of the boundary, n denoting a unit vector drawn outwards normal to dS. Again, Stokes's theorem takes the form

$$\int\mathbf{A}\,ds=\int\text{curl }\mathbf{A}\,.\,n\,dS, \quad . \quad . \quad . \quad (25)$$

where the integral on the right extends over any open surface, whilst on the left ds is an element of the bounding curve, treated as a vector. A certain convention is implied as to the relation between the positive directions of n and ds.

It is to be observed that the term "vector" has been used to include two distinct classes of geometrical and physical entities. The first class is typified by a displacement, or a mechanical force. A *polar* vector, as it is called, is a magnitude associated with a certain linear direction. This may be specified by any one of a whole assemblage of parallel lines, but the two "senses" belonging to any one of the lines are distinguished. The members of the second class, that of *axial* vectors, are primarily not vectors at all. An axial vector is exemplified by a couple in statics; it is a magnitude associated with a closed contour lying in any one of a system of parallel planes, but the two senses in which the contour may be described are distinguished. It was therefore termed by H. Grassmann a *Plangrösse* or *Ebenengrösse*. Just as a polar vector may be indicated by a length, regard being paid to its sense, so an axial vector may be denoted by a certain area, regard being paid to direction round the contour. A theory of "Plangrössen" might be developed throughout on independent lines; but since the laws of combination prove to be analogous to those of suitable vectors drawn perpendicular to the respective areas, it is convenient for mathematical purposes to include them in the same calculus with polar vectors. In the case of couples this procedure has been familiar since the time of L. Poinsot (1804). In the Cartesian treatment of the subject no distinction between polar and axial vectors is necessary so long as we deal with congruent systems of co-ordinate axes. But when we pass from a right-handed to a left-handed system the formulae of transformation are different in the two cases. A polar vector (*e.g.* a displacement) is reversed by the process of reflection in a mirror normal to its direction, whilst the corresponding axial vector (*e.g.* a couple) is unaltered.

References.—The methods of vector analysis are chiefly used as a means of condensed expression of various important relations which are of frequent occurrence in mathematical physics, more especially in electricity. They are freely employed, for example, in many recent German treatises. The historical development of the subject can only be briefly referred to. The notions of scalar and vector products originated independently with Sir W. R. Hamilton (1843) (see Quaternions) and H. Grassmann (1844), but were associated with various other conceptions of which no use is made in the simplified system above sketched. The present currency of this latter system is due mainly to the advocacy of O. Heaviside and J. W. Gibbs, although for the systematic physical interpretation of the various combinations of symbols which constantly recur in electricity and allied subjects we are indebted primarily to the classical treatise of J. C. Maxwell on *Electricity and Magnetism* (1873). For further details and applications of the calculus reference may be made to the following: O. Heaviside, *Electro-Magnetic Theory* (London, 1894); J. W. Gibbs, *Vector Analysis* (2nd ed., New York, 1907); M. Abraham, *Die Maxwellsche Theorie d. Elektrizität* (Leipzig, 1904); the articles by H. E. Timerding and M. Abraham in vol. iv. of the *Encycl. d. Math. Wiss.* (Leipzig, 1901–2); A. H. Bucherer, *Elemente d. Vektor-Analysis* (Leipzig, 1905). For an account of other systems of vector analysis see H. Hankel, *Theorie d. complexen Zahlensysteme* (Leipzig, 1867), and A. N. Whitehead, *Universal Algebra*, vol. i. (Cambridge, 1898). (H. Lb.)

VEDDAHS, or Weddahs (from Sanskrit *veddha*, "hunter"), a primitive people of Ceylon, probably representing the *Yakkos* or "demons" of Sanskrit writers, the true aborigines of the island. During the Dutch occupation (1644–1796) they were found as far north as Jaffna, but are now confined to the south-eastern district, about the wooded Bintenna, Badulla and Nilgala hills, and thence to the coast near Batticaloa. They are divided into two classes, the *Kele Weddo* or jungle Veddahs, and the *Gan Weddo*, or semi-civilized village Veddahs. The Veddahs exhibit the phenomenon of a race living the wildest of savage lives and yet speaking an Aryan dialect. Craniometrical evidence strongly favours the theory, now generally accepted, that they represent a branch of the pre-Aryan Dravidians of southern India, and that their ancestors probably made a settlement in the island of Ceylon in prehistoric times, detaching themselves from a migrating horde which passed through the island to find at last a permanent home in the continent of Australia.

The true jungle veddahs are almost a dwarfish race. They are dark-skinned and flat-nosed, slight of frame and very small of skull, and average no more than 5 ft. Their black hair is shaggy rather than lank. They are a shy, harmless, simple folk, living chiefly by hunting; they lime birds, catch fish by poisoning the water, and are skilled in getting wild honey; they have bows with iron-pointed arrows and breed hunting dogs. They dwell in caves or bark huts, and their word for house is Sinhalese for a hollow tree, *rukula*. They count on their fingers, and make fire with the simplest form of fire-drill twirled by hand. They are monogamous, and their conjugal fidelity contrasts strongly with the vicious habits of the Sinhalese. Their religion has been described as a kind of demon-worship, consisting of rude dances and shouts raised to scare away the evil spirits, whom they confound with their ancestors.

The Veddahs are not to be confounded with the Rodiyas of the western uplands, who are a much finer race, tall, well-porportioned, with regular features, and speak a language said to be radically distinct from all the Aryan and Dravidian dialects current in Ceylon. There is, however, in Travancore, on the mainland, a low-caste "Veda" tribe, nearly black, with wavy or frizzly hair, and now speaking a Malayâlim (Dravidian) dialect (Jagor), who probably approach nearer than the insular Veddahs to the aboriginal pre-Dravidian "negrito" element of southern India and Malaysia.

See Percival, *Description of Island of Ceylon* (1805); Cordiner, *Description of Ceylon* (1807); John Davy, *Ceylon and its Inhabitants* (1821); Stirr, *Ceylon and the Singhalese* (1850), Sir Emerson Tennent, *Ceylon* (1859); J. Baily, *Trans. of Ethnol. Soc.*, New Series, vol. ii. (1863); Rolleston, *Trans. of Brit. Ass.* (1872); B. F. Hartshorne, *Fortnightly Review*, New Series, vol. xix. p. 406. The most elaborate monograph is that of Professor Virchow, *Über die Weddas von Ceylon und ihre Beziehungen zu den Nachbarstämmen* (Berlin, 1882). See also E. B. Tylor, *Primitive Culture*; A. Thomson, "Osteology of Veddahs," in *Journ. Anthrop. Institute* (1889), vol. xix. p. 125; L. de Zoysa, "Origin of Veddahs," in *Journal, Ceylon Branch, Royal Asiatic Society*, vol. vii.

VEDDER, ELIHU (1836–   ), American artist; was born in New York City on the 26th of February 1836. He studied under the genre and historical painter Tompkins H. Matteson (1813–1884), at Sherburne, N.Y., later under Picot, in Paris, and then, in 1857–61, in Italy. After 1867 he lived in Rome, making occasional visits to America. He was elected to full membership in the National Academy of Design, New York, in 1865. He devoted himself to the painting of genre pictures, which, however, attracted only modest attention until the publication, in 1884, of his illustrations to the *Rubaiyat* of Omar Khayyâm; these immediately gave him a high place in the art world. Important decorative work came later, notably the painting symbolizing the art of the city of Rome, in the Walker Art Gallery of Bowdoin College, Maine, and the five lunettes (in the entrance hall) symbolical of government, and the mosaic "Minerva" in the Congressional Library at Washington. Among his better-known pictures are: "Lair of the Sea Serpent," in the Boston Museum of Fine Arts; "Young Marsyas," "Cumaean Sibyl," "Nausicaa," in the collection of J. Pierpont Morgan; and "Genii and Fisherman," in the collection of Martin Brimmer, Boston.

VEDETTE, a French military term (formed from Lat. *videre*, to see), adopted into English and other languages for a mounted sentry or outpost, whose function it is to bring information, give signals or warnings of danger, etc., to the main body of troops.

VEERE, a town in the province of Zeeland, Holland, on the island of Walcheren, 4 m. N.N.E. of Middelburg, with which it is connected by canal (1867–72). It contains several interesting architectural remains of the days of its former prosperity, many of its quaintly gabled old houses dating from the 16th century. There is a fine Gothic church dating from 1348, but subsequently in part destroyed and used for secular purposes; the town hall (1475) has a fine gable filled with sculpture, and contains some interesting antiquities.

VEGA, GARCILASO DE LA (1503–1536), Spanish soldier and poet, was born at Toledo on the 6th of February 1503. His father, Garcilaso (Garcias Laso or Garcilasso) de la Vega, was counsellor of state to Ferdinand and Isabella, and for some time their ambassador at the court of Rome; by his mother he was descended from the illustrious house of Guzman. At the age of seventeen he was attached to the bodyguard of Charles V., and fought against the insurgent *comuneros*, being wounded at the battle of Olias near Toledo. He afterwards served in the north of Italy, and gained great distinction by his bravery at the battle of Pavia in 1525. In the following year he married a lady-in-waiting to Queen Eleanor. He took part in the repulse of the Turks from Vienna in 1529, was present at the coronation of the emperor at Bologna in 1530, and was charged with a secret mission to Paris in the autumn of the same year. In 1531 he accompanied the duke of Alva to Vienna, where, for conniving at the clandestine marriage of his nephew to a maid-of-honour, he was imprisoned on an island in the Danube. During this captivity he composed the fine cancion, "Con un manso ruido de agua corriente y clara." Released and restored to favour in June 1532, he went to Naples on the staff of Don Pedro de Toledo, the newly appointed viceroy, by whom he was twice sent on public business of importance to Barcelona, in 1533 and 1534. After having accompanied the emperor on the expedition to Tunis (1535), where he received two severe wounds, he was employed as a confidential agent at Milan and Genoa in negotiations connected with the proposed invasion of Provence, and joined the expedition when it took the field. Being with Charles in the neighbourhood of Fréjus during the retreat from Marseilles, Garcilaso de la Vega was ordered to storm a fort at Muy, which had checked the advance of the army. In the successful discharge of this duty he was mortally wounded and died twenty-one days afterwards, at Nice (14th of October 1536). His poems were entrusted to his friend Boscan, who was preparing them for publication along with his own when death overtook him in 1540. The volume ultimately appeared at Barcelona in 1543, and has often been reprinted. Garcilaso's share in it consists principally of three *eglogas* or pastorals, which the Spaniards regard as among the finest works of the kind in their language, and which for sweetness of versification and delicacy of expression take a high rank in modern European literature. In addition to the pastorals, there are thirty-seven sonnets, five canciones, two elegies and a blank verse epistle, all influenced by Italian models. The poems rapidly gained a wide popularity; and within a century of their appearance they were edited as classics by Francisco Sanchez (1577), Herrera (1580) and Tamayo de Vargas (1622). An English translation of his works was published by Wiffen in 1823. Garcilaso's delicate charm has survived all changes of taste, and by universal consent he ranks among the most accomplished and artistic of Spanish poets.

See E. Fernández de Navarrete, "Vida de Garcilaso de la Vega," in the *Documentos inéditos para la historia de España*, vol. xvi.; Francesco Flamini, "Imitazioni italiani in Garcilaso de la Vega," in the *Biblioteca delle scuole italiane* (Milano. 1899).

VEGA, GARCILASO DE LA, called "Inca" (*c.* 1535–1616), historian of Peru, was born at Cuzco. His father, Sebastiano Garcilaso (d. 1559), was a cadet of the illustrious family of La Vega, who had gone to Peru in the suite of Pedro de Alvarado, and his mother was of the Peruvian blood-royal, a circumstance of which he was very proud as giving him a right to the title which he claimed by invariably subscribing himself "Inca." About 1560 he removed to Spain, and after serving against the Moors incurred the hatred of Philip II. and was imprisoned at Valladolid. He died in Spain in 1616. A diligent student of the language and traditions of his maternal ancestors, Garcilaso left a valuable work on Peruvian history; the first part, entitled *Comentarios reales que tratan del origen de los Yncas*, was first published at Lisbon in 1609, and the second part, *Historia general del Peru*, in 1617.

His history is a source from which all subsequent writers on the subject have largely drawn, and still continues to be one of the chief authorities on ancient Peru. An English translation by Sir Paul Rycaut was published in 1688; one of the first part of the work by Sir C. R. Markham for the Hakluyt Society (London, 1869–71); and the book has also been translated into French. Garcilaso also wrote a history of Florida, *La Florida del Ynca, historia del adelantado Hernando de Sota* (Lisbon, 1605, and again Madrid, 1723). An edition of his works in seventeen volumes was published at Madrid in 1800. See W. H. Prescott, *History of the Conquest of Peru*, vol. i. (London, 1902); Sir C. R. Markham, *The Incas of Peru* (1910).

VEGA CARPIO, LOPE FELIX DE (1562–1635), Spanish dramatist and poet, was born on the 25th of November 1562 at Madrid. His father and mother, Felix de Vega Carpio and Francisca Hernandez Flores, originally came from the valley of Carriedo in Asturias, where the hamlet of Vega still exists. Lope began his studies at the Theatine college in Madrid, and according to his admiring biographer, Pérez de Montalbán, his precocity was extraordinary. On leaving college he entered the service of Don Jerónimo Manrique, bishop of Avila, and appears to have then begun the composition of his earlier dramas. He quitted the bishop's service to enter the university of Alcalá de Henares, where he devoted himself to what was called philosophy. The date of Lope's matriculation is unknown, as his name does not appear in the university books; but it seems probable that he was in residence between 1576 and 1581. He took part in the expedition to the Azores in 1582, and from 1583 to 1587 was secretary to the marqués de las Navas. In February 1588 he was banished for circulating criminal libels against his mistress, Elena Osorio, whom he has celebrated under the name of Filis. He defied the law by returning to Madrid soon afterwards and eloping with Isabel de Urbina, daughter of Philip II.'s herald; he married her by proxy on the 10th of May 1588, and joined the Invincible Armada, losing his brother in one of the encounters in the Channel. He settled for a short while at Valencia, where he made acquaintance with a circle of young poets who were afterwards to be his ardent supporters in founding the new comedy. He joined the household of the duke of Alva, with whom he remained till 1595. Soon afterwards he lost his wife; he was prosecuted for criminal conversation in 1596, became secretary to the marquis de Malpica (afterwards count de Lemos), and in 1598 married a second wife, Juana de Guardo, by whom he had two children (Carlos, who died in 1612, and Feliciana Felix); but she died, shortly after giving birth to the latter, in 1613. During this wife's lifetime the poet had by a mistress, Micaela de Luxan, two other children—Marcela del Carpio, who became a nun in 1621, and Lope Felix del Carpio y Luxan, who chose the profession of arms and perished at sea about 1634. Widowed a second time in 1613, Lope sought a refuge in the church. After having been for some time affiliated to a tertiary order, he took priest's orders.

At this juncture, about 1614, he was in the very zenith of his glory. A veritable dictator in the Spanish world of letters, he wielded over all the authors of his nation a power similar to that which was afterwards exercised in France by Voltaire. At this distance of time Lope is to us simply a great dramatic poet, the founder of the Spanish theatre; but to his contemporaries he was much more. His epics, his pastorals, his odes, his sonnets, now forgotten, all placed him in the front rank of authorship. Such was his prestige that he dealt with his noble patrons almost on a footing of equality. The duke of Sessa in particular, his Maecenas from 1605 onwards, was also his personal friend, and the tone of Lope's letters to him is one of frank familiarity, modified only by some forms of deference. Lope's fame, too, had travelled abroad: foreigners of distinction passing through Madrid made a point of visiting him; papal legates brought him the compliments of their master; in 1627 Urban VIII., a Barberini, sent him the diploma of doctor of theology in the Collegium Sapientiae and the cross of the order of St John of Jerusalem (whence the poet's titles of "Doctor" and "Frey"). His last days were full of sadness; the death of his son Lope, the elopement of his daughter, Antonia Clara, wounded him to the soul. Montalbán tells us that every Friday the poet scourged himself so severely that the walls of his room were sprinkled with his blood. His death, on the 27th of August 1635, was followed by national mourning.

Leaving out of account certain theories which in the long run greatly influenced his manner of writing, Lope belonged in literature to what may be called the school of good sense; he boasted that he was a Spaniard *pur sang*, and steadfastly maintained that a writer's business is to write so as to make himself understood. When brought face to face with the coterie of the *précieux* and *quintessenciés*, Lope takes the position of a defender of the language of ordinary life, the good old Castilian tongue. In the dispute which arose between the partisans of the two schools of *cultos* and *llanos*, he ranged himself on the side of the latter. In the matter of versification he refuses to admit that the long Italian verse has the advantage of the Castilian octosyllabic. Unfortunately the books that he read, his literary connexions, his fear of Italian criticism, all exercised an influence upon his naturally robust spirit, and, like so many others, he caught the prevalent contagion of mannerism and of pompous phraseology. His literary culture was chiefly Latin-Italian; and, if he defends the tradition of the nation and the pure simplicity of the old Castilian against "los de la nueva poesía," that is to say, the innovators of the school of Góngora and against the jargon of the *cultos*, still he does not wish to be taken for an uninformed person, a writer devoid of classical training: he especially emphasizes the fact that he has passed through the university, and is continually accentuating the difference between the *ingenios cientificos* (those who know Latin) and *legos ignorantes* (ignorant laymen). With what a sense of superiority, for example, does he mention that Cervantes was not to his mind sufficiently *cientifico* (preface to *Las Fortunas de Diana*), the fact being that Cervantes had been neither at Alcalá nor at Salamanca!

For a rapid survey of the works of Lope, it is convenient to begin with those which the Spaniards include under the name of *Obras Sueltas*, the title of the large collection of the poet's non-dramatic works (Madrid, 21 vols. 4to, 1776–79). We shall enumerate the most important of these, as far as possible in the order of publication. The *Arcadia* (1598), a pastoral romance, inspired by Sannazaro, is one of the poet's most wearisome productions. *La Dragontea* (1598) is a fantastic history in verse of Sir Francis Drake's last expedition and death. *Isidro* (1599), a narrative of the life of Isidore, patron of Madrid, is called a Castilian poem on account of the rhythm in which it is composed—*quintillas* of octosyllabic verse. The *Hermosura de Angélica* (1602), in three books, is a sort of continuation of the *Orlando Furioso*, in octaves after the fashion of the original poem. Finally, the *Rimas* are a miscellany of short pieces. In 1604 was published the *Peregrino en su Patria*, a romance similar in kind to the *Aethiopica* of Heliodorus. Having imitated Ariosto, he proceeded to imitate Tasso; but his *Jerusalem Conquistada* (1609) has preserved nothing of the art shown in its model, and is an insipid performance. Next follows the *Pastores de Belen* (1612), a pious pastoral, dedicated to his son Carlos, which forms a pendant to his secular *Arcadia*; and incidental pieces published in connexion with the solemnities of the beatification and canonization of St Isidore in 1620 and 1622. It is enough to mention *La Filomena* (1621), *La Circe* (1624) and other poems published about the same date, as also the four prose novels, *Las Fortunas de Diana*, *El Desdichado por la Honra*, *La Más Prudente Venganza* and *Guzmán el Bravo*. The great success of the *Novelas Exemplares* of Cervantes (1613) had stimulated Lope, but in this instance at least the *cientifico* was completely defeated by the *lego*: Lope's novels have none of the grace, naturalness or interest which characterize those of his rival. The last important work which has to be mentioned before we leave the narrative poetry of Lope is the *Laurel de Apolo* (1630). This piece describes the coronation of the poets of Spain on Helicon by Apollo, and it is more meritorious as a bibliographical manual of Spanish poetry at that time than as genuine poetry. One other *obra suelta*, closely akin to Lope's dramatic works, though not, properly speaking, a drama, is *La Dorotea* (1632). Lope describes it as an "action in prose," but it is rather a "romance in dialogue"; for, although divided into acts, the narrative is dramatic in form only. Of all Lope's productions *Dorotea* shows most observation and study; the style also is unusually simple and easy. Of all this mass of *obras sueltas*, filling more than twenty volumes, very little (leaving *Dorotea* out of account) holds its own in the judgment of posterity. The lyrical element alone retains some vitality. From the *Rimas* and other collections of detached pieces one could compile a pleasing anthology of sonnets, epistles, elegies and romances, to which it would be proper to add the *Gatomaquia*, a burlesque poem published along with other metrical pieces in 1634 by Lope under the pseudonym of Tomé de Burguillos. But here the list would end.

It is, however, to his dramatic writings that Lope owes his eminent place in literary history. It is very curious to notice how he himself always treats the art of comedy-writing as one of the humblest of trades (*de pane lucrando*), and protests against the supposition that in writing for the stage his aim is glory and not money. The reason is not far to seek. The Spanish drama, which, if not literally the creation of Lope, at least owes to him its definitive form—the three-act comedy—was totally regardless of the precepts of the school, the pseudo-Aristotelianism of the doctors of the period. Lope accordingly, who stood in awe of the criticism of the *cientificos*, felt bound to prove that, from the point of view of literary art, he attached no value to the "rustic fruits of his humble *vega*." In his *Arte Nuevo de hacer comedias en este tiempo* (1609), Lope begins by showing that he knows as well as any one the established rules of poetry, and then excuses himself for his inability to follow them on the ground that the "vulgar" Spaniard cares nothing about them. "Let us then speak to him in the language of fools, since it is he who pays us." Another reason which made it necessary for him to speak deprecatingly of his dramatic works, is the circumstance that the vast majority of them were written in haste and to order. The poet does not hesitate to confess that "more than a hundred of my comedies have taken only twenty-four hours to pass from my brain to the boards of the theatre." Perez de Montalbán, who has a great admiration for this kind of cleverness, tells how, at Toledo, on a certain occasion, Lope composed fifteen acts in fifteen days—that is to say, five entire comedies, which he read to his friends step by step with the process of their composition. On another occasion, when pressed by a manager who wanted something for the carnival, Lope took Montalbán as a collaborator; the two friends parcelled out the comedy between them, Lope undertaking the first act, Montalbán the second, and the third, to save time, was divided between them. In two days they had finished the first two acts, and on the third Montalbán rose at two in the morning and at eleven he had finished. Then he went in search of Lope, who, when questioned as to his progress, replied: "I got up at five, finished the act, breakfasted, wrote an epistle of fifty tercets, and have now finished watering the garden, and a rather tough business it has been." Nevertheless, Lope did write dramas in which the plan is more fully matured and the execution more carefully carried out; still, hurried composition and reckless production are after all among the distinctive marks of his theatrical works. Towards the close of his career Lope somewhat modified the severe and disdainful judgments he had formerly passed upon his dramatic performances; he seems to have had a presentiment that posterity, in spite of the grave defects of his work in that department, would nevertheless place it much higher than *La Dragontea*, the *Jerusalem Conquistada* and other works of which he himself thought so much. We may certainly credit Lope with creative power, with the instinct which enabled him to reproduce the facts of history or those supplied by the imagination in a multitude of dramatic situations with an astonishing cleverness and flexibility of expression; but unfortunately, instead of concentrating his talent upon the production of a limited number of works which he might have brought to perfection, he dissipated it, so to say, and scattered it to the winds.

The catalogue of Lope's comedies has been drawn up by himself; and, in spite of some discrepancies in his figures, it is established that up to 1604 he had composed, in round numbers, as many as 230. In 1609 the figure had risen to 483, in 1618 to 800, in 1620 to 900, in 1625 to 1070, and in 1632 to 1500. Ultimately Montalbán in the *Fama Postuma* (1636) set down the total of Lope's dramatic productions at 1800 plays and more than 400 *autos sacramentales*. Of this number there are 637 plays which are known to us by their titles (from the lists of the *Peregrino*); but the printed or MS. text of only 458 is actually accessible, besides some 50 *autos* and a few *entremeses*. Very many of these pieces were printed during Lope's lifetime, either in collections of *varios autores* or as separate issues by booksellers who surreptitiously bought from the actors the manuscripts of their rôles or else caused the unpublished comedy to be written down from memory by persons whom they sent to attend the first representation. Such pieces therefore as do not figure in the collection published under Lope's own direction or under that of his friends cannot be regarded as perfectly authentic, and it would be unfair to hold their author responsible for all the faults and defects they exhibit. On the other hand, there exist comedies in Lope's own handwriting which have not yet been printed.

The classification of this enormous mass of dramatic literature is a task of great difficulty, inasmuch as the terms usually employed, such as comedy, tragedy and the like, do not apply here. There is not explicitness enough in the division current in Spain, which recognizes three categories:—(1) *comedias de capa y espada*, the subjects of which are drawn from everyday life and in which the persons appear as simple *caballeros*; (2) *comedias de ruido* or *de teatro*, in which kings and princes are the leading characters and the action is accompanied with a greater display of dramatic machinery; (3) *comedias divinas* or *de santos*. Some other arrangement must be attempted. In the first place, Lope's work belongs essentially to the drama of intrigue; be the subject what it may, it is always the plot that determines everything else. Lope in the whole range of his dramatic works has no piece comparable to *La Verdad Sospechosa* of Ruiz de Alarcón, the most finished example in Spanish literature of the comedy of character; and the comedy of manners is represented only by *El Galán Castrucho*, *El Anzuelo de Fenisa*, and one or two others. It is from history, and particularly Spanish history, that Lope has borrowed more than from any other source. It would in fact be difficult to say what national and patriotic subjects, from the reign of the half-fabulous King Pelayo down to the history of his own age, he has not put upon the stage. But it is to the class of *capa y espada*—also called *novelesco*, because the subjects are almost always love intrigues complicated with affairs of honour—that Lope's most celebrated plays belong. In these he has most fully displayed his powers of imagination (the subjects being all invented) and his skill in elaborating a plot. Among the plays of this class which are those best known in Europe, and most frequently imitated and translated, may be specially mentioned *Los Ramilletes de Madrid*, *La Boba para los Otros y Discreta para si*, *El Perro del Hortelano*, *La Viuda de Valencia*, and *El Maestro de Danzar*. In some of them Lope has sought to set forth some moral maxim, and illustrate its abuse by a living example. Thus, on the theme that "poverty is no crime," we have the play entitled *Los Flores de Don Juan*, in which he shows in the history of two brothers the triumph of virtuous poverty over opulent vice; at the same time he attacks indirectly the institution of primogeniture, which often places in the hands of an unworthy person the honour and substance of a family when the younger members would be much better qualified for the trust. Such pieces are, however, rare in Lope's repertory; in common with all other writers of his order in Spain, with the occasional exception of Ruiz de Alarcón, his sole aim is to amuse and stir his public, not troubling himself about its instruction. The strong point of such writers is and always will be their management of the plot. As has been said by Le Sage, a good judge: "The Spaniards are our masters in the art of planning and skilfully working out a plot; they know how to set forth their subject with infinite art and in the most advantageous light." It is not necessary to dwell here upon the other varieties of comedy represented in Lope's works, that is, the *comedias divinas*, *fiestas* (mythological dramas for the most part), *entremeses* and *autos*. In none of them has he produced anything of the highest order, or even comparable to the better performances of his contemporaries and successors.

To sum up, Lope found a poorly organized drama, plays being composed sometimes in four acts, sometimes in three; and, though they were written in verse, the structure of the versification was left far too much to the caprice of the individual writer. The style of drama then in vogue he adopted, because the Spanish public liked it. The narrow framework it afforded he enlarged to an extraordinary degree, introducing everything that could possibly furnish material for dramatic situations,—the Bible, ancient mythology, the lives of the saints, ancient history, Spanish history, the legends of the middle ages, the writings of the Italian novelists, current events, Spanish life in the 17th century. Before him manners and the conditions of persons and characters had been barely sketched; with fuller observation and more careful description he created real types, and gave to each social order the language and drapery appropriate to it. The old comedy was awkward and poor in its versification; he introduced order into the use of all the forms of national poetry, from the old romance couplets to the rarest lyrical combinations borrowed from Italy. Hence he was justified in saying that those who should come after him had only to go on along the path which he had opened up.

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(A. M.-FA.; J. F.-K.)

VEGETABLE (Late Lat. *vegetabilis*, full of life, animating, from *vegetare*, frequentative of *vegere* to quicken, arouse, *vegetus*, vigorous, active, cf. *vigor*, strength, vigour, &c.), a word used as a general term for plants (*q.v.*), and specifically, in popular language, of such plants as can be eaten by man or animals, whether cooked or raw, and whether the whole of such plants are edible, or only the leaves or the roots or tubers. Among such edible or culinary plants or portions of plants, a further distinction is made popularly between "fruits" and "vegetables," for which see FRUIT.

For the botany and cultivation of vegetables see under the specific names, *e.g.* POTATO, TURNIP, &c. &c., and generally, HORTICULTURE.

VEGETABLE MARROW, *Cucurbita Pepo*, var. *ovifera*, the most important of the gourds (*q.v.*), used as an esculent, furnishing in good seasons a very large supply for the table. They are best when eaten quite young and not over-boiled, the flesh being then tender, and the flavour sweet and nutty. The *Custard Marrow*, or crown gourd, bears a peculiar-looking flattened fruit with scalloped edges, which has a sweeter and less nutty flavour than the true marrow. A very distinct form known as Pen-y-Byd has a delicate creamy white nearly globular fruit, with a firm flesh. The bush marrows are more bushy in habit and taller and more sturdy in growth.

Vegetable marrows require a warm situation and a rich soil free from stagnant moisture. They do well on a rubbish or old-dung heap, or in a warm border on little hillocks made up with any fermenting material, to give them a slight warmth at starting. The seeds should be sown in a warm pit in April, and forwarded under glass, but in a very mild heat; the plants must be shifted into larger pots, and be gradually hardened previous to being planted out, when the mild weather sets in in May or June. The use of hand-glasses makes it possible to transplant earlier than would otherwise be advisable. The seeds may be sown early in May in pots under a hand-glass, or towards the end of May in the open ground, if heat is not at command. The true vegetable marrow bears fruit of an oblong-elliptical shape, about 9 in. long, pale-greenish while young, with whitish flesh, and scarcely any indication of ribs; when mature it is of a pale yellow colour. There is a variety which is more oblong, grows to 15 or 18 in., and has the surface slightly marked by irregular longitudinal obtuse ribs. The shoots may be allowed to run along the surface of the ground, or they may be trained against a wall or paling, or on trellises. As the gourds cross readily, care is necessary to keep any particular variety true. One of the best vegetable marrows is called Moore's Vegetable Cream.

VEGETARIANISM, a comparatively modern word, which came into use about the year 1847, as applied to the practice of living upon foods from which fish, flesh and fowl are excluded. There have from time to time been various sects or schools of thought that have advocated narrower views. Some of these have excluded all animal products—such as milk and eggs and cheese. Some have excluded all cooked foods, and have preached the virtues of fruits and nuts and grains in their natural ripe state. Some have abstained from all underground-grown roots and tubers, and have claimed special benefits from using only those fruits and vegetables that are grown in the sunlight. Some have given up all grain and pulse foods, and have declared that old age can be best resisted by living entirely upon fruits, salads, nuts, soft water and milk products. Some have added fish to their dietary; but, speaking generally, all who are called vegetarians will be found to abstain from the use of flesh and fowl and almost invariably also from fish as food.

The fact, however, must not be overlooked that while vegetarian societies claim as "vegetarians" all who abstain from flesh foods, there is a large and growing number of people who repudiate the name of "vegetarian" because of its associations, but who none the less, for some of the reasons detailed below, abstain from eating anything that has been killed. The Order of the Golden Age, for example, with its headquarters at Barcombe Hall, Paignton, South Devon, adopted the words "Fruitarian" and "Fruitarianism" to denote the dietary of its members. The rule laid down by the Order is abstinence so far as possible from all foods which are obtained by the cruel infliction of pain, and the minimum that is set is complete "abstinence from flesh and fowl," while net-caught fish may be used by associate members.

The reasons that are advanced for the practice of fruitarianism or vegetarianism are very comprehensive, but the principal ones may be considered to be the following:—

1. *Health.*—(α) On the ground that animals are affected by diseases which are communicable, and are actually communicated, to man by the ingestion of their flesh, *e.g.* parasites, tuberculosis; (β) on the ground that the flesh of artificially fed animals is full of excretory substances, and that, therefore, *under modern conditions*, flesh-eating is injurious, and may be a cause of excretory substance and uric acid deposits or rapid tissue-destroying diseases in man; *e.g.* gout, cancer.
2. *Economy.*—On the ground that the assimilable nutriment from a given weight of selected fruit and grain and nut and vegetable foods will cost less than the same nutriment obtained from flesh foods.
3. *Social Economy.*—On the ground that an acre of cultivable land under fruit and vegetable cultivation will produce from two to twenty times as much food as if the same land were utilized for feeding cattle.
4. *Racial Improvement.*—On the ground that the aim of every prosperous community should be to have a large proportion of hardy country yeomen, and that horticulture and agriculture demand such a high ratio of labour, as compared with feeding and breeding cattle, that the country population would be greatly increased by the substitution of a fruit and vegetable for an animal dietary.
5. *Character Improvement.*—On the ground that after the virtues of courage and valour and fearlessness have been taught in the lower stages of evolution, the virtue of gentle humaneness and extended sympathy for all that can suffer should be taught in the higher cycles of the evolutionary spiral. Flesh-eating entailing necessarily an immense volume of pain upon the sentient animal creation should be abstained from by the "higher classes" in the evolutionary scale.

Organizations have been established to advocate this method of living under the name of "Vegetarian Societies" in many countries—chiefly the United Kingdom, America, Germany, France, Austria, Holland and Australia. Propagandism is carried on by lectures, literature, cookery demonstrations and restaurants. In England, the oldest and one of the most important societies is "The Vegetarian Society," of which the headquarters are at Oxford Street, Manchester. There are also several small London societies, and an active London Association. A few provincial towns, too, have small societies. An attempt has been made to organize the various vegetarian societies of the world under the title of "The Vegetarian Federal Union." The headquarters of the London societies and of the "Union" are at Memorial Hall, Farringdon Street, E.C.

There are nominally about 35 organized societies in existence, but the extent to which public opinion and practice in the matter of dietary has been affected by vegetarianism is not to be gauged by the membership of such organizations. There are in England a number of vegetarian restaurants and boarding-houses, one hospital and one or two sanatoria. In Germany and America there are many institutions where flesh is only prescribed in special cases. Flesh food is not included in the dietary of the chief hospitals and orphanages of the native states of India, excepting in the wards devoted to Europeans.

The athletic side of the movement has been represented in national and international races by vegetarians winning the Berlin and Dresden walking match (125 m.), the Carwardine Cup (100 m.) and Dibble Shield (6 hours) cycling races (1901 and 1902), the amateur championship of England in racquets and in tennis (held by Mr Eustace Miles for a series of years), the cycling championship of India (3 years), half-mile running championship of Scotland (1896), world's amateur cycle records for all times from 4 hours to 13 hours (1902), 100 miles championship Yorkshire Road Club (1899, 1901).

In the religious world the Seventh-Day Adventists (who are connected with many sanatoria and the manufacture of food specialities) and some Bible Christians, the worshippers of Vishnu and the Swami Narang and Vishnoi sects, amongst others, preach abstinence from flesh food. The Salvation Army, the Tolstoyans and the Doukhobors encourage it. A number of orders in the Roman Catholic church (*e.g.* the Trappists) and in the Hindu faith (*e.g.* the Dadupanthi Sadus) are pledged abstainers.

The general question of food values is discussed in the article Dietetics; see also Nutrition. But there is no doubt that, whatever may be the view taken as to the extreme theory of vegetarianism, it has had considerable effect in modifying the excessive meat-consuming régime of previous days, and in introducing new varieties of vegetable cooking into the service of the table.

The literature on the subject is considerable, but the two classics are perhaps *The Ethics of Diet*, by Howard Williams, and *The Perfect Way in Diet*, by Dr Anna Kingsford. In former years the "Vegetarian Society" was the most active in producing literature, but since about 1901 the Order of the Golden Age has come to the front with new and up-to-date books, booklets and leaflets, and the Ideal Publishing Union has reprinted much of the earlier literature. The chief periodicals are the *Vegetarian* (weekly), the *Herald of the Golden Age* (monthly), the *Vegetarian Messenger* (monthly), the *Vegetarian* (American monthly), the *Children's Garden* (monthly). (J. O.)

VEGETIUS (Flavius Vegetius Renatus), a celebrated military writer of the 4th century. Nothing is known of his life, station and military experience, save that in MSS. he is called *vir illustris* and also *comes*. His treatise, *Epitoma rei militaris, sive institutorum rei militaris libri quinque*, was dedicated to the reigning emperor (? Theodosius the Great). His sources, according to his own statement, were Cato, Cornelius Celsus, Frontinus, Paternus and the imperial constitutions of Augustus, Trajan and Hadrian. The book, which is a confused and unscientific compilation, has to be used with great caution, but is none the less invaluable to the student of the ancient art of war.

The first book is a plea for army reform, and vividly portrays the military decadence of the empire. The third contains a series of military maxims which were (rightly enough, considering the similarity in the military conditions of the two ages) the foundation of military learning for every European commander, from William the Silent to Frederick the Great. When the French Revolution and the "nation in arms" came into history, we hear little more of Vegetius. Some of the maxims may be mentioned here as illustrating the principles of a war for limited political objects (see Army) with which he deals. "All that is advantageous to the enemy is disadvantageous to you, and all that is useful to you, damages the enemy"; "No man is to be employed in the field who is not trained and tested in discipline"; "It is better to beat the enemy through want, surprises and care for difficult places (*i.e.* through manœuvre) than by a battle in the open field"—maxims that have guided the leaders of professional armies in all countries and at all times, as witness the Chinese generals Sun and Wu (see E. F. Calthrop, *The Book of War*, London, 1908). His "seven normal dispositions for battle," once in honour amongst European students of the art of war, are equally ludicrous if applied to present-day conditions. His book on siegecraft is important as containing the best description of late empire and medieval siege matters, &c., and from it amongst other things we learn details of the siege engine called *onager*, which afterwards played a great part in sieges. The fifth book is an account of the material and personnel of the Roman navy.

In manuscript, Vegetius's work had a great vogue from the first, and its rules of siegecraft were much studied in the middle ages. It was translated into English, French and even Bulgarian before the invention of printing. The first printed editions are assigned to Utrecht (1473), Cologne (1476), Paris (1478), Rome (in *Veteres de re mil. scriptores*, 1487), and Pisa (1488). A German translation by Ludwig Hohenwang appeared at Ulm in 1475. Vegetius's position as the premier military critic was thenceforward assured. As late as the 18th century we find so eminent a soldier as Marshal Puységur basing his own works on this acknowledged model, and the famous Prince de Ligne wrote "C'est un livre d'or." The fullest and most important modern edition is that of Karl Lang (Leipzig, 1869). An English version through the French was published by Caxton in 1489. For a detailed critical estimate of Vegetius's works and influence see Max Jähns, *Gesch. der Kriegswissenschaften*, i. 109–125.

VEGLIA (Slavonic, *Krk*), an island in the Adriatic Sea, off the west coast of Croatia, from which it is separated by the Canale della Morlacca. It is situated in the Gulf of Quarnero, and is separated from the island of Cherso, lying on the S.W., by the Canale di Mezzo. Together with Cherso and Lussin, the three principal islands of the Quarnero group, it forms the administrative district of Lussin, belonging to the Austrian crownland of Istria. Veglia is the largest island of the Quarnero group, having an area of 146 sq. m. It is 24 m. long and about 14 m. across at its widest part. The surface is mostly rugged and mountainous; but the central, southern and western districts are fertile. The principal town is Veglia (pop. 2074), situated on the south-west coast, with a good harbour and an interesting cathedral.

VEII, an ancient town of Etruria, Italy, situated about 10 m. N. by W. of Rome by road. It is mentioned in the earliest history of Rome as a constant enemy, being the nearest Etruscan city to Rome. The story of the slaughter of the Fabii, who had encamped in the territory of Veii, and of whom but one boy escaped, is well known. After constant warfare, the last war (the fourteenth, according to the annalists) broke out in 406 B.C. The Romans laid siege to the city, and, after a ten years' siege, M. Furius Camillus took it by storm in 396, by means, so we are told, of a tunnel leading into the citadel. According to the legend, the *emissarium* of the Alban Lake was constructed in obedience to the Delphic oracle, which declared that, until it was drained, Veii could not be taken. The territory of Veii was three years afterwards divided among the Roman plebs. Veii is mentioned in connexion with the defeat of the Romans at the Allia in 390 B.C., after which many Roman soldiers fled there, while a project was actually broached for abandoning Rome for Veii, which was successfully opposed by Camillus. From this time onwards we hear little or nothing of Veii up to the end of the Republic. Propertius speaks indeed of the shepherds within its walls. Augustus, however, founded a municipality there (*municipium Augustum Veiens*), inscriptions of which have been found down to the time of Constantius, after which, at some date unknown, the place was deserted. The medieval castle of Isola Farnese, on a hill to the south of the city,[1] is first mentioned in a document of A.D. 1003; but Veii itself had disappeared to such an extent that its very site was uncertain, though some scholars identified it correctly, until the excavations of the 19th century finally decided the question. Veii was not on a high road, but was reached by branch roads from the Via Clodia. The site is characteristic—a plateau, the highest point of which is 407 ft. above sea-level, divided from the surrounding country by deep ravines, and accessible only on the west, where it was defended by a wall and fosse. Remains of the city walls, built of blocks of tufa 2 ft. high, may be traced at various points in the circuit. The area covered measures about 1 sq. m. There are no other remains on the site of the city earlier than the Roman period, and these are now somewhat scanty. The site of the Forum has been discovered on the west side of the plateau; a statue of Tiberius, now in the Vatican, and the twelve Ionic columns now decorating the colonnade on the W. side of the Piazza Colonna at Rome were found there. The acropolis was at the eastern extremity of the site, where the two ravines converge; it is connected with the rest of the plateau by a narrow neck, and here a large number of ex-votos in terra-cotta, indicating the presence of a temple, and dating at earliest from the 3rd century B.C., have been found. The first discovery of them was made in 1655–1667, when remains of the temple (of Juno?) to which they belonged were also found (R. Lanciani, *Pagan and Christian Rome*, London, 1892, p. 64). In the deep ravine to the N. of the site of the town, traversed by the Cremera brook, are the ruins of two ancient bridges and of some baths of the Roman period; and here is also the Ponte Sodo, a natural tunnel, artificially enlarged, through which the stream passes. Outside the city tombs have been discovered at various times. The earliest belonged to the Villanova period (8th and 9th centuries, B.C.), probably before the coming of the Etruscans. Others are cut in the rock and are Etruscan. The most famous is the Grotta Campana found in 1843, which contains paintings on the walls with representations of animals, among the earliest in Etruria. There are also several tumuli. To a later period belongs a columbarium cut in the rock, with niches for urns.

See L. Canina, *L'antica città di Veio* (Rome, 1847); G. Dennis, *Cities and Cemeteries of Etruria* (London, 1883), i. 1 sqq.

(T. As.)

VEIL (O.Fr. *veile*, mod. *voile*, from Lat. *velum*, cloth, awning, sail), a cloth or piece of other fabric used as a means of concealing something from the view, as in the veils of the Jewish tabernacle, which hung before the Holy Place, and before the Most Holy Place. The word is, however, chiefly used of a covering for the face and head, as worn by women. The veiling of the face by women is a practice among the Mohammedan races of the East and among those peoples which have come under the influence of Islam. It is observed only when outside the harem and not by slaves or by the very poor, and rarely by the Bedouin women. The face-veil (*burka'*) is a long strip of white muslin covering the whole of the face except the eyes and reaching nearly to the feet. Among the poorer classes the *burka'* is made of coarse black crêpe, or the *tarhah*, the head-veil, is drawn round the lower part of the face. There is also the double veil or *yashmak*, serving as a head- and face-veil (see INDIA, § *Indian Costume*). In European countries the veil has played a large part in the head-dress of women. It took many shapes in the early middle ages and could be brought over the face as a covering or protection. Later it became a mere ornamental appendage, hanging down from the high, peaked and elaborate head-dresses then worn. In modern times it has become a piece of gauze, lace or net attached to the hat or bonnet and used as a protection against dust, light or wind.

VEINS, in anatomy. The veins (Lat. *vena*) are blood vessels which return the blood from the capillaries toward the heart. As they approach that organ they join together to form larger and larger trunks. In man and other mammals three venous systems are recognized: (1) the *general venous system*; (2) the *pulmonary system*; and (3 the *hepatic portal system*. (See also VASCULAR SYSTEM.)

The *general venous system* consists of superficial and deep veins; the former lie in the superficial fascia and are often visible through the skin. They are usually accompanied by lymphatic vessels though not as a rule by arteries, and, sooner or later, they empty their blood into the deep veins, often passing through special openings in the deep fascia to do so. The deep veins always accompany arteries, and are therefore known as *venae comites*. With small and medium-sized arteries—that is to say, arteries whose diameter is not much greater than that of an ordinary lead pencil—there are two of these venae comites, one on each side, connected by occasional cross communications, but arteries of a larger calibre have only one companion vein. In the scalp and face the superficial veins are remarkable for accompanying, more or less closely, corresponding arteries—more or less closely because the arteries in this region are very tortuous (see ARTERIES), and so are sometimes near their veins and sometimes far away, since the veins run a comparatively straight course. *Frontal*, *superficial temporal*, *posterior auricular* and *occipital veins* are found in the scalp, their names indicating the areas they drain. Like all other superficial veins, they anastomose freely with one another and also at certain places communicate, through foramina in the skull, with the intracranial blood sinuses; these communications are known as *emissary veins*, and act as safety-valves to the sinuses. The frontal vein on the forehead passes down on the inner side of the eyelids, where it is known as the *angular*, and then becomes the *facial vein*, which runs down to an inch in front of the angle of the jaw, whence it passes into the neck to join the common facial. In the greater part of its course it lies some distance behind the facial artery. The *superficial temporal vein* runs down in front of the ear, where it joins the internal maxillary vein from the pterygoid plexus and so forms the *temporo-maxillary trunk*, which passes down, embedded in the parotid gland, to about the angle of the jaw. Here it divides into an anterior branch, which joins the facial vein to form the common facial, and a posterior, which receives the posterior auricular vein and in this way forms the external jugular.

The *external jugular vein* is easily recognized through the skin and platysma muscle on the side of the neck, and eventually pierces the deep fascia above the middle of the clavicle to join the subclavian vein. The *occipital vein* sinks deeply into the back of the neck and so forms the beginning of the vertebral vein.

The *intracranial blood sinuses* lie between two layers of the dura mater and differ from the veins in having fibrous walls which do not contract or expand. The *superior longitudinal sinus* runs along the upper margin of the falx cerebri (see BRAIN), while the inferior longitudinal sinus runs along the lower margin; these drain the surface of the brain, and the blood passes backward in both. Where the falx meets the tentorium cerebelli, the inferior longitudinal sinus receives the *veins of Galen* from the interior of the brain and then passes backward as the *straight sinus* to join the superior longitudinal sinus at the internal occipital protuberance (see SKULL). This meeting-place is known as the *torcular Herophili*, and from it the blood passes outward and downward through the right and left *lateral sinuses*, which groove the cranium (see SKULL) until they reach the posterior lacerated foramina, through which they pass to form the beginning of the internal jugular veins. Most of the blood from the base of the brain passes into the *cavernous sinuses* which lie in the middle cranial fossa, one on each side of the pituitary fossa. These receive the ophthalmic veins from the orbit in front and, after running backward for about an inch, divide into the *superior* and *inferior petrosal sinuses*, the former of which joins the lateral sinus within the cranium, but the latter runs to the posterior lacerated foramen, after passing through which it joins the lateral sinus, which is now becoming the internal jugular vein.

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[1] Some have considered Isola Farnese to have been the arx of Veii, but this is unlikely.

The *internal jugular vein* (fig. 5, I.J.) thus formed runs down at first behind and then to the outer side of the internal and common carotid arteries and at the root of the neck joins the subclavian vein of its own side to form the innominate vein. In its course down the neck it receives the common facial vein already mentioned, as well as tributaries from the tongue, pharynx, larynx and thyroid body. The deep veins of the head and face tend to form plexuses rather than venae comites; of these, *pterygoid*, *deep temporal*, *pharyngeal* and *suboccipital plexuses* are recognized.

Veins of the Upper Extremity.—On the dorsum of the hand and in front of the wrist superficial venous plexuses are easily seen through the skin. From these the blood passes up the forearm chiefly on its flexor surface by the *radial*, *median* and *anterior* and *posterior ulna veins*. Just below the bend of the elbow the median vein communicates with the deep veins and then divides into two branches like the limbs of a Y. Of these the inner is the *median basilic* and is noticeable as the vein from which patients were usually bled, while the outer is the *median cephalic*. After a course of an inch or two the median basilic is joined by the anterior and posterior ulnar veins and the median cephalic by the radial. After this junction the median basilic is continued up the inner side of the arm as the *basilic* which pierces the deep fascia about the middle of the arm and in the axilla joins the venae comites of the brachial artery to form the *axillary vein*, which lies on the inner side of its artery. The median cephalic vein after joining the radial runs up the outer side of the arm as the *cephalic* and a little below the clavicle passes through the costo-coracoid membrane to enter the upper part of the axillary vein. At the outer border of the first rib the axillary vein becomes the subclavian (fig. 5, S.), which lies in front of and below its artery and is separated from it by the scalenus anticus muscle. The arrangement of the superficial veins, especially in front of the elbow, is liable to great variation and often differs on the right and left sides of the same body.

Veins of the Lower Extremity.—The superficial veins of the lower extremity begin in a venous arch on the dorsum of the foot. From the inner extremity of this the *internal saphenous vein* runs up, in front of the inner ankle, along the inner side of the leg, and, passing behind the inner side of the knee, continues up the thigh, gradually working forward until it reaches the *saphenous opening* in the deep fascia of the thigh a little below the spine of the pubis. Here it pierces the deep fascia (*fascia lata*) to enter the common femoral vein. In this long course it has many valves and receives numerous tributaries, one of which, the *saphenous collateral*, runs up nearly parallel to it and on its outer side and joins it just below the saphenous opening. From the inner end of the dorsal arch of the foot the *external saphenous vein* runs up behind the outer ankle along the mid line of the calf to pierce the deep fascia in the popliteal space behind the knee to open into the popliteal vein. Among the deep veins venae comites are found until the popliteal artery is reached, while above this *superficial*, *deep* and *common femoral veins* accompany their respective arteries. In the groin the common femoral vein lies on the inner side of its artery.

Veins of the Abdomen.—The common femoral vein, after passing deep to Poupart's ligament, becomes the *external iliac* (fig. 5, E.I.) which runs along the brim of the true pelvis and, after a course of some three inches, joins the *internal iliac* (fig. 5, I.I.) which drains the pelvis and so forms the *common iliac vein*. In front of the body of the fifth lumbar vertebra the common iliac veins of the two sides unite to form the *inferior vena cava* (fig. 5, I.V.C.), a very large trunk which runs up on the right of the abdominal aorta to an opening in the diaphragm (*q.v.*). On its way it receives spermatic or ovarian veins from the genital glands, *renal veins* (fig. 5, R.V.) from the kidneys, and *lumbar veins* (fig. 5, L.V.) from the abdominal walls. Before reaching the diaphragm it lies in a groove in the back of the liver (*q.v.*) and receives the *hepatic veins* from that organ. The hepatic portal system which lies in the abdomen will be treated later.

Veins of the Thorax.—The inferior vena cava, after piercing the diaphragm, has a very short thoracic course and opens into the lower and back part of the right auricle of the heart (*q.v.*). The *right* and *left innominate veins* (fig. 5, R.I. and L.I.) are formed behind the sternal end of the clavicle by the union of the subclavian and internal jugulars of their own side. The left vein is much longer than the right and runs nearly horizontally behind the upper half of the manubrium sterni to join its fellow on the right side of that bone just below the first rib. By the junction of these the *superior vena cava* (fig. 5, S.V.C.) is formed, which runs down to the right auricle of the heart. The chief tributaries of the innominate veins are the *vertebral*, the *internal mammary* and the *inferior thyroid*.

The intercostal veins open into the *azygos veins*, which begin in the abdomen sometimes by a vertical trunk joining the lumbar veins known as the *ascending lumbar*, sometimes on the right side by a communication with the inferior vena cava. The right azygos vein is known as the *vena azygos major* (fig. 5, A.M.) and passes through the aortic opening of the diaphragm. Entering the thorax, it runs up in front of the thoracic vertebrae, to the right of the aorta and thoracic duct, and receives the intercostal veins of the right side. At the level of the fourth thoracic vertebra it arches forward to open into the posterior surface of the superior vena cava.

On the left side, the upper intercostal veins join to form the left superior intercostal vein (fig. 5, L.S.I.), which opens into the left innominate. Lower down the intercostal veins from the fourth to the seventh spaces form the *superior hemiazygos vein* or hemiazygos accessoria (fig. 5, H.A.), which runs down on the left of the spinal column and, crossing it about the level of the eighth or ninth thoracic vertebra, opens into the vena azygos major. The lower intercostal veins on the left side join the *inferior hemiazygos vein* (fig. 5, H.V.), which runs up and opens either into the superior hemiazygos or into the azygos major below the opening of that vein.

Pulmonary Venous System.—The veins emerging from the lungs bring back the oxygenated blood from those organs to the left ventricle of the heart and also the greater part, if not all, of the blood carried by the bronchial arteries to nourish the lungs. The existence of bronchial veins is asserted, but they are extremely difficult to demonstrate, and if present are quite incapable of returning all the blood which the bronchial arteries carry to the lungs. There are three pulmonary veins coming out of the right lung, while on the left there are only two. On the right side, however, two of the three veins usually unite in the root of the lung, so that there are, as a rule two pulmonary veins entering the left auricle of the heart on each side, but it is not uncommon to find three on the right side or one on the left. The pulmonary veins have no valves and return the blood carried to the lungs by the pulmonary arteries as well as most, if not all, of that carried by the bronchial arteries.

Hepatic Portal System.—The veins which drain the blood from the stomach, intestines, spleen and pancreas unite to form a large vein which begins behind the head of the pancreas and ends by dividing into right and left branches in the transverse fissure of the liver. This is the *portal vein* which lies in front of the inferior vena cava and is about three inches long. Its formative tributaries are the *superior* and *inferior mesenteric* and the *splenic veins*. These accompany the arteries of the same name, and their most usual method of termination is that the inferior mesenteric runs up and joins the splenic to the left of the middle line of the body, and this, after running horizontally to a point a little to the right of the middle line, joins the superior mesenteric, and so the portal vein is formed. There are two marked characteristics of the portal system; one is that it has no valves and the other that it begins and ends in capillaries, since the two terminal branches of the portal vein branch and rebranch in a manner already described in the article LIVER. In the lower part of the rectum the veins run partly into the portal and partly into the general system, and in this dependent position they are liable to become varicose and to form haemorrhoids or piles.

The histology of the veins corresponds very closely to that of the arteries (*q.v.*); their walls are, however, much thinner and there is less muscular and elastic tissue. At certain places, especially where tributaries come in, the endothelial lining is raised to form semilunar pocket-like valves. In most cases there are two cusps to each valve, but three or one are sometimes found. The opening of the pocket is of course arranged so that it shall only be filled when there is a tendency to regurgitation of the blood.

Embryology.

The *vitelline* or *omphalo-mesenteric veins*, returning the blood from the yolk sac, are the first to appear, and later on, with the formation of the placenta, the umbilical veins develop. Both these open into the hinder (caudal) part of the heart, which is already being constricted off as the *sinus venosus* (see fig. 1).

While this is going on the veins from the different body segments are received into two longitudinal trunks on each side, the anterior (cephalic) of which is the *primitive jugular* or anterior cardinal (fig. 1, P.J.), and the posterior (caudal), the *posterior cardinal* or simply *cardinal vein* (fig. 1, P.C.). As the heart is at first situated in the region which will later be the neck of the embryo, the primitive jugular receives very few segmental veins and the cardinal very many. These two trunks join one another on each side and open into the side of the *sinus venosus* (S.V.) by a transverse communication which is called the *duct of Cuvier* (D.C.). The condition of the venous system at this stage is shown in the accompanying diagram (fig. 1).

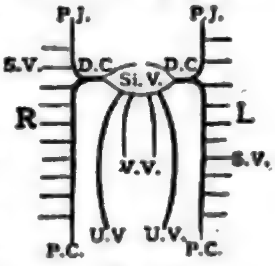

FIG. 1.

As the vitelline veins run from the yolk sac to the heart along each side of the primitive fore-gut they pick up the mesenteric veins from the intestines as well as the splenic and pancreatic veins as soon as these viscera are formed. The liver, however, is developed right across their path, and both they and the umbilical veins break up into a mass of capillaries in it, leaving that part of them which lies between the liver and the heart to form the primitive hepatic veins (fig. 2, H.V.). While the vitelline veins are lying on each side of the fore-gut (future duodenum) they are connected by three transverse channels, the anterior and posterior of which appear on the ventral side of the gut, the middle on the dorsal side (see fig. 2).

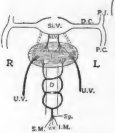

FIG. 2.

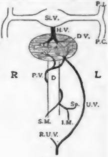

FIG. 3.

This figure of eight does not persist, however, because the anterior (cephalic) part of it on the left and the posterior (caudal) part on the right become obliterated, and what is left forms the *portal vein* (fig. 3, P.V.). The two umbilical veins unite at the umbilicus (fig. 3) and soon all the blood from the placenta passes through the left one, the right becoming rudimentary.

The left umbilical vein on reaching the liver now joins the left branch of the portal vein and establishes a new communication with the left hepatic vein. This is the *ductus venosus* (fig. 3, D.V.), and, as soon as it is formed, there is no longer any need that all the blood returning from the placenta should pass through the liver capillaries. The development of the cardinal veins must now be returned to. As the heart moves from the neck into the thorax the primitive jugulars elongate and it is now recognized become the internal jugulars in the greater part of their extent. When the arms begin to bud out subclavian veins are developed (fig. 4, S.) and an oblique connecting vein (figs. 4 and 5, L.I.) is established between the point of junction of the left subclavian with the primitive jugular and the hinder part of the primitive jugular of the right side. This connexion becomes the left innominate vein, while the hinder part of the primitive jugular persists as the *left superior intercostal vein* (fig. 5, L.S.I.). On the right side that part of the primitive jugular between the subclavian and the junction with the left innominate becomes the right innominate (figs. 4 and 5, R.I.) while the hinder (caudal) part of the right primitive jugular and the right duct of Cuvier become the superior vena cava (figs. 4 and 5, S.V.C.). The external jugular is a later formation. The right and left posterior cardinal veins receive the intercostal and lumbar segmental veins and are continued into the lower limbs as the internal iliac and eventually the sciatic veins (figs. 4 and 5, I.I.), the primitive bloodpath from the thighs. The veins from the primitive kidneys open into the segmental veins, and when the permanent kidney is formed (see URINARY SYSTEM) a large *renal vein* on each side is established. There are, however, many cross communications (fig. 4, T.C.) between the right and left posterior cardinal veins, some of which become very important later on, though most of them are transitory. The probable origin of the *inferior vena cava* is to be sought in a pair of veins called *subcardinals* which have been found in the rabbit embryo lying parallel and a little ventral to the posterior cardinals (fig. 4, R.S.C.–L.S.C.) and effecting a junction with the renals and transverse communications (T.C.) as they cross these. Posteriorly (caudal) they join the cardinals, but anteriorly the right one establishes a communication with the ductus venosus (fig. 4, D.V.) a little below the point at which that vessel joins the left hepatic. It is from the right one of these that the greater part of the inferior vena cava is formed. It will now be seen that the adult vena cava is formed by contributions from four embryonic veins, most anteriorly the hepatic, then the ductus venosus, then the right subcardinal and posteriorly the right posterior cardinal (F. T. Lewis, *Am. J. of Anat.* vol. 1, 229, 1902). The anterior (cephalic) part of the right posterior cardinal forms the *vena azygos major*, and an inspection of fig. 4 will show that in the adult this may rise from the renal, from an ascending lumbar vein or, by a cross communication above the renal, from the inferior vena cava. The left posterior cardinal becomes obliterated below and its segmental tributaries find their way by cross communications to the vena cava (fig. 5). Above (cephalad) the left renal vein the left cardinal forms the hemiazygos (fig. 5, H.V.) and, higher still, the hemiazygos accessoria (fig. 5, H.A.). These open into the azygos major by persistent cross communications which lie dorsal to the heart when that organ reaches its permanent position. It must be mentioned in this connexion that some modern authorities doubt whether the azygos veins of mammals are really persistent cardinals except quite in their anterior parts, just before they join the ducts of Cuvier. The left duct of Cuvier is only represented in the human adult by the oblique vein of Marshall on the dorsum of the left auricle. The external iliac veins (figs. 4 and 5, E.I.) become fully developed, like their arteries, when the blood changes its course from the back to the front of the thigh. After birth the umbilical vein and the ductus venosus become converted into fibrous cords and the circulation in the pulmonary veins is established. (For further details see *Development of the Human Body*, by J. P. McMurrich, London, 1906. In this will be found the literature of the subject up to that date, the writings of F. Hochstetter being the most important. See also Quain's *Anat.* vol. i., 1908.)

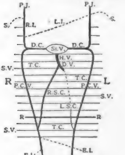

FIG. 4.

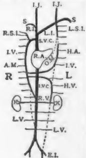

FIG. 5.

Comparative Anatomy.

In the Acrania (*Amphioxus*), although there is no heart, the blood vessels returning the blood to the subpharyngeal region are distinctly of a vertebrate type. There is a subintestinal vessel or vein bringing the blood from the intestine to the liver and breaking up into capillaries in that organ just as the portal vein does in the higher forms. From the liver a hepatic vein carries the blood forward to the region below the pharynx where the heart is formed in Vertebrata. There is no renal portal system. In the Cyclostomata (lampreys and hags) the cardinal veins are formed and the blood from the caudal vein passes directly into the posterior cardinals without any renal portal system. In fishes the single caudal vein divides into two branches, each of which runs forward to the outer side of its respective kidney and ends by giving numerous branches to that viscus. The blood returning from the kidney passes into the beginning of its own posterior cardinal vein or sinus, which lies on the inner side of the kidney. This constitutes a *renal portal system*. The cardinal veins and ducts of Cuvier closely resemble the arrangement already detailed in the human foetus, while the hepatic portal system from the intestine to the liver is constant in this and all other vertebrates.

In the Dipnoi (mud-fish) a pulmonary vein from the lung-like swim-bladder is formed and an inferior vena cava or postcaval vein carries the blood from the kidneys to the heart. This is its first appearance in the vertebrate phylum. In the lower fishes there is a vein of the lateral line on each side, but in the Dipnoi these coalesce and form a median anterior (ventral) abdominal vein which is constant in the Amphibia. Subclavian and iliac veins return the blood from the fins and open respectively into the junction of the anterior and posterior cardinals and into the caudal vein.

In the tailed Amphibia (*Urodela*) the postcaval and posterior cardinal veins are well developed, the former vessel running from the right cardinal vein a little in front of (cephalad) the kidney to the hepatic vein, in this way closely foreshadowing man's embryology. In the Anura (frogs and toads) the posterior cardinals are usually suppressed, but these are very specialized animals. The anterior abdominal vein in amphibians joins the portal vein close to the liver.

In the Reptilia the renal portal circulation persists, but is rudimentary in birds and disappears in mammals. The anterior abdominal or epigastric vein of amphibians and reptiles returns the blood from the allantois in the embryo and in higher forms becomes the umbilical veins returning the blood from the placenta; there is, therefore, a continuous line of ascent from the lateral line veins of the fish to the umbilical vein of man. In reptiles, birds, monotremes, marsupials and many rodents, insectivores, bats and ungulates, a left superior vena cava (precaval vein) is present as well as a right; it passes ventral to the root of the left lung and then dorsal to the left auricle of the heart until it reaches the coronary sinus to open into the right auricle. Its course is indicated in man by the left superior intercostal vein, the vestigial fold of Marshall (see COELOM AND SEROUS MEMBRANES) and the oblique vein of Marshall. It can be readily reconstructed from figs. 4 and 5 if the transverse communication (L.I.) is obliterated. In some mammals the postcaval vein is double, especially in its hinder (caudal) part, and this sometimes occurs as a human abnormality (see F. W. McClure, *Am. Journ. of Anat.* vol. 2, 1903, and vol. 5, 1906, also *Anat. Anzeiger*, Bd. 29, 1906).

Except in Cetacea, one or both azygos veins are always present in mammals. When there is only one it is usually the right, though a few forms among the marsupials, rodents and ungulates have only the left (F. E. Beddard, *P.Z.S.*, 1907, p. 181). In many of the lower mammals the external jugular vein is much larger than the internal and returns most of the blood from the brain through an opening called the postglenoid foramen. For this reason it was formerly regarded as the representative of the primitive jugular. It is now, however, thought that the internal jugular is that representative, and that the arrangement of man, in which the internal jugular drains the interior of the cranium, is the more generalized and primitive.

For further details and literature see R. Wiedersheim's *Comparative Anatomy of Vertebrates*, translated by W. N. Parker (London, 1907). (F. G. P.)

VEINS, in geology, masses of rock which occupy fissures in other rocks. They may have originated in many different ways and present a great variety of forms and structures. We may classify them in three groups: (i.) veins of igneous rock, (ii.) of sedimentary, and (iii.) of minerals deposited by water or by gases.

Veins of igneous rock are practically the same as dikes; yet a distinction is sometimes made that dikes are narrow, often straight-walled and run for considerable distances, while veins are irregular, discontinuous and of limited extent. Where granite invades sedimentary or metamorphic rocks it very commonly emits vast numbers of dikes. The margin of the granite is full of blocks of all sizes, so that it is often impossible to say where the solid granite ends and the fringe of veins begins. An intrusion plexus of this sort seldom extends for more than a few hundred yards; many granites, on the other hand, have sharp and well-defined margins and send few veins into the country rock.

In plutonic rock areas veining is also very common. Great intrusive masses have not as a rule been injected in one stage but have been slowly enlarged by gradual or repeated inflows, and often the earliest portions had consolidated before the last were introduced. Very frequently the older rocks are of a different character, being usually more basic than those which succeed them, and this makes the veining more obvious. For instance, it is common to find peridotite traversed by many veins of gabbro, or diorite injected with numerous veins of granite, though in either case the rocks are part of one plutonic boss or laccolite. The crystalline structure of the vein-rock and the surrounding mass is usually quite similar and there may be no fine-grained edges to the veins; these facts establish that the older mass though solid had not yet cooled down, so that the veining is directly connected with the injection process and the two rocks have been derived from the same source, but one is slightly later than the other.

Among the Laurentian or Lewisian gneisses, which resemble granites, diorites and gabbros in composition, but have a banded or foliated structure, veining of this type is almost universal. The veins are of all sizes and of very irregular shape. Frequently they run along the foliation of the gneiss, but often also they cross it obliquely or at right angles. Such gneisses were produced by the injection of a partly differentiated and consequently non-homogeneous magma, by successive stages, under a rock crust which was in movement or was subjected to intermittent pressures during consolidation.

In certain cases the new material introduced into the rock by these veins bulks almost as largely as the original substance. A shale, slate or phyllite is sometimes so filled with threads of granite that its composition and appearance are completely altered. Thin pale threads of quartz and felspar, not more than a tenth of an inch in thickness may be seen following the bedding planes, or the cleavage and sometimes also the slip-cleavage. The distance between the veins may be no greater than the breadth of the veins themselves, and thus a striped or banded rock is produced, resembling a gneiss but of dual origin, a mixed rock which is described properly as a "composite" or "synthetic" gneiss. The French geologists who first insisted on the importance of this group of rocks have called the process *lit par lit* (bed-by-bed) injection. The best examples of this in Britain are to be found around the granites of Mull and northern Sutherlandshire. The rocks invaded by granite in this manner often show intense contact alteration and are to a large extent recrystallized.

The short irregular veins which commonly occur within areas of granite, diorite, gabbro and other plutonic rocks are often much more coarsely crystalline than the rock around them. This is no doubt partly due to the high temperature of the whole complex and to slow crystallization, but it may also be ascribed to the action of vapours dissolved in the magma and gradually released as it solidifies. Such coarse-grained igneous rocks are called pegmatites (*q.v.*). It is clear that they are not purely igneous but are partly pneumatolytic.

With the pegmatites we may class the fine-grained acid veins (aplites) which are found not only in granites but also in many diabases. They occur in irregular streaks or as long branching well-defined veins, and are usually more rich in quartz and felspar than the surrounding rock. Formerly they were often described as contemporaneous or as segregation veins; but no vein can be in strict accuracy contemporaneous with the rock which it intersects, and many of them give evidence of having been intruded into their present situation, since their minerals are so arranged as to show flexion structure. But they are always intimately connected, as their mineral composition indicates, with the rock mass in which they lie, and they represent merely the last part of the magma to consolidate. The fissures they occupy are presumably due to contraction, seeing that they are not accompanied by displacement, brecciation or faulting.

Veins of sedimentary rock are few and of little importance. They occur where sediment has gathered in cavities of other rocks. Lava streams, for example, when they cool become split up into irregular blocks, and in the crevices between these ashes, sand and clay will settle. Submarine lavas are often traversed by great numbers of thin veins of sandstone, and a similar phenomenon may also be noted in the tuff of submarine necks or other ash beds. Cracks in limestone and dolomite are widened by the solvent action of percolating waters and may be filled with gravel, soil, clay and sand. In the Carboniferous Limestone, for instance, veins of bedded sandstone sometimes pass down from overlying Triassic deposits. The upper surface of the chalk in the south of England has frequently many deep funnel-shaped pipes which are occupied by Tertiary or recent accumulations.

The third group of veins, namely, those which have been filled by deposits from solution in water or in vapours, is of the greatest importance as including a very large number of mineral veins and ore-bodies. They are also the source of the great majority of the finely crystallized specimens of minerals.

The deposition of minerals on the walls of fissures by a process of sublimation may be observed at any active volcano. The cracks in the upper part of lava flows are often lined by crystals of sal-ammoniac, sodium chloride, ferric chloride and other volatile substances. By oxidation of the iron chloride bright scales of haematite (ferric oxide) arise; sulphurous acid and sulphuretted hydrogen, given out as gases, react on one another, producing yellow encrustations of sulphur; and copper oxide (tenorite) and a great variety of other minerals (alum, iron sulphate, realgar, borates and fluoride) are found about fumaroles of Vesuvius and other volcanoes.

Most veins, however, are not of superficial origin but have been formed at some depth. The heat given out by masses of rocks which were injected in a molten state is no doubt sufficiently high to volatilize many minerals. The pressure, however, also must be taken into account, as it tends to retain these substances in a liquid condition. Water vapour is always the most abundant gas in a volcanic magma, and next to it are carbonic acid, sulphurous acid, sulphuretted hydrogen and hydrochloric acid. The physical condition of the substances passing outwards from an igneous mass through fissures in the superincumbent rocks will depend on the nature of the substances, on the temperature and the pressure. Near the granite the heat is so great, at first at any rate, that gaseous materials must greatly preponderate; but farther away many of them will be condensed and hot aqueous solutions of complex composition will fill the cracks.

Veins deposited by the action of gases and vapours are said to be of "pneumatolytic" origin; where hot aqueous solutions have been the principal agency in their formation they are "hydatogenetic." It is often very difficult to ascertain to which of these classes a mineral vein belongs, especially as we are in ignorance of the behaviour of many substances at high temperatures and under great pressures

The veins which yield tin-ores in Cornwall and in most other tin-producing countries are generally regarded as typical pneumatolytic deposits. Tin forms a volatile fluoride which may be decomposed by water, forming tin oxide, the fluorine passing into hydrofluoric acid which may act as a catalytic agent or carrier by again combining with tin. Around tin-bearing veins and in the material which fills them there are usually many minerals containing fluorine, such as topaz, fluor-spar and white mica. Some borates too are volatile at high temperatures, and minerals containing boron (especially tourmaline) are very common in tin veins. Also since ore deposits of this character are found nearly invariably in granite or in the rocks which have been invaded by granite there is good reason to hold that fluoric and boric gases were important agents in the production of tin veins. It is not necessary, however, to believe that all the materials which are found in these veins were introduced as vapours, for as the temperature sank currents of hot water would follow which would fill up any cavities.

The tin veins of Cornwall often contain copper ores in their upper parts and at greater distances from the granite, a fact which indicates that the copper salts were deposited from solution at lower temperatures than the tin ores. A very large number of important ore deposits have been laid down by hot waters emanating from deep-seated intrusive masses. Nearly all the principal goldfields (except gravels or placers) are in districts where igneous dikes, veins and sills abound, and it is often perfectly clear that the introduction of the gold ores is intimately connected with the intrusive masses. The Witwatersrand deposits, although by many considered to be old auriferous gravel, have been regarded as owing their value to gold deposited from vapours emanating from certain of the dikes which traverse the banket rock or conglomerate. The importance of these hot ascending currents of water, proceeding from eruptive magmas, has been fully recognized, and is now probably the most widely accepted theory of the genesis of mineral veins.

The water falling on the earth's surface will to a large extent percolate downwards into the rocks, and it will dissolve mineral matters, especially at the greater depths, owing to the increased temperature and pressure; conversely, as it ascends it will lay down deposits or veins. This is the theory of "lateral secretion," at one time in great favour, but now regarded as of less importance. Ferruginous waters on passing through limestone rocks may deposit their iron as haematite or siderite, removing a proportionate amount of lime, and in this way great bodies of ironstone have been formed, as in Cumberland and Yorkshire, partly along the bedding of the limestone but also in veins, pockets and irregular masses. Many lead and zinc veins probably belong also to this class. By analysis it has been proved that in nearly all the common rocks there exist very minute quantities of such metals as gold, silver, lead, copper, zinc. If these can be extracted in solution in water they might conceivably be deposited subsequently in fissures in the rocks.

Controversy has raged between opposing schools of geologists, one considering that most mineral veins owe their existence to currents of hot water ascending from deep-seated igneous rocks, and the other that the metals were derived from the country rocks of the veins and were extracted from them by cold descending currents of water. There are cases which can be explained on one of these hypotheses only, and sufficiently establish that both of them are valid; but the general opinion at the present time is in favour of the first of these explanations as the most general.

The fissures in which veins have been deposited owe their origin to a variety of causes. Many of them are lines of fault, the walls of which have been displaced before the introduction of the vein minerals. Others seem to be of the same nature as joints, and are due either to contraction of the rocks on solidification, to folding or to earthquake shocks. In the vicinity of intrusive masses many fissures have been produced by the contraction of rock masses which had been greatly heated and then slowly cooled. Veins often occur in groups or systems, which have a parallel trend and may sometimes be followed for many miles. The larger veins may branch and the branches sometimes unite after a time, enclosing masses of country rock or "horses." Cross-courses are fissures which intersect the lodes; they are often barren, and at other times carry an entirely different suite of minerals from those of the mineral veins. A peculiar group of veins has been described from the Bendigo district of Australia; they are saddle-shaped and in transverse section resemble an inverted U. The beds in which they occur are folded sharply into arches and troughs, and in folding they have separated at the crests of the arches, leaving hollows which were subsequently filled up with ore.

The minerals occurring in the veins are sometimes classified as "ores" and "gangue": the former being those which are of value while the others are unprofitable. The commonest of the gangue minerals are quartz, calcite, barytes and fluor-spar. Usually a large number of minerals occurs in each vein, and the natural association or "paragenesis" of certain minerals which frequently are found together is a practical guide of much value to the engineer and prospector. A definite sequence in the order of deposit of the constituent minerals can often be recognized, the earlier being situated on the walls of the fissures or enclosed and surrounded by the later, and the microscopic study of veinstone shows that they have often a complicated history.

Many types of structure are met with in veinstones and vein deposits. Some are structureless, homogeneous or massive, like the quartz veins which are often found in districts composed of slate or phyllite. Others are banded, with sheets of deposit, each consisting of one mineral, usually parallel to the walls of the lode. These veins are often symmetrical, with corresponding layers following one another inwards from the walls on each side.

The veinstones are frequently crushed either by faulting or by irregular movements of the walls, and in such cases the veinstones have a shattered or brecciated appearance. If the crushing took place while the ore deposits were still being introduced, the broken rock is often cemented together into a compact mass. Rounded masses of rock or of veinstone are often met with, looking exactly like pebbles, but they are analogous to crush-conglomerates, as the fragments have been shaped by the movements of the walls of the vein. Frequently these movements have reopened a fissure which had been filled up, and a new vein is subsequently formed alongside of the old one; this process may be repeated several times.

The mineral-bearing solutions may exert a powerful influence on the walls of the veins, removing certain constituents and depositing others; in this way the walls of the vein become ill defined. The commonest change of this kind is silicification, and rocks of many different kinds, such as slate, limestone, andesite and felsite, are often completely replaced by quartz in the vicinity of mineral veins which have a quartzose gangue. Tin veins in granite and slate may be surrounded by a zone of rock which has been impregnated with cassiterite and is worth working for the metal. These changes are of a "metasomatic" type involving replacement of the original rock-substance by introduced materials. Many of the best examples of this are furnished by limestone, which is one of the rocks most easily affected by percolating solutions.

The distinction between mineral veins and other veins is to a large extent artificial. With improvement of methods of mining and extraction deposits formerly unprofitable become payable, and in all cases veins vary considerably in the amount of ore they carry. The rich parts are sometimes called shoots or bonanzas, while the barren portions are often left standing in the mine. Near the ground surface the veinstones become oxidized and the metallic minerals are represented by oxides, carbonates, hydrates, or in the case of gold and silver veins they may be rich in the metals themselves. Below the zone where oxidizing surface-waters percolate a different series of minerals occurs, such as sulphides, arsenides and tellurides. If the ores are insoluble they will tend to be concentrated in the upper part of the vein rock, which may be greatly enriched in this way. Pyritic veins are changed to rusty-looking masses, "gossans," owing to the oxidation of the iron at the surface. Though instances are known of veins which come to an end when followed downwards, it seems probable that the majority of veins descend to great depths, and there is little reason to believe that they become less rich in the heavy metals. (J. S. F.)

VEIT, PHILIPP (1793–1877), German painter, one of the leaders of the German romantic school, was born in Berlin. Having received his first art education in Dresden and Vienna, he was strongly influenced by, and joined the group of, the Nazarenes in Rome, where he worked for some years before taking up his abode in Frankfort. In this city, where his most important works are preserved at the Staedel Institute, he was active from 1830 to 1843, as director of the art collections and as professor of painting. From 1853 to his death in 1877 he held the post of director of the municipal gallery at Mayence. Like his fellow-Nazarenes he was more draughtsman than painter, and though his sense of colour was stronger than that of Overbeck or Cornelius, his works are generally more of the nature of coloured cartoons than of paintings in the modern sense. His principal work is the large fresco of "The Introduction of Christianity into Germany by St Boniface," at the Staedel Institute in Frankfort. In the cathedral of that city is his "Assumption," whilst the Berlin National Gallery has his painting of "The Two Marys at the Sepulchre." To Veit is due the credit of having been the first to revive the almost forgotten technique of fresco painting.

See *Kunst, Künstler und Kunstwerke*, by Valentin Veit.

VEITCH, JOHN (1829–1894), Scottish poet, philosopher, and historian of the Scottish border, son of a Peninsular veteran, was born at Peebles on the 24th of October 1829, and educated at Edinburgh University. He was assistant lecturer successively to Sir William Hamilton and A. Campbell Fraser (1856–60). In 1860 he was appointed to the chair of logic, metaphysics and rhetoric at St Andrews, and in 1864 to the corresponding chair at Glasgow. In philosophy an intuitionist, he dismissed the idealist arguments with some abruptness, and thereby lost much of the influence gained by the force of his personal character. He died on the 3rd of September 1894. He will be remembered chiefly for his work on Border literature and antiquities.

He published translations of Descartes' *Discours de la méthode* (1850) and *Méditationes* (1852); an edition of Sir W. Hamilton's lectures with memoir (1869, in collaboration with H. L. Mansel); *Tweed, and other Poems* (1875); *History and Poetry of the Scottish Border* (1877; ed. 1893); *Institutes of Logic* (1885); *Knowing and Being* (1889); *Merlin* (1889); *Dualism and Monism* (1895); *Border Essays* (1896). See *Memoir* by his niece, Mary R. L. Bryce (1896).

VEJÉR DE LA FRONTERA, a town of southern Spain, in the province of Cadiz, on the right bank of the river Barbate and on the Cadiz-Tarifa railway. Pop. (1900) 11,298. Vejér de la Frontera occupies a low hill overlooking the Straits of Gibraltar and surrounded by orchards and orange groves. It contains several ancient churches and convents, and the architecture of many of its houses recalls the period of Moorish rule, which lasted from 711 until the town was captured by St Ferdinand of Castile in 1248. Agriculture and fruit-farming are the chief industries; fighting bulls are also bred in the neighbourhood.

VELARIUM, the curtain or awning extended above the auditorium of the Roman theatres and amphitheatres to protect the spectators from sun and rain.

VELAZQUEZ, DIEGO RODRIGUEZ DE SILVA Y (1599–1660), the head of the Spanish school of painting and one of the greatest painters the world has known, was born in Seville early in June 1599, the year in which Van Dyck also first saw the light at Antwerp. His European fame is of comparatively recent origin, dating from the first quarter of the 19th century. Till then his pictures had lain immured in the palaces and museum of Madrid; and from want of popular appreciation they had to a large extent escaped the rapacity of the French marshals during the Peninsular War. In 1828 Sir David Wilkie[1] wrote from Madrid that he felt himself in the presence of a new power in art as he looked at the works of Velazquez, and at the same time found a wonderful affinity between this master and the English school of portrait painters, being specially reminded of the firm, square touch of Raeburn. He was struck by the sense of modernness of impression, of direct contact with nature, and of vital force which pervaded all the work of Velazquez, in landscape as well as in portraiture. Time and criticism have now fully established his reputation as one of the most consummate of painters, and accordingly Ruskin says of him that "everything Velazquez does may be taken as absolutely right by the student." At the present day his marvellous technique and strong individuality have given him a power in European art such as is exercised by no other of the old masters. Although acquainted with all the Italian schools, and the friend of the foremost painters of his day, he was strong enough to withstand every external influence and to work out for himself the development of his own nature and his own principles of art. A realist of the realists, he painted only what he saw; consequently his imagination seems limited. His religious conceptions are of the earth earthy, although some of his works, such as the "Crucifixion" and the "Christ at the Column," are characterized by an intensity of pathos in which he ranks second to no painter. His men and women seem to breathe, his horses are full of action and his dogs of life, so quick and close is his grasp of his subject. England was the first nation to recognize his extraordinary merit, and it owns by far the largest share of his works outside of Spain.[2] But Velazquez can only be seen in all his power in the gallery of the Prado at Madrid, where over sixty of his works are preserved, including historical, mythological and religious subjects, as well as landscapes and portraits. It is hardly creditable to the patriotism of Seville, his native town, that no example of his work is to be seen in the gallery of that city. Seville was then in the height of its prosperity, "the pearl of Spain," carrying on a great trade with the New World, and was also a vigorous centre of literature and art. For more than a hundred years it had fostered a native school of painting which ranked high in the Peninsula, and it reckoned among its citizens many whose names are prominent in Spanish literature.

Velazquez was the son of Rodriguez de Silva, a lawyer in Seville, descended from a noble Portuguese family, and was baptized on the 6th of June 1599. Following a common Spanish usage, he is known by his mother's name Velazquez. There has been considerable diversity of opinion as to his full name, but he was known to his contemporaries as Diego de Silva Velazquez, and signed his name thus. He was educated, says Palomino, by his parents in the fear of God, and was intended for a learned profession, for which he received a good training in languages and philosophy. But the bent of the boy was towards art, and he was placed under the elder Herrera, a vigorous painter who disregarded the Italian influence of the early Seville school. From his works in Seville we can see that Herrera was a bold and effective painter; but he was at the same time a man of unruly temper, and his pupils could seldom stay long with him. Velazquez remained but one year—long enough, however, to influence his life. It was probably from Herrera that he learned to use long brushes, or, as J. E. Hodgson, R.A., suggested, brushes with long bristles, by means of which his colours seem to be floated on the canvas by a light, fluent touch, the envy and despair of his successors. From Herrera's studio Velazquez betook himself to a very different master, the learned and pedantic Pacheco, the author of a heavy book on painting, and, as we see by his works at Madrid, a dull, commonplace painter, though at times he could rise to a rare freedom of handling and to a simple, direct realism that is in direct contradiction to the cult of Raphael preached by him in his writing. A portrait by Pacheco, owned by Sir Frederick Cook, which shows this master's full power, was exhibited at Burlington House in 1907. In Pacheco's school Velazquez remained for five years, studying proportion and perspective, and seeing all that was best in the literary and artistic circles of Seville. Here also he fell in love with his master's daughter Juana, whom he married in 1618 with the hearty approval of Pacheco, who praises his hand and heart, claiming at the same time all the credit of having been his master. The young painter set himself to copy the commonest things about him—earthenware jars of the country people, birds, fish, fruit and flowers of the market-place. To paint well and thoroughly what he saw, to model with his brush, and to colour under the influence of light and shade were for him the vital purpose, the first lesson, in his art. It was with deliberate purpose that Velazquez painted these *bodegones* (tavern-pieces), as they were called; for we are told that he said he would rather be the first painter of common things than the second in higher art. Carrying out this idea still further, Velazquez felt that to master the subtlety of the human face he must make this a special study, and he accordingly engaged a peasant lad to be his servant and model, making innumerable studies in charcoal and chalk, and catching his every expression. We see this model, probably, in the laughing boy of the Hermitage "Breakfast," or in the youngest of the "Musicians" acquired for the Berlin Museum in 1906. In such work as this, and in his studies by the wayside, Velazquez laid the foundation of his subsequent mastery of expression, of penetration into character, and of rendering the life of his sitter to the quick. He saw the world around him teeming with life and objects interesting to the painter, and he set himself to render these. His manner is as national as that of Cervantes. He lived and died racy of the soil. The position and reputation of Velazquez were now assured at Seville. There his wife bore him two daughters—all his family so far as is known. The younger died in infancy, while the elder, Francisca, in due time married Bautista del Mazo, a painter, whose large family is that which is represented in the important picture in Vienna which was at one time called the "Family of Velazquez." This picture is now by common consent given to Mazo. In the gallery at Madrid there is a portrait of Juana, his wife, holding a drawing-tablet on her knee. There was formerly in the possession of Lord Dudley another portrait of his wife by Velazquez, painted, perhaps, in the first year of their happy marriage. Of this early Seville manner we have an excellent example in "El Aguador" (the Water-Carrier) at Apsley House (London). Firm almost to hardness, it displays close study of nature. One can see in it the youthful struggle to portray the effects of light stealing here and there over the prominent features of the face, groping after the effects which the painter was to master later on. The brushwork is bold and broad, and the outlines firmly marked. As is usual with Velazquez at this time, the harmony of colours is red, brown and yellow, reminding one of Ribera. For sacred subjects we may turn to the "Adoration of the Magi" at Madrid, dated 1619, and the "Christ and the Pilgrims of Emmaus" in the collection of Don Manuel de Soto in Zurich, in both of which we have excellent examples of his realism. In the "St John in the Desert" we again find his peasant boy transformed into the saint.

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[1] See Cunningham's *Life*, vol. ii.

[2] Of the 274 works attributed to Velazquez by Mr Curtis, 121 are in the United Kingdom, while France has but 13, Austria-Hungary 12, Russia 7, and Germany about the same number. Beruete, who only allows 90 known pictures to be genuine works of Velazquez, allots 14 to the United Kingdom, which number still considerably exceeds that of any other country save Spain.

But Velazquez was now eager to see more of the world. Madrid, with its fine Titians, held out strong inducements. Accordingly, in 1622, fortified with letters of introduction to Fonseca, who held a good position at court, he spent some months there, accompanied only by his servant. Here he painted the portrait of the poet Gongora, a commission from Pacheco, but the picture known by that name in the gallery at Madrid cannot with certainty be identified as Velazquez's portrait; it is more probably by Zurbaran. The impression which Velazquez made in the capital must have been very strong, for in the following year he was summoned to return by Olivares, the all-powerful minister of Philip IV., fifty ducats being allowed to defray his expenses. On this occasion he was accompanied by his father-in-law. Next year (1624) he received from the king three hundred ducats to pay the cost of the removal of his family to Madrid, which became his home for the remainder of his life. Weak and worthless as a king, Philip had inherited the art-loving propensities of his race, and was proud to be considered a poet and a painter. It is one of the best features of his character that he remained for a period of thirty-six years the faithful and attached friend of Velazquez, whose merit he soon recognized, declaring that no other painter should ever paint his portrait. By his equestrian portrait of the king, painted in 1623, Velazquez secured admission to the royal service with a salary of twenty ducats per month, besides medical attendance, lodgings and payment for the pictures he might paint. The portrait was exhibited on the steps of San Felipe, and was received with enthusiasm, being vaunted by poets, among them Pacheco. It has unfortunately disappeared, having probably perished in one of the numerous fires which occurred in the royal palaces. The Prado, however, has two portraits of the king (Nos. 1070 and 1071) in which the harshness of the Seville period has disappeared and the tones are more delicate. The modelling is firm, recalling that of Antonio Mor, the Dutch portrait painter of Philip II., who exercised a considerable influence on the Spanish school. In the same year the prince of Wales (afterwards Charles I.) arrived at the court of Spain. We are told that he sat to Velazquez, but the picture has disappeared.[1]

In 1628 Rubens visited Madrid on a diplomatic mission for nine months, and Velazquez was appointed by the king to be his guide among the art treasures of Spain. Rubens was then at the height of his fame, and had undertaken as a commission from Olivares the large pictures which now adorn the great hall in Grosvenor House (London). These months might have been a new turning-point in the career of a weaker man than Velazquez, for Rubens added to his brilliant style as a painter the manner of a fascinating courtier. Rubens had a high opinion of the talent of Velazquez, as is attested by Fuensalida, but he effected no change in the style of the strong Spaniard. He impressed him, however, with the desire to see Italy and the works of her mighty painters. In 1627 the king had given for competition among the painters of Spain the subject of the Expulsion of the Moors. Velazquez bore off the palm; but his picture was destroyed in a fire at the palace in 1734. Palomino, however, describes it. Philip III. points with his baton to a crowd of men and women driven off under charge of soldiers, while Spain, a majestic female, sits looking calmly on. The triumph of Velazquez was rewarded by his being appointed gentleman usher. To this was shortly afterwards added a daily allowance of twelve reals, the same amount as was allowed to the court barbers, and ninety ducats a year for dress, which was also paid to the dwarfs, buffoons and players about the king's person—truly a curious estimate of talent at the court of Spain. As an extra payment he received (though it was not paid for five years) one hundred ducats for the picture of Bacchus, painted in 1629 (No. 1058 of the Madrid gallery). The spirit and aim of this work are better understood from its Spanish name, "Los Borrachos" or "Los Bebedores" (the Topers), who are paying mock homage to a half-naked ivy-crowned young man seated on a wine barrel. It is like a story by Cervantes, and is brimful of jovial humour. One can easily see in this picture of national manners how Velazquez had reaped the benefit of his close study of peasant life. The painting is firm and solid, and the light and shade are more deftly handled than in former works. Altogether, this production may be taken as the most advanced example of the first style of Velazquez. It is usual to divide his artistic career by his two visits to Italy, his second style following the first visit and his third the second. Roughly speaking, this somewhat arbitrary division may be accepted, though it will not always apply, for, as is usual in the case of many great painters, his styles at times overlap each other. Velazquez rarely signed his pictures, and the royal archives give the dates of only his more important works. Internal evidence and history, as regards his portraits, supply to a certain extent the rest.

In 1629 Philip gave Velazquez permission to carry out his desire of visiting Italy, without loss of salary, making him besides a present of four hundred ducats, to which Olivares added two hundred. He sailed from Barcelona in August in the company of the marquis de Spinola, the conqueror of Breda, then on his way to take command of the Spanish troops at Milan. It was during this voyage that Velazquez must have heard the details of the surrender of Breda from the lips of the victor, and he must have sketched his fine head, known to us also by the portrait by Van Dyck. But the great picture was not painted till many years later, for Spinola had fallen into disfavour at court. In Venice Velazquez made copies of the "Crucifixion" and the "Last Supper" of Tintoretto, which he sent to the king, and in Rome he copied Michelangelo and Raphael, lodging in the Villa Medici till fever compelled him to remove into the city. Here he painted the "Forge of Vulcan" (No. 1059 of the Madrid gallery), in which Apollo narrates to the astonished Vulcan, a village blacksmith, the news of the infidelity of Venus, while four Cyclops listen to the scandal. The mythological treatment is similar to that of the "Bacchus": it is realistic and Spanish to the last degree, giving a picture of the interior of an Andalusian smithy, with Apollo thrown in to make the story tell. The conception is commonplace, yet the impression it produces is undoubted from the vividness of the representation and the power of expression. The modelling of the half-naked figures is excellent. Altogether this picture is much superior to the other work painted at the same time, "Joseph's Coat," which now hangs in the Escorial. Both these works are evidently painted from the same models.

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[1] In 1847 Mr John Snare of Reading exhibited a picture which had come from the sale of Lord Fife in 1809, and which he maintained to be the long-lost work. This led to much controversy; but the claim was rejected by experts, and the picture is said to be now in America.

In looking at these two pictures the spectator is especially struck by the fact that they betray no trace of the influence of the Italians. Velazquez remained true to himself. At Rome he also painted the two beautiful landscapes of the gardens of the Villa Medici, now in the Madrid museum (1106 and 1107), full of sparkle and charm. Landscape as an expression of art never had attraction for the Spaniards; but Velazquez here shows how great a master he was in this branch. The silvery views of Aranjuez, which at one time passed under his name, are now considered to be the work of his pupil Mazo. After a visit to Naples in 1631, where he worked with his countryman Ribera, and painted a charming portrait of the Infanta Maria, sister of Philip, Velazquez returned early in the year to Madrid.

He then painted the first of many portraits of the young prince, Don Baltasar Carlos, the heir to the throne, dignified and lordly even in his childhood, caracoling in the dress of a field-marshal on his prancing steed. The Wallace collection includes an example which is probably a copy by Mazo; but the finest in the United Kingdom is the well-known picture at Grosvenor House, a masterly example of the second manner of Velazquez. The colour is warm and bright, the workmanship solid and fused like enamel, while light and air pervade every corner. The scene is in the riding-school of the palace, the king and queen looking on from a balcony, while Olivares is in attendance as master of the horse to the prince. Don Baltasar died in 1646 at the age of seventeen, so that judged by his age this picture must have been painted about 1641, two years before the fall of Olivares. This powerful minister was the early and constant patron of the painter. His impassive, saturnine face is familiar to us from the many portraits painted by Velazquez, a face which, like his royal master's, seems never to have known a smile, and in which are written pride and disdain. Two are of surpassing excellence—the full-length formerly in the Holford collection (exhibited at Burlington House in 1887), stately and dignified, in which he wears the green cross of Alcantara and holds a wand, the badge of his office as master of the horse; the other the great equestrian portrait of the Madrid gallery (No. 1069), in which he is flatteringly represented as a field-marshal in all his pomp during an action. It is difficult to overpraise the excellence of this work, either as regards its dramatic power or its masterly execution. In these portraits Velazquez has well repaid the debt of gratitude which he owed to his first patron, whom he stood by in his fall, thus exposing himself to the risk—and it was not a light one—of incurring the anger of the jealous Philip. The king, however, showed no sign of malice towards his favoured painter. Faithful in few things, Philip kept true to Velazquez, whom he visited daily in his studio in the palace, and to whom he stood in many attitudes and costumes, as a huntsman with his dogs, as a warrior in command of his troops, and even on his knees at prayer, wearing ever the same dull uninterested look. His pale face and lack-lustre eye, his fair flowing hair and moustaches curled up to his eyes, and his heavy projecting Austrian under-lip are known in many a portrait and nowhere more supremely than in the wonderful canvas of the London National Gallery (No. 745), where he seems to live and breathe. Few portraits in the whole range of art will compare with this work, in which the consummate handling of Velazquez is seen at its best, for it is in his late and most perfect manner.[1] From one of the equestrian portraits of the king, painted in 1638, the sculptor Montañes modelled a statue which was cast in bronze by the Florentine sculptor Tacca, and which now stands in the Plaza del Oriente at Madrid, "a solid Velazquez," as it has been well named by Ford. This portrait exists no more; but there is no lack of others, for Velazquez was in constant and close attendance on Philip, accompanying him in his journeys to Aragon in 1642 and 1644, and was doubtless present with him when he entered Lerida as a conqueror. It was then that he painted the great equestrian portrait (No. 1066 of the Madrid gallery) in which the king is represented as a great commander leading his troops—a rôle which Philip never played except in a theatrical pageant. All is full of animation except the stolid face of the king. It hangs as a pendant to the great Olivares portrait—fit rivals of the neighbouring Charles V. by Titian, which doubtless fired Velazquez to excel himself, and both remarkable for their silvery tone and their feeling of open air and harmony combined with brilliancy. The light plays on the armour and scarf thrown to the wind, showing how completely Velazquez had mastered the effects he strove to reach in his early days. Of these two great works the Wallace collection includes small but excellent copies.

But, besides the forty portraits of Philip by Velazquez, or attributed to him, we have portraits of other members of the royal family, of Philip's first wife, Isabella of Bourbon, and her children, especially of her eldest son, Don Baltasar Carlos, of whom, besides those already mentioned, there is a beautiful full-length in a private room at Buckingham Palace. Cavaliers, soldiers, churchmen and poets of the court, as for example the Quevedo at Apsley House (shown in Burlington House in 1887), sat to the painter and, even if forgotten by history, will live on his canvas. The Admiral Pulido Pareja from Lord Radnor's collection, now at the National Gallery, is said to have been taken by Philip for the living man; nevertheless, A. de Beruete is emphatic in denying Velazquez's authorship of this picture, which he attributes to Mazo. It has been remarked that the Spaniards have always been chary of committing to canvas the portraits of their beautiful women. Queens and infantas may be painted and exhibited, but ladies rarely. One wonders who the beautiful woman can be that adorns the Wallace collection, the splendid brunette so unlike the usual fair-haired female sitters to Velazquez. She belongs to this period of his work, to the ripeness of his middle period. Instinct with life, her bosom seems to heave and the blood to pulsate through her veins. The touch is firm but free, showing the easy strength of the great master. Rarely has flesh been painted with such a glow, yet with such reserve. This picture is one of the ornaments of the Wallace collection. But, if we have few ladies of the court of Philip, we have in great plenty his buffoons and dwarfs. Even these deformed or half-witted creatures attract our sympathy as we look at their portraits by Velazquez, who, true to his nature, treats them gently and kindly, as in "El Primo" (the Favourite), whose intelligent face and huge folio with ink-bottle and pen by his side show him to be a wiser and better-educated man than many of the gallants of the court. "El Bobo de Coria," "El Niño de Vallecas" and "Pablillos," a buffoon evidently acting a part, all belong to this middle period. From these commissioned portraits of the menials of the court it is pleasant to turn to one of the greatest of historical works, the "Surrender of Breda," often known as "Las Lanzas," from the serried rank of lances breaking the sky, which is believed to have been painted about 1647. It represents the moment when the vanquished Justin of Nassau in front of his Dutch troops is submissively bending as he offers to his conqueror Spinola the keys of the town, which, with courteous grace, the victor refuses to accept, as he lays his hand gently on the shoulder of his defeated foe. Behind Spinola stand the Spanish troops bearing their lances aloft, while beyond is a long stretch of the Low Country, dotted with fortifications and giving the impression of vast space and distance. The picture is full of light and air, and is perhaps the finest example of the silvery bluish style of Velazquez. In conception it is as fine as in execution, and one looks in vain for a trace of "the malicious pencil" which Sir William Stirling-Maxwell discerned in the treatment of Justin and his gallant Dutchmen.

The greatest of the religious paintings by Velazquez belongs also to this middle period, the "Christ on the Cross" (Madrid gallery, No. 1055). Palomino says it was painted in 1638 for the convent of San Placido. It is a work of tremendous power and of great originality, the moment chosen being that immediately after death. The Saviour's head hangs on his breast and a mass of dark tangled hair conceals part of the face. The beautiful form is projected against a black and hopeless sky from which light has been blotted out. The figure stands absolutely alone, without any accessory. The skull and serpent described by Sir William Stirling-Maxwell were added by some pious bungler at a much later date. The picture was lengthened to suit its place in an oratory; but this addition has since been removed. To the same period belongs the great "Boar Hunt" at the National Gallery, a magnificent work in spite of some restorations. The smaller "Boar Hunt" in the Wallace collection is from the brush of Mazo; and the "Conversation, a Group of Thirteen Persons," at the Louvre, a picture which in conception has much in common with these hunting scenes, probably owes its origin to the same artist. A. de Beruete emphatically denies Velazquez's authorship of this much belauded picture, which he describes as a "mediocre imitation, probably by Mazo."

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[1] In this and in all his portraits Philip wears the *golilla*, a stiff linen collar projecting at right angles from the neck. It was invented by the king, who was so proud of it that he celebrated it by a festival, followed by a procession to church to thank God for the blessing (Madame D'Aulnoy, *Voyage d'Espagne*). The *golilla* was thus the height of fashion and appears in most of the male portraits of the period. In regard to the wonderful structure of Philip's moustaches, it is said that, to preserve their form, they were encased during the night in perfumed leather covers called *bigoteras*.

Velazquez's son-in-law Mazo had succeeded him as usher in 1634, and he himself had received steady promotion in the royal household, receiving a pension of 500 ducats in 1640, increased to 700 in 1648, for portraits painted and to be painted, and being appointed inspector of works in the palace in 1647. Philip now entrusted him with the carrying out of a design on which he had long set his heart, the founding of an academy of art in Spain. Rich in pictures, Spain was weak in statuary, and Velazquez was commissioned to proceed to Italy to make purchases. Accompanied by his faithful slave Pareja, whom he taught to be a good painter, he sailed from Malaga in 1649, landing at Genoa, and proceeding thence by Milan to Venice, buying Titians, Tintorettos and Veroneses as he went. A curious conversation which he is said to have had with Salvator Rosa is reported by Boschini,[1] in which the Spaniard with perfect frankness confesses his want of appreciation of Raphael and his admiration of Titian, "first of all Italian men." It seems a possible story, for Velazquez bought according to his likings and painted in the spirit of his own ideals. At Modena he was received with much favour by the duke, and doubtless here he painted the portrait of the duke at the Modena gallery and two splendid portraits which now adorn the Dresden gallery, for these pictures came from the Modena sale of 1746. They presage the advent of the painter's third and latest manner, a noble example of which is the great portrait of Innocent X. in the Doria palace at Rome, to which city Velazquez now proceeded. There he was received with marked favour by the pope, who presented him with a medal and gold chain. Of this portrait, thought by Sir Joshua Reynolds to be the finest picture in Rome, Palomino says that Velazquez took a copy to Spain. There exist several in different galleries, some of them possibly studies for the original or replicas painted for Philip. One of the most remarkable is that in Apsley House, exhibited in Burlington House in 1887. The modelling of the stern impassive face comes near to perfection, so delicate are the gradations in the full light; all sharpness of outline has disappeared; and the features seem moulded by the broad and masterly brushwork. When closely examined, the work seems coarse, yet at the proper distance it gives the very essence of living flesh. The handling is rapid but unerring. Velazquez had now reached the *manera abreviada*, as the Spaniards call this bolder style. This is but another way of saying that his early and laborious studies and his close observation of nature had given to him in due time, as to all great painters, the power of representing what he saw by simpler means and with more absolute truth. At Rome he painted also a portrait of his servant Pareja, probably the picture of Lord Radnor's collection, which procured his election into the academy of St Luke. Philip was now wearying for his return; accordingly, after a visit to Naples, where he saw his old friend Ribera, he returned to Spain by Barcelona in 1651, taking with him many pictures and 300 pieces of statuary, which he afterwards arranged and catalogued for the king. Undraped sculpture was, however, abhorrent to the Spanish Church, and after Philip's death these works gradually disappeared.

Isabella of Bourbon had died in 1644, and the king had married Mariana of Austria, whom Velazquez now painted in many attitudes. He was specially chosen by the king to fill the high office of "aposentador major," which imposed on him the duty of looking after the quarters occupied by the court whether at home or in their journeys—a responsible function, which was no sinecure and interfered with the exercise of his art. Yet far from indicating any decline, his works of this period are amongst the highest examples of his style. The dwarf "Don Antonio el Inglés" (the Englishman) with his dog, "Aesop," "Menippus" and "the Sculptor Montañes," all in the Madrid gallery, show his surest and freest manner. To these may be added the charming portraits of the royal children in the Louvre and Vienna, among the choicest of his works. It is one of these infantas, Margarita Maria, the eldest daughter of the new queen, that is the subject of the well-known picture "Las Meniñas" (the Maids of Honour), 1062, in the Madrid gallery, painted in 1656, where the little lady holds court, surrounded by her ladies-in-waiting, her dwarfs and her mastiff, while Velazquez is seen standing at his easel. This is the finest portrait we have of the great painter. It is a face of much dignity, power and sweetness—like his life, equable and serene, unruffled by care. "Las Meniñas" was the picture of which Luca Giordano said that it was the "theology of painting," another way of expressing the opinion of Sir Thomas Lawrence, that this work is the philosophy of art, so true is it in rendering the desired effect. The result is there, one knows not by what means, as if by a first intention without labour, absolutely right. The story is told that the king painted the red cross of Santiago on the breast of the painter, as it appears to-day on the canvas. Velazquez did not, however, receive the honour till 1659, three years after the execution of this work. Even the powerful king of Spain could not make his favourite a belted knight without a commission to inquire into the purity of his lineage on both sides of the house. The records of this commission have been found among the archives of the order of Santiago by M. Villaamil. Fortunately the pedigree could bear scrutiny, as for generations the family was found free from all taint of heresy, from all trace of Jewish or Moorish blood and from contamination by trade or commerce. The difficulty connected with the fact that he was a painter was got over by his being painter to the king and by the declaration that he did not sell his pictures. But for this royal appointment, which enabled him to escape the censorship of the Inquisition, we should never have had his splendid "Venus and Cupid," formerly belonging to Mr Morritt of Rokeby Hall and bought by the National Art Collections Fund for £45,000 for the National Gallery in 1905. It is painted in his latest manner and is worthy of comparison with Titian.[2] There were in truth but two patrons of art in Spain—the church and the art-loving king and court. Murillo was the artist favoured by the church, while Velazquez was patronized by the crown. One difference, however, deserves to be noted. Murillo, who toiled for a rich and powerful church, left scarcely sufficient means to pay for his burial, while Velazquez lived and died in the enjoyment of good salaries and pensions. Yet on occasions Philip gave commissions for religious pictures to Velazquez—among others, and belonging to this later period, the "Coronation of the Virgin" (Madrid, 1056), splendid in colour—a harmony of red, blue and grey—but deficient in religious feeling and dignity. It was painted for the oratory of the queen, doubtless Mariana, in the palace at Madrid. Another royal commission for the hermitage of Buen Retiro was the "St Anthony the Abbot and St Paul the Hermit," painted in 1659, the landscape of which excited the warm admiration of Sir David Wilkie (No. 1057 in the Prado). The last of his works which we shall name is "Las Hilanderas" or the Spinners (Madrid, 1061), painted about 1656, representing the interior of the royal tapestry works. The subject is nothing, the treatment everything. It is full of light, air and movement, splendid in colour and marvellous in handling. This picture, Raphael Mengs said, seemed to have been painted not by the hand but by the pure force of will. We see in it the full ripeness of the power of Velazquez, a concentration of all the art-knowledge he had gathered during his long artistic career of more than forty years. In no picture is he greater as a colourist. The scheme is simple—a harmony of red, bluish-green, grey and black, which are varied and blended with consummate skill.

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[1] See Stirling-Maxwell's *Velazquez and his Works*, p. 161.

[2] Some uncertainties in the proprietorial history of this picture have led to considerable discussion concerning its authenticity. But the suggestion that Mazo's signature could be detected on it was repudiated by an expert committee in 1910 who carefully examined the painting.

In 1660 a treaty of peace between France and Spain was to be consummated by the marriage of the infanta Maria Theresa with Louis XIV., and the ceremony was to take place in the Island of Pheasants, a small swampy island in the Bidassoa. Velazquez was charged with the decoration of the Spanish pavilion and with the whole scenic display. In the midst of the grandees of the first two courts in Christendom Velazquez attracted much attention by the nobility of his bearing and the splendour of his costume. On the 26th of June he returned to Madrid, and on the 31st of July he was stricken with fever. Feeling his end approaching, he signed his will, appointing as his sole executors his wife and his firm friend Fuensalida, keeper of the royal records. He died on the 6th of August 1660, passing away in the full possession of his great powers, and leaving no work behind him to show a trace of decay. He was buried in the Fuensalida vault of the church of San Juan, and within eight days his wife Juana was laid beside him. Unfortunately this church was destroyed by the French in 1811, so that his place of interment is now unknown. There was much difficulty in adjusting the tangled accounts outstanding between Velazquez and the treasury, and it was not till 1666, after the death of Philip, that they were finally settled.

Velazquez can hardly be said to have formed a school of painting. Apart from the circumstance that his occupations at court would have prevented this, his genius was too personal for transmission by teaching. Yet his influence on those immediately connected with him was considerable. In 1642 he befriended young Murillo on his arrival in Madrid, received him into his house, and directed his studies for three years. His son-in-law Mazo painted in his manner, and doubtless many pictures by Mazo are attributed to the master. Carreño, though never a pupil, was a favourite and had the good sense to appreciate him and imitate him. His faithful slave Pareja studied his methods and produced work which by the favour of Velazquez procured his manumission from Philip. But the appreciation of the fine talent of Velazquez passed away quickly in Spain, as that country began to fall to pieces.

In addition to the standard works by Palomino (1724), Cean Bermudez (1800) and Pacheco (1649), see the biographical notice by Don Pedro de Madrazo in his *Catalogo del Museo del Prado* (1872); *Velazquez and his Works* (1855) and *Annals of Artists of Spain* (1848), by W. Stirling (afterwards Sir W. Stirling-Maxwell); Ford's *Handbook to Spain* (1855) and his article in the *English Cyclopaedia*; *Velazquez and Murillo*, by Charles B. Curtis (1883); the works of W. Burger (T. Thoré); *Gesch. d. Malerei*, by Woltmann and Woermann; Sir Edmund Head's *Handbook of Spanish Painting* (1848); *Works of Velazquez* (prints), by G. W. Reid (1872); *Gaz. d. Beaux Arts*, art. "Velazquez," by Paul Lefort (second period, 1879–82); Carl Justi, *Diego Velazquez u. sein Jahrhundert* (2 vols., Bonn, 1888); *The Life of Velazquez*, by Sir Walter Armstrong (London, 1896); *Velazquez*, by R. A. M. Stevenson (London, 1899); *Velazquez outside the Prado Museum*, by Don Manuel Mesonero Romanos (Madrid, 1899); *The Life and Works of Don Diego Velazquez*, by Don Jacinto Octavio Picon (Madrid, 1899); *Days with Velazquez*, by C. Lewis Hind (London, 1906); and, finally, Don A. de Beruete's standard work on the subject, *Velazquez* (London, 1906), which contains reproductions of all the master's paintings of which the author admits the authenticity. (J. F. W.; P. G. K.)

VELEIA, an ancient town of Aemilia, Italy, situated about 20 m. S. of Placentia. It is mentioned by Pliny among the towns of the eighth region, though the Veleiates were Ligurians by race. Its inhabitants were in the census of Vespasian found to be remarkable for their longevity. Nothing further was known of it until 1747, when some ploughmen found the famous *Tabula alimentaria*, now in the museum at Parma. This, the largest inscribed bronze tablet of antiquity (4 ft. 6 in. by 9 ft. 6 in.) contains the list of estates in the territories of Veleia, Libarna, Placentia, Parma and Luca, in which Trajan had assigned before 102 B.C. 72,000 sesterces (£720) and then 1,044,000 sesterces (£10,440), on a mortgage bond to forty-six estates, the total value of which was reckoned at over 13,000,000 sesterces (£130,000), the interest on which at 5% was to serve for the support of 266 boys and 36 girls, the former receiving 16, the latter 12 sesterces a month. See *Ligures Baebiani* for a similar inscription. Excavations were begun on the site in 1760, and were at first successful; the forum and basilica, the thermae and the amphitheatre, private houses, &c., with many statues (twelve of marble from the basilica, and a fine bronze head of Hadrian) and inscriptions were discovered. Pre-Roman cremation tombs have also been found, with objects of bronze and iron of no great value. But later excavations which were carried on at intervals up to 1876 have given less fruitful results. The oldest dated monument is a bronze tablet with a portion of the text of the *Lex Rubria* of 49 B.C. which dealt with the administration of justice in Cisalpine Gaul in connexion with the extension to it of the privileges of the Roman franchise, the latest an inscription of A.D. 276. How and when it was abandoned is uncertain: the previously prevalent view that it was destroyed by a landslip was proved to be mistaken by the excavations of 1876. Most of the objects found are in the museum at Parma.

See G. Antolini, *Le Rovine di Veleia* (Milan, 1831); G. Mariotti in *Notizie degli Scavi* (1877), 157; E. Bormann in *Corpus Inscript. Latin* (Berlin, 1888), xi. 204 sqq. (T. As.)

VÉLEZ-MÁLAGA, a town of southern Spain, in the province of Málaga, finely situated in a fertile valley at the southern base of the lofty Sierra de Alhama, and on the left bank of the small river Vélez, 1 m. from its mouth and 27 m. by road E.N.E. of Málaga. Pop. (1900) 23,586. Vélez-Málaga formerly was a place of considerable commercial importance, but its prosperity has much declined; there is no railway, and the town suffered severely in the earthquakes of 1884 and the floods of 1907. The vegetation of the neighbourhood is most luxuriant, including the aloe, palm, sugar-cane, prickly pear, orange, vine, olive and sweet potato. Vélez-Málaga was held by the Moors from 711 to 1487, when it was captured by Ferdinand of Castile. Under Moorish rule the citadel was built and the town became an important trading station and fortress. Its harbour, the Vélez estuary, affords good anchorage and is well sheltered.

VELIA (Gr. Ὑέλη, later Ἐλέα), an ancient town of Lucania, Italy, on the hill now crowned by the medieval castle of Castellammare della Bruca, 440 ft. above sea-level, on the S.W. coast, 1¾ m. N.W. of the modern railway station of Ascéa, 25 m. S.E. of Paestum. Remains of the city walls, with traces of one gate and several towers, of a total length of over 3 m., still exist, and belong to three different periods, in all of which the crystalline limestone of the locality is used. Bricks were also employed in later times; their form is peculiar to this place, each having two rectangular channels on one side, and being about 15 in. square, with a thickness of nearly 4 in. They all bear Greek brick-stamps. There are some remains of cisterns on the site, and various other traces of buildings. The town was mainly celebrated for the philosophers who bore its name (see ELEATIC SCHOOL). About 530 B.C. the Phocaeans, driven from Corsica, seized it from the Oenotrians. Its coins were widely diffused in S. Italy, and it kept its independence even in Roman times, and only became a *municipium* after the Social War.

See W. Schlenning in *Jahrbuch des K. Deutschen Arch. Instituts* (1889), iv. 169 sqq. (T. As.)

VELIUS LONGUS (2nd cent. A.D.), Latin grammarian during the reign of Trajan (or Hadrian), author of an extant treatise on Orthography (H. Keil, *Grammatici Latini*, vii.). He is mentioned by Macrobius (*Saturnalia*, iii. 6, 6) and Servius (on *Aen.* x. 245) as a commentator on Virgil.

See M. Schanz, *Geschichte der römischen Litteratur*, iv. 1 (1904); Teuffel, *Hist. of Roman Literature* (Eng. trans., 1900), 343, 2.

VELLEIUS PATERCULUS, MARCUS (*c.* 19 B.C.–*c.* A.D. 31), Roman historian. Although his praenomen is given as Marcus by Priscian, some modern scholars identify him with Gaius Velleius Paterculus, whose name occurs in an inscription on a north African milestone (*C.I.L.* viii. 10, 311). He belonged to a distinguished Campanian family, and early entered the army. He served as military tribune in Thrace, Macedonia, Greece and the East, and in A.D. 2 was present at the interview on the Euphrates between Gaius Caesar, grandson of Augustus, and the Parthian king. Afterwards, as praefect of cavalry and legatus, he served for eight years (from A.D. 4) in Germany and Pannonia under Tiberius. For his services he was rewarded with the quaestorship in 7, and, together with his brother, with the praetorship in 15. He was still alive in 30, for history contains many references to the consulship of M. Vinicius in that year. It has been conjectured that he was put to death in 31 as a friend of Sejanus, whose praises he celebrates in a most fulsome manner.

He wrote a compendium of Roman history in two books dedicated to M. Vinicius, from the dispersion of the Greeks after the siege of Troy down to the death of Livia (A.D. 29). The first book brings the history down to the destruction of Carthage, 146 B.C.; portions of it are wanting, including the beginning. The later history, especially the period from the death of Caesar, 44 B.C., to the death of Augustus, A.D. 14, is treated in much greater detail. Brief notices are given of Greek and Roman literature, but it is strange that no mention is made of Plautus, Horace and Propertius. The author is a vain and shallow courtier, and destitute of real historical insight, although generally trustworthy in his statements of individual facts. He may be regarded as a courtly annalist rather than an historian. His knowledge is superficial, his blunders numerous, his chronology inconsistent. He labours at portrait-painting, but his portraits are daubs. On Caesar, Augustus and above all on his patron Tiberius, he lavishes praise or flattery. The repetitions, redundancies, and slovenliness of expression which disfigure the work may be partly due to the haste with which (as the author frequently reminds us) it was written. Some blemishes of style, particularly the clumsy and involved structure of his sentences, may perhaps be ascribed to insufficient literary training. The inflated rhetoric, the straining after effect by means of hyperbole, antithesis and epigram, mark the degenerate taste of the Silver Age, of which Paterculus is the earliest example. He purposed to write a fuller history of the later period, which should include the civil war between Caesar and Pompey and the wars of Tiberius; but there is no evidence that he carried out this intention. His chief authorities were Cato's *Origines*, the *Annales* of Q. Hortensius, Pompeius Trogus, Cornelius Nepos and Livy.

Velleius Paterculus was little known in antiquity. He seems to have been read by Lucan and imitated by Sulpicius Severus, but he is mentioned only by the scholiast on Lucan, and once by Priscian. The text of the work, preserved in a single badly written and mutilated MS. (discovered by Beatus Rnenanus in 1515 in the abbey of Murbach in Alsace and now lost), is very corrupt. Editio princeps, 1520; early editions by the great scholars Justus Lipsius, J. Gruter, N. Heinsius, P. Burmann; modern editions, Ruhnken and Frotscher (1830–39), J. C. Orelli (1835), F. Kritz (1840, ed min. 1848), F. Haase (1858), C. Halm (1876), R. Ellis (1898) (reviewed by W. Warde Fowler in *Classical Review*, May 1899); on the sources see F. Burmeister, "De Fontibus Vellei Paterculi," in *Berliner Studien für classische Philologie* (1894), xv. English translation by J. S. Watson in Bohn's Classical Library.

VELLETRI (anc. *Velitrae*), a town and episcopal see of the province of Rome, Italy, at the south-east foot of the outer ring wall of the Alban crater, 26 m. S.E. of Rome by rail, 1155 ft. above sea-level. Pop. (1901) 14,243 (town), 18,734 (commune). It is the seat of the bishop of Ostia, and has a statue of Pope Clement VIII. Good wine is made in the fertile vineyards of the district, and there is a government experimental station for viticulture. Velletri is the junction of the Terracina line and a branch to Segni on the main line to Naples. Velletri has a fine view of the Volscian mountains and over the Pomptine Marshes to the Circeian promontory. The town contains a few objects of interest; at the highest point is the prominent municipal palace, containing a few ancient inscriptions, among them one relating to a restoration of the amphitheatre under Valentinian and Valens. The internal façade of the Palazzo Ginetti is finely decorated with stucco, and has a curious detached baroque staircase by Martino Lunghi the younger, which Burckhardt calls unique if only for the view to which its arched colonnades serve as a frame. The lofty campanile of S. Maria in Trivio, erected in 1353 in gratitude for the liberation of the city from a plague which devastated it in 1348, is in the style of contemporary brick campanili in Rome, but built mainly of black selce, with white marble columns at the windows. The cathedral (the see of the titular bishop of Ostia) was reconstructed in 1660, but contains traces of the older structure. Of the ancient town nothing practically remains above ground; scanty traces of the city walls have been excavated (and covered again) near the railway station, and the present walls are entirely medieval.

The ancient city of Velitrae was Volscian in Republican times, and it is the only Volscian town of which an inscription in that language is preserved (4th century B.C.). It mentions the two principal magistrates as *medix*. It was, however, a member of the Latin League in 499 B.C., so that in origin it may have been Latin and have fallen into Volscian hands later. It was important as commanding the approach to the valley between the Alban and Volscian mountains. In 494 it was taken from the Volscians and became a Roman colony. This was strengthened in 404, but in 393 Velitrae regained its freedom and was Rome's strongest opponent; it was only reduced in 338, when the freedom of Latium finally perished. Its resistance was punished by the destruction of its walls and the banishment of its town councillors to Etruria, while their lands were handed over to Roman colonists. We hear little or nothing of it subsequently except as the home of the *gens Octavia*, to which the Emperor Augustus belonged. The neighbourhood contains some remains of villas, but not proportionately very many; there are more on the side towards Lanuvium (W.). The Via Appia passed considerably below the town (some 5 m. away), which was reached by a branch road from it, diverging at the post station of Sublanuvio. During the whole of the middle ages it was subject to the papacy.

(T. As.)

VELLORE, a town of British India, in the North Arcot district of Madras, on the river Palar and the South Indian railway, 87 m. W. of Madras city. Pop. (1901) 43,537. It has a strongly built fortress, which was famous in the wars of the Carnatic. It dates traditionally from the 13th century, but more probably only from the 17th. It is a fine example of Indian military architecture, and contains a temple adorned with admirable sculptures. In 1780 it withstood a siege for two years by Hyder Ali. After the fall of Seringapatam (1799) Vellore was selected as the residence of the sons of Tippoo Sahib, and to their intrigues has been attributed the mutiny of the sepoys here in 1806. An American mission manages a high school, raised to the rank of a college in 1898; and the police training school for the presidency is also situated here. Vellore has a large grain trade, and flowers are cultivated in the vicinity.

VELVET, a silken textile fabric having a short dense piled surface. In all probability the art of velvet-weaving originated in the Far East; and it is not till about the beginning of the 14th century that we find any mention of the textile. The peculiar properties of velvet, the splendid yet softened depth of dye-colour it exhibited, at once marked it out as a fit material for ecclesiastical vestments, royal and state robes, and sumptuous hangings; and the most magnificent textures of medieval times were Italian velvets. These were in many ways most effectively treated for ornamentation, such as by varying the colour of the pile, by producing pile of different lengths (pile upon pile, or double pile), and by brocading with plain silk, with uncut pile or with a ground of gold tissue, &c. The earliest sources of European artistic velvets were Lucca, Genoa, Florence and Venice, and Genoa continues to send out rich velvet textures. Somewhat later the art was taken up by Flemish weavers, and in the 16th century Bruges attained a reputation for velvets not inferior to that of the great Italian cities.

VELVETEEN, a cotton cloth made in imitation of velvet. The term is sometimes applied to a mixture of silk and cotton. Some velveteens are a kind of fustian, having a rib of velvet pile alternating with a plain depression. The velveteen trade varies a good deal with the fashions that control the production of velvet. Velveteens are commonly woven in sheeting looms, and manufacturers are able to alternate the two kinds of goods according to the demand.

VENAFRUM, an ancient town of Campania, Italy, close to the boundaries of both Latium adjectum and Samnium. Its site is occupied by the modern Venafro, a village with 4716 inhabitants (1901), on the railway from Isernia to Caianello, 15 m. S.W. of the former, 658 ft. above sea-level. Ancient authors tell us but little about it, except that it was one of those towns governed by a prefect sent yearly from Rome, and that in the Social War it was taken by the allies by treachery. Augustus founded a colony there and provided for the construction of an aqueduct (cf. the long decree relating to it in *Corp. Inscr. Lat.* x. No. 4842). It seems to have been a place of some importance. Its olive oil was the best in Italy, and Cato mentions its brickworks and iron manufactures. The original line of the Via Latina probably ran through Venafrum, making a détour, which the later road seems to have avoided (cf. LATINA, VIA). Rufrae was probably dependent on it. Roads also ran from Venafrum to Aesernia and to Telesia by way of Allifae. Of ancient remains hardly anything is left—some traces of an amphitheatre and fragments of polygonal walls only. (T. As.)

VENDACE, the name of a British freshwater fish of the genus *Coregonus*, of which two other species are indigenous in the fresh waters of the British Islands, the gwyniad and the pollan. The vendace (*C. vandesius*) is restricted to some lochs in Dumfriesshire, Scotland; it is, however, very similar to a species (*C. albula*) which inhabits some of the large and deep lakes of northern Europe. From its general resemblance to a dace the French name of the latter, *vandoise*, was transferred to it at the period when French was the language of the court and aristocracy of Scotland. So great is the local celebrity of the fish that a story has been invented ascribing to Mary Queen of Scots the merit of having introduced it into the Lochmaben lochs. It is considered a great delicacy, and on favourable days when the shoals rise to the surface, near the edges of the loch, great numbers may be taken. It spawns in November. In length it scarcely exceeds 8 in.

VENDÉE, a maritime department of western France, formed in 1790 out of Bas-Poitou, and taking its name from an unimportant tributary of the Sèvre Niortaise. It is bounded by Loire-Inférieure and Maine-et-Loire on the N., by Deux-Sèvres on the E., by Charente-Inférieure on the S. and by the Atlantic Ocean on the W. for 93 m. Pop. (1906) 442,777. Area, 2708 sq. m. The islands of Yeu (area, 8¼ sq. m.) and Noirmoutier (*q.v.*) are included. The Sèvre Nantaise on the N.E. and the Sèvre Niortaise on the S., besides other streams of minor importance, form natural boundaries. The department falls into three divisions—woodland (*Bocage*), plain (*Côte*) and marsh (*Marais*).

The highest point (748 ft.) is situated in the woodland, which occupies the greater part of Vendée, on the water-parting between the Loire and the rivers of the coast. This region, which, geologically, is composed of granite, gneiss, mica-schist, schist and lias, abounds in springs, and is fresh and verdant; the landscape is characterized by open fields surrounded by trees, which supplied ambushes and retreats to the Vendéans in the civil war at the end of the 18th century. The marshes, raised above the sea-level within historic times (four centuries ago), consist of two portions, the Breton marsh in the north and the Poitevin marsh in the south; the latter extends into the departments of Charente-Inférieure and Deux-Sèvres. The region includes productive salt marshes and fertile cultivated areas artificially drained. Its area is constantly being increased by the alluvium of the rivers and the secular elevation of the coast. The celebrated beds of sea-shells near St Michel en l'Herm—2300 ft. long, 985 ft. broad and from 30 to 50 ft. deep—show to what extent the coast has risen. The plain of Vendée lying between the Bocage and the Poitevin marsh is bare and treeless, but fertile, though poor in springs; geologically it is composed of lias and oolite. The department is drained by the Sèvre Nantaise (tributary of the Loire) and the Boulogne (a feeder of Lake Grandlieu in Loire-Inférieure), both draining into the basin of the Loire; and by the Vie, the Lay (with the Yon), and the Sèvre Niortaise (with the Autise and the Vendée), which flow into the Atlantic. The climate is that of the Girondine region, mild and damp, the temperature rarely rising above 77° or falling below 18° F.; 120 to 150 days of rain give an average annual rainfall of 25 in. The woodland is colder than the plain, and the marsh is damp and unhealthy.

The department is agriculturally prosperous. Wheat is the most important crop, oats, potatoes, clover, lucerne and mangold-wurzels ranking next. Beans, flax and colza may also be mentioned. Wine is grown in the south of the department. The rearing of live stock flourishes in the Bocage and the marsh, the pastures of the latter nourishing fine oxen and horses, and sheep famous for the excellence of their mutton. Cider-apples, pears, peaches, plums, cherries and walnuts are among the fruits grown. Coal is mined in the south-east of the department (basin of Vouvant) and antimony is found; limestone is quarried. The spinning and weaving of wool, cotton and flax is carried on, and there are potteries, paper-mills, tan-yards, dye-works, manufactories of hats, boots and shoes, glass and lampblack, flour-mills, distilleries, oil-works, tile-works and shipbuilding yards. Sardines and tinned foods are prepared. The sardine fishery is active on the coast and there are extensive oyster-beds near Sables-d'Olonne. Corn, cattle, mules, fish, salt, wine, honey, wood, glass and manure are exported; wine, wood, building material, coal, phosphates and petroleum are among the imports. Sables-d'Olonne is the principal fishing and commercial port.

Vendée is served by the Ouest-État railway and has 81 m. of navigable rivers and canals. The department forms the diocese of Luçon, has its court of appeal and educational centre at Poitiers, and is included in the district of the XI. Army Corps (headquarters at Nantes). There are three arrondissements (La Roche-sur-Yon, Fontenay-le-Comte and Sables-d'Olonne), 30 cantons, and 304 communes. The principal towns are La Roche-sur-Yon, Les Sables-d'Olonne, Fontenay-le-Comte and Luçon, which are treated under separate headings. Other places of interest are Foussais, Nieul-sur-l'Autise and Vouvant, with Romanesque churches; Pouzauges, which has a stronghold of the 13th century; Maillezais, with the ruins of its old cathedral; Talmont and Tiffauges, both possessing ruined castles; and Le Bernard with noteworthy megalithic remains.

VENDÉE, WARS OF THE, a counter-revolutionary insurrection which took place during the French Revolution (*q.v.*), not only in Vendée proper but also in Lower Poitou, Anjou, Lower Maine and Brittany. The district was mainly inhabited by peasants; it contained few important towns, and the *bourgeois* were but a feeble minority. The ideas of the Revolution were slow in penetrating to this ignorant peasant population, which had always been less civilized than the majority of Frenchmen, and in 1789 the events which roused enthusiasm throughout the rest of France left the Vendéans indifferent. Presently, too, signs of discontent appeared. The priests who had refused to submit to the Civil Constitution of the Clergy perambulated these retired districts, and stigmatized the revolutionists as heretics. In 1791 two "representatives on mission" informed the Convention of the disquieting condition of Vendée, and this news was quickly followed by the exposure of a royalist plot organized by the marquis de la Rouërie.

The signal for a widespread rising was the introduction of conscription acts for the recruiting of the depleted armies on the eastern frontiers. In February 1793 the Convention decreed a levy on the whole of France, and on the eve of the ballot the Vendée, rather than comply with this requisition, broke out in insurrection. The Vendéan peasant refused to join the republican army, not for want of fighting qualities or ardour, but because the army of the old régime was recruited from bad characters and broken men, and the peasant, ignorant of the great change that had followed the Revolution, thought that the barrack-room was no place for a good Christian. In March 1793 the officer commanding at Cholet was killed, and republicans were massacred at Machecoul and St Florent. Giving rein to their ancient antipathy, the revolted peasantry attacked the towns, which were liberal in ideas and republican in sympathies. The leaders of these first risings were men of humble birth, such as J. Cathelineau, a pedlar, J. N. Stofflet, a gamekeeper, and the barber Gaston. Cholet, Bressuire, Fontenay-le-Comte and Samur were surprised. The influence of the priests kept up the fanaticism of the peasants, and a great manifestation of religious feeling took place on Easter eve, but the republican soldiers taken prisoners were often maltreated and even tortured.

These first successes of the Vendéans coincided with grave republican reverses on the frontier—war with England, Holland and Spain, the defeat of Neerwinden and the defection of Dumouriez. The *émigrés* then began to throw in their lot with the Vendéans. Royalist nobles like the marquis de Bonchamp, F. A. Charette de la Contrie, Gigot d'Elbée, Henri de la Rochejaquelein and the marquis de Lescure placed themselves at the head of the peasants. Although several of these leaders were Voltairians, they held up Louis XVI., who had been executed in January 1793, as a martyr to Catholicism, and the Vendéans, who had hitherto styled themselves the Christian Army, now adopted the name of the Catholic and Royal Army.

The Convention took measures against the *émigrés* and the refractory priests. By a decree of the 19th of March 1793 every person accused of taking part in the counter-revolutionary revolts, or of wearing the white cockade (the royalist emblem), was declared an outlaw. The prisoners were to be tried by military commissions, and the sole penalty was death with confiscation of property. The Convention also sent representatives on mission into Vendée to effect the purging of the municipalities, the reorganization of the national guards in the republican towns, and the active prosecution of the revolutionary propaganda. These measures proving insufficient, a decree was promulgated on the 30th of April 1793 for the despatch of regular troops; but, in spite of their failure to capture Nantes (where Cathelineau was mortally wounded), the successes of the Vendéans continued. On the 31st of July, therefore, at Barère's suggestion, it was decreed that the woods of the Vendée should be burnt, the harvest carried off to safe places in rear of the army, the cattle seized, the women and children concentrated in camps in the interior, and that every male from the age of sixteen in the neighbouring regions should be called upon to take arms. Further, on the 1st of August, the troops that had formed the garrison of Mainz, which were unavailable against foreign enemies by the terms of their capitulation to the Austrians, were ordered to Vendée. The programme was carried out by the so-called "infernal columns."

At the end of August 1793, the republicans had three armies in the Vendée—the army of Rochelle, the army of Brest and the *Mayençais*; but their generals were either ciphers, like C. P. H. Ronsin, or divided among themselves, like J. A. Rossignol and J. B. C. Canclaux. They were uncertain whether to cut off the Vendéans from the sea or to drive them westwards; and moreover, their men were undisciplined. Although the peasants had to leave their chiefs and work on the land, the Vendéans still remained formidable opponents. They were equipped partly with arms supplied by England, and partly with fowling-pieces, which at that period were superior to the small-arms used by the regular troops, and their intimate knowledge of the country gave them an immense advantage. They gathered and burst like a storm on their enemies, and, if repulsed, dispersed at the famous order, "Egaillez-vous les gars," to unite again some days later.

The dissensions of the republican leaders and the demoralizing tactics of the Vendéans resulted in republican defeats at Chantonnay, Torfou, Coron, St Lambert, Montaigu and St Fulgent. The Convention resolved to bring the war to an end before October, and placed the troops under the undivided command, first of Jean Léchelle and then of Louis Turreau, who had as subordinates such men as Marceau, Kléber and Westermann. On the 7th of October the various divisions concentrated at Bressuire, took Châtillon after two bloody engagements, and defeated the Vendéans at Cholet, Beaupréau and La Tremblaye. After this repulse, the royalists, under Stofflet and La Rochejaquelein, attempted to rouse the Cotentin and crossed the Loire. Beaten back at Granville, they tried to re-enter the Vendée, but were repulsed at Angers. They re-formed at Le Mans, where they were defeated by Westermann, and the same officer definitively annihilated the main body of the insurgents at Savenay (December 1793).

Regular warfare was now at an end, although Turreau and his "infernal columns" still continued to scour the disaffected districts. After the 9th Thermidor attempts were made to pacify the country. The Convention issued conciliatory proclamations allowing the Vendéans liberty of worship and guaranteeing their property. General Hoche applied these measures with great success. He restored their cattle to the peasants who submitted, "let the priests have a few crowns," and on the 20th of July 1795 annihilated an *émigré* expedition which had been equipped in England and had seized Fort Penthièvre and Quiberon. Treaties were concluded at La Jaunaie (February 15, 1795) and at La Mabillaie, and were fairly well observed by the Vendéans; and nothing remained but to cope with the feeble and scattered remnant of the Vendéans still under arms, and with the Chouans (*q.v.*). On the 30th of July 1796 the state of siege was raised in the western departments.

During the Hundred Days there was a revival of the Vendéan war, the suppression of which occupied a large corps of Napoleon's army, and in a measure weakened him in the northern theatre of war (see WATERLOO CAMPAIGN).

In 1832 again an abortive insurrection broke out in support of the Bourbons, at the instigation of the duchess of Berry; the Vendéan hero on this occasion was the baron de Charette.

There are numerous articles on the Vendéan insurrection of 1793 in the *Revue du Bas-Poitou*, *Revue historique de l'Anjou*, *Revue de Bretagne, de Vendée et d'Anjou*, *Revue historique de l'Ouest*, *Revue historique et archéologique du Maine*, and *La Vendée historique*. See also R. Bittard des Portes, "Bibliographie historique et critique des guerres de Vendée et de la Chouannerie" in the *Revue du Bas-Poitou* (1903 seq.); C. L. Chassin, *Études sur la Vendée et la Chouannerie* (*La Préparation de la guerre—La Vendée patriote—Les Pacifications de l'Ouest*), Paris, 1892 seq., 11 vols. (the best general work on the subject); C. Port, *Les Origines de la Vendée* (Paris, 1888); C. Leroux-Cesbron, "Correspondance des représentants en mission à l'armée de l'ouest (1794–95)" in the *Nouvelle Revue rétrospective* (1898); Blachez, *Bonchamps et l'insurrection vendéenne* (Paris, 1902); P. Mautouchet, *Le Conventionnel Philippeaux* (Paris, 1901). On 1815 a modern work is *Les Cent Jours en Vendée; le général Lamarque*, by B. Lasserre (Paris, 1907); on 1832 see *La Vendée*, by Vicomte A. de Courson (1909). (R. A.*)

VENDÉMIAIRE (from Lat. *vindemia*, vintage), the name given during the French Revolution to the first month of the year in the Republican Calendar. Vendémiaire began on the 22nd, 23rd or 24th of September, and ended on the 22nd, 23rd or 24th of October according to the year, and was the season of the vintage in the wine districts of northern France. In accordance with the suggestion of Fabre d'Eglantine, each of the days of the republican year was consecrated to some useful object. For instance, 1 Vendémiaire was the festival of the grape, 10 Vendémiaire of the vat, 13 Vendémiaire of the pumpkin, 15 Vendémiaire of the ass, 20 Vendémiaire of the wine-press, and 30 Vendémiaire of the cask. The most important event in this month was the quelling of the royalist rising on 13 Vendémiaire year IV. (4th of October 1795), in which General Bonaparte (afterwards the emperor Napoleon) distinguished himself by his energy and skill in using artillery.

See Baron R. de Larcy, *Le 13 Vendémiaire* (Paris, 1872).

VENDETTA (Ital. from Lat. *vindicta*, revenge, *vindicare*, to defend oneself), the term applied to the custom of the family feud, by which the nearest kinsman of a murdered man was obliged to take up the quarrel and avenge his death. From being an obligation upon the nearest, it grew to be an obligation on all the relatives, involving families in bitter private wars among themselves. It is a development of that stage in civilization common to all primitive communities, when the injury done was held to be more than personal, a wrong done to the whole *gens*.

The term originated in Corsica, where the vendetta has long played an important part in the social life. If the murderer could not be found, his family were liable to fall victims to the vendetta. The feud was sometimes complicated by the *vendetta transversale*, when each of two branches of a family had a murder to revenge on the other. In Corsica it was regarded as the most sacred family duty. Mediators (*parolanti*) sometimes intervened successfully to end the feuds, and extort an oath to forgo vengeance. The custom still survives in Corsica in its complete form, and partially in Sardinia, Sicily, Montenegro, Afghanistan, among the Mainotes of Greece, the Albanians, Druses and Bedouins.

VENDÔME, LOUIS JOSEPH, Duc de (1654–1712), marshal of France, was the son of Louis, 2nd duke of Vendôme, and the great-grandson of Henry IV. and Gabrielle d'Estrées. Entering the army at the age of eighteen he soon distinguished himself by his vigour and personal courage in the Dutch wars, and by 1688 he had risen to the rank of lieutenant-general. In the war of the Grand Alliance he rendered conspicuous service under Luxemburg at Steinkirk and under Catinat at Marsaglia, and in 1695 he was placed in command of the army operating in Catalonia where he took Barcelona. Soon afterwards he received the marshalate. In 1702, after the first unsuccessful campaign of Catinat and Villeroi, he was placed in command of the Franco-Spanish army in Italy (see Spanish Succession War). During three campaigns in that country he proved himself a worthy antagonist to Prince Eugene, whom at last he defeated at Cassano by his magnificent courage and command over his troops, converting the defeat that his indolent brother, the Grand Prior, had incurred into a glorious success. Next year, after holding his own as before, he was sent to Flanders to repair the disaster of Ramillies with the result that his successors Marsin and Philip of Orleans were totally defeated, while in the new sphere Vendôme was merely the mentor of the pious and unenterprising duke of Burgundy, and was unable to prevent the defeat of Oudenarde. He therefore retired in disgust to his estates, but it was not long before he was summoned to take command of the army of Philip in Spain, and there he won his last victories, crowning his work with the battle of Villaviciosa. Before the end of the war he died suddenly at Vinaros on the 11th of June 1712. Vendôme was one of the most remarkable soldiers in the history of the French army, and second only to Villars amongst the generals of France of the 18th century. He had, besides the skill and the fertile imagination of the true army leader, the brilliant courage of a soldier. But the real secret of his uniform success was his extraordinary influence over his men.

VENDÔME, a town of north-central France, capital of an arrondissement in the department of Loir-et-Cher, 22 m. N.W. of Blois by rail. Pop. (1906) town, 7381; commune, 9804. Vendôme is situated on the Loir, which here divides into numerous arms intersecting the town. On the south it is overlooked by an eminence on which stand ruins of the castle of the counts of Vendôme, dating in part to the 11th century. The abbey-church of the Trinity (12th to 15th century) has a fine façade in the florid Gothic style. The belfry, surmounted by a stone steeple, stands isolated in front of the church; it belongs to the middle of the 12th century, and is one of the finest examples of Transition architecture. Abbey buildings of various periods lie round the church. The church of La Madeleine (15th century) is surmounted by a stone spire, an indifferent imitation of that of the abbey. The fine tower of St Martin (16th century) is all that remains of the church of that name. The town hall occupies the old gate of St George; its river front is composed of two large crenelated and machicolated towers, connected by a pavilion. The ancient hospital of St Jacques afterwards became a college of the Oratorians, and now serves as a lycée for boys; the charming chapel, dating from the 15th century, in the most florid Gothic style, is preserved. The town has a well-known archaeological and scientific society, and possesses a library with more than three hundred MSS., and a museum, mostly archaeological, in front of which stands a statue of the poet Ronsard. There is also a statue of Marshal Rochambeau, born at Vendôme in 1725. There are some interesting houses of the 15th and 16th centuries. Vendôme has a sub-prefecture and a tribunal of first instance. The river supplies motive power to flour-mills, and the town manufactures gloves, paper and carved mouldings, and carries on tanning and nursery-gardening together with trade in butter and cheese.

Vendôme (*Vindocinum*) appears originally to have been a Gallic oppidum, replaced later by a feudal castle, around which the modern town arose. Christianity was introduced by St Bienheuré in the 5th century, and the important abbey of the Trinity (which claimed to possess a tear shed by Christ at the tomb of Lazarus) was founded about 1030. When the reign of the Capetian dynasty began, Vendôme was the chief town of a countship belonging to Bouchard, called "the Venerable," who died in the monastery of Saint-Maur-des-Fossés in 1007. The succession passed by various marriages to the houses of Nevers, Preuilly and Montoire. Bouchard VII., count of Vendôme and Castres (d. *c.* 1374), left as his heiress his sister Catherine, the wife of John of Bourbon, count of la Marche. The countship of Vendôme was raised to the rank of a duchy and a peerage of France for Charles of Bourbon (1515); his son Anthony of Bourbon, king of Navarre, was the father of Henry IV., who gave the duchy of Vendôme in 1598 to his natural son Caesar (1594–1665). Caesar, duke of Vendôme, took part in the disturbances which went on in France under the government of Richelieu and of Mazarin, and had as his sons Louis, duke of Vendôme (1612–1669), who married a niece of Mazarin, and Francis, duke of Beaufort. The last of the family in the male line (1645–1712) was Louis XIV.'s famous general, Louis Joseph, duke of Vendôme (*q.v.*). The title of duke of Vendôme is now borne by Prince Emmanuel of Orleans, son of the duke of Alençon.

See J. de Pétigny, *Histoire archéologique du Vendômois* (2nd ed., 1882).

VENEER, a thin layer of wood, ivory, pearl or other material of high decorative value fixed to a poorer surface by glue or other adhesive to improve its appearance. Wood veneers are exceedingly common: only the best woods are used and the layer may be as thin as paper—a circumstance due to improvements in the machinery for cutting the logs. The surface to which the veneer is to be attached is prepared perfectly smooth, a film of glue applied, and then the veneer laid on. It is now ironed perfectly flat, all superfluous glue being pressed out, and then allowed to dry in a press. The surface is now ready for polishing.

VENER [*Wener* or *Väner*; often written, with the addition of the definite article, *Venern*], the largest lake in Sweden and the third largest in Europe. It has an area of 2149 sq. m.; a maximum length of 87 m.; an extreme breadth of 44 m.; a maximum depth of 292 ft.; and an altitude above sea-level of 144 ft., though the surface sometimes rises as much as 10 ft. or more, for the lake is the recipient of the waters of numerous streams, the largest being the Klar, which drains the forests of Vermland and Kopparberg to the north. It is drained by the Göta river southward to the Cattegat. It is divided into two basins by two peninsulas and a group of islands, the western half being known as Lake Dalbo. The northern shores are high, rocky and in part wooded, the southern open and low, though isolated hills occur, such as the Kinnekulle (988 ft.), an abrupt hill exhibiting a remarkable series of geological strata. Several islands fringe this shore; of these Leckö has a fine medieval castle. This lake and Lake Vetter contain degenerate species of marine fauna, left after the retreat of the sea in which both were formerly included.

By means of the Dalsland Canal from Köpmannabro, midway on the west shore of Dalbo, the lake, which is the scene of a busy traffic in timber, iron and agricultural produce, has communication with Fredrikshald in Norway; and it is traversed from Venersborg on the south to Sjötorp on the east by the Göta (*q.v.*) Canal route. The principal lake-ports are—on the north Karlstad (*q.v.*) and Kristinehamn, with iron-works and tobacco factory; on the east Mariestad, chief town of the district of Skaraborg, taking its name from the queen of Charles IX. (1599–1611); on the south Lidköping, near the Kinnekulle, and Venersborg at the outflow of the Göta, with its old bridge and canal of the 17th century, a museum, and iron foundries, tanneries and match and paper factories.

VENERABLE (Lat. *venerabilis*, worthy of reverence, *venerari*, to reverence, to worship, allied to *Venus*, love; the Indo-Germ. root is *wen-*, to desire, whence Eng. "win," properly to struggle for, hence to gain), worthy of honour, respect and reverence, especially a term applied to dignified or honourable age. It is specifically used as a title of address given to archdeacons in the Anglican Church. It was naturally a term of respectful address from early times; thus St Augustine (*Epist.* 76, 88, 139) cites it of bishops, and Philip I. of France was styled *venerabilis* and *venerandus* (see Du Cange, *Gloss.* s.v. *Venerabilitas*). In the Roman Church the granting of the title "venerable" is the first step in the long process of the canonization of saints (see CANONIZATION).

VENEREAL DISEASES (from "venery," *i.e.* the pursuit of Venus, the goddess of love), a general term for the diseases resulting from impure sexual intercourse. Three distinct affections are included under this term—gonorrhoea, local contagious ulcers, known as chancres, and syphilis. At one time these were regarded as different forms of the same disease. They are, however, three distinct diseases, due to separate causes, and have nothing in common except their habitat. The cause in each case is a definite specific virus, a micro-organism. In the case of gonorrhoea the virus attacks the mucous membranes, especially that of the urethra, the vagina and the uterus. Chancres attack the mucous membranes and the skin. In syphilis the whole system comes under the influence of the poison.

Though these three affections are generally acquired as the result of impure sexual intercourse, there are other methods of contagion, as, for example, when the accoucheur is poisoned whilst delivering a syphilitic woman, the surgeon when operating on a syphilitic patient, the wet-nurse who is suckling a syphilitic infant, and so on. An individual may be attacked by any one or any two of the three, or by all at the same time, as the result of one and the same connexion. But they do not show themselves at the same time. In other words, they have different stages of incubation. In gonorrhoea the disease appears very rapidly. So also in the case of the soft chancres, the first symptoms commencing as a rule three or four days after inoculation. It is different, however, with syphilis, the period of incubation being twenty-eight days, though it may be much longer. The length of the period of incubation, therefore, is of great diagnostic help in the case of syphilis.

For many years the term "venereal disease" was used very loosely, though the writers before the year 1786 had a tolerably clear idea that three distinct diseases were included under the term: the lues venerea, now called syphilis, gonorrhoea, and a condition leading to bubo and associated with a multiple chancre which is known at the present day as "soft sores." John Hunter, as the result of an unfortunate experiment, taught that there was but a single venereal poison which manifested itself in different ways. It took the French school many years of hard work to show that the poison of syphilis was distinct from that producing a soft sore, and that the virus of a soft sore was incapable, when pure, of causing gonorrhoea.

The evidence brought forward by Ricord, by Lancereaux and by Fournier was convincing. It has been confirmed by bacteriology, and it has happened by a remarkable coincidence that the truth of the French teaching about syphilis was first established on the firm basis of experiment in France itself, when Professor Metchnikoff at the Institut Pasteur in Paris gave in his adherence to Schaudinn's work, which showed that the *Spirochaeta pallida* germ was the cause of the disease.

A. *Gonorrhoea.*

Gonorrhoea is a specific inflammation of the mucous membrane of the urethra and other passages, by the reception into it of germs known as diplococci (διπλόοι, double; κόκκος, berry—the germs being double, like the halves of a walnut). After the illustrious discoverer, the germ is often spoken of as the gonococcus of Neisser. Gonorrhoea is apt to be a very serious disease, and it sometimes ends fatally.

The germs find entrance during coitus and multiply at enormous rate, spreading to all the glands and crevices of the membrane, and setting free in their development a toxin which causes great irritation of the passage with inflammation and swelling. They remain quietly incubating for three or four days, or even longer; then acute inflammation comes on, with profuse discharge of thick yellow matter, with much scalding during micturition, and there may be so much local pain that it is difficult for the person to move about. Microscopic examination of the discharge shows abundant pus corpuscles and epithelial cells from the membrane, together with swarms of diplococci (gonococci).

The inflammatory process may extend backwards and give rise to acute prostatitis (see PROSTATE GLAND), with retention of urine; to the duct of the testes and give rise to acute epididymitis (swollen testicle); and to the bladder, causing acute cystitis. It may also cause local abscesses, or, by irritation, set up crops of warts.

The treatment of acute gonorrhoea is best carried out if the patient can lie up for a while. He must avoid all fermented drinks and rich foods, and sexual and other excitement, and he should drink freely of such things as barley-water, in order to dilute, and lessen the irritation of, the urine. Hot baths are comforting. Laxatives should be freely given. The urethra should be frequently washed out with a warm solution of permanganate of potash, a grain to the pint, and, later, a weak solution of one of the zinc or silver salts may be used as an injection.

Capsules of copaiba or oil of sandalwood, and a paste of cubebs pepper, have a beneficial influence, and, later, if the man is depressed, quinine and iron will be found useful.

In ten days or a fortnight the inflammation gradually subsides, a thin watery discharge remaining which is known as *gleet*. But inasmuch as this discharge contains gonococci it may, though scarce noticeable, set up acute specific inflammation in the opposite sex.

In the case of the female the inflammation is apt to extend to the uterus and along the Fallopian tubes, perhaps to give rise to an abscess in the tube (salpingitis) which, bursting, may cause fatal peritonitis.

A lingering gleet may be due to the presence of a definite ulceration in the urethra, as shown by examination with a slender tube illuminated by electricity—the endoscope. The ulcer having been induced to heal by the application of a nitrate of silver lotion, all discharges cease. Chronic inflammation is necessarily associated with the formation of interstitial fibrous tissue, and the contraction of this new formation causes narrowing of the urethra, or stricture. Thus gleet and stricture are often associated, and the occasional passage of a large bougie may suffice to cure both. Often, however, a stricture of the urethra proves rebellious in the extreme, and leads to diseases of the bladder and kidneys which may prove fatal.

One of the most important points in the management of a case of gonorrhoea is to prevent all risk of the septic discharge coming into contact with the eye. It sometimes happens that the patient inadvertently introduces the germs into his own eye by his finger, or that his eye, or the eye of some member of the household, becomes inoculated by the use of an infected towel. If this happen, prompt and energetic measures must be taken to save the eye.

If so be that at the time of delivery a woman be the subject of gonorrhoea, there is great probability of the eyes of the infant being affected. The symptoms appear on the third day after birth, and the disease may end in complete blindness. The name of the disease is *ophthalmia neonatorum* (see BLINDNESS).

By the term *gonorrhoeal rheumatism* it is implied that the gonococci have been carried by the blood stream to one or more joints in which an acute inflammation has been set up. It is apt to occur in the third week of the disease, and it may end in permanent stiffness of the joints or in abscess.

In rare cases the germs find their way to the pleura or pericardium, setting up an inflammation which may even end fatally.

For a man to marry whilst there is the slightest risk of his still being the subject of gonorrhoea would be to subject his wife to the probability of infection, ending with chronic inflammation of the womb or of septic peritonitis. Yet it is often extremely difficult to say when a man is *cured*. That there is no longer any discharge does not suffice to show that he has ceased to be infective. Nothing less than repeated examinations of the urethral mucus by the microscope, ending in a negative result, should be accepted as evidence of the cure being complete. And these examinations should be made after he has returned to his former ways of eating, drinking and working.

B. *Local Contagious Ulcers.*

Chancroid, *soft chancre* or *soft sore* is so named in contradistinction to the Hunterian sore of syphilitic infection, the one characteristic of which is its hardness. The soft chancre is a contagious ulcer of the genitals, due to the inoculation of a distinct form of micro-organism, the bacillus of Ducrey; and, provided that the specific germ of syphilis is not inoculated at the same time, the chancre is not followed by constitutional affection. In other words, the disease is purely local, and if some of the discharge of one of these ulcers is inoculated on another part of the body of the individual a sore of an exactly similar nature appears. This reproduction of the sore can be done over and over again on the same individual.

always with the same result. But in the case of the Hunterian sore, inoculation of the individual from the primary sore gives no result, because, as explained below, the constitutional disease has rendered the individual proof against further infection. The soft sore is often multiple. It makes its appearance about three days after the exposure, and as it increases in size free suppuration takes place. It is often of about the size of a silver threepence. Its base remains soft. In individuals broken down in health, the ulceration is apt to extend with great rapidity, and is then spoken of as *phagedaenic*.

Just as an individual may contract syphilis and gonorrhoea at the same connexion, so also he may be inoculated simultaneously with the bacilli of the soft chancre and the spirochaete of syphilis. In this case the soft chancres may make their appearance, as usual, within the first three or four days, but though passing through the customary stages they may refuse quite to heal, or, having healed, they may become indurated in the second month, constitutional symptoms following in due course.

The virulence of soft sores being due to the presence of harmful germs, the surface of the sores should be touched with pure carbolic acid, which has the effect of destroying the germs and converting the sores into healthy ulcers. Or the chancres may be treated by the application of lint soaked in weak carbolic lotion. If the sore happens to be under a tight prepuce, and the germs are of great activity—as is apt to happen in such a case—ulceration may extend with extreme rapidity. It is advisable, therefore, to remove or to lay open the prepuce, in order that the sores may be effectively dealt with.

Bubo.—The bacilli from the soft sore are apt to find their way into the lymphatic vessels, and so to reach the glands in the groin, when they set up destructive inflammation. Under the influence of rest the inflammation may subside, but if it continues and suppuration threatens, the gland had better be laid open and scraped out. If a speck of the contents of the abscess be inoculated on to the skin, a soft chancre is again produced.

C. *Syphilis.*

The cause of syphilis, whether inherited or acquired, is the presence in the blood and tissues of the same organism, which can be demonstrated in the various secondary lesions, in the blood and in the internal organs. The name of the germ is *Spirochaeta pallida*;[1] it is a protozoon of spiral form, from 4 to 20 μ in length and $\frac{1}{4}$ μ in diameter, with a flagellum at either extremity. It possesses motility of three kinds—a lashing, a corkscrew and a to-and-fro movement. It stains pale pink with Giemsa's fluid. At the time of writing (1910) it has not been found practicable to make an artificial cultivation of the spirochaete. But it may generally be found in primary and secondary syphilitic lesions by the aid of a $\frac{1}{12}$ in. oil-immersion lens—and abundant patience. The pale, spiral, hair-like germ is also found in children who inherit syphilis. Inoculations of the spirochaete in monkeys have produced the characteristic primary (Hunterian) sores, which have proved infective to other monkeys. And in the reproduced primary sores, as also in the secondary lesions following them, the same specific micro-organism has been demonstrated.

Syphilis is an infective fever, and its life-history may well be compared with that of vaccinia. A child is vaccinated on the arm with vaccine lymph—for two or three days nothing is observed; but on the fourth day redness appears, and by the eighth day a characteristic vaccine vesicle is formed, which bursts and sets free a discharge which dries into a scab. If on the eighth day the clear lymph in the vesicle is introduced at another point in the child's skin, no characteristic local effect follows. The system is "protected" by the previous inoculation; this protection will last for some years, and perhaps for life. There is, then, exposure to a poison; its introduction locally; a period of incubation; a characteristic appearance at the seat of inoculation; a change in the constitution of the individual, and protection for a variable period. So with syphilis. The syphilitic poison is introduced at the seat of an abrasion either on the genital organs or on some other part of the surface of the body. The poison lies quiescent for a variable period. The average period is four weeks. A cartilaginous, button-like hardness appears at the seat of inoculation. If this is irritated in any way, an ulceration takes place; but ulceration is an accident, not an essential. From the primary seat the system becomes infected. The virus, passing along the lymphatic vessels, attacks the nearest chain of lymphatic glands. If the original sore is in the genital organs, the glands in the groin are first attacked; if in the hand, the glands of the elbow or armpit; if on the lip, the glands below the jaw. The affected glands are indurated and painless; they may become inflamed, just as the primary lesion may, but the inflammation is an accident, not an essential. In due course the poison may affect the whole glandular system. The body generally is so altered that various skin eruptions, often symmetrical, break out. Any irritation of the mucous membrane is followed by superficial ulcerations, and in the later stages of the disease skin-eruptions, scaly, pimply, pustular or tuberculous in type, appear. These eruptions do not itch. The individual is as a general rule protected against a second attack of syphilis, although there have been rare cases recorded in which individuals have been attacked a second time. In weakly people, in severe cases, or in cases that have not been properly treated by the surgeon, syphilitic deposits termed gummata are formed, which are very apt to break down and give rise to deep ulcerations. Gummata may attack any part; the skin, muscles, liver and brain are the favourite sites.

It by no means follows that because the infecting sore is small, unimportant or quickly healed, the attack, of which the sore is the first (*primary*) symptom, will be mild. The most serious train of symptoms may follow the healing of a primary sore which has been so unimportant as scarcely to have attracted the attention of the individual, or actually to have escaped notice. Indeed, it not infrequently happens that the most serious forms of secondary or tertiary symptoms succeed a sore which was regarded as of such trivial nature that the individual declined to submit himself to treatment, or quickly withdrew himself from it to enter a fool's paradise. The advisability of ceasing from treatment should always be determined by the surgeon, never by the patient; mercurial treatment must be continued long after the disappearance of the secondary eruptions. It is the *disease* which the surgeon has to cure, not the *symptoms*. The patient is apt to think only of the symptoms.

"Is the disease curable?" This is the question constantly put by the patient on his coming for treatment. The answer is: "Yes; beyond doubt." But the individual must be made to understand the necessity of his submitting himself trustfully and patiently to a prolonged course of treatment. A second question is as to whether, in the course of the disease, his hair will fall out, his body will be covered with sores and his face with blotches, and if his bones will be attacked. Here, again, the answer will be that prompt submission to treatment will render all such calamities extremely improbable. Another question often put is as to whether the disease is contagious or infectious. Obviously, if a man has a primary sore or a secondary eruption upon the lip or tongue he should use his own glass, cup or spoon, and should refrain from kissing any one. If due care thus be taken no danger is likely to ensue.

The *diagnosis* of syphilis is often difficult. The first appearance of the sore about four weeks after exposure to the risk of infection, its hardness, the indolent enlargement of the associated lymphatic glands, and the occurrence of rash or of sore throat, are all helpful. But when the primary sore occurs on the finger, the face or, indeed, in any extra-genital region, it is apt to be lacking in the usual characteristics, and so the diagnosis may for a while be missed. In the case of doubt, the blood of the patient should be submitted to the delicate test known as the Wassermann reaction.

The General Treatment of Syphilis.—It is impracticable to lay down a hard and fast line for the treatment of the disease, for no two individuals are exactly alike, neither does the disease follow a strict path in all cases. But experience has amply shown that in the early stages of the disease, mercury, at least for the present, is the only drug on which reliance can be placed. Guaiacum was at one time extensively used, and somehow or another sarsaparilla acquired a bubble reputation; but the practical surgeon of to-day ignores these drugs in the treatment of syphilis. Still, mercury must be prescribed with great judgment. For a man worn out by alcoholic or other excesses, or with health broken down by tuberculosis or other exhausting disease, mercury must be given with great caution. In times past, its reckless administration until profuse salivation was set up, or until the teeth fell out and the very jawbones became diseased, deservedly brought the mercurial treatment into disrepute. "Better the disease than the remedy," said public opinion, and not without reason. But this miscarriage of treatment is absolutely a thing of the past. Before placing a patient under mercurial treatment it ought to be seen that there is no unwholesome condition of his gums, and that his teeth are put in a satisfactory state; unless this is done, the administration of small doses of mercury may have the effect of producing salivation, and, in consequence, a temporary cessation of the treatment. In any case the gums must be watched, and the treatment stopped if tenderness occurs.

There are several ways of giving mercury: (*a*) by the mouth; (*b*) by rubbing a mercurial ointment into the skin; (*c*) by injection into the muscles; (*d*) by inhalation of mercurial vapour. Inunction is especially suited for those whom mercury given by the mouth causes diarrhoea or other disturbance; in a private house, however, it is found "dirty" and objectionable.

The fumigation-treatment is carried out by seating the naked man on a cane-bottomed chair and covering him over with a blanket; calomel being volatilized, its fumes are carried under the blanket along with steam.

Treatment by intra-muscular injections is increasing in popularity, but in carrying it out, great care must be taken that no septic germs are introduced. The preparation of mercury is given in solution or mixed with oil, and is usually injected about once a week into the muscles of the buttock or loin. The "grey oil," which is much used for injections, consists of finely divided metallic mercury in some fluid fat. Calomel is also used suspended in olive oil. After a few months of weekly injections there should be some weeks of rest from treatment.

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[1] From χαίτη, long hair, on account of the waving, hair-like appearance of the germ.

But the most usual, and, perhaps, the most satisfactory method of administering mercury is by the mouth, in the form of pills or mixtures. The pills generally contain metallic mercury finely divided, as in "blue pill" and as in pills made of "grey powder," or as calomel, or some other salt of mercury, such as the bichloride or tannate. The preparation given in a mixture is usually a solution of perchloride of mercury.

Whilst the individual is undergoing mercurial treatment his diet must be regulated. Plain meat, roast and boiled, and vegetables which cannot cause indigestion or diarrhoea, will form his chief food. Spirits and liqueurs should be absolutely forbidden, but a glass or two of wholesome wine or beer may occasionally be allowed. If there is any secondary eruption of the tongue, mouth or throat, smoking must be forbidden. The dress must be warm, and there should be no exposure to extremes of cold or heat, nor should excessive work or amusement be undertaken. Briefly, it may be said that the subject of syphilis should live low and think high. It has been said by an English physician who delighted in epigrams, "Syphilis once, syphilis ever"; but this is not true. If the individual places himself unreservedly and continuously under the treatment of a trustworthy practitioner, he may confidently look forward to a cure; and, if so be that he is eventually married, may depend upon his children showing no sign of his unfortunate infection.

Unlike whooping-cough, smallpox or pleurisy, syphilis is not a disease which, left untreated, cures itself in the course of time. Syphilis is a disease which peculiarly calls for treatment, and that treatment, to be effectual, must be prolonged. To promote the healing of an ulcer, or to get rid of a cutaneous eruption, the result of syphilis, is not to treat syphilis. It is merely to free the patient of a symptom of the disease. To cure syphilis—and the disease is curable—the treatment must be patient and prolonged. And it must be for the surgeon to say to the individual that he may consider himself as cured, not for the patient to take upon himself the assumption that, because no secondary or tertiary symptoms have been seen for a certain number of months, he is cured.

In the midst of the uncertainties which surround the subject of syphilis, the question sometimes arises as to whether the treatment by mercury, for instance, is of the importance which is ascribed to it. Two instances may be given in proof of its undoubted value. First, a woman who has been infected and never properly treated, becomes pregnant, and though, perhaps, showing signs of good health in every other respect, has a miscarriage; pregnancy and miscarriage follow each other at short intervals, four, six or eight times. Then, at last, she is put upon mercurial treatment, and, going to her full time, bears a healthy infant. Second, an infected but healthy-looking woman, who has not been properly treated, produces a child who, in the course of a few weeks, becomes shrivelled and wan. His food does him no good, and daily he becomes more miserable. At last some mercurial ointment is spread upon his "binder," and he quickly becomes healthy and happy, and, in due course, if the treatment is persevered in, is entirely cured.

When should the Treatment of Syphilis be begun?—The answer to this important question is: "As soon as the disease is diagnosed." As soon as it is seen that the primary sore is hard, and that the glands in anatomical association with it are swollen, mercury should be administered. It may not prevent the outbreak of the secondary symptoms, but it may greatly modify them. But if a surgeon is in doubt as to whether a sore is truly an infecting one, he should wait before condemning the individual as syphilitic, and placing him under the necessity of submitting himself to perhaps a two years' treatment, which, after all, may not have been necessary. Time would quickly clear up doubt.

Abortive Treatment.—When it is remembered that the germs of syphilis have been incubating at the seat of inoculation for a month, more or less, before the primary sore or chancre makes its appearance, it may be taken for granted that the removal of the sore by wide dissection, or its destruction by cautery, will not prevent the occurrence of secondary symptoms. For during those weeks the germs were finding their way into the lymphatics and the blood vessels and were producing a general infection.

When the disease has undergone a sufficient treatment by mercury, or when a patient presents himself with lesions which denote the fact that the disease has passed into the tertiary stage, a solution of iodide of potassium is given in combination with that of perchloride of mercury, or the iodide is given by itself. In these conditions the effect of the potassium salt is often most remarkable. It is a drug of the greatest value, and, recognized as such, is apt to be found an important ingredient in popular "blood mixtures." If given, however, in doses larger than can be borne by the patient, its poisonous effects are manifested by a metallic taste, by watering of the eyes and by the breaking out on the back and shoulders of scattered pimples.

Thus, mercury in some form is the recognized and proper treatment for syphilis in the secondary stage, and iodide of potassium in the tertiary. And, for as much as one cannot say where the secondary stage ends and the tertiary begins, it is a common practice to combine the mercuric with the potash salt in the treatment of certain phases of the disease.

In 1910 attention was hopefully directed towards Professor Ehrlich's treatment of syphilis by a complex preparation of arsenic, conveniently spoken of as "606."

Gummata.—The most characteristic form of the generalized syphilitic infection, which may not manifest itself for several years after the reception of the virus, is a new growth in various organs—the liver, testes or brain, the muscles (tongue and jaw-muscles especially), the periosteum, the skin and the lungs. The deposits are called gummata from the tenacious appearance of the fresh-cut surface and of the discharge oozing from it. The structure consists of small round cells among thin fibres; it closely resembles granulation-tissue, only that the cells are smaller and the intercellular substance (fibres) denser. Molecular death, or necrosis, overtakes this ill-organized, new formation at various central points, owing to the inadequacy of the blood supply. One remarkable feature of the process is the overgrowth of cells in the inner coat of the arteries within the affected area, which may obliterate the vessel. Gummata, and the ulcers left by them, constitute the *tertiary* manifestations of syphilis.

In a large proportion of cases only the secondary symptoms occur, and not the tertiary, the virus having presumably exhausted itself or been destroyed by treatment in the earlier manifestations.

Inherited Syphilis.—In the syphilis of the offspring it is necessary to distinguish two classes of effects—there are the effects of general intra-uterine mal-nutrition, due to the placental syphilis of the mother; and there are the true specific effects acquired by inheritance from either parent and conveyed, along with all other inherited qualities, in the sperm-elements or in the ovum. These two classes of effects are commingled in such a way as not to be readily distinguished; but it is probable that the ill-organized growth of bone, at the epiphysial line in the long bones (sometimes amounting to suppuration), and on the surfaces of the membrane-bones of the skull (*Parrot's nodes*) is a result of general placental mal-nutrition, like the corresponding errors of growth in rickets. The rashes and fissures of the skin, the snuffles and such-like well-known symptoms in the offspring are characteristic effects of the specific taint; so also the peculiar overgrowth in the liver, the interstitial pneumonia alba of the lungs and the like. As in rickets, it is in many cases some months after birth before the congenital syphilitic effects show themselves, while other effects come to light during childhood and youth.

It must be remembered that the moist eruptions and ulcerations about the mouth and anus of the infant, as well as the skin affections generally, are charged with the spirochaetes and are highly contagious.

From the second to the sixth year there is commonly a rest in the symptoms that are regarded as characteristic, but the tibiae may become thickened from periostitis, or a joint may become swollen and painful, and resolve under mercurial treatment.

The characteristic physiognomy gradually manifests itself if the child is not treated with mercury—the flattened nose, the square forehead, the radiating lines from the mouth, the stunted figure and pallid face. During the second dentition, the three signs, as pointed out by Jonathan Hutchinson, may be looked for—the notched incisor teeth of the upper jaw, interstitial corneitis and syphilitic deafness. Perforation of the soft or hard palate may occur, and ulcerations of the skin and cellular tissue. Destruction of the nasal bones, caries of the forehead and skull, of the long bones, may also take place.

Colles' Law.—A woman giving birth to a syphilitic infant cannot be inoculated with syphilis by the infant when she is suckling it; in other words, though the mother may have shown no definite signs of syphilis, she is immune; whereas the syphilitic infant put to the breast of a healthy woman may inoculate her nipple and convey syphilis to her. This is known as Colles' Law, and it is explained by the theory that, the mother's blood being already infected, her skin is proof against a local cultivation of germs in the form of a Hunterian sore.

Syphilis and Marriage.—The question as to how soon it would be safe for a person with secondary syphilis to marry is of extreme importance, and the disregard of it may cause lasting mental distress to the parent and permanent physical injury to the offspring. A man who finds himself to be the subject of secondary syphilis when he is engaged to be married would do well honourably to free himself from responsibility. But should a person who has been under regular and continuous treatment desire to marry, consent may be given when he has seen no symptoms of his disease for two full years. But even then no actual promise can be made that his troubles are at an end.

The *transmission of syphilis to the third generation* is quite possible, but it is difficult of absolute proof because of the chance of there having been intercurrent infection of the offspring of the second generation.

REFERENCES.—A. Fournier, *Treatment of Syphilis*, trans. C. F. Marshall (1906); R. Clement Lucas, *Brit. Med. Journal* (1908); *A Manual of Venereal Diseases*, by Sir Alfred Keogh and others (1907); Power and Murphy, *A System of Syphilis* (1908). (E.O.*)

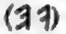
VENETI, the name given to two ancient European tribes. (1) A Celtic people in the N.W. of Gallia Celtica, whose territory corresponded roughly to the department of Morbihan. They were the most powerful maritime people on the Atlantic and carried on a considerable trade with Britain. Their name still remains in the town of Vannes. In the winter of 57 B.C., with some of their neighbours, they took up arms against the Romans, and in 56 were decisively defeated in a naval engagement, details of which are given in Caesar's *Bell. Gall.* iii. and Dio Cassius xxxix. 40–43.

For criticisms of these narratives, and a discussion of the question of the scene of operations, see T. R. Holmes, *Caesar's Conquest of Gaul* (1899), pp. 205, 663, 674, and for the extent of their territory, p. 509.

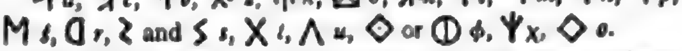
(2) The inhabitants of a district in the north of Italy (also called 'Ενετοί, Heneti, by the Greeks). The extent of their territory before their incorporation by the Romans is uncertain. It was at first included in Cisalpine Gaul, but under Augustus was known as the tenth region of Italy (Venetia and Histria). It was bounded on the W. by the Athesis (Adige), or, according to others, by the Addua (Adda); on the N. by the Carnic Alps; on the E. by the Timavus (Timavo) or the Formio (Risano); on the S. by the Adriatic Gulf. From the earliest times the Veneti appear to have been a peaceful people, chiefly engaged in commercial pursuits. They carried on an extensive trade in amber, which reached them overland from the shores of the Baltic. They were especially famous for their skill in the training and breeding of horses, attributed to their stay in Thrace, whence they brought the cult of Diomede into their Italian home. Homer (*Il.* ii. 85) speaks of the Paphlagonian Heneti as breeders of "wild mules," and their fondness for horses is regarded as a proof of their descent from the "horse-taming" Trojans. Dionysius, tyrant of Syracuse, who assisted them to repel the attacks of the Liburnian pirates, is said to have kept a stud in their country. Herodotus mentions a curious marriage custom, which seems of Eastern origin. Once a year the marriageable maidens of a village were collected together. Each young man chose a bride, for whom he had to pay a sum of money in proportion to her beauty. The sums thus obtained were used by the public officials to dower the less beautiful and thus afford them the chance of obtaining a husband. According to the pseudo-Scymnus of Chios (*Periegesis*, 400) the Veneti were fond of wearing black, a custom even now prevalent amongst them. They were a flourishing and wealthy people, and noted for their uprightness and morality.

The first historical mention of the Veneti occurs in connexion with the capture of Rome by the Gauls, whose retreat is said to have been caused by an irruption of the Veneti into their territory (Polybius ii. 18). At the request of the Romans they rendered them assistance in their wars against the Gauls north and south of the Po, and ever afterwards remained their loyal allies. Some time during the Second Punic War they passed, not by right of conquest but by force of circumstances, under Roman rule. At first they possessed complete autonomy in internal administration; in 89 Gnaeus Pompeius Strabo bestowed upon them the *jus Latinum*; they probably obtained the full franchise from Caesar at the same time as the Transpadane Gauls (49). Under the Empire Venetia and Istria were included in the tenth region of Italy, with capital Aquileia. Down to the time of the Antonines the country enjoyed great prosperity, which was interrupted by the invasion of the Quadi and Marcomanni and a destructive plague. From that time it was devastated at intervals by the barbarians—by the Alamanni, Franks and Juthungi in 286; by the Goths under Alaric (beginning of the 5th century); by the Huns under Attila (452), who utterly destroyed Aquileia and several other cities. Under Theodoric the Great (ruler of Italy from 493–526) the land had rest, and in 568 was occupied by the Lombards. The most important river of Venetia was the Athesis (Adige); its chief towns Patavium (see PADUA), Aquileia (*q.v.*), Altinum (Altino), Belunum (Belluno, still a considerable town).

Language.—We have nearly 100 inscriptions which record the language spoken by the tribe in pre-Roman days, the bulk of which we owe to the admirable and devoted excavations carried out at Este since 1890 by Prof. A. Prosdocimi and Sign. A. Alfonsi. But a not unimportant number have also come to light at Verona and Padua, and at different points along the great North and South route of the Brenner Pass, especially at Bozen; and there are a few more scanty and scattered monuments in the Carinthian Alps now preserved chiefly in the Museums at Klagenfurt and Vienna (the *K.K. Naturhistorisches Museum, Ethnographische Abteilung*). All but a few of these Venetic inscriptions were seen and transcribed by the present writer in the spring of 1908, and their texts with a careful collection of the local and personal names of the district made by Miss S. E. Jackson will appear as the first part of "The Pre-Italic Dialects" in the *Proceedings of the British Academy*.

The alphabet of the inscriptions, in all its varieties, is probably (in spite of Pauli, *Die Veneter*, p. 226, whose judgment seems somewhat arbitrary) either derived from or at least influenced by some form of the Etruscan alphabet, since it not merely coincides with that alphabet in several characteristic signs, such as the use of the compound symbol *vh* () with the value of *f*, but lacks the symbols for the mediae B D G. These, or the sounds which had descended from them in Venetic, were represented by using symbols which in the Western Greek alphabets denoted kindred sounds; *z* where we should expect *d* (*zoto*, "he gave"), Φ φ where we should expect *b* (φohuos, "Boius"), Ψ (*i.e.* χ) where we should expect *g* (·e·χo, "ego"). But though we find the symbols in positions where they correspond to the mediae in kindred languages, it is uncertain what the precise variety of sound which they denoted was; thus, for example, Venetic ·e·χo, is certainly equivalent to the Latin *ego*, but we cannot be certain that the sound of the two words was precisely the same. The symbol for *θ* is not used to denote *d* (since that is represented by *z*). In the inscriptions of Padua and Verona the sign is O and seems there to denote some variety of sound closely akin to *t*; the word which at Padua and Verona is written ·e·kupeθari·s· (probably meaning "charioteer") appears as *ecupetaris* in Latin alphabet in an inscription published by Elia Lattes ("Iscrizioni Inedite Venete ed Etrusche," *Rendiconti del R. Ist. Lomb. di Sc. e Lett.*, Serie II. vol. 34, 1901). The full Venetic alphabet at its best period is preserved for us on several curious and interesting dedicatory objects found at Este, which were offered to the goddess of the place called *Rehtia*, a name obviously equivalent to Latin *Rectia*, some of whose prerogatives, to judge from the long nails which are offered to her, frequently accompanied by small wedges, would seem to have been those of the goddess whom Horace calls Necessitas (*Odes*, i. 35, 17). The offerings in question are thin bronze plates of whose surface the greater part is covered by alphabetic signs, with an inscription stating that such and such a worshipper makes an offering of the plate to the Goddess Rectia. Besides the letters of the alphabet in their order, these plates contain a kind of catalogue of the most common combination of letters, and although none of the plates is now completely preserved this characteristic and their general likeness to one another provide enough material to place the alphabet of Este beyond all doubt. It is written from right to left, and the alternate lines curl round so that the letters proceed in the opposite direction and stand with their feet turned towards those in the preceding line. This characteristic, technically known as "serpentine boustrophedon," with the sign for *h* (I|I), points to some connexion with the alphabets of the East Italic ("Sabellic") inscriptions (see SABELLIC).

The alphabet of Este then, in what the archaeological remains show to have been the 4th and 3rd centuries B.C., was as follows:—


a, c, v, z, h, θ, k, l, m, n, p,
ś, r, and s, t, u, or φ, χ, o.

Pauli (*Die Veneter*, p. 229) compares it to the Western Greek alphabet as used in Elis, but it is difficult to point to any especial mark of affinity with this particular branch of the Western alphabet, while there are some marked differences, such as X instead of Elean T, C instead of Elean (prevailingly) Ϸ and R·. X instead of I and ||| instead of the regular Western ⊟ though the latter symbol is not quoted as occurring in Elis itself (E. S. Roberts, *Greek Epigraphy*, i. 390).

Even the few words that have already been cited from the inscriptions will have shown that the language belongs to the Indo-European group. Unfortunately the inscriptions of Este, although numerous, belong to only two classes, dedications and epitaphs; hence the forms with which they supply us, though attested by welcome repetition, are somewhat limited in number. The typical beginning for a dedication is *meχo....zona·s·to sahnatei rehtiiah*, *i.e.* "me dedit Rectiae Sanatrici," "so and so gave me to the Healing Goddess Rectia"; and sometimes the form of the verb is simply *z·o·to*. The correspondence of these two forms with the Greek middle aorist of the verb (*ἐ-δοτο*), and with the Latin *donare* is obvious, and the present writer is convinced, for reasons which it is impossible to state fully here, that the dots which, it will be observed, are placed on either side of the last sound of their syllable, denote the accent of the word; the most striking evidence being the coincidence in position of the dots with the place of the Greek accent on kindred words; for example, the cognomen *Lehvo·s·* on an inscription of Vicenza is clearly identical with the Latin *Laevus* and the Greek λαιϝός. These signs are altogether absent from some words, *e.g.* from the Accusative μεχο (presumably a proclitic) and syllables containing the letter ɸ, whose form would make the dots a cumbrous addition. One other inscription of special linguistic interest should be cited here; it appears to be the artist's inscription of a vase of the 6th century B.C. found recently at Padua—

voθo kluθeari·s· vhaχ·s·to,

where the first name appears to be identical with the Latin *Otho* and to explain its aspirate, and the last word appears to be the Venetic equivalent of the Latin *fecit*, but to be in the middle voice without any augment. If this interpretation be correct—and the use of ἐποίησε by Greek artists commends it strongly—the form illustrates in rather a striking way the character of the language as intermediate between Greek and Latin.[1]

In the archaeological aspect the Venetic remains are particularly interesting as representing very fully the culture of what is known as the early Iron Age, the monuments of which were discovered in the excavations at Villanova, and are now admirably exhibited in the Museum at Bologna. The earliest begin, according to the generally accepted dating, from the 11th century B.C. The remains at Este begin a very little later, but no inscriptions appear upon them until we reach the pottery of the 6th century B.C. It remains therefore to be determined whether this Venetic language was the proper speech of the people who as it is generally supposed, brought with them the early Iron culture into Italy from north of the Alps in the 11th century B.C., or whether it was the language of the people of the soil whom they conquered. So far as the scanty linguistic evidence at present extends, in the place names and the personal names of the Ligurian and the Venetic districts, it appears to the present writer on the whole to be more in favour of the second view. This probability would become a certainty if we could accept as established the view of Professor Ridgeway and others, which identifies the authors of the early Iron culture with the Umbrians of historical times and ascribes to them the Umbro-Safine language (which with Latin constitutes the Italic division of the Indo-European languages), and which almost certainly was the language originally spoken by the patrician class at Rome (see further SABINI). Even now it must be admitted that this view possesses a high degree of probability.

The chief authority on the Venetic inscriptions published up to 1908 is Carl Pauli (*Altital. Studien*, vol. 3, "Die Veneter," Leipzig, 1891), but so far as the present writer's observation may be trusted the text which Pauli gives of the inscriptions is somewhat defective. Some were reported by Mommsen, *Die Inschriften Norditalischen Alphabets* (Zürich, 1853); the rest have been recorded in the *Notizie degli Scavi* as they appeared, by Ghirardini in the volumes for 1880 and 1888, by Prosdocimi in that for 1890. These articles contain careful accounts of the archaeological remains. (R. S. C.)

VENETIA, a territorial division of northern Italy, lying between the Alps and the Adriatic, and stretching from the frontier of Carinthia and Istria (Austria) in the north-east to the lower Po and Lombardy in the south-west. It comprises the provinces of Belluno, Padua, Rovigo, Treviso, Udine, Venice, Verona and Vicenza, and has an area of 9476 sq. m. Pop. (1881) 2,814,173; (1901) 3,192,897. The crops principally grown are maize, wheat, rice, grapes, mulberry leaves, tobacco, chestnuts, potatoes and hemp. Copper and lignite are mined, and turf is dug. The chief industries are the manufacture of woollens, cottons, silks, glass, laces, tobacco, straw-plait, paper, sugar and hemp, the breeding of silkworms, iron-founding and working, timber-cutting and shipbuilding. At Mira is a large candle factory. The peasantry suffer much from pellagra.

The territory differs much in character; the Po and other smaller rivers which fall into the Adriatic terminate in a huge and continually advancing delta which extends right along the coast, and is liable to inundation. The shore lagoons are, however, rendered healthy by the ebb and flow of the tide, which is much more considerable than elsewhere in the Mediterranean. To the north of the Po at the foot of the mountains is a fertile territory, while the mountains themselves are not productive. The chief towns in the various provinces, with their communal population in 1901, are: Belluno 19,050; total of province 214,803, number of communes 66; Padua 81,242; Monselice 11,571, Este 10,779, Piove di Sacco 10,021; total of province 444,360, number of communes, 103; Rovigo 10,735, Adria 15,711; total of province 222,057, number of communes 63; Treviso 32,793, Castelfranco Veneto 12,440, Montebelluna 10,284, Conegliano 10,252; total of province 416,945, number of communes 95; Udine 36,899, Pordenone 12,409, S. Vito al Tagliamento 10,160; total of province 614,270, number of communes 179; Venice 148,471, Chioggia 31,218, Cavarzere 16,388, Mira 12,169, Mestre 11,625; total of province 399,823, number of communes 50; Verona 73,917, Legnago 14,535; total of province 427,018, number of communes 113; Vicenza 43,703, Bassano 15,097; Schio 13,524; Arzignano 10,426, Lonigo 10,390; total of province 453,621, number of communes 123. Railway communication in Venetia is fairly good; there is a main line from Milan to Mestre (the junction for Venice) and thence to Trieste by a line near the coast, or by Treviso, Udine and Pontebba (Pontafel) into Austria. Another route into Austria, the Brenner, leaves the Milan-Venice line at Verona, which is connected with Modena (and so with central and southern Italy) by a railway through Mantua. Another main line runs from Bologna to Ferrara, Rovigo and Padua, joining the Milan-Venice line at the last-named place. Intercommunication between the main lines is secured by branch railways and steam tramways. The Po, however, forms somewhat of an obstacle, but is crossed by the main lines to Modena and Bologna near Mantua and Rovigo respectively.

The district which later bore the name of Venetia was inhabited, under the Roman Republic, by a variety of tribes—Celts, Veneti, Raeti, &c. Under Augustus, Venetia and Histria formed the tenth region of Augustus, the latter including the Istrian peninsula as far as the river Arsia, *i.e.* with the exclusion of the strip along the E. coast (Liburnia). In all directions, indeed, it extended farther than Venetia in the modern sense, being bounded on the S. by the Po and its main (north) arm, extending on the W. as far as the Adda and on the N. into a part of southern Tirol. It was thus far the largest of the regions of Italy, but possessed comparatively few towns; though such as there were, with the large territories, acquired considerable power and influence. The easiness of the Brenner pass and the abundance of communication with the sea led to the rise of such towns as Verona, Padua and Aquileia: and Milan only became more important than any of these when the German attacks on Italy were felt farther west.

When the Roman Empire fell the towns were many of them destroyed by Attila, and the inhabitants took refuge in the islands of the lagoons. It is to this that Venice owes its origin, under Byzantine protection, early in the 9th century A.D. For the gradual growth of Venetian supremacy over the whole territory, and for its subsequent history, see VENICE.

VENETTE, JEAN DE (*c.* 1307–*c.* 1370), French chronicler, was born at Venette, near Compiègne. He became prior of the Carmelite convent in the Place Maubert, Paris, in 1339, and was provincial of France from 1341 to 1366. In 1368 he was still living, but probably died within a year or two of that date. His Latin Chronicle, covering the years 1340 to 1368, was published by Achery (*Spicilegium*, vol. iii.) with the continuations of the chronicle of William of Nangis, though it has every claim to be considered as an independent work. During the years 1358 and 1359 the entries were contemporary with the events recorded; the earlier portion of the work, if it was begun as early as 1340, was subjected to revision later. Jean de Venette was a child of the people, and his sympathies were entirely with the peasants. His point of view is thus directly opposed to that of Froissart. His democratic sympathies led him to support Étienne Marcel, and though he returned to his allegiance to the kings of France he remained a severe critic. Jean de Venette also wrote a long French poem, *La Vie des trois Maries*, about 1347.

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[1] Some further details will be found in the Preliminary Report presented to the British Academy published in the *Athenaeum*, August 8th, 1908.

See Lacurne de Sainte-Palaye in *Mémoires de l'Académie*, vols. viii. and xiii.; Géraud and Déprez in *Mélanges de l'école de Rome* (1899), vol. xix.; and A. Molinier, *Les Sources de l'histoire de France* (1904), tome iv.

VENEZUELA,[1] a republic of South America, facing the Caribbean sea, and bounded E. by British Guiana and Brazil, S. by Brazil and W. by Colombia. Its boundary with Colombia is unfixed, a decision by the king of Spain, as arbitrator, in March 1891, having been rejected by Venezuela. The boundary dispute with British Guiana was settled in October 1899 by an arbitration court in Paris. The line is subject to any question between the two countries and Brazil. The boundary with Brazil was fixed by a special commission in 1880. The republic lies between lat. 1° 40′ S. and 12° 26′ N., long. 59° 40′ and 73° 31′ W., and has an area of 599,538 sq. m. according to the Venezuelan *Year Book* of 1906. This area, however, was subject to the settlement of the Colombia boundary line, and the measurement is only approximate.

Topography.—The surface of Venezuela is broken into three very irregular divisions by its mountain systems: (1) the mountainous area of the N.W. and N.; (2) the Orinoco basin with the *llanos* on its northern border and great forested areas in the S. and S.W.; and (3) the Guiana highlands. A branch of the eastern chain of the Andes enters Venezuela in the west about 7° N. lat., and under the name of the Sierra Nevada de Mérida proceeds north-eastwards towards Trieste Gulf. This branch consists of parallel chains enclosing elevated valleys, in one of which lies the town of Mérida at the height of 5410 ft., overlooked by the highest summit of the chain (Picacho de la Sierra, 15,420 ft.). The sierra contains the water-parting between the basin of the Orinoco and those of the small rivers on the north-west. Hence it may be considered to terminate where the Rio Cojedes, which drains the elevated valley in which Barquisimeto stands, after rising on its western slopes flows eastwards into the basin of the Orinoco. Beyond the Cojedes begin two parallel ranges known as the Maritime Andes of Venezuela, which stretch east and west along the coast. The valley between these two ranges is the most densely peopled part of Venezuela. Above Carácas the highest peak of the system, Silla de Carácas, rises to 8531 ft. Behind the wide bay between Cape Codera and Cumana there is an interruption in the Maritime Andes; but both ranges reappear between Cumana and the Gulf of Paria. West of the Maritime Andes low ranges (3500–5000 ft.) trend northwards from the end of the Sierra de Mérida towards the coast on the east side of the Lake of Maracaibo, while the region on the west of that lake consists of lagoon-studded lowlands. East and south of the Sierra de Mérida and the Maritime Andes the region is thinly populated and little known. It consists of two portions—a vast, hilly or mountainous area, densely wooded, in the south-east and south, and level plains in the north-west between the Orinoco and the Apuré and the mountains. The latter is known as the *llanos* of the Orinoco, a region described by Humboldt as a vast "sea of grass," with islands of wood scattered here and there. Since the time of Humboldt, however, the aspect of these plains would seem to have changed. On the occasion of Karl F. Appun's visit in 1850 trees seem still to have been comparatively rare; but a different aspect was presented when Dr P. Jonas visited the *llanos* in 1878. From the Galera, the southernmost range of hills north of the Orinoco basin, the traveller saw a vast plain thickly grown with low trees. As far as Calabozo (about one-third of the distance between the hills and the Apuré) it was now chaparros (*Curatella americana*), now mimosas, which were the prevailing feature of the landscape. But towards the south the open grass-covered spaces increased in number and area. To the south of Calabozo woods of considerable extent were seen. This change is due to the decline of horse- and cattle-rearing in the *llanos*, partly in consequence of political disturbances and partly of a murrain which broke out in 1843 among horses, mules and asses. The decline in stock-raising would also suspend the practice of burning off the dead grass to improve the new pasturage. Along the Brazilian frontier and about the sources of the Orinoco tributaries on the eastern slopes of the Andes there are extensive forests, sometimes broken with grassy *campos*. The surface of the *llanos* is almost a dead level, the general elevation varying from about 375 to 400 ft., rising almost imperceptibly to 600–800 ft. around its immediate margins. So uniform is the level over a great part of these plains that in the rainy season hundreds of square miles are submerged, and the country is covered with a network of connecting channels. When the Orinoco is reached its lower basin is contracted between the Guiana highlands and the northern sierras, and its tributaries begin to come in more nearly at right angles, showing that the margins of the actual valley are nearer and higher. About 62° 30′ the great river reaches what may be considered sea-level, and from this point numerous channels find their way across the silted-up delta plain to the sea. This region, together with that of the Guiana frontier, is heavily forested. In the extreme S. (territory of Amazonas) and S.E. the surface again rises into mountain ranges, which include the Parima and Pacaraima sierras on and adjacent to the Brazilian frontier, with a number of short spurs reaching northward toward the Orinoco, such as the Mapichi, Maraguaca, Maigualida, Matos, Rincote and Usupamo. All this region belongs to the drainage basin of the Orinoco, and rivers of large volume flow down between these spurs. Some of the culminating points in these ranges are the Cerros Yaparana (7175 ft.) and Duida (8120 ft.) in the Parima sierras near the upper Orinoco, the Sierra de Maraguaca (8228 ft.), and the celebrated flat-topped Mt Roraima (8530 ft.) in the Pacaraima sierras on the boundary line with Brazil and British Guiana. Near the Orinoco the general elevation drops to about 1500 ft. All this region is densely forested, and is inhabited only by scattered tribes of Indians.

Probably not less than four-fifths of the territory of Venezuela belong to the drainage basin of the Orinoco (*q.v.*). The Orinoco is supposed to have 436 tributaries. of which, among the largest, the Caroni-Paragua, Aro, Caura, Cuchivero, Suapure, Sipapo and Ventuari have their sources in the Guiana highlands; the Suata, Manapere and Guaritico in the northern sierras; and the Apuré, Uricana, Arauca, Capanaparo, Meta, Vichada and Guaviare (the last three being Colombian rivers) in the *llanos* and Andes. The Apuré receives two large tributaries from the northern sierras—the Guarico and Portuguesa. Apart from these, the rivers of Venezuela are small and, except those of the Maracaibo basin, are rarely navigable. The larger are the Guanipa and Guarapiche, which flow eastwards to the Gulf of Paria; the Aragua, Unare and Tuy, which flow to the Caribbean coast E. of Carácas; the Yaracui, Aroa and Tocuyo to the same coast W. of Carácas; and the Motatan, Chama, Escalante, Catatumbo, Apan and Palmar, which discharge into Lake Maracaibo. The hydrography of the region last mentioned, where the lowlands are flat and the rainfall heavy, is extremely complicated owing to the great number of small rivers and of lakes on or near the lower river courses. The deep lower courses of these streams and the small neighbouring lakes were once part of the great lake itself, which is being slowly filled by silt. The lakes of Venezuela are said to number 204. The largest are the Maracaibo (*q.v.*); El Zulia, with an area of 290 sq. m., a short distance S. of Maracaibo among a large number of lakes, lagoons and swamps; Valencia, near the city of that name, in the Maritime Andes, about 1350 ft. above sea-level, with an area of 216 sq. m.; Laguneta, in the state of Zulia; and Taciragua, a coastal lagoon in the state of Miranda. There are numerous lagoons in the *llano* districts caused by the periodical floods of the rivers, and extensive *esteros* and *cienagas*, in part due to the same causes, but these either dry up in the dry season or are greatly reduced in area.

The coast outline of Venezuela is indented with a large number of gulfs and bays, comparatively few of which, however, are open to foreign commerce. The larger indentations are the Gulf of Maracaibo, or Venezuela, which extends inland through the Lake of Maracaibo, with which it is connected by a comparatively narrow channel, and is formed by the peninsulas of Goajira and Paraguaná; the Gulf of Paria, between the peninsula of that name and the island of Trinidad; the Gulf of Coro, opening into the Gulf of Maracaibo; the Gulf of Cariaco, between the peninsula of Araya and the state of Bermúdez; the Golfo Triste, on the E. coast of the state of Lara; and the small Gulf of Santa Fé, on the northern coast of Bermúdez. Besides these there are a number of small indentations, sheltered anchorages formed by islands and reefs like that of Puerto Cabello, and estuaries and also open roadsteads, like those of La Guaira and Carúpano, which serve important ports. The islands on the coast forming part of the national territory number 71, with an aggregate area of 14,633 sq. m., according to official calculations. The largest of these is the island of Margarita, N. of the peninsula of Araya, in the vicinity of which is the island of Tortuga and several groups of islets, generally uninhabited. (A. J. L.)

Geology.—Geologically Venezuela consists of three distinct regions: (1) South of the Orinoco a great mass of granite, gneiss, pyroxenite and other crystalline rocks, continuous with that of Guiana and probably of Archean age. This mass also forms the bed of the Orinoco from its junction with the Apuré nearly to its mouth, and it probably extends northwards for some distance beneath the more recent deposits of the plain. (2) The *llanos*, covered by deposits of Quaternary or late Tertiary age. (3) The mountain ranges of the north-west and north. These ranges appear to belong to two systems. The Cordillera of Mérida is one of the

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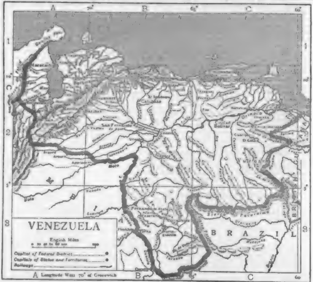
[1] The name means "little Venice," and is a modification of the name of Venecia (Venice), originally bestowed by Alonzo de Ojeda in 1499 on an Indian village, composed of pile dwellings on the shores of the Gulf of Maracaibo, which was called by him the Gulf of Venecia.



Emery Walker sc.

branches of the Andes, and the strike of the folds which compose it is usually from south-west to north-east. The Caribbean chain along the north coast is part of the Antillean system, and here the strike of the folds is nearly west to east or west-south-west to east-north-east. The two systems of folds meet about Barquisimeto, where the structure becomes very complex and is not thoroughly understood. The rocks of Falcón are believed by Sievers to belong to the Andean system; while the outlying peninsula of Paraguaná probably belongs, geologically, to the same massif as Goajira and the Sierra Nevada de Santa Maria in Colombia. The oldest rocks in the country are the granites, gneisses, &c., of the southern massif and the crystalline schists which form the axis of the Cordillera and the Caribbean chain. In the latter range a few Ordovician fossils have been found, but in general the oldest strata which have yielded organic remains belong to the Cretaceous system. The Cretaceous beds form a band along each side of the Cordillera and along the southern flank of the Caribbean chain, and they spread over the greater part of the provinces of Falcón and Lara. The Lower Cretaceous consists chiefly of sandstones and shales and the Middle Cretaceous of very fossiliferous limestone. There is considerable difference of opinion as to the chronology of the succeeding beds, and the boundary between the Cretaceous and Tertiary systems is drawn at various horizons by different observers. The Cerro de Oro series is the most important group of these beds and takes a considerable share in the formation of the mountain ranges. It belongs either to the Upper Cretaceous or to the Lower Tertiary, or possibly in part to the one and in part to the other.[1] (P. LA.)

Climate.—The climate of Venezuela is everywhere tropical except where modified by altitude. In the Maritime Andes at and above the altitude of Carácas it may be described as semi-tropical, and in the still higher regions of western Venezuela it approaches the mild temperate. On the coast and the northern slopes of the Maritime Andes the tropical heat is greatly modified by the trade-winds. At La Guaira the mean temperature for the year is 85° F., at Carácas (3025 ft.) it is 71·2° (or 66·2° according to an official return), at Cumaná it is 83°, at Valencia 76°, Coro 82°, Barquisimeto 78°, Yaritagua 80·6°, Mérida 61°, Trujillo 72°, and Maracaibo 81°. South of the sierras, however, the climate is much drier and hotter. The low temperatures of the night in these regions lower the mean annual temperatures. At Calabozo, for instance, the mean is about 88°, though the maximum in summer is not far from 100°. At Ciudad Bolivar, which is less sheltered from the trade-winds, the mean is 83° and the maximum 91·4°. The lowest temperatures recorded in official reports are those of Mucuchies, in the state of Mérida, where the maximum is 68°, the minimum 43° and the mean 56°. The year is divided into two seasons, the dry and wet, the latter occurring from April to October, when the temperature is also the highest. On the *llanos* the dry season destroys the pasturage completely, dries up the small streams and lagoons, and compels many animals of semi-aquatic habits to aestivate. At Carácas the annual rainfall ranged from 602 to 863 millimetres between 1894 and 1902. In general the climate of Venezuela is healthy wherever the ocean winds have free access. Sheltered places in the lowlands, especially near streams and lagoons, are malarial and enervating, and at some points on the coast are subject to dangerous fevers. The sanitary condition is generally bad, and many forms of disease prevail that are not due to the climate.

Fauna.—The fauna and flora of Venezuela are similar in nearly all respects to those of the neighbouring regions of Guiana, Brazil and Colombia, the open *llanos* of the Orinoco being something of a neutral district between the great forested regions on the E., S. and W. Among the animals indigenous to the country are seven species of the cat family, including the puma, the jaguar and the ocelot; the wild dog (*Canis Azarae*); several representatives of the marten family, including two species of *Galictis*, two of the otter (*Lutra brasiliensis* and *L. pteronura*) and one of the skunk; two species of bear (*Ursus ornatus* and *U. nasutus*); and the "kinkajou." There are six species of monkey corresponding to those of Guiana and the Amazon valley, the sloth and ant-eater, 12 known genera of rodents, including many species of *Mures*, the cavy, the capybara, the paca, the nutria, the agouti, the tree porcupine, *Loncheres cristata*, *Echimys cayen* and the Brazilian hare. Among the pachyderms the tapir is found in the forests of the Orinoco. There are two species of the peccary, *Dicotyles torquatus* and *D. labiatus*. There are also 2 species of deer, *Cervus rufus* and *C. simplicornis*. There are 3 species of opossum. On the coast and in the Orinoco there may be found the manatee and the dolphin. The Reptilia include 11 species of the crocodile, alligator and lizard, including the savage *jacaré* of the Amazon, several species of turtle, 4 species of batrachians, and 29 species of serpents, including the striped rattlesnake (*Crotalus durissus*), *Lachesis mutus*, and a rather rare species of *Cophias*. Among the non-venomous species, the commonest are the boa-constrictor, the anaconda (*Eunectes murinus*) and the *Coluber variabilis*. Bird life is represented chiefly by migratory species, particularly of genera that inhabit the shores of streams and lagoons. The shallow lagoons of the *llanos*, like those of the Argentine *pampas*, are favourite fishing grounds for these birds. In the *garzeros* of Venezuela are to be found nearly every kind of heron, crane, stork and ibis, together with an incredible number of Grallatores. Ducks are also numerous in species and individuals, including a small bird called the *guiriri*, in imitation of its cry. Birds of prey are numerous. One species, the guacharo (*Steatornis caripensis*), or oil-bird, is commonly said to occur only in Venezuela, though it is found in Colombia and Ecuador also. They live in caves, especially in Caripe, and are caught in large numbers for the oil extracted from them, which is commonly known as "Caripe butter." The bell-bird (*Chasmorhynchus carunculatus*) is common in the forests of the Orinoco. Insect life is perhaps poorer and less varied than in Brazil, but in the 14 orders of insects there are no less than 98 families, each including many genera and species. There are 8 families of Coleoptera, 6 of Orthoptera, 23 of Hymenoptera, 14 of Lepidoptera and 7 of Diptera. Locusts are very numerous in the interior, and commit great ravages. Molluscs are common on the coasts, including the pearl oyster, and in the fresh-water streams and lakes. The coral polyp is also found in Venezuelan waters. The domestic animals of Venezuela—the horse, ass, ox, sheep, goat, hog, dog, cat, &c.—are not indigenous.

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[1] See G. P. Wall, "On the Geology of a part of Venezuela and of Trinidad," *Quart. Journ. Geol. Soc. London*, vol. xvi. (1860), pp. 460–70, pl. xxi.; H. Karsten, *Géologie de la Colombie Bolivarienne* (Berlin, 1886); W. Sievers, "Karten zur physikalischen Geographie von Venezuela," *Peterm. Mittheil.* vol. xlii. (1896), pp. 125–29, pl. x.

Flora.—The flora of Venezuela covers a wide range because of the vertical climatic zones. The coastal zone and lower slopes of all the mountains, including the lower Orinoco region and the Maracaibo basin, are clothed with a typical tropical vegetation. There is no seasonal interruption in vegetation. The tropical vegetation extends to an altitude of about 1300 ft., above which it may be classed as semi-tropical up to about 3500 ft., and temperate up to 7200 ft., above which the vegetation is Alpine. Palms grow everywhere; among them the coco-nut palm (*Cocos nucifera*) is the most prominent. There are some exotics in this zone, like the mango, which thrive so well that they are thought to be indigenous. The cacau is at its best in the humid forests of this region and is cultivated in the rich alluvial valleys, and the banana thrives everywhere, as well as the exotic orange and lemon. On the mountain slopes orchids are found in great profusion. Sugar-cane is cultivated in the alluvial valleys and coffee on their slopes up to a height of about 2000 ft. Among the many tropical fruits found here are bananas, guavas, mangoes, cashews, bread-fruit, aguacates, papayas, zapotes, granadillas, oranges, lemons and limes. In the next zone are grown many of the cereals (including rice), beans, tobacco, sugar-cane, peaches, apricots, quinces and strawberries. The *llanos* have some distinguishing characteristics. They are extensive grassy plains, the lowest being the bed of an ancient inland lake about which is a broad terrace (*mesa*), the talus perhaps of the ancient encircling highlands. The lower level has extensive lagoons and swampy areas and suffers less from the long periodical drought. Its wild grasses are luxuriant and a shrubby growth is found along many of its streams. The decline in stock-breeding resulted in a considerable growth of trees and chaparral over the greater part of the plain. A large part of the chaparral consists of the *chaparro*, a low evergreen oak of hardy characteristics, mixed with mimosa, desmauthus, zonia and others. Much of this region is covered with *gamelote*, a tall, worthless, grass with sharp stiff blades. One of the most remarkable palms of the Orinoco region is the "moriche" (*Mauritia flexuosa*). The fruit is edible and its juice is made into beer; the sap of the tree is made into wine, and its pith into bread; the leaves furnish an excellent thatch, and the fibre extracted from their midribs is used for fish lines, cordage, hammocks, nets, &c.; and the wood is hard and makes good building material. The fruit of the *Guilielma* is also widely used for food among the natives. Among other forest trees of economic importance are the silk-cotton tree (*Bombax ceiba*), the *palo de vaca*, or cow-tree (*Brosimum galactodendron*), whose sap resembles milk and is used for that purpose, the *Inga saman*, the *Hevea guayanensis*, celebrated in the production of rubber, and the *Attalea speciosa*, distinguished for the length of its leaves.

The principal economic plants of the country are cacau, coffee, cassava (manioc) called "mandioca" in Brazil, Indian corn, beans, sweet potatoes, taro, sugar-cane, cotton and tobacco. Of these coffee and sugar-cane were introduced by Europeans.

Population.—The population of Venezuela is largely a matter of conjecture, no census having been taken since the third general census of 1891, which gave a total population of 2,323,527, of which 1,137,139 were males and 1,186,388 females, and there were 42,898 foreign residents. The official *Handbook of Venezuela* for 1904 estimated the population for the preceding year as 2,663,671. The population consists of a small percentage of whites of European descent, chiefly Spaniards, various tribes and settlements of Indians, largely of the Arawak and Carib families, and a large percentage of *mestizos*, or mixed bloods. There is a large admixture of African blood. Hübner estimates the mixed of all races at 93%, the highest among all the South American nationalities, and the creoles at 1% only; but this is clearly incorrect. Perhaps a closer approximation would be to rate the creole element (whites of European descent) at 10%, as in Colombia, and the mixed races at 70%, the remainder consisting of Africans, Indians and resident foreigners.

Territorial Divisions.—The territorial divisions of Venezuela have been subjected to many changes. Under the constitution of the 27th of April 1904, the republic was divided into 13 states, 1 federal district and 5 territories, the names of which are as follows, those of the capital cities being given in brackets: Federal District (Carácas and La Asunción); Aragua (La Victoria); Bermúdez (Cumana); Bolívar (Ciudad Bolívar); Carabobo (Valencia); Falcón (Coro); Guárico (Calabozo); Lara (Barquisimeto); Mérida (Mérida); Miranda (Ocumare); Táchira (San Cristóbal); Trujillo (Trujillo); Zamora (San Carlós); Zulia (Maracaibo), with the following territories: Amazonas (San Fernando de Atabapo); Colón (Gran Roque); Cristobal Colón (Cristobal Colón); Delta-Amacuro (San José de Amacuro); Yaruari (Guacipati).

On the 5th of August 1909, however, a new division was promulgated, giving 20 states, 1 federal district and 2 territories. Under this division some of the recognized administrative units were greatly altered in area or even abolished, and the capital status of several cities was apparently affected. The division was as follows: Federal District (Carácas); Anzoátegui (Barcelona); Apuré (San Fernando de Apuré); Aragua (La Victoria); Bolívar (Ciudad Bolívar); Carabobo (Valencia); Cojedes (San Carlós); Falcón (Coro); Guárico (Calabozo); Lara (Barquisimeto); Mérida (Mérida); Miranda (Ocumare); Monagas (Maturín); Nueva Esparta (La Asunción); Portuguesa (Guanare); Sucre (Cumaná); Táchira (San Cristóbal); Trujillo (Trujillo); Yaracuy (San Felipe); Zamora (Barinas); Zulia (Maracaibo), with the following territories: Amazonas (San Fernando de Atabapo); Delta-Amacuro (Tucupita).

Communications and Commerce.—There has been no great development of railway construction in Venezuela, partly on account of political insecurity and partly because of the backward industrial state of the country. In 1908 there were only 13 railway lines with a mileage of about 540 m., including the short lines from Carácas to El Valle and La Guaira to Maiquetia and Macuto, and the La Vela and Coro. The longest of these is the German line from Carácas to Valencia (111 m.), and the next longest the Great Táchira, running from Encontrada on Lake Maracaibo inland to Uracá (71 m.), with a projected extension to San Cristóbal. Another line in the Lake Maracaibo region is known as the Great La Ceiba, and runs from a point near the lake to the vicinity of Valera and Trujillo. An important line connects the thriving city of Barquisimeto with the port of Tucacas. The best known of the Venezuelan railways is the short line from La Guaira to Carácas (22¾ m.), which scales the steep sides of the mountain behind La Guaira and reaches an elevation of 3135 ft. before arriving at Carácas. It is a British enterprise, and is one of the few railways in Venezuela that pay a dividend. The Puerto Cabello and Valencia line (34 m.) is another British undertaking and carries a good traffic. A part of this line is built with a central cog-rail. Probably a return to settled political and industrial conditions in Venezuela will result in a large addition to its railway mileage, as a means of bringing the fertile inland districts into direct communication with the coast.

In steamship lines the republic has almost nothing to show. A regular service is maintained on Lake Maracaibo, one on Lake Valencia, and another on the Orinoco, Apuré and Portuguesa rivers, starting from Ciudad Bolívar.

The coast of Venezuela has an aggregate length of 1876 m., and there are 32 ports, large and small, not including those of Lakes Maracaibo and Tacarigua and the Orinoco. The great majority of these have only a limited commerce, restricted to domestic exchanges. The first-class ports are La Guaira, Puerto Cabello, Ciudad Bolívar, Maracaibo and Carupano, and the second-class are Sucre, Juan Griego, Guiria, Caño Colorado, Guanta, Tucacas, La Vela and Porlamar. The commerce of these ports, both in the foreign and domestic trade, is small, tariff regulations being onerous, and the people too impoverished to be consumers of much beyond the barest necessaries of life. The total foreign trade in 1908 amounted to $9,778,810 imports and $14,560,830 exports, the values being in U.S. gold. The exports to the United States were valued at $5,550,073 and to France $5,496,627. The principal exports were coffee, cacau, divi-divi, rubber, hides and skins, cattle and asphalt. The imports include manufactured articles of all kinds, hardware and building materials, earthenware and glassware, furniture, drugs and medicines, wines, foodstuffs, coal, petroleum and many other things. The coasting trade is largely made up of products destined for exportation, or imports trans-shipped from the first-class ports to the smaller ones which have no direct relations with foreign countries. In the absence of statistical returns it is impossible to give the values of this branch of trade. The exchanges of domestic products are less important than they should be. The Orinoco trade is carried on almost wholly through Port of Spain, Trinidad, where merchandise and produce is transferred between light draught river boats and foreign ocean-going steamers. The distance from Port of Spain to Ciudad Bolívar is 299 m. and the traffic is carried by foreign-owned steamers. Under the administration of President Cipriano Castro this traffic was suspended for a long time, and trans-shipments were made at La Guaira. Above Ciudad Bolívar transportation is effected by two or three small river steamers and a great number of small craft (*lauchas, bungos, balandras*, &c.), using sails, oars and punting poles.

Agriculture.—The principal industries of Venezuela are agricultural and pastoral. Both have suffered heavily from military operations, but still they have remained the basis of Venezuelan wealth and progress. Much the greater part of the republic is fertile and adapted to cultivation. Irrigation, which has not been used to any great extent, is needed in some parts of the country for the best results, but in others, as in the valleys and on the northern slopes of the Maritime Andes, the rainfall is sufficiently well distributed to meet most requirements. The long dry season of the *llanos* and surrounding slopes, which have not as yet been devoted to cultivation, will require a different system of agriculture with systematic irrigation. In colonial times the *llanos* were covered with immense herds of cattle and horses and were inhabited by a race of hardy, expert horsemen, the *llaneros*. Both sides in the War of Independence drew upon these herds, and the *llaneros* were among the bravest in both armies. The end of the war found the *llanos* a desert, both herds and herdsmen having nearly disappeared. Successive civil wars prevented their recovery, and these great plains which ought to be one of the chief sources of meat supply for the world are comparatively destitute of stock, and the only source of revenue from this industry is the small number of animals shipped to the West Indies. The breeding of goats and swine is an important industry in some regions. The climatic conditions are not so favourable as in Argentina, but these are counterbalanced to some extent by the great river system of the Orinoco, whose large navigable tributaries cross the plains from end to end, and whose smaller streams from the surrounding highlands provide superior opportunities for water storage and irrigation. On the *mesas* alfalfa could be substituted for the native grasses and be used for stock when the pasturage of the lower plains is not available. Other industries of the colonial period were the cultivation of indigo and tobacco. The former has nearly disappeared, but the latter is still one of the more important products of the country. The best known tobacco-producing localities are Capadare, Yaritagua, Mérida, Cumanacoa, Guanape, Guaribe and Barinas. The best quality is that from the Capadare district, in the state of Falcón, which rivals that of the Vuelta Abajo of Cuba. No effort is made to improve the Venezuelan product, a part of which is exported to Cuba for cigar making. The principal agricultural products are coffee, cacau (cacao), sugar, Indian corn and beans. Coffee was introduced from Martinique in 1784 and its exportation began five years later. It is grown at elevations of 1600 to 3000 ft., and the yield is reported to be ½ to ¾ lb per tree, which is much less than the yield in São Paulo, Brazil. An official work (Veloz Goiticoa, *Venezuela*, Washington, 1904) gives the number of coffee trees in Venezuela as 250,000,000 belonging to 33,000 estates; the output was 42,806 tons in 1907. Several grades are produced in Venezuela, determined by geographical position, altitude and method of curing and preparing for market. The Maracaibo type from the mountain-slopes of Mérida, Trujillo and Táchira is perhaps the best known and brings the best price. Cacau (*Theobroma cacao*) is an indigenous product and is extensively cultivated on the Caribbean slopes. It requires a high temperature (about 80° F.), rich soil and a high degree of humidity for the best development of the tree. The tree has an average height of 12–13 ft., begins bearing five years after planting, requires little attention beyond occasional irrigation, bears two crops a year (June and December), and produces well until it is forty years of age—the yield being from 490 to 600 lb per acre of 100 trees. There are two grades of Venezuelan cacau—the *criollo* or native, and the *trinitario*, or Trinidad, the first being superior in quality. The best cacau comes from the vicinity of Carácas and is marketed under that name. The exportation of 1907 was about 14,000 tons. Sugar-cane is not indigenous, but it is cultivated with marked success in the lowlands of Zulia, and at various points on the coast. The industry, however, has not kept pace with its development in other countries and, in great part, still employs antiquated methods and machinery. Its principal product is "papelón," or brown sugar, which is put on the market in the shape of small cylindrical and cubical masses of 1¾ to 3½ lb weight. This quality is the only one consumed in the country, with the exception of a comparatively small quantity of granulated, and of refined sugar in tablets prepared for people of the well-to-do classes. The annual output is about 3000 tons. Cotton was produced in several places in colonial times, but the output has declined to a few thousand pounds. The plant is indigenous and grows well, but, unlike cacau, it requires much manual labour in its cultivation and picking and does not seem to be favoured by the planters. Indian corn is widely grown and provides the staple food of the people, especially in the interior. Beans also are a common food, and are universally produced, especially the black bean. Wheat was introduced by the Spaniards immediately after their occupation of Venezuela, and is grown in the elevated districts of Aragua and the western states, but the production does not exceed home consumption. Rice is a common article of food and is one of the principal imports. Several states are offering bounties to encourage its cultivation at home. Other agricultural products are sweet potatoes, cassava (manioc), yuca, yams, white potatoes, maguey, okra, peanuts, pease, all the vegetables of the hot and temperate climates, oranges, lemons, limes, bananas, plantains, figs, grapes, coco-nuts, pine-apples, strawberries, plums, guavas, breadfruit, mangoes and many others. There are also many fruits found growing wild, like those of the cactus and various palms, and these are largely consumed. The forest products, whose collection and preparation form regular industries, are rubber (called *caucho* or *goma*), tonka beans, vanilla, copaiba, chique-chique, sarsaparilla, divi-divi, dye-woods, cabinet-woods and fibres. The rubber forests are on the Orinoco and its tributaries of the Guiana highlands.

Mining.—The principal minerals are gold, copper, iron, sulphur, coal, asphalt and petroleum. Silver, tin, lead, mercury and precious stones are listed among the mineral resources of the country, but no mines have been developed, and they are possibilities only. Gold is found throughout a wide area, but chiefly in the Yuruari region, about 100 m. S.W. of the principal mouth of the Orinoco and near the borders of British Guiana, where the famous El Callao mines are. These mines have produced as much as 181,040·2 Spanish oz. in one year (1886) and a total of 1,320,929·09 oz. from 1871 to 1890, while another report gives an output valued at $23,000,000 U.S. gold in the fifteen years from 1884 to 1899. The production since then has greatly declined. There are 14 copper mines in the country, those at Aroa, 70 m. W. of Puerto Cabello and in railway communication with Tucacas (89 m.), being the most productive. They date from 1605 and now belong to an English company. The output from 1878 to 1891 was 329,218 tons of ore and 53,053 tons of regulus, valued at £2,794,986. Iron of a good quality has been found in the Imataca region, Delta-Amacuro territory, 53 m. from the "Boca Grande" of the Orinoco. The principal coal deposits developed are at Naricual, near Barcelona, and a railway has been constructed to bring the output to the port of Guanta. Asphalt is taken from several deposits—from Maracaibo, Cumaná and Pedernales in the Orinoco delta. The latter place also yields petroleum. Sulphur is mined near Carúpano, and salt in Zulia and on the peninsula of Araya. The latter is a government monopoly, and the high prices at which it is sold constitute a serious prejudice to the people and to industries like that of meat packing.

Pearl Fisheries.—One of the oldest of Venezuelan industries, the Margarita pearl fisheries, was prohibited in 1909 for an indefinite time because of the threatened extinction of the oyster beds. The industry dates from the first exploration of this coast and was probably carried on before that by the natives. The fisheries are established about the islands of Margarita, Coche and Cubagua, the best producing beds being at El Tirano and Macanao, the first N.E. and the other N.W. of Margarita. The natives engaged in the fishery used some 400 sailboats of 3 to 15 tons capacity, and the beds were raked in search of pearl oysters. In 1900 a concession was granted for an exclusive right to fish for pearls, &c., between Margarita and the coast, the contractor to use submarine apparatus.

Manufactures.—There are few manufacturing industries in Venezuela, and these usually of the parasitic type, created by official favour and protected by high tariffs on imports in competition. The manufactures of this class include aerated waters, beer, candles, chocolate, cigarettes, cotton fabrics, hats, ice, matches, boots and shoes, drugs and medicines. There are a number of electric plants, three of which use water power, one at El Encantado, 10 m. from Carácas, one at Mérida, and the third at San Cristóbal, Táchira. The plants using steam for motive power are at Carácas, Maracaibo, Valencia and Puerto Cabello. There has been some development in the manufacture of agricultural machinery and implements, vehicles, pianos and furniture, and some older industries, such as tanning leather and the manufacture of saddles and harness, the milling of wheat and Indian corn, distilling, soap-making, &c. At Guanta there is a factory for the manufacture of patent fuel from Naricual coal and asphalt. In 1901 there was one *saladero*, or meat-packing establishment, in the Orinoco-Apuré region, but it did not prove successful because of the high cost of salt.

Government.—The government of Venezuela is that of a federal republic of nominally independent, self-governing states, administered according to the provisions of the constitution of the 27th of April 1904, modified or revised on the 5th of August 1909. The legislative power is nominally vested in a national Congress of two houses—the Senate and Chamber of Deputies—which meets at Carácas every two years on the 23rd of May, the session lasting 90 days. The Senate consists of two members from each state, or 40 members, who are elected by the state legislatures for a period of four years. A senator must be a native-born citizen and not less than thirty years of age. The Chamber consists of popular representatives, elected by direct vote, in the proportion of one deputy for each 35,000 of population, each state being entitled to at least one deputy, or two in case its population exceeds 15,000, the federal district and territories being entitled to representatives on the same terms. A deputy must also be a native-born citizen, not less than twenty-one years of age, and is elected for a period of four years.

The executive power is vested by the constitution in a president, two vice-presidents and a cabinet of ministers. The president and vice-presidents, who must be Venezuelans by birth and more than thirty years old, are elected by an electoral body or council composed of members of the national Congress, one member from each state and the Federal District. This council elects by an absolute majority of votes. The presidential term is four years (it was six years under the constitution of 1904), and the president cannot succeed himself. The powers of the executive, direct and implied, are very broad and permit the exercise of much absolute authority. The president is assisted by a cabinet of seven ministers and the governor of the federal district, their respective departments being interior, foreign relations, finance and public credit, war and marine, *fomento* (promotion), public works and public instruction. The ministers are required to countersign all acts relating to their respective departments, and are held responsible both before Congress and the courts for their acts. The department of *fomento* is charged with the supervision of all matters relating to agriculture, stock-raising, mines, industries, commerce, statistics, immigration, public lands, posts, telegraphs and telephones. The department of the interior is also charged with matters relating to the administration of justice, religion and public worship.

The judicial power is vested in a supreme federal court, called the Corte Federal y de Casación, and such subordinate tribunals as may be created by law. As the laws and procedure are uniform throughout the republic and all decrees and findings have legal effect everywhere, the state judicial organizations may be considered as taking the place of district federal courts, although the constitution does not declare them so. The federal court consists of 7 members, representing as many judicial districts of the republic, who are elected by Congress for periods of six years (Const. 1904), and are eligible for re-election. It is the supreme tribunal of the republic, having original jurisdiction in cases of impeachment, the constitutionality of laws, and controversies between states or officials. It is also a court of appeal (*Casación*) in certain cases, as defined by law. The judicial organization of the states includes in each a supreme court of three members, a superior court, courts of first instance, district courts and municipal courts. The judicial terms in the states are for three years. In the territories there are civil and criminal courts of first instance, and municipal courts. The laws of Venezuela are well codified both as to law and procedure, in civil, criminal and commercial cases.

The state governments are autonomous and consist of legislative assemblies composed of deputies elected by ballot for a period of three years (Const. 1904), which meet in their respective state capitals on the 1st of December for sessions of thirty days, and for each a president and two vice-presidents chosen by the legislative assembly for a term of three years. The states are divided into districts and these into *municipios*, the executive head of which is a *jefe politico*. There is a municipal council of seven members in each district, elected by the municipios, and in each municipio a communal junta appointed by the municipal council. The governors of the federal territories are appointees of the president of the republic, and the *jefe politico* of each territorial municipio is an appointee of the governor. The Federal District is the seat of federal authority, and consists of a small territory surrounding Carácas and La Guaira, known in the territorial division of 1904 as the West district, and the island of Margarita and some neighbouring islands, known as the East district.

There are two classes of citizens in Venezuela—native-born and naturalized. The first includes the children of Venezuelan parents born in foreign countries; the latter comprises four classes: natives of Spanish-American republics, foreign-born persons, foreigners naturalized through special laws and foreign women married to Venezuelans. The power of granting citizenship to foreigners is vested in the president of the republic, who is also empowered to refuse admission to the country to undesirable foreigners, or to expel those who have violated the special law (April 11, 1903) relating to their conduct in Venezuelan territory. The right of suffrage is exercised by Venezuelan males over 21 years of age, and all electors are eligible to public office except where the constitution declares otherwise. Foreign companies are permitted to transact business in Venezuela, subject to the laws relating to non-residents and also to the laws of the country governing national companies.

Army.—The military forces of Venezuela consist nominally of about 20 battalions of infantry, of 400 men each. and 8 batteries of artillery, of 200 men each. There is also a battalion of marines employed about the ports and in the arsenals. The organization and equipment is defective, and the force deficient in numbers and discipline. The police force and fire companies in the larger cities are organized on a military basis, and are sometimes used for military purposes. For a people so accustomed to revolutionary outbreaks, the Venezuelans are singularly deficient in military organization. There is no lack of officers of the highest grades, but the rank and file are not uniformed, equipped or drilled, and military campaigns are usually irregular in character and of comparatively short duration. It should be said that Venezuela has a modern military organization so far as law can make it. It is drawn in imitation of European models, and makes military service compulsory for all Venezuelans between 21 and 50 years. This national force is divided into actives and reserves, the strength of the first being fixed by Congress, and all the rest, of unknown number, belong to the latter. The provisions of the law, however have never been enforced, and the actives or regular army are recruited by impressment rather than through conscription. There is a military academy at Carácas, and battalion schools are provided for officers and privates, but they are of little value.

Education.—In popular education Venezuela has done almost nothing worthy of record. As in Chile, Peru and Colombia, the ruling classes and the Church have taken little interest in the education of the Indians and *mestizos*. Venezuela, it is true, has a comprehensive public instruction law, and attendance at the public schools is both gratuitous and nominally compulsory. But outside the cities, towns and large villages near the coast there are no schools and no teachers, nor has the-government done anything to provide them. This law has been in force since about 1870, but on the 30th of June 1908 there were only 1150 public schools in the republic with a total enrolment of 35,777 pupils. There are a number of parochial and conventual schools, the church being hostile to the public-school system. An overwhelming majority of the people is illiterate and is practically unconscious of the defect. In 1908 the educational facilities provided by the republic, not including some private subventioned schools, were two universities and thirty-three national colleges. The universities are at Carácas and Mérida, the latter known as the Universidad de los Andes. The Carácas institution dates from early colonial times and numbers many prominent Venezuelans among its alumni. The national college corresponds to the lyceum and high school of other countries. There are law, medical and engineering schools in the country, but one rarely hears of them. The episcopal seminaries are usually good, especially the one at Carácas. In addition to these, there are normal, polytechnic, mining and agricultural schools, the last at Carácas and provided with a good library and museum. There are several mechanics' schools (*Artes y Oficios*) in the larger cities, and a large number of private schools. Further educational facilities are provided by a national library with about 50,000 volumes, a national museum, with a valuable historical collection, the Cajigal Observatory, devoted to astronomical and meteorological work, and the Venezuelan Academy and National Academy of History—the first devoted to the national language and literature, and the second to its history.

Religion.—The Roman Catholic is the religion of the state, but freedom of worship is nominally guaranteed by law. The president, however, is empowered to deny admission into the country of foreigners engaged in special religious work not meeting his approval. Practically no other form of worship exists in the country than that of the Roman Catholic Church, the Protestant and other denominations holding their services in inconspicuous chapels or private apartments in the larger cities, where considerable numbers of foreigners reside. The state contributes to the support of the Church, builds its churches and provides for the salaries of its clergy, and at the same time it has the right to approve or reject all ecclesiastical appointments and to permit or forbid the execution of all decrees of the Roman See relating to Venezuela. The Church hierarchy consists of one archbishop (Carácas) and four suffragan bishops (Mérida, Guáyana, Barquisimeto and Guárico).

Finance.—The financial situation in Venezuela was for a long time extremely complicated and discreditable, owing to defaults in the payment of public debts, complications arising from the guarantee of interest on railways and other public works, responsibility for damages to private property during civil wars and bad administration. To meet increasing obligations, taxation has been extended and heavily increased. The public revenues are derived from customs taxes and charges on imports and exports, transit taxes, cattle taxes, profits on coinage, receipts from state monopolies, receipts from various public services such as the post office, telegraph, Carácas waterworks, &c., and sundry taxes, fines and other sources. From 60 to 70% of the revenue is derived from the custom-house, and the next largest source is the transit tax. The official budget returns for 1904–6 show the revenues and expenditures to have been—

	1904. *Bolivares.*	1905. *Bolivares.*	1906. *Bolivares.*
Revenue . . .	57,576,741	49,385,379	49,293,067
Expenditure . . .	52,925,521	54,718,163	51,874,694

A considerable part of the expenditure since 1903 consists of payments on account of foreign debts which Venezuela was compelled to satisfy. To meet these, taxes were increased wherever possible, thus increasing both sides of the budget beyond its normal for those years.

The public debt of Venezuela dates back to the War of Independence, when loans were raised in Europe for account of the united colonies of Colombia, Ecuador and Venezuela. The separation of the Colombian republic into its three original parts took place in 1830, and in 1834 the foreign debt contracted was divided among the three, Venezuela being charged with 28½%, or £2,794,826, of which £906,430 were arrears of interest. Other items were afterwards added to liquidate other obligations than those included in the above, chiefly on account of the internal debt. Several conversions and compositions followed, interest being paid irregularly. In 1880–81 there was a consolidation and conversion of the republic's foreign indebtedness through a new loan of £2,750,000 at 3%, and in 1896 a new loan of 50,000,000 *bolivares* (£1,980,198) for railway guarantees and other domestic obligations. In August 1904 these loans and arrears of interest brought the foreign debt up to £5,618,725, which in 1905 was converted into a "diplomatic" debt of £5,229,700 (3%). During these years Venezuela had been pursuing the dangerous policy of granting interest guarantees on the construction of railways by foreign corporations, which not only brought the government into conflict with them on account of defaulted payments, but also through disputed interpretations of contracts and alleged arbitrary acts on the part of government officials. In the civil wars the government was also held responsible for damages to these properties and for the mistreatment of foreigners residing in the country. Some of these claims brought Venezuela into conflict with the governments of Great Britain, Germany and Italy in 1903, and Venezuelan ports were blockaded and there was an enforced settlement of the claims (about £104,417), which were to be paid from 30% of the revenues of the La Guaira and Puerto Cabello custom-houses. This settlement was followed by an adjustment of all other claims, payment to be effected through the same channels. In 1908 (July 31) the total debt of Venezuela (according to official returns) consisted of the following items:—

	Bolivares.
Consolidated internal debt	63,171,818
Diplomatic debt (Spanish, French and Dutch) .	7,014,569
„ „ (French, 1903–4)	5,733,490
„ „ of 1905	132,049,925
Unconsolidated debt in circulation . . .	4,561,742
Total .	212,531,544
or, at 25¼ *bolivares* per £.	£8,417,091

The currency of Venezuela is on a gold basis, the coinage of silver and nickel is restricted, and the state issues no paper notes. Foreign coins were formerly legal tender in the republic, but this has been changed by the exclusion of foreign silver coins and the acceptance of foreign gold coins as a commodity at a fixed value. Under the currency law of the 31st of March 1879, the thousandth part of a kilogramme of gold was made the monetary unit and was called a *bolivar*, in honour of the Venezuelan liberator. The denominations provided for by this law are—

Gold: 100, 50, 20, 10 and 5 *bolivares.*
Silver: 5, 2, 1 *bolivares*; 50, 20 *céntimos.*
Nickel: 12½ and 5 *céntimos.*

These denominations are still in use except the silver 20-*céntimos* piece, which was replaced by one of 25 *céntimos* in 1891. The silver 5-*bolivar* piece is usually known as a "dollar," and is equivalent to 48¼ pence, or 96½ cents U.S. gold. The old "peso" is no longer used except in accounts, and is reckoned at 4 *bolivares*, being sometimes described as a "soft" dollar. Silver and nickel are legal tender for 50 and 20 *bolivares* respectively. Paper currency is issued by the banks of Venezuela, Carácas and Maracaibo under the provisions of a general banking law, and their notes, although not legal tender, are everywhere accepted at their face value.

The metric weights and measures have been officially adopted by Venezuela, but the old Spanish units are still popularly used throughout the country. (A. J. L.)

History.—The coast of Venezuela was the first part of the American mainland sighted by Columbus, who, during his third voyage in 1498, entered the Gulf of Paria and sailed along the coast of the delta of the Orinoco. In the following year a much greater extent of coast was traced out by Alonzo de Ojeda, who was accompanied by the more celebrated Amerigo Vespucci. In 1550 the territory was erected into the captain-generalcy of Carácas, and it remained under Spanish rule till the early part of the 19th century. During this period negro slaves were introduced; but less attention was given by the Spaniards to this region than to other parts of Spanish America, which were known to be rich in the precious metals.

In 1810 Venezuela rose against the Spanish yoke, and on the 14th of July 1811 the independence of the territory was proclaimed. A war ensued which lasted for upwards of ten years and the principal events of which are described under Bolivar (*q.v.*), a native of Carácas and the leading spirit of the revolt. It was not till the 30th of March 1845 that the independence of the republic was recognized by Spain in the treaty of Madrid. Shortly after the battle of Carabobo (June 24, 1821), by which the power of Spain in this part of the world was broken, Venezuela was united with the federal state of Colombia, which embraced the present Colombia and Ecuador; but the Venezuelans were averse to the Confederation, and an agitation was set on foot in the autumn of 1829 which resulted in the issue of a decree (December 8) by General Paez dissolving the union, and declaring Venezuela a sovereign and independent state. The following years were marked by recurring attempts at revolution, but on the whole Venezuela during the period 1830–1846 was less disturbed than the neighbouring republic owing to the dominating influence of General Paez, who during the whole of that time exercised practically dictatorial power. In 1849 a successful revolution broke out and Paez was driven out of the country. The author of his expulsion, General José Tadeo Monagas, had in 1847 been nominated, like so many of his predecessors, to the presidency by Paez, but he was able to win the support of the army and assert his independence of his patron. Paez raised the standard of revolt, but Monagas was completely victorious. For ten years, amidst continual civil war, Monagas was supreme. The chief political incident of his rule was a decree abolishing slavery in 1854. General Juan José Falcon, after some years of civil war and confusion, maintained himself at the head of affairs from 1863 to 1868. In 1864 he divided Venezuela into twenty states and formed them into a Federal republic. The twenty parties whose struggles had caused so much strife and bloodshed were the Unionists, who desired a centralized government, and the Federalists, who preferred a federation of semi-autonomous provinces. The latter now triumphed. A revolt headed by Monagas broke out in 1868, and Falcon had to fly the country. In the following year Antonio Guzman Blanco succeeded in making himself dictator, after a long series of battles in which he was victorious over the Unionists.

For two decades after the close of these revolutionary troubles in 1870 the supreme power in Venezuela was, for all practical purposes, in the hands of Guzman Blanco. He evaded the clause in the constitution prohibiting the election of a president for successive terms of office by invariably arranging for the nomination of some adherent of his own as chief of the executive, and then pulling the strings behind this figurehead. The tenure of the presidential office was for two years, and at every alternate election Guzman Blanco was declared to be duly and legally chosen to fill the post of chief magistrate of the republic. In 1889 there was an open revolt against the dictatorial system so long in vogue; and President Rojas Paul, Blanco's *locum tenens*, was forced to flee the country and take refuge in the Dutch colony of Curaçoa. A scene of riot and disorder was enacted in the Venezuelan capital. Statues of Blanco, which had been erected in various places in the city of Carácas, were broken by the mob, and wherever a portrait of the dictator was found it was torn to pieces. No follower of the Blanco regime was safe. An election was held and General Andueza Palacios was nominated president. A movement was set on foot for the reform of the constitution, the principal objects of this agitation being to prolong the presidential term to four years, to give Congress the right to choose the president of the republic, and to amend certain sections concerning the rights of persons taking part in armed insurrection arising out of political issues. All might have gone well for President Palacios had he not supposed that this extension of the presidential period might be made to apply to himself.

His attempt to force this question produced violent opposition in 1891, and ended in a rising headed by General Joaquin Crespo. This revolt, which was accompanied by severe fighting, ended in 1892 in the triumph of the insurgents, Palacios and his followers being forced to leave the country to save their lives. General Crespo became all-powerful; but he did not immediately accept the position of president. The reform of the constitution was agreed to, and in 1894 General Crespo was duly declared elected to the presidency by Congress for a period of four years. One of the clauses of the reformed constitution accords belligerent rights to all persons taking up arms against the state authority, provided they can show that their action is the outcome of political motives. Another clause protects the property of rebels against confiscation. Indeed, a premium on armed insurrection is virtually granted.

In April 1895 the long-standing dispute as to the boundary between British Guiana and Venezuela was brought to a crisis by the action of the Venezuelan authorities in arresting Inspectors Barnes and Baker, of the British Guiana police, with a few of their subordinates, on the Cuyuni river, the charge being that they were illegally exercising the functions of British officials in Venezuelan territory. Messrs Barnes and Baker were subsequently released, and in due course made their report on the occurrence. For the moment nothing more was heard of this boundary question by the public, but General Crespo instructed the Venezuelan minister in Washington to ask for the assistance of the United States in the event of any demand being made by the British Government for an indemnity. Whilst this frontier difficulty was still simmering, an insurrection against General Crespo was fomented by Dr J. P. Rojas Paul, the representative of the Blanco regime, and came to a head in October 1895, risings occurring in the northern and southern sections of the republic. Some desultory fighting took place for three or four months, but the revolt was never popular, and was completely suppressed early in 1896. The Guiana boundary question began now to assume an acute stage, the Venezuelan minister in Washington having persuaded President Cleveland to take up the cause of Venezuela in vindication of the principles of the Monroe doctrine. On the 18th of December 1895 a message was sent to the United States Congress by President Cleveland practically stating that any attempt on the part of the British Government to enforce its claims upon Venezuela as regards the boundary between that country and Guiana without resort to arbitration would be considered as a *casus belli* by his government. The news of this message caused violent agitation in Carácas and other towns. A league was formed binding merchants not to deal in goods of British origin; patriotic associations were established for the purpose of defending Venezuela against British aggression, and the militia were embodied. The question was subsequently arranged in 1899 by arbitration, and by the payment of a moderate indemnity to the British officers and men who had been captured. Diplomatic relations between the two countries, which had been broken off in consequence of the dispute, were resumed in 1897.

In 1898 General Crespo was succeeded as president by Señor Andrade, who had represented Venezuela in Washington during the most acute stage of the frontier question. Towards the end of the year a revolutionary movement took place with the object of ousting Andrade from power. The insurrection was crushed, but in one of the final skirmishes a chance bullet struck General Crespo, who was in command of the government troops, and he died from the effects of the wound. A subsequent revolt overthrew President Andrade in 1900. General Cipriano Castro then became president. During 1901 and 1902 the internal condition of the country remained disturbed, and fighting went on continually between the government troops and the revolutionists.

The inhabitants of Venezuela have a right to vote for the members of Congress, but in reality this privilege is not exercised by them. Official nominees are as a rule returned without any opposition, the details of the voting having been previously arranged by the local authorities in conformity with instructions from headquarters. In these circumstances the administration of public affairs fell into the hands of an oligarchy, who governed the country to suit their own convenience. President Castro was for eight years a dictator, ruling by corrupt and revolutionary methods, and in defiance of obligations to the foreign creditors of the country. The wrongs inflicted by him on companies and individuals of various nationalities, who had invested capital in industrial enterprises in Venezuela, led to a blockade of the Venezuelan ports in 1903 by English, German and Italian warships. Finding that diplomacy was of no avail to obtain the reparation from Castro that was demanded by their subjects, the three powers unwillingly had recourse to coercion. The president, however, sheltered himself behind the Monroe doctrine and appealed to the government of the United States to intervene. The dispute was finally referred by mutual consent to the Hague Court of Arbitration. The Washington government had indeed no cause to be well disposed to Castro, for he treated the interests of Americans in Venezuela with the same high-handed contempt for honesty and justice as those of Europeans. The demand of the United States for a revision of what is known as the Olcott Award in connexion with the Orinoco Steamship Company was in 1905 met by a refusal to reopen the case. Meanwhile the country, which up to the blockade of 1903 had been seething with revolutions, now became much quieter. In 1906, the president refused to allow M. Taigny, the French minister, to land, on the ground that he had broken the quarantine regulations. In consequence, France broke off diplomatic relations. In the following year, by the decision of the Hague Tribunal, the Venezuela government had to pay the British, German and Italian claims, amounting to £691,160; but there was still £840,000 due to other nationalities, which remained to be settled. The year 1907 was marked by the repudiation of the debt to Belgium, and fresh difficulties with the United States. Finally, in 1908 a dispute arose with Holland on the ground of the harbouring of refugees in Curaçoa. The Dutch Minister was expelled, and Holland replied by the despatch of gunboats, who destroyed the Venezuelan fleet and blockaded the ports. In December General Castro left upon a visit to Europe, nominally for a surgical operation. In his absence a rising against the dictator took place at Carácas, and his adherents were seized and imprisoned. Juan Vincenti Gomez, the vice-president, now placed himself at the head of affairs and formed an administration. He was installed as president in June 1910.

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VENGURLA, a seaport on the west coast of India in Ratnagiri district, Bombay. Pop. (1901) 19,018. It was an early site of both Dutch and English factories, and was formerly the port for communication with the garrisons in the Southern Mahratta country. In the neighbourhood are the "Burnt Islands," with the Vengurla Rock lighthouse.

VENICE (*Venezia*), a city and seaport of Italy, occupying one of the most remarkable sites in the world. At the head of the Adriatic, between the mountains and the sea, lies that part of the Lombard plain known as the Veneto. The whole of this plain has been formed by the *débris* swept down from the Alps by the rivers Po, Ticino, Oglio, Adda, Mincio, Adige, Brenta, Piave, Livenza, Tagliamento and Isonzo. The substratum of the plain is a bed of boulders, covered during the lapse of ages by a deposit of rich alluvial soil. The rivers when they debouch from the mountains assume an eastern trend in their effort to reach the sea. The result is that the plain is being gradually extended in an easterly direction, and cities like Ravenna, Adria and Aquileia, which were once seaports, lie now many miles inland. The encroachment of land on sea has been calculated at the rate of about three miles in a thousand years. A strong current sets round the head of the Adriatic from east to west. This current catches the silt brought down by the rivers and projects it in long banks, or *lidi*, parallel with the shore. In process of time some of these banks, as in the case of Venice, raised themselves above the level of the water and became the true shore-line, while behind them lay large surfaces of water, called lagoons, formed partly by the fresh water brought down by the rivers, partly by the salt-water tide which found its way in by the channels of the river mouths. Along the coast-line, roughly speaking between the Apennines at Rimini and the Carnic Alps at Trieste, three main systems of lagoons were thus created, the lagoon of Grado or Marano to the east, the lagoon of Venice in the middle, and the lagoon of Comacchio to the south-west (for plan, see HARBOUR). All three are dotted with small islands, possibly the remains of some earlier *lido*. These islands are little else than low mud banks, barely rising above the water-level. On a group of these mud banks about the middle of the lagoon of Venice stands the city of Venice. It would be difficult to imagine a site less adapted for the foundation and growth of a great community. The soil is an oozy mud which can only be made capable of carrying buildings by the artificial means of pile-driving; there is no land fit for agriculture or the rearing of cattle; the sole food supply is fish from the lagoon, and there is no drinking-water save such as could be stored from the rainfall. Yet the group of islands called Rialto, in mid-Venetian lagoon, were first the asylum and then the magnificent and permanent home of a race that took a prominent part in the medieval and Renaissance history of Europe. The local drawbacks and difficulties once surmounted, Venice by her geographical position became the seaport nearest the heart of Europe.

Ethnography and Early History.—As to the ethnography of the race little is known that is certain. It has frequently been said that the lagoon population was originally composed of refugees from the mainland seeking asylum from the incursions of Huns, Goths and Lombards; but it is more probable that, long before the date of the earliest barbarian inroad, the lagoon islands already had a population of fisherfolk. In any case we may take it that the lagoon-dwellers were racially identical with the inhabitants of the neighbouring mainland, the Heneti or Veneti. That the Heneti themselves were immigrants is generally admitted. The earlier ethnographers, like Strabo, put forward three theories as to the original home of the race. Strabo himself talks of Armoric Heneti, and supposes them to have come from the neighbourhood of Brittany, another theory gives us Sarmatian Heneti, from the Baltic provinces; while the most widely accepted view was that they reached Italy from Paphlagonia. Modern scholarship has rejected these theories. Pauli and Kretschmer, proceeding on the basis of language, have reached conclusions which in the main are identical. Pauli, who has published all the known inscriptions of the Heneti, holds that the language is Illyrian, closely connected with Messapian. Kretschmer goes further and divides the Illyrian language into two sharply defined dialects, the northern dialect being represented by the Heneti. The result is that in the present condition of our knowledge we must conclude that the Heneti were a branch of the Illyrian people. The Eneti of Paphlagonia, the Veneti of Brittany and the Venedi of the Baltic, are probably quite distinct, and the similarity of name is merely a coincidence.

The dwellings of the primitive settlers in the lagoons were, in all probability, rude huts made of long reeds, such as may be seen to this day in the lagoon of Grado. A ditch was cut deep into the mud so as to retain the water at low tide, and there the boats of the fishermen lay. The ground about the hut was made solid and protected from corrosion by a palisade of wattled osiers, thus creating the earliest form of the *fondamenta*, or quay, which runs along the side of so many Venetian canals and is so prominent a feature in the construction of the city. Gradually, as time went on, and probably with the influx of refugees from the mainland, bricks made of lagoon mud came to take the place of wattle and reeds in the construction of the houses. Groups of dwellings, such as are still to be seen on some of the small canals at Burano, clustered together along the banks of the deeper channels which traverse the lagoon islands and give access to the tide. It is these channels which determined the lines of construction; the dwellings followed their windings, and that accounts for the extraordinarily complex network of calles and canals which characterizes modern Venice. The alleys or *calli* number 2327, with a total length of 89¾ m.; the canals number 177 and measure 28 m. The whole site of Venice is dominated by the existence of one great main canal, the Grand Canal, which, winding through the town in the shape of the letter S, divides it into two equal parts. This great canal was probably at one time the bed of a river flowing into the lagoons near Mestre. The smaller canals all serve as arteries to the Grand Canal. One other broad canal, once the bed of the Brenta, divides the island of the Giudecca from the rest of the city and takes its name from that island. The ordinary Venetian house was built round a courtyard, and was one storey high; on the roof was an open *loggia* for drying clothes; in front, between the house and the water, ran the *fondamenta*. The earliest churches were built with cemeteries for the dead; and thus we find the nucleus of the city of Venice, little isolated groups of dwellings each on its separate islet, scattered, as Cassiodorus[1] says, like sea-birds' nests over the face of the waters. Some of the islets were still uninhabited, covered with a dense low growth which served as cover for game and even for wolves.

With the destruction of the mainland cities by repeated barbarian invasions, and thanks to the gradual development of Venice as a centre of coasting trade in the northern Adriatic, the aspect of the city changed. Brick and more rarely stone took the place of wood and wattle. The assaults of the Dalmatian pirates, attracted by the growing wealth of the city, necessitated the building of strong castellated houses, of which no example has come down to our day, but we may gather what they were like from Petrarch's description of his house on the Riva degli Schiavoni, with its two flanking towers, probably retaining the primitive form, and also from the representations of protecting towers which occur in Carpaccio's pictures. The canals too were guarded by chains stretched across their mouths and by towers in some cases, as, for example, in the case of the Torresella Canal, which takes its name from these defence works. These houses clustered round the churches which now began to be built in considerable numbers, and formed the various *contrade* of the city. The *Cronica altinate* in the vision of Fra Mauro gives us a picturesque account of the founding of the various parishes, Olivolo or Castello, St Raffaello, St Salvadore, Sta Maria Formosa, S. Giovanni in Bragora, the Apostoli and Sta Giustina Tradition has it that the earliest church in Venice was S. Giacomo di Rialto, said to have been founded in 432. The canals between these clusters of houses were deepened and cleared out, and in some cases trees were planted along the banks, or *fondamenta*; we hear of the cypresses on San Giorgio Maggiore, of an ancient mulberry tree at San Salvadore, of a great elder tree near the Procuratie Vecchie where the magistrates were wont to tie their horses. There were vineyards and orchards (*broli*) on land reclaimed from the sea, and lying between the various clusters of houses, which had not yet been consolidated into one continuous city. The canals were crossed by wooden bridges without steps, and in the case of the wide Grand Canal the bridge at Rialto was carried on boats. Gradually, however, stone bridges came into use. The earliest of these was the bridge of San Zaccaria, mentioned in a document of 1170. The Rialto bridge was designed in 1178 by Nicolo Barattieri, and was carried on pontoons. In 1255 and 1264 it was rebuilt, still in wood. It was carried on beams and could be raised in the middle, as we see it in Carpaccio's picture of "The Miracle of the Cross." The present bridge, the work of Antonio or Giovanni Contino, whose nickname was da Ponte, dates from 1588–91, and cost 250,000 ducats. The same architect was responsible for the lofty "Bridge of Sighs" (1595–1605), connecting the ducal palace with the state prisons (1591–97) on the opposite side of the narrow canal on the east of the Rio del Palazzo.

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[1] Secretary to Theodoric the Great, in a letter dated A.D. 523.

The early bridges were inclined planes and could easily be crossed by horses. It was not till the city became more populous and when stone-stepped bridges were introduced that the use of horses died out. As late as 1365 the Doge Lorenzo Celsi owned a famous stud of chargers, and in 1490 the Doge Michele Steno's stables, where the present Zecca stands, were famous throughout Italy. In 1392 a law put an end to riding in the Merceria, on account of the crowd, and all horses and mules were obliged to carry bells to warn foot-passengers. The lanes and alleys of the early city were unpaved and filthy with slops from the houses. But in the 13th century the Venetians began to pave the more frequented streets with brick. Ferries or *traghetti* for crossing the canals were also established as early as the 13th century; we find record of ferries at San Gregorio, San Felice, San Tomà, San Samuele, and so on, and also of longer ferries to the outlying islands like Murano and Chioggia, or to the mainland at Mestre and Fusina. The boatmen early erected themselves into gilds.

Gondolas.—The characteristic conveyances on the canals of Venice—which take the place of cabs in other cities—are the gondolas, flat-bottomed boats, some 30 ft. long by 4 or 5 ft. wide, curving out of the water at the ends, with ornamental bow and stern pieces and an iron beak (*ferro*), resembling a halberd, which is the highest part of the boat. The gondolier stands on a *poppa* at the stern with his face towards the bow, and propels the gondola with a single oar. There is a low cabin (*felze*) for passengers; the ordinary gondolas can take four or six persons, and larger ones (*barca* or *battello*) take eight. Gondolas are mentioned as far back as 1094, and, prior to a sumptuary edict passed by the great council in the 16th century, making black their compulsory colour, they were very different in appearance from now. Instead of the present boat, with its heavy black cabin and absence of colouring, the older forms had an awning of rich stuffs or gold embroideries, supported on a light arched framework open at both ends; this is the gondola still seen in Carpaccio's and Gentile Bellini's pictures (*c.* 1500). Since 1880 services of omnibus steamers (now municipal) have also been introduced.

Byzantine Architecture.—We can trace the continuous growth of Venice through the successive styles of Byzantine, Gothic, early Renaissance and late Renaissance architecture. The whole subject is magnificently treated in Ruskin's *Stones of Venice*. The two most striking buildings in Venice, St Mark's and the Doge's Palace, at once give us an example of the two earlier styles, the Byzantine and the Gothic, at least in their general design, though both are so capricious in development and in decoration that they may more justly be considered as unique specimens rather than as typical examples of their respective styles. In truth, owing to its isolated position on the very verge of Italy, and to its close connexion with the East, Venetian architecture was an independent development. Though displaying a preponderance of Oriental characteristics, it retained a quality of its own quite unlike the styles evolved by other Western countries.

The Byzantine style prevailed in Venice during the 11th and 12th centuries. The arches of this period are semicircular and usually highly stilted. Sculptured ornamentation, flowing scroll-work of semi-conventional foliage mingled with grotesque animals, birds or dragons, is freely applied to arches and string courses. The walls are built of solid brickwork and then covered with thin slabs of rich and costly marbles. Sculptured panels, with conventional motives, peacocks, eagles devouring hares, peacocks drinking from a cup on a tall pillar, are let into both exterior and interior walls, as are roundels of precious marbles, sawn from columns of porphyry, serpentine, verd antique, &c. The adoption of veneer for decoration prohibited any deep cutting, and almost all the sculpture is shallow. Only in the capitals, which are of extraordinary richness and variety, do we get any deep or bold relief. Dentil mouldings, of which examples may still be seen in the remains of the palace of Blachernae at Constantinople, are characteristic of Venetian ornamentation at this period, and remain a permanent feature in Venetian architecture down to the 11th century. The dome is the leading idea or motif in Byzantine ecclesiastical architecture; the domes are placed over square, not circular apartments, and their bases are brought to a circle by means of pendentives. In exterior elevation the chief effect is produced by the grouping of the domes. In the interior the effect is gained by broad masses of chromatic decoration in marble-veneer and mosaics on a gold ground to cover the walls and vaults, and by elaborate pavements of *opus sectile* and *opus Alexandrinum*. Owing to the marshy site the foundations of buildings in Venice offered considerable difficulties. A trench was dug in the soft upper mud until the stratum of stiff blue clay was reached. Piles of elm, oak, white poplar or larch were driven into this clay to the depth of 16 to 20 ft. or until absolute resistance was encountered. The heads of the piles were from 10 to 11 in. in diameter and they were driven in almost in contact. On this surface of pile heads was laid a platform of two layers of squared oak beams; and on this again the foundations proper were built. In some cases, however, as for example in the ducal palace itself, if the clay appeared sufficiently firm, the piles were dispensed with and the foundations went up directly from the oak platform which rested immediately on the clay. During the middle ages the walls of Venetian buildings were constructed invariably of brick. They were usually solid, but in some cases they were built *a sacco*—that is to say, two thin outer walls were built and the space between them was filled with grouted rubble. The delicate creamy Istrian stone, which is now so prominent a feature in Venetian architecture, did not come into common use till after the 11th century, when the Istrian coast became permanently Venetian. Before 1405 the mortar used in Venice was made of lime from Istria, which possessed no hydraulic qualities and was consequently very perishable, a fact which to a large extent accounts for the fall of the Campanile of San Marco. But when Venice took possession of the mainland her builders were able to employ a strong hydraulic dark lime from Albettone, which formed a durable cement, capable of resisting salt water and the corrosive sea air.

St Mark's.

The church of St Mark's, originally the private chapel of the doge, is unique among the buildings of the world in respect of its unparalleled richness of material and decoration. It grew with the growing state whose religious centre it was, and was adorned with the spoils of countless other buildings, both in the East and on the Italian mainland. A law of the republic required every merchant trading to the East to bring back some material for the adornment of the fane. Indeed, the building has been compared to the treasure den of a gang of "sea sharkers," and from a museum of sculpture of the most varied kind, nearly every century from the 4th down to the latest Renaissance being represented. The present church is the third on this site. Soon after the concentration at Rialto (see *History* below), a small wooden church was erected about the year 828 for the reception of the relics of St Mark, which had been brought from Alexandria when the Moslems pulled down the church where he was buried. St Mark then became the patron saint of Venice in place of St Theodore. This church was burned in 976 along with the ducal palace in the insurrection against the Doge Candiano IV Pietro Orseolo and his successors rebuilt the church on a larger scale in the form of a basilica with three eastern apses and no transept, and Byzantine workmen were employed. As the state grew in wealth and importance the church grew with it. About the year 1063 the Doge Contarini resolved to remodel St Mark's. There can be no doubt that Byzantine artists had a large share in the work, but it is equally certain that Lombard workmen were employed along with the Orientals, and thus St Mark's became, as it were, a workshop in which two styles, Byzantine and Lombard, met and were fused together, giving birth to a new style, peculiar to the district, which may fairly be called Veneto-Byzantine.

In plan (see the article ARCHITECTURE) St Mark's is a Greek cross of equal arms, covered by a dome in the centre, 42 ft. in diameter, and by a dome over each of the arms. The plan is derived from the Church of the Holy Apostles at Constantinople, now covered by the mosque of Mahommed II., and bears a strong resemblance to the plan of St Front at Périgueux in France (1120). The addition of a narthex before the main front and a vestibule on the northern side brings the whole western arm of the cross to a square on plan. In elevation the façade seems to have connexion with the five-bayed façade of the Kahriyeh Jamè, or mosaic mosque, at Constantinople. The exterior façade is enriched with marble columns brought from Alexandria and other cities of the East, and bearing in many cases incised graffiti. Mosaics are employed to decorate the spandrils of the arches. Only one of the original mosaics now exists, the one over the doorway at the north-western, or St Alipio, angle. Its subject, which is of high historical value as a record of costume, represents the translation of the body of St Mark, and gives us a view of the west façade of the church as it was at the beginning of the 13th century before the addition of the ogee gables, with alternating crockets and statues, and the intermediate pinnacled canopies placed between the five great arches of the upper storey. The top of the narthex forms a wide gallery, communicating with the interior at the triforium level. In the centre of this gallery stand the four colossal bronze horses which belonged to some Graeco-Roman triumphal quadriga, and were brought to Venice by the Doge Enrico Dandolo after the fall of Constantinople in 1204; they were carried off by Napoleon to Paris in 1797, and restored by Francis of Austria in 1815.

Mosaic is the essential decoration of the church, and the architectural details are subordinated to the colour scheme. These mosaics belong to very various dates. The Doge Domenico Selvo began the decoration of the church in 1071, though it is uncertain whether any of his work can be now identified. The mosaics of the domes would seem to belong to the 12th century, probably before 1150. The mosaics of the atrium date from 1200 to 1300; the subjects are taken from Old Testament story. The baptistery mosaics represent the life of St John. The mosaics in the chapel of St Isidore (finished by Andrea Dandolo), giving us the life of the saint, were executed in 1355. In the sacristy is a series of 10th-century mosaics, and in other parts of the church are inferior and later mosaics from cartoons by later Venetian masters. Below the mosaics the walls and arches are covered with rare marbles, porphyries and alabaster from ancient columns sawn into slices and so arranged in broad bands as to produce a rich gamut of colour.

The eastern crypt, or *confessio*, extends under the whole of the choir and has three apses, like the upper church. The body of St Mark formerly rested here, but is now within the high altar. Below the nave is another crypt. The floors of both crypts have sunk considerably and are often under water; this settlement accounts for the inequalities of the pavement. The original part of the magnificent mosaic pavement probably dates from the middle of the 12th century, if we may judge from the pavement at Murano, exactly similar in style, material and workmanship, which bears the date 1140. The pavement consists partly of *opus Alexandrinum* of red and green porphyry mixed with marbles, partly of tesselated work of glass and marble tesserae.

The choir stands about 4 ft. above the nave and is separated from it by a marble rood-screen, on the architrave of which stand fourteen figures, the signed work of Jacobello and Pietro Paolo delle Masegne, 1394.

The Pala d'oro, or retable of the high altar, is one of the chief glories of St Mark's. It is one of the most magnificent specimens of goldsmiths' and jewellers' work in existence. It was ordered in 976 at Constantinople by the Doge Pietro I. Orseolo, and was enlarged and enriched with gems and modified in form, first by a Greek artificer in 1105, and then by Venetians between 1209 and 1345. It is composed of figures of Christ, angels, prophets and saints, in Byzantine enamel run into gold plates. It is about 11 ft. 6 in. wide, and about 4 ft. 8 in. high. It contains 1300 great pearls, 400 garnets, 90 amethysts, 300 sapphires, 300 emeralds, 15 rubies, 75 balas rubies, 4 topazes, 2 cameos; the gems, except where they have been replaced, are cut *en cabochon*. The treasury of St Mark's contains a magnificent collection of church plate and jewels.

Fine examples of Venetian Byzantine palaces—at least of the façades—are still to be seen on the Grand Canal and in some of the small canals. The interiors have been modified past recognition of their original disposition. The Byzantine palace seems to have had twin angle-towers—*geminas angulares turres*—such as those of the Ca' Molin on the Riva degli Schiavoni, where Petrarch lived. The restored (1880) Fondaco[1] dei Turchi (13th century), now the Museo Civico, also has two angle-towers. The façades presented continuous colonnades on each floor with semicircular high stilted arches, leaving a very small amount of wall space. The buildings were usually battlemented in fantastic form. A good specimen may be seen in Lazzaro Sebastiani's picture of the piazzetta, in the Museo Civico. There on the right we see the handsome building of the old bakery, occupying the site of the present library; it has two arcades of Saracenic arches and a fine row of battlements. Other specimens still in existence are the municipal buildings, Palazzo Loredan and Palazzo Farsetti—if, indeed, these are not to be considered rather as Romanesque—and the splendid Ca' da Mosto, all on the Grand Canal. The richest ornamentation was applied to the arches and string courses, while plaques of sculpture, roundels and coats of arms adorned the façades. The remains of a Byzantine façade now almost entirely built into a wall in the Rio di Ca' Foscari offer us excellent illustration of this decorative work.

Byzantine palaces.

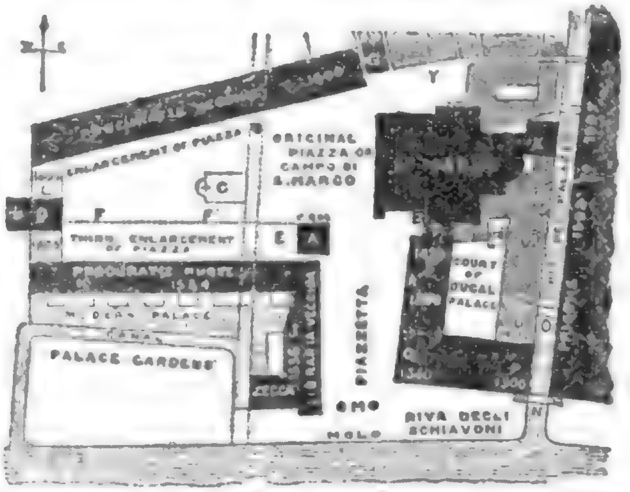

FIG. 1.—Square of St Mark and surrounding buildings. The original *campo* was bounded on the west by the canal B, with the 6th-century church of S. Geminiano, C, on its west bank. The first enlargement of the square was effected by Doge Sebastiano Ziani in 1176, when he filled up the canal and rebuilt the church on a new site at D, thus nearly doubling the size of the square. Lastly, the square was extended southwards in the 16th century, when the new palace of the procurators, K, was built by Scamozzi. Gentile Bellini's picture shows a line of houses along FF, reaching up to the great campanile, A. Napoleon I. in 1805-10 pulled down the church of S. Geminiano and built a new block at the west end of the square, L. The dates of the various parts of the existing ducal palace are indicated on the plan; the rebuilding was carried on in the following order, P, Q, R, S, T, U, V. At Z is the treasury of St Mark, which was originally one of the towers belonging to the old ducal palace; E, site of old houses; G, clock-tower; H, old palace of procurators; J, old library; M, two columns; N, Ponte della Paglia; O, Bridge of Sighs; W, Giants' Staircase; X, sacristy of St Mark; Y, Piazzetta.

Gothic Architecture.—Venetian Gothic, both ecclesiastical and domestic, shares most of the characteristics of north Italian Gothic generally, though in domestic architecture it displays one peculiarity which we shall presently note. The material, brick and terra-cotta, is the determining cause of the characteristics of north Italian Gothic

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[1] This palace was originally the property of the Pesaro family, and afterwards of the duke of Este, and finally of the republic, which used it as a dwelling-place for royal guests before letting it to Turkish merchants. The word *Fondaco* (derived through Arabic from the Greek πανδοχεῖον), as applied to some of the Venetian palaces, denotes the mercantile headquarters of a foreign trading nation. Those still existing are the Turkish and the German (*F. de' Tedeschi*), the latter now converted into the post office.

Flatness and lack of deep shadows, owing to the impossibility of obtaining heavy cornices in that material, mark the style. The prevalence of sunlight led to a restriction of the windows and exaggeration of wall space. The development of tracery was hindered both by the material and by the relative insignificance of the windows. On the other hand, the plastic quality of terracotta suggested an abundance of delicate ornamentation on a small scale, which produced its effect by its own individual beauty without broad reference to the general scheme. Coloured marbles and frescoes served a like purpose. The exteriors of the north Italian Gothic churches are characterized by the flatness of the roof; the treatment of the west façade as a mere screen wall, masking the true lines of the aisle roofs; the great circular window in the west front for lighting the nave; the absence of pinnacles owing to the unimportance of the buttresses; the west-end porches with columns resting on lions or other animals. The peculiarity of Venetian domestic Gothic to which we have referred is this: we frequently find tracery used to fill rectangular, not arched, openings. The result is that the tracery itself has to support the structure above it—is, in fact, constructional—whereas in most other countries the tracery is merely, as it were, a pierced screen filling in a constructional arch. Hence the noticeable heaviness of Venetian tracery.

The ducal palace.

The ducal palace, like St Mark's, is a symbol and an epitome of the race which evolved it. Soon after the concentration at Rialto the doge Angelo Particiaco began an official residence for the head of the state. It was probably a small, strongly fortified castle; one of its massive angle-towers is now incorporated in St Mark's and serves as the treasury. During the earlier years of the republic the ducal palace was frequently destroyed and rebuilt. It was burnt in 976 and again in 1106. At the close of the 12th century (1173–1179) Sebastian Ziani restored and enlarged the palace. Of his work some traces still remain in the richly sculptured bands built in at intervals along the 14th-century façade on the Rio, and part of the handsome larch-wood beams which formed the loggia of the piazzetta façade, still visible on the inner wall of the present loggia. The present magnificent building was a slow growth extending over three centuries and expanding gradually as the republic grew in riches.

The palace as we now see it was begun about 1300 by Doge Pietro Gradenigo, who soon after the closing of the great council gave its permanent form to the Venetian constitution. It is therefore, in a sense, contemporaneous with the early manhood of the state. Gradenigo built the façade along the Rio. About 1309 the arcaded façade along the lagoon front was taken in hand, and set the design for the whole of the external frontage of the palace. Towards the end of the 14th century, this façade, with its lower colonnade, upper loggia with handsome Gothic tracery, and the vast impending upper storey, which give to the whole building its striking appearance and audacious design, had been carried as far as the tenth column on the piazzetta side. At this point, perhaps out of regard for the remains of Ziani's palace, the work seems to have been arrested for many years, but in 1424 the building was resumed and carried as far as the north-west, or judgment, angle, near St Mark's, thus completing the sea and piazzetta façades as we now see them. The great gateway, the Porta della Carta, was added in 1439–42 from designs by Bartholomeo Buono (or Bon) and his son. The block of buildings in the interior, connecting the Porta della Carta to the Rio wing, was added about 1462 by the doge Cristoforo Moro. In 1479 a fire consumed the earlier buildings along the Rio, and these were replaced (1480–1550) by the present Renaissance structure.

The two main façades, those towards the sea and the piazzetta, consist of a repetition of the same design, that which was begun in the early years of the 14th century. The name of the architect who began the work and thus fixed the design of the whole is not certainly known, but it must have been a man of an earlier generation than that of Filippo Calendario, who is often stated to have been the chief architect of the older portion. Calendario was an accomplice in the conspiracy of Marino Faliero, and was executed together with the doge in 1355. It appears probable that a Venetian architect and sculptor named Pietro Baseggio was the chief master-builder in the first half of the 14th century. The design of these façades is very striking and unlike that of any other building in the world. It consists of two storeys with open colonnades, forming a long loggia on the ground and first floors, with seventeen arches on the sea front and eighteen on the other façade. Above this is a lofty third storey, pierced with a few large windows, with pointed arches once filled with tracery, which is now lost. The whole surface of the ponderous upper storey is covered with a diaper pattern in slabs of creamy white Istrian stone and red Verona marble, giving a delicate rosy-orange hue to the building. Very beautiful sculpture, executed with an ivory-like minuteness of finish, is used to decorate the whole building with wonderful profusion. At each of the three free angles is a large group immediately over the lower column. At the south-east angle is the "Drunkenness of Noah," at the south-west the "Fall of Man," and at the north-west the "Judgment of Solomon." Over each, at a much higher level, is a colossal figure of an archangel—Raphael, Michael and Gabriel.

The great internal court is surrounded with arcading. From the interior of the court access is given to the upper loggia by a very beautiful staircase of early Renaissance style, built in the middle of the 15th century by Antonio Rizzo. Two colossal statues of Neptune and Mars at the top of these stairs were executed by Jacopo Sansovino in 1554—hence the name "giants' staircase." Owing to a fire which gutted a great part of the palace in 1574, the internal appearance of the rooms was completely changed, and the fine series of early Paduan and Venetian paintings which decorated the walls of the chief rooms was lost. At present the magnificent council chambers for the different legislative bodies of the Venetian republic and the state apartments of the doges are richly decorated with gilt carving and panelling in the style of the later Renaissance. On the walls of the chief council chambers are a magnificent series of oil-paintings by Tintoretto and other less able Venetians—among them Tintoretto's masterpiece, "Bacchus and Ariadne," and his enormous picture of Paradise, the largest oil-painting in the world.

Gothic churches.

Among the many Gothic churches of Venice the largest are the Franciscan church of Santa Maria Gloriosa dei Frari (1250–1280), and the Dominican church of SS. Giovanni e Paolo (1260–1400). The Frari is remarkable for its fine choir-stalls and for the series of six eastern chapels which from outside give a very good example of Gothic brick-work, comparable with the even finer apse of the now desecrated church of San Gregorio. The church of SS. Giovanni e Paolo was the usual burying-place of the doges, and contains many noble mausoleums of various dates. Besides these two churches we may mention Santo Stefano, an interesting building of central Gothic, "the best ecclesiastical example of it in Venice." The apse is built over a canal. The west entrance is later than the rest of the edifice and is of the richest Renaissance Gothic, a little earlier than the Porta della Carta.

Gothic palaces.

But it is in the domestic architecture of Venice that we find the most striking and characteristic examples of Gothic. The introduction of that style coincided with the consolidation of the Venetian constitution and the development of Venetian commerce both in the Levant and with England and Flanders. The wealth which thus accrued found architectural expression in those noble palaces, so characteristic of Venice, which line the Grand and smaller canals. They are so numerous that we cannot do more than call attention to one or two.

The most striking example is undoubtedly the Ca' d' Oro, so called from the profusion of gold employed on its façade. It was built for Marino Contarini in 1421, rather a late period in the development of the style.

Marino kept a minute entry of his expenses, a document of the highest value, not merely for the history of the building, but also for the light it throws on the private life of the great patricians who gave to Venice such noble examples of art. Contarini was to some extent his own architect. He had the assistance of Marco d' Amadeo, a master-builder, and of Matteo Reverti, a Milanese sculptor, who were joined later on by Giovanni Buono and his son Bartolomeo. Other artists, of whom we know nothing else, such as Antonio Busetto, Antonio Foscolo, Gasparino Rosso, Giacomo da Como, Marco da Legno and others, were called in to help in evolving this masterpiece of decorated architecture, affording us an example of the way in which the ducal palace and other monuments of Venice grew out of the collaboration of numerous nameless artists. By the year 1431 the façade was nearly completed, and Contarini made a bargain with Martino and Giovanni Benzon for the marbles to cover what was yet unfinished. The façade is a triumph of graceful elegance; so light is the tracery, so rich the decoration, so successful the breach of symmetry which gives us a wing upon the left-hand side but none upon the right. But Contarini was not content to leave the marbles as they were. He desired to have the façade of his house in colour. The contract for this work, signed with Master Zuan de Franza, conjures up a vision of the Ca' d' Oro ablaze with colour and gleaming with the gold ornamentation from which it took its name.

Other notable examples of this style are the Palazzo Ariani at San Raffaelle, with its handsome window in a design of intersecting circles; the beautiful window with the symbols of the four Evangelists in the spandrils, in the façade of a house at San Stae; the row of three Giustinian palaces at S. Barnaba; the Palazzo Priuli at San Severo, with a remarkably graceful angle-window, where the columnar mullion carries down the angle of the wall; the flamboyant balconies of the Palazzo Contarini Fasan; the Palazzo Bernardo on a side canal near S. Polo, a late central Gothic building (1380–1400) which Ruskin describes as "of the finest kind and superb in its effect of colour when seen from the side. Taken as a whole, after the ducal palace this is the noblest effect of all in Venice."

Early Renaissance.—Towards the close of the 15th century Venetian architecture began to feel the influence of the classical revival; but, lying far from Rome and retaining still her connexion with the East, Venice did not fall under the sway of the classical ideals either so quickly or so completely as most Italian cities. Indeed, in this as in the earlier styles, Venice struck out a line for herself and developed a style of her own, known as Lombardesque, after the family of the Lombardi (Solari) who came from Carona on the Lake of Lugano and may be said to have created it.

The essential point about the style is that it is intermediary between Venetian Gothic and full Renaissance. We find it retaining some traces of Byzantine influence in the decorated surfaces of applied marbles, and in the roundels of porphyry and verd antique, while it also retained certain characteristics of Gothic, as, for instance, in the pointed arches of the Renaissance façade in the courtyard of the ducal palace designed by Antonio Rizzo (1499). Special notes of the style are the central grouping of the windows, leaving comparatively solid spaces on each side, which gives the effect of a main building with wings; the large amount of window space; the comparative flatness of the façades; the employment of a cornice to each storey; the effect of light and shade given by the balconies; and in churches by the circular pediments on the façades.

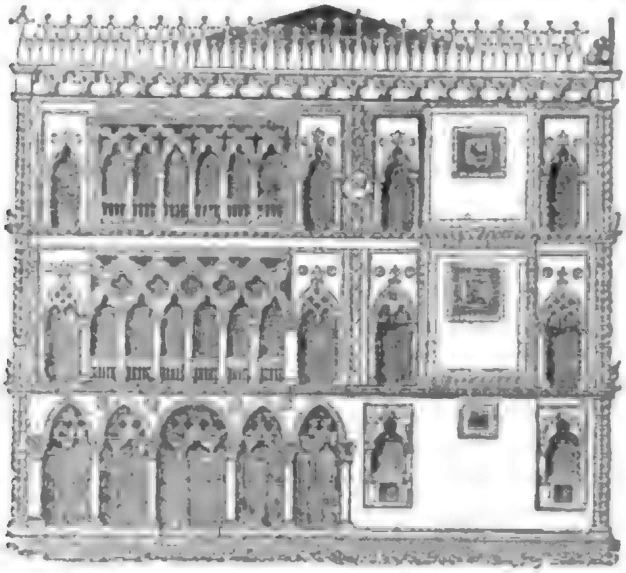

FIG. 2.—Ca' d' Oro, as originally built.

Churches.

The most perfect example of this style in ecclesiastical architecture is the little church of the Miracoli built by Pietro Lombardo in 1480. The church is without aisles, and has a semicircular roof, and the choir is raised twelve steps above the floor of the nave. The walls, both internally and externally, are encrusted with marbles. The façade has the characteristic circular pediment with a large west window surrounded by three smaller windows separated by two ornamental roundels in coloured marble and of geometric design. Below the pediment comes an arcade with flat pilasters, which runs all round the exterior of the church. Two of the bays contain round-headed windows; the other three are filled in with white marble adorned by crosses and roundels in coloured marble. The lower order contains the flat pilastered portal with two panelled spaces on each side.

Similar results are obtained in the magnificent façade of the Scuola di San Marco, at SS. Giovanni e Paolo, which has six semicircular pediments of varying size crowning the six bays, in the upper order of which are four noble Romanesque windows. The lower order contains the handsome portal with a semicircular pediment, while four of the remaining bays are filled with quaint scenes in surprisingly skilful perspective. The façade of San Zaccaria (1457–1515), the stately design of Anton Marco Gambello and Mauro Coducci, offers some slight modifications in the use of the semicircular pediment, the line of the aisle roof being indicated by quarter-circle pediments abutting on the façade of the nave. San Salvadore, the work of Tullio Lombardo (1530), is severer and less highly ornamented than the preceding examples, but its plan is singularly impressive, giving the effect of great space in a comparatively small area. In this connexion we must mention the Scuola of S. Giovanni Evangelista at the Frari, with its fore-court and screen adorned by pilasters delicately decorated with foliage in low relief, and its noble staircase whose double flights unite on a landing under a shallow cupola. This also was the work of Pietro Lombardo and his son Tullio.

Palaces.

Early Renaissance palaces occur frequently in Venice and form a pleasing contrast with those in the Gothic style. The Palazzo Dario with its dedication, *Urbis genio*, the superb Manzoni-Montecuculi-Polignac, with its friezes of spread-eagles in low relief, and the Vendramini-Calergi or *Non nobis* palace, whose façade is characterized by its round-headed windows of grouped twin lights between columns,—are among the more important; though beautiful specimens, such as the Palazzo Trevisan on the Rio della Paglia, and the Palazzo Corner Reali at the Fava, are to be found all over the city.

Library of San Marco.

Later Renaissance.—When we come to the fully developed Renaissance, architecture in Venice ceases to possess that peculiarly individual imprint which marks the earlier styles. It is still characterized by great splendour; indeed, the library of San Marco, built by Jacopo Sansovino in 1536, is justly considered the most sumptuous example of Renaissance architecture in the world. It is rich, ornate, yet hardly florid, distinguished by splendid effects of light and shade, obtained by a far bolder use of projections than had hitherto been found in the somewhat flat design of Venetian façades. The columned, round-headed windows are set in deeply between the pillars which carry the massive entablature, and this again is surmounted by a balustrade with obelisks at each angle and figures marking the line of each bay. The Istrian stone of which the edifice is built has taken a fine patina, which makes the whole look like some richly embossed casket in oxidized silver.

The full meaning of the change which had come over Venetian architecture, of the gulf which lies between the early Lombardesque style, so purely characteristic of Venice, and the fully developed classical revival, which now assumed undisputed sway, may best be grasped by comparing the old and the new Procuratie. Not more than eighty years separate these two buildings; the old Procuratie were built by Bartolomeo Buono about 1500, the new by Scamozzi in 1580, yet it is clear that each belongs to an entirely different world of artistic ideas. The Procuratie Vecchie is perhaps the longest arcaded façade in the world and certainly shows the least amount of wall space; the whole design is simple, the moulding and ornamentation severe. The Procuratie Nuove, which after all is merely Scamozzi's continuation of Sansovino's library, displays all the richness of that ornate building.

Churches.

Among the churches of this period we may mention San Geminiano, designed by Sansovino, and destroyed at the beginning of the 19th century to make room for the ball-room built by Napoleon for Eugène Beauharnais. The churches of San Giorgio Maggiore and of the Redentore, a votive church for liberation from the plague, are both by Palladio. In 1632 Baldassare Longhena built the fine church of Santa Maria della Salute, also a votive church, erected by the state to commemorate the cessation of the plague of 1630. This noble pile, with a large and handsome dome, a secondary cupola over the altar, and a striking portal and flight of steps, occupies one of the most conspicuous sites in Venice on the point of land that separates the mouth of the Guidecca from the Grand Canal. In plan it is an octagon with chapels projecting one on each side. The volute buttresses, each crowned with a statue, add quaintly but happily to the general effect. After Longhena's date church architecture in Venice declined upon the dubious taste of baroque; the façades of San Moisè and of Santa Maria del Giglio are good specimens of this style.

Palaces.

The palaces of the later Renaissance are numerous and frequently grandiose though frigid in design. The more remarkable are Sansovino's Palazzo Corner, Longhena's massive and imposing Palazzo Pesaro, the Palazzo Rezzonico, from designs by Longhena with the third storey added by Massari, Sammicheli's Palazzo Corner at San Polo, and Massari's well-proportioned and dignified Palazzo Grassi at San Samuele, built in 1740.

Modern Buildings.—In recent times the general prosperity of the city, which is on the ascendant, has brought about a revival of domestic and civic architecture. The architects Rupolo and Sardi have erected a considerable number of buildings, in which they have attempted, and with considerable success, to return either to Venetian Gothic or to the early Renaissance Lombardesque style. The most striking of these modern buildings are the new wing of the Hotel d'Italie, San Moisè, and the very successful fish market at Rialto, designed by Laurenti and carried out by Rupolo, in which a happy return to early Venetian Gothic has been effected in conjunction with a skilful adaptation of one of the most famous of the old houses of Venice, the Stalòn, or palace of the Quirini family.

Gild Halls.—Among the most remarkable buildings in Venice are the *scuole*, or gild halls, of the various confraternities. They were pious foundations created for mutual benefit and for purposes of charity. The *scuole* were divided into the six *scuole grandi*, so called from their numbers, wealth and privileges, and the *scuole minori* or *fraglie*, which in most cases were associated with an art or craft. The *scuole minori* were usually attached to some church in the quarter where the particular trade flourished. They had their special altar dedicated to the patron of the gild, a private burying-place, and a room in which they held their chapter. The six *scuole grandi*, San Teodoro, S. Maria della Carità, S. Giovanni Evangelista, San Marco, della Misericordia and San Rocco, on the other hand, built themselves magnificent gild halls. We have already mentioned two of these, the Scuola di San Giovanni Evangelista and the Scuola di San Marco, both of them masterpieces of the Lombardesque style. The Scuola di San Marco is now a part of the town hospital, and besides its façade, already described, it is remarkable for the handsome carved ceiling in the main hall (1463). Other beautiful ceilings are to be found in the great hall and the hall of the Albergo in the Scuola della Carità, now the Accademia. They are the work of Marco Cozzi of Vicenza and were executed between 1461 and 1464. The design of the former is a trellis crossing the ceiling diagonally; in each of the lacunae is carved a cherubim with eight wings; the figures and the trellis are gilded; the ground is a rich ultramarine. But the most magnificent of these gild halls is the Scuola di San Rocco, designed by Bartolomeo Buono in 1517 and carried out by Scarpagnino and Sante Lombardo. The façade on the Campo is large and pure in conception. The great staircase and the lower and upper halls contain the unrivalled series of paintings by Tintoretto, which called forth such unbounded enthusiasm on the part of Ruskin.

Campanili.—Among the more striking features of Venice we must reckon the *campanili* or bell-towers (see CAMPANILE). These were at one time more numerous than at the present day; earthquakes and subsidence of foundations have brought many of them down, the latest to fall being the great tower of San Marco itself, which collapsed on July 14th, 1902. Its reconstruction was at once undertaken, and completed in 1910. In a few other cases, for example at San Giorgio Maggiore, the fallen campanili were restored; but for the most part they were not replaced. The Venetian campanile usually stands detached from the church. It is almost invariably square; the only examples of round campanili in this part of Italy are to be found at Ravenna and at Caorle to the east of Venice; while inside Venice itself the solitary exception to the square plan was the campanile of San Paternian, built in 999 and now demolished, which was a hexagon. The campanile is usually a plain brick shaft with shallow pilasters running up the faces. It has small angle-windows to light the interior inclined plane or staircase, and is not broken into storeys with grouped windows as in the case of the Lombard bell-towers. Above the shaft comes the arcaded bell-chamber, frequently built of Istrian stone; and above that again the attic, either round or square or octagonal, carrying either a cone or a pyramid or a cupola, sometimes surmounted by a cross or a gilded angel which serves as a weathercock. Cressets used to be kept burning at night on some of the campanili to serve as beacons for those at sea. Among the existing campanili the oldest are San Geremia, dating from the 11th century, San Samuele from the 12th, San Barnaba and San Zaccaria from the 13th. The campanile of S. Giovanni Elemosinario at Rialto (1398–1400) is called by Ruskin "the most interesting piece of central Gothic remaining comparatively intact in Venice."

Public Monuments.—Venetian sculpture is for the most part ancillary to architecture; for example, Antonio Rizzo's "Adam" and "Eve" (1464), which face the giants'-staircase in the ducal palace, are parts of the decorative scheme; Sansovino's splendid monument to Tomaso Rangone is an essential feature of the façade of San Giuliano. The most successful Venetian sculpture is to be found in the many noble sepulchral private monuments. The jealousy of the Venetian republic forbade the erection of monuments to her great men. The sole exception is the superb equestrian statue in honour of the General Bartolomeo Colleoni, which stands on the Campo SS. Giovanni e Paolo. By his will Colleoni left his vast fortune to Venice on condition that a monument should be raised to him at St Mark's. He meant the great piazza, but by a quibble the republic evaded the concession of so unique an honour and claimed to have fulfilled the conditions of the bequest by erecting the monument at the Scuola of St Mark. The republic entrusted the work to the Florentine Verrocchio, who dying before the statue was completed begged the government to allow his pupil Lorenzo di Credi to carry it to a conclusion. The Venetians, however, called in Alessandro Leopardi, who cast the great equestrian group and added the pure and graceful pedestal. The monument was unveiled on the 21st of March 1496. Leopardo was also the creator (1505) of the three handsome bronze sockets in front of St Mark's which held the flagstaffs of the banners of Cyprus, Morea and Crete, when the republic was mistress of those territories.

By the side of the sea in the piazzetta, on to which the west façade of the ducal palace faces, stand two ancient columns of Egyptian granite, one red and the other grey. These great monoliths were brought as trophies to Venice by Doge Domenico Michieli in 1126, after his victories in Syria. In 1180 they were set up with their present fine capitals and bases by a Lombard engineer, Niccolo de' Barattieri. The grey column is surmounted by a fine bronze lion of Byzantine style, cast in Venice for Doge Ziani about 1178 (this was carried off to Paris by Napoleon in 1797, and sent back in pieces in 1816; but in 1893 it was put together again); and in 1329 a marble statue of St Theodore, standing upon a crocodile, was placed on the other column. Among modern monuments the most successful is that to Goldoni at San Bartolomeo near the Rialto. It is the work of the sculptor dal Zotto.

The arsenal.

Institutions.—Perhaps the most famous institution of Venice is the arsenal, whose history and activity has continued unbroken from the earliest days of the republic down to the present time. The arsenal was founded about the year 1104 by the doge Ordelap Falier. Before that date Venetian shipping was built at the spot near the piazzetta, known as the *terra nova*, where the royal gardens now are. The arsenal, which was famous in Dante's day, received its first enlargement in 1304, when, on the design of Andrea Pisano, new building sheds and the rope walk or *Tana* were erected. Pisano's building sheds, nine in a row, with peculiarly shaped roofs, were still standing intact—one of the most interesting medieval monuments of Venice—until recently, but they have been modified past recognition. In 1325 the second addition, the *arsenale nuovo*, was made, and a third, the *arsenale nuovissimo*, in 1473; a fourth, the *Riparto delle Galeazze*, about 1539; and in 1564 the fifth enlargement, the *Canal delle Galeazze e Vasca*, took place. After the fall of the republic the arsenal continued to occupy the attention of the various governments. In 1810 the site of the suppressed convent and church of the Celestia was added. The entire circuit of the arsenal, about two miles in extent, is protected by a lofty wall with turrets. The main door of the arsenal is the first example in Venice of the purely classical style. It is a noble portal, erected in 1460, apparently from designs by Fra Giocondo, with the lion of St Mark in the attic. The statuary, with Sta Giustina on the summit of the tympanum, was added in 1571 and 1578. The whole design was modified in 1688 so as to represent a triumphal arch in honour of Morosini Peloponnesiaco, who brought from Athens to Venice the four lions in Pentelic marble which now stand before the gate. (On the largest of these lions is cut a runic inscription recording an attack on the Piraeus in the 11th century by Norse warriors of the Varangian guard, under Harold Hardrada, afterwards—1047—king of Norway.) The arsenal suffered frequently and severely from fires, the worst being those of 1509 and 1569; yet such was the wealth of Venice that in the following year she put upon the seas the fleet that crushed the Turks at Lepanto in 1571.

The Lido.

The Lido, which lies about 2 m. S.E. of Venice and divides the lagoon from the sea, is rapidly becoming a fashionable bathing-place. The point of San Nicolò del Lido is strongly fortified to protect the new entrance to the port (see harbour). Inside the fortress lies the old Protestant burying-ground, with tombs of Sackville, of John Murray, of Sir Francis Vincent, last ambassador but one from Great Britain to the republic, of Consul Smith, whose collection of books forms the nucleus of the King's library in the British Museum, and of Catherine Tofts, the singer, Smith's first wife. At Sant' Elisabetta is the bathing establishment.

Libraries.—The library of San Marco contains upwards of 35,000 printed volumes and about 10,000 manuscripts. The library is said to owe its origin to Petrarch's donation of his books to the republic. Most of these have now disappeared. In 1635 Fra Fortunato Olmo found in a room over the great door of St Mark's a number of books which he supposed to be Petrarch's gift. He sent a list to Tomasini, who published it in his *Petrarca Redivivus* (Patavii, 1635). These codices passed to the Marciana, and Zanetti catalogued them as the *Fondo antico*. It is very doubtful whether these books really belonged to Petrarch. We may date the true foundation of the library to the donation of Cardinal Bessarion. Bessarion had intended to bequeath his books to the Benedictines of San Giorgio Maggiore, but Pietro Morosini, Venetian ambassador at Rome, pointed out the inconvenience of housing his library on an island that could not easily be reached. The cardinal therefore obtained a bull from Pope Paul II., permitting him to recall his original donation, and in a letter dated from the baths of Viterbo, May 13th, 1468, he made over his library to the republic. The principal treasures of the collection, including splendid Byzantine book-covers, the priceless codices of Homer, the Grimani Breviary, an early Dante, &c., are exhibited under cases in the Sala Bessarione in the Zecca or mint where the library has been installed. Another library was left to the public by the munificence of Count Quirini-Stampalia, who bequeathed his collections and his house at Santa Maria Formosa to be held in trust for students. The state archives are housed in the Franciscan monastery at the Frari. They contain the voluminous and invaluable records of the Venetian republic, diplomatic, judicial, commercial, notarial, &c. Under the republic the various departments of state stored their records in various buildings, at the ducal palace, at the Scuola di San Teodoro, at the Camerlenghi. The Austrian government gathered all these into one building and arranged the vast masses of papers in fairly convenient order. Though the state papers of Venice have suffered from fire and the series begins comparatively late, yet their fullness and the world-wide sweep of Venetian interests render this collection an inexhaustible storehouse of data for students. Among other learned institutions we may mention the Ateneo Veneto, the Deputazione per la Storia Patria, and the Royal Institute of Science, Letters and Art, which has its seat in the Palazzo Loredan at Santo Stefano.

Harbour.—Under the republic commercial shipping used to enter Venice by the port of San Nicolò del Lido and lie along the quay called the Riva degli Schiavoni, in the basin of San Marco, and up the broad Giudecca Canal. But with the decline of Venice the trade of the port fell off; the mouth of the Lido entrance became gradually silted up owing to the joint action of the tide and the current, and for many years complete stagnation characterized the port. Under Austrian rule a revival began, which has been continued and intensified since Venice became part of united Italy. When the railway bridge brought Venice into touch with the mainland and the rest of Europe, it became necessary to do something to reopen the harbour to larger shipping. The Austrians, abandoning the nearer Lido entrance to the lagoons, resolved to deepen and keep open the Malamocco entrance. This is 8 m. distant from Venice, and can only be reached by a long and tortuous channel across the lagoon, whose course is marked out by those groups of piles which are so characteristic a feature of the lagoon landscape. The channel required constant dredging and was altogether inconvenient; yet for many years it remained the main sea approach to Venice. A dock was constructed at the western or farther end of the Giudecca Canal, near the railway. The unification of Italy, the growing prosperity of the country, above all the opening of the Suez Canal, which restored to Venice the full value of her position as the port farthest into the heart of Europe, brought about an immense expansion of trade. The government accordingly resolved to reopen the Lido entrance to the lagoon, and thus to afford a shorter and more commodious access from the sea. As at the Malamocco entrance so at the Lido, two moles were run out in a south-westerly direction; the westerly is about 2 m., the easterly about 3 m. in length. The natural scour thus created has given a depth of 26 ft. of water through the sand-bank. The mean rise and fall of the tide is about 2 ft., but under certain conditions of wind the variation amounts to 5 ft. and over. The health of the city depends, of course, to a large extent on this ebb and flow. The government also turned its attention to the inadequate accommodation at the docks, and proposals for a new quay on the western side of the present basin, and for a second basin 900 yds. long and 170 yds. wide, were the result.

Trade.—A comparison between the exports and imports of the years 1886 and 1905 will give an exact idea of the rate at which the port of Venice developed. In 1886 the total value of exports to foreign countries amounted to £7,239,479; of imports, £8,788,012. In 1905 the exports to foreign countries valued £11,650,932, the imports £13,659,306. As has been the case throughout her history, the trade of Venice is still mainly a transit trade. Wheat, coal, cotton, petroleum, wood, lime and cement are brought into Venice for shipment to the Levant or for distribution over Italy and Europe.

Venice became very celebrated in the 15th century for textiles. Its damasks and other silk stuffs with patterns of extraordinary beauty surpassed in variety and splendour those of the other chief centres of silk-weaving, such as Florence and Genoa. In addition to the native stuffs, an immense quantity of costly Oriental carpets, wall-hangings and other textiles was imported into Venice, partly for its own use, and partly for export throughout western Europe. On occasions of festivals or pageants the balconies, the bridges, the boats, and even the façades of the houses, were hung with rich Eastern carpets or patterned textiles in gold and coloured silk. The glass manufactory of Murano (*q.v.*), a small island about 1½ m. to the north of Venice, was a great source of revenue to the republic. Glass drinking cups and ornamental vessels, some decorated with enamel painting, and "silvered" mirrors were produced in great quantities from the 14th century downwards, and exported. Like many other arts in Venice, that of glass-making appears to have been imported from Moslem countries, and the influence of Oriental design can be traced in much of the Venetian glass. The art of making stained-glass windows was not practised by the Venetians; almost the only fine glass in Venice is that in a south transept window in the Dominican church, which, though designed by able Venetian painters, is obviously the work of foreigners.

The ancient glass-bead industry (*conterie*), which some years since suffered severely from over-production, has now regained its position through the union of the different factories, by which the output is controlled in such a way as to render trade profitable. Venetian beads are now sent in large quantities to the various colonies in Africa, and to India, Sumatra and Borneo. Similarly, the glass industry has revived. New amalgams and methods of colouring have been discovered, and fresh forms have been diligently studied. Special progress has been made in the production of mirrors, electric lamps, candelabra and mosaics. New industries are those of tapestry, brocades, imitation of ancient stuffs, cloth of silver and gold, and Venetian laces. The secret of lace-making was believed to have been lost, but the late Signor Fambri discovered at Chioggia an old woman who knew it, and placed her at the head of a lace school. Fambri was ruined by his enterprise, but other manufacturers, more expert than he, drew profit from his initiative, and founded flourishing factories at Pellestrina and Burano. Other important industries are wood-carving (of an artistic excellence long unknown), artistic iron-working, jewelling, bronze-casting, the production of steam-engines, machinery, matches (largely exported to Turkey, Egypt, Russia, Austria-Hungary and Greece), clock-making, wool-weaving and the manufacture of chemical manures.

Population.—In 1548 the population of Venice numbered 158,069; in 1607–29, 142,804; in 1706, 140,256; in 1785, 139,095; in 1881, 132,826. The municipal bulletin of the 31st of December 1906 gives a total of 169,563, not including 4835 soldiers.

Administration.—Venice is administered by a prefect representing the crown and responsible to the central government at Rome, from whom he receives orders. Under his cognizance come questions of public order, health and elections to parliament. The two arms of the police, the Carabinieri and the Publica Sicurezza, are at his disposal. Purely local matters, however, are in the hands of the municipio or town council. At the head of the town council is the Sindaco or mayor, elected by the council itself.

Under the republic, and until modern times, the water supply of Venice was furnished by the storage of rain-water supplemented by water brought from the Brenta in boats. The famous Venetian *pozzi*, or wells for storing rain-water from the roofs and streets, consisted of a closed basin with a water-tight stratum of clay at the bottom, upon which a slab of stone was laid; a brick shaft of radiating bricks laid in a permeable jointing material of clay and sand was then built. At some distance from the shaft a square water-tight wall was built, and the space between it and the shaft was filled in with sand, which was purified of all saline matter by repeated washings; on the ground-level perforated stones set at the four corners of the basin admitted the rain-water, which was discharged from the roofs by lead pipes; this water filtered through the sand and percolated into the shaft of the well, whence it was drawn in copper buckets. The present water supply, introduced in 1884, is brought from the commune of Trebaseleghe, where it is collected from 120 artesian wells. It is carried under the lagoon to Sant' Andrea, where the reservoirs are placed.

Of the 19,000 houses in Venice only 6000 have drains and sinks, all the others discharge sewage through pipes directly or indirectly into the canals. With the rise and fall of the tide the discharge pipes are flushed at the bottom. An important investigation undertaken by the Bacterioscopical Laboratory, with regard to the pollution of the Venetian canals by the city sewage, led to the discovery that the water of the lagoons possesses auto-purifying power, not only in the large canals but even in the smallest ramifications of the waterways. The investigation was carried out with scrupulous scientific rigour upon samples of water taken in every part of the city, at all states of the tide and under various atmospheric conditions.

The church is ruled by the patriarch of Venice, the metropolitan of the province formed by the Veneto. The patriarch of Venice is usually raised to the purple. The patriarchate dates from 1451, when on the death of Domenico Michiel, patriarch of Grado, the seat of that honour was transferred from desolate and insalubrious Grado to the cathedral church of Castello in Venice, and Michiel's successor, Lorenzo Giustinian, assumed the title of patriarch of Venice. On the fall of the republic St Mark's became the cathedral church of the patriarch. There are thirty parishes in the city of Venice and fifteen in the lagoon islands and on the littoral.

In recent times there has been a good deal of activity in Venice in regard to the preservation of its artistic and architectural treasures. Some of the earlier activity was unfortunately misplaced. St Mark's suffered on two occasions: first during the restoration of the north façade in 1843, and again during that of the south façade, begun in 1865 and finished in 1878. The latter façade was completely reconstructed upon 2200 piles driven to great depths, with the result that the general harmony of the monument—the effect of time and of atmospheric conditions—was completely lost. A lively agitation all over Europe, and particularly in England (conducted by Ruskin and William Morris), led the Italian government to discard the Austrian plan of restoration, at least as regards the interior of the Basilica, and to respect the ancient portions which had stood the test of time and had escaped "renewal" by man. In 1880 a Vigilance Committee was appointed to watch over the restoration of the interior. The committee secured much *verde antico* and porphyry for the restoration of the pavement, in place of the common marbles which it had been intended to use, and organized special workshops for the restoration and preservation of the ancient mosaics, which it had been intended to detach and replace. Pieces already detached were restored to their original positions, and those blackened by damp and dust were carefully cleaned. Breaks were filled up with cubes obtained from fragments of contemporary mosaics previously demolished. In this way the mosaics of the two arches of the atrium and those of the Zeno chapel were cleaned and preserved.

Contemporaneously with the restoration of the southern façade of St Mark's, the restoration of the colonnade of the ducal palace towards the Piazzetta and the Mole was undertaken at a cost of £23,000. The chief work was executed at the south-west angle, where the columns of the arcade had become so broken and distorted as to menace the safety of the whole building. The corner towards the Ponte della Paglia was also restored, and the hideous device of walling up the five last arches, adopted in the 16th century by the architect Da Ponte, was removed without prejudice to the stability of the structure. In order to lighten the palace the Venetian Institute of Science, Letters and Arts removed its headquarters and its natural history collection to Santo Stefano. For the same reason the Biblioteca Marciana with its 350,000 volumes was moved to the Old Mint, opposite the ducal palace. The space thus cleared has been used for the rearrangement of the Archaeological and Artistic Museum. Side by side with these changes has proceeded the reorganization of the Royal Gallery of Ancient Art, which, created by Napoleon I. for the students of the adjoining Academy of Fine Arts, gradually acquired such importance that in 1882 the government divided it from the academy and rendered it autonomous. The gallery now constitutes a unique collection of Venetian paintings from the most ancient artists down to Tiepolo, one hall only being reserved for other Italian schools and one for foreign schools. Altogether the gallery contains twenty rooms, one being assigned to the complete cycle of the "History of Saint Ursula," by Carpaccio; another to Giambellino and to the Celliniani; and a whole wall of a third being occupied by the famous Veronese, "Il Convito in casa di Levi." Titian's "Presentazione al Tempio," painted for the Scuola della Carita, which is now the seat of the gallery, has been placed in its original position. The hall of the Assumption has been left untouched. Nineteenth-century pictures have been eliminated as foreign to the character of the collection, and inferior works relegated to a side passage. The reorganization of the Archaeological and Artistic Museum and of the Royal Gallery of Ancient Art coincided with the inauguration in April 1895 of a series of biennial International Art Exhibitions, arranged in order to celebrate the silver wedding of the king and queen of Italy. A special brick structure was erected in the public gardens to receive the works of contemporary artists, both Italian and foreign. The selection of works was made by an international jury from which Venetian artists were excluded. The second exhibition, visited by 336,500 persons, was held in 1897, and a third in 1899. The success of this exhibition (visited by 407,930 persons) led to the organization of a fourth exhibition in 1901, largely devoted to the works of Ruskin. The institution of these exhibitions furnished Prince Giovanelli with an opportunity to found at Venice a Gallery of Modern Art, for which a home was found in the Palazzo Pesaro, bequeathed to the city by Princess Bevilacqua la Masa.

History.—It is usually affirmed that the state of Venice owes its origin to the barbarian invasions of north Italy; that it was founded by refugees from the mainland cities who sought asylum from the Huns in the impregnable shallows and mud banks of the lagoons; and that the year 452, the year when Attila sacked Aquileia, may be taken as the birth-year of Venice. That is true in a measure. Venice, like Rome and other famous cities, was an asylum city. But it is nearly certain that long before Attila and his Huns swept down upon the Venetian plain the little islands of the lagoon already had a population of poor but hardy fisherfolk living in quasi-independence, thanks to their poverty and their inaccessible site. This population was augmented from time to time by refugees from the mainland cities of Aquileia, Concordia, Opitergium Altinum and Patavium. But these did not mingle readily with the indigenous population; as each wave of barbarian invasion fell back, these refugees returned to their mainland homes, and it required the pressure of many successive incursions to induce them finally to abandon the mainland for the lagoon, a decision which was not reached till the Lombard invasion of 568. On each occasion, no doubt, some of the refugees remained behind in the islands, and gradually built and peopled the twelve lagoon townships, which formed the germ of the state of Venice and were subsequently concentrated at Rialto or in the city we now know as Venice. These twelve townships were Grado, Bibione, Caorle, Jesolo, Heraclea, Torcello, Murano, Rialto, Malamocco, Poveglia, Chioggia and Sottomarina. The effect of the final Lombard invasion is shown by the resolve to quit the mainland and the rapid building of churches which is recorded by the *Cronaca altinate*. The people who finally abandoned the mainland and took their priests with them are the people who made the Venetian republic. But they were not as yet a homogeneous population. The rivalries of the mainland cities were continued at closer quarters inside the narrow circuit of the lagoons, and there was, moreover, the initial schism between the indigenous fisher population and the town-bred refugees, and these facts constitute the first of the problems which now affronted the growing community: the internal problem of fusion and development. The second problem of prime importance was the external problem of independence. The early history of the republic is chiefly concerned with the solution of these two problems.

To take the problem of independence first. There is little doubt that the original lagoon population depended for its administration, as far as it had any, upon the larger cities of the mainland. There is a tradition that Venice was founded by "consuls from Padua"; and Padua claimed complete control of the course of the Brenta down to its mouth at Malamocco. The destruction of the mainland cities, and the flight of their leading inhabitants to the lagoons, encouraged the lagoon population to assert a growing independence, and led them to advance the doctrine that they were "born independent." Their development as a maritime people, engaged in small trading and intimately acquainted with their home waters, led Belisarius to seek their help in his task of recovering Italy from the Goths. He was successful; and the lagoons became, theoretically at least, a part of the Eastern empire. But the empire was vast and weak, and its capital lay far away; in practice, no doubt, the lagoon population enjoyed virtual independence, though later the Byzantine claim to suzerainty became one of the leading factors in the formation of the state. It was from Byzantium that the Venetian people received the first recognition of their existence as a separate community. Their maritime importance compelled Narses, the imperial commander, to seek their aid in transporting his army from Grado; and when the Paduans appealed to the Eunuch to restore their rights over the Brenta, the Venetians replied by declaring that islands of the lagoon and the river mouths that fell into the estuary were the property of those who had rendered them habitable and serviceable. Narses declined to intervene, Padua was powerless to enforce its claims and Venice established a virtual independence of the mainland. Nor was it long before Venice made a similar assertion to the imperial representative, Longinus. He was endeavouring to treat with Alboin and the Lombards, and desired to assure himself of Venetian support. He invited the Venetians to give him an escort to Constantinople, which they did, and also to acknowledge themselves subjects of the empire. But they replied that "God who is our help and protector has saved us that we might dwell upon these waters. This second Venice which we have raised in the lagoons is our mighty habitation; no power of emperor or of prince can touch us." That was an explicit statement of Venetian aims and contentions: the place and people had made each other and now belonged exclusively to each other. Longinus admitted that the Venetians were indeed "a great people with a strong habitation"; but by dint of promising large concessions and trading privileges, he induced the Venetians to make an act of submission—though not upon oath. The terms of this pact resulted in the first diploma conferred on Venice as a separate community (584). But it was inevitable that, when the barbarians, Lombard or Frank, were once established on the mainland of Italy, Venice should be brought first into trading and then into political relations with their near neighbours, who as masters of Italy also put forward a claim to sovereignty in the lagoons. It is between the two claims of east and west that Venice struggled for and achieved recognized independence.

Turning to the other problem, that of internal fusion and consolidation, we find that in 466, fourteen years after the fall of Aquileia, the population of the twelve lagoon townships met at Grado for the election of one tribune from each island for the better government of the separate communities, and above all to put an end to rivalries which had already begun to play a disintegrating part. But when the lagoon population was largely augmented in 568 as the result of Alboin's invasion, these jealousies were accentuated, and in 584 it was found expedient to appoint twelve other tribunes, known as the *Tribuni Majores*, who formed a kind of central committee to deal with all matters affecting the general weal of the lagoon communities. But the *Tribuni Majores* were equally powerless to allay the jealousies of the growing townships which formed the lagoon community. Rivalry in fishing and in trading, coupled with ancient antipathies inherited from the various mainland cities of origin, were no doubt the cause of these internecine feuds. A crisis was reached when Christopher, patriarch of Grado, convened the people of the lagoon at Heraclea, and urged them to suppress the twelve tribunes and to choose a single head of the state. To this they agreed, and in 697 Venice elected her first doge, Paulo Lucio Anafesto.

The growing importance of the lagoon townships, owing to their maritime skill, their expanding trade, created by their position between east and west, their monopoly of salt and salted fish, which gave them a strong position in the mainland markets, rendered it inevitable that a clash must come over the question of independence, when either east or west should claim that Venice belonged to them; and inside the lagoons the growing prosperity, coupled with the external threat to their liberties, concentrated the population into two well-defined parties—what may be called the aristocratic party, because it leaned towards imperial Byzantium and also displayed a tendency to make the dogeship hereditary, and the democratic party, connected with the original population of the lagoons, aspiring to free institutions, and consequently leaning more towards the church and the Frankish kingdom which protected the church. The aristocratic party was captained by the township of Heraclea, which had given the first doge, Anafesto, to the newly formed community. The democratic party was championed first by Jesolo and then by Malamocco.

The advent of the Franks determined the final solution. The emperor Leo, the Isaurian, came to open rupture with Pope Gregory II. over the question of images. The pope appealed to Liutprand, the powerful king of the Lombards, to attack the imperial possessions in Ravenna. He did so, and expelled the exarch Paul, who took refuge in Venice and was restored to his post by the doge of the Heraclean or Byzantine party, Orso, who in return for this assistance received the imperial title of *hypatos*, and trading rights in Ravenna. The pope, however, soon had cause for alarm at the spread of the Lombard power which he had encouraged. Liutprand proceeded to occupy territory in the Ducato Romano. The pope, looking about for a saviour, cast his eyes on Charles Martel, whose victory at Tours had riveted the attention of the world. Charles's son, Pippin, was crowned king of Italy, entered the peninsula at the head of the Franks, defeated the Lombards, took Ravenna and presented it to the pope, while retaining a feudal superiority. Desiderius, the last Lombard king, endeavoured to recover Ravenna. Charlemagne, Pippin's son, descended upon Italy, broke up the Lombard kingdom (774), confirmed his father's donation to the pope, and in reprisals for Venetian assistance to the exarch, ordered the pope to expel the Venetians from the Pentapolis. Venice was now brought face to face with the Franks under their powerful sovereign, who soon showed that he intended to claim the lagoons as part of his new kingdom. In Venice the result of this menace was a decided reaction towards Byzantium. In opposition to the Frankish claim, Venice resolved to affirm her dependence on the Eastern empire. But the democratic party, the Frankish party in Venice, was powerful. Feeling ran high. A crisis was rapidly approaching. The Byzantine Doge Giovanni Galbaio attacked Grado, the see of the Francophil Patriarch Giovanni, captured it, and flung the bishop from the tower of his palace. But the murdered patriarch was succeeded by his no less Francophil nephew Fortunatus, a strong partisan, a restless and indomitable man, who along with Obelerio of Malamocco now assumed the lead of the democratic party. He and his followers plotted the murder of the doge, were discovered, and sought safety at the court of Charlemagne, where Fortunatus strongly urged the Franks to attack the lagoons.

Meantime the internal politics of Venice had been steadily preparing the way for the approaching fusion at Rialto. The period from the election of the first doge to the appearance of the Franks was characterized by fierce struggles between Heraclea and Jesolo. At length the whole population agreed to fix their capital at Malamocco, a compromise between the two incompatible parties, marking an important step towards final fusion at Rialto.

That central event of early Venetian history was reached when Pippin resolved to make good his title as king of Italy. He turned his attention to the lagoon of Venice, which had been steadily growing in commercial and maritime importance, and had, on the whole, shown a sympathy for Byzantium rather than for the Franks. Pippin determined to subdue the lagoons. He gathered a fleet at Ravenna, captured Chioggia, and pushed on up the Lido towards the capital of the lagoons at Malamocco. But the Venetians, in face of the danger, once more removed their capital, this time to Rialto, that group of islands we now call Venice, lying in mid-lagoon between the *lidi* and the mainland. This step was fatal to Pippin's designs. The intricate water-ways and the stubborn Venetian defence baffled all his attempts to reach Rialto; the summer heats came on; the Lido was unhealthy. Pippin was forced to retire. A treaty between Charlemagne and Nicephorus (810) recognized the Venetians as subjects of the Eastern empire, while preserving to them the trading rights on the mainland of Italy which they had acquired under Liutprand.

The concentration at Rialto marks the beginning of the history of Venice as a full-grown state. The external menace to their independence had welded together the place and the people; the same pressure had brought about the fusion of the conflicting parties in the lagoon townships into one homogeneous whole. There was for the future one Venice and one Venetian people dwelling at Rialto, the city of compromise between the dangers from the mainland, exemplified by Attila and Alboin, and the perils from the sea, illustrated by Pippin's attack. The position of Venice was now assured. The state was a vassal of a weak and distant empire, which would leave it virtually free to pursue its own career; it was an independent tributary of a near and powerful kingdom with which it could trade, and trade between east and west became henceforth the note of its development.

The first doge elected in Rialto was Angelo Particiaco, a Heraclean noble, with a strong bias towards Byzantium, and his reign was signalized by the building of the first church of San Marco, and by the translation of the saint's body from Alexandria, as though to affirm and to symbolize the creation of united Venice.

The history of Venice during the next two hundred years is marked externally by the growth of the city, thanks to an ever-expanding trade, both down the Adriatic, which brought the republic into collision with the Dalmatian pirates and led to their final conquest, in 1000, by the doge Pietro Orseolo II., and also on the mainland, where Venice gradually acquired trading rights, partly by imperial diploma, partly by the establishment and the supply of markets on the mainland rivers, the Sile and the Brenta. Internally this period is characterized by the attempt of three powerful families, the Particiachi, the Candiani and the Orseoli, to create an hereditary dogeship, and the violent resistance offered by the people. We find seven of the Particiachi, five Candiani and three Orseoli reigning in almost unbroken succession, until, with the ostracism of the whole Orseolo family in 1032, the dynastic tendency was crushed for ever. During the same period we also note the development of certain families, thanks to the accumulation of wealth by trade, and here we get the beginnings of that commercial aristocracy whose evolution was the dominant factor in the constitutional history of the republic.

The growing wealth of Venice soon attracted the cupidity of her piratical neighbours on the coast of Dalmatia. The swift Liburnian vessels began to raid the Lido, compelling the Venetians to arm their own vessels and thus to form the nucleus of their famous fleet, the importance of which was recognized by the Golden Bull of the emperor Basil, which conferred on Venetian merchants privileges far more extensive than any they had hitherto enjoyed, on condition that the Venetian fleet was to be at the disposition of the emperor. But the Dalmatian raids continued to harass Venetian trade, till, in 1000, the great doge Pietro Orseolo II. attacked and captured Curzola and stormed the piratical stronghold of Lagosta, crushing the freebooters in their citadel. The doge assumed the title of duke of Dalmatia, and a great step was taken towards the supremacy of Venice in the Adriatic, which was essential to the free development of her commerce and also enabled her to reap the pecuniary advantages to be derived from the Crusades. She now commanded the route to the Holy Land and could supply the necessary transport, and from the Crusades her growing aristocracy reaped large profits. Orseolo's victory was commemorated and its significance affirmed by the magnificent symbolical ceremony of the "wedding of the sea" (*Sposalizio del Mar*), celebrated henceforward every Ascension day. The result of the first three Crusades was that Venice acquired trading rights, a Venetian quarter, church, market, bakery, &c., in many of the Levant cities, *e.g.* in Sidon (1102) and in Tyre (1123). The fall of Tyre marks a great advance in development of Venetian trade; the republic had now passed beyond the Adriatic, and had taken an important step towards that complete command of the Levant which she established after the Fourth Crusade.

This expansion of the trade of Venice resulted in the rapid development of the wealthier classes, with a growing tendency to draw together for the purpose of securing to themselves the entire direction of Venetian politics in order to dominate Venetian commerce. To achieve their object, a double line of conduct was imposed upon them: they had to absorb the powers of the doge, and also to deprive the people of the voice they possessed in the management of state affairs by their presence in the *concione* or general assembly of the whole community, which was still the fountain of all authority. The first step towards curtailing the power of the doge was taken in 1032, when the family of the Orseoli was finally expelled from Venice and the doge Domenico Flabianico was called to the throne. A law was then passed forbidding for the future the election of a doge-consort, a device by which the Particiachi, the Candiani and the Orseoli had each of them nearly succeeded in carrying out their dynastic ambitions. Further, two ducal councillors were appointed to assist the doge, and he was compelled, not merely permitted, to seek the advice of the more prominent citizens at moments of crisis. By this reform two important offices in the Venetian constitution—the privy council (*consiglieri ducali*) and the senate (the *pregadi* or invited)—came into being. Both were gradually developed on the lines desired by the aristocracy, till we reach the year 1171.

The growth of Venetian trade and wealth in the Levant roused the jealousy of Genoa and the hostility of the imperial court at Constantinople, where the Venetians are said to have numbered 200,000 and to have held a large quarter of the city in terror by their brawls. The emperor Manuel I., urged on by the Genoese and other rivals of Venice, seized the pretext. The Venetians were arrested and their goods confiscated. Popular feeling at Venice ran so high that the state was rashly swept into war with the empire. To provide the requisite funds for this vast undertaking, a forced loan of 1% on net incomes was raised; the money bore interest at the rate of 4%. The bonds were negotiable, and afford us the earliest instance of the issue of government stock. The doge Vitale Michiel II. led the expedition in person. It proved a disastrous failure, and on the return of the shattered remnants (1171) a great constitutional reform seemed necessary. The Venetians resolved to create a deliberative assembly, which should act with greater caution than the *concione*, which had just landed the state in a ruinous campaign. Forty members were elected in each of the six divisions of the city, giving a body of 480 members, who served for one year and on retiring named two deputies for each *sestiere* to nominate the council for the succeeding year. This was the germ of the great council, the Maggior Consiglio, which was rendered strictly oligarchic in 1296. As the duties of this council were to appoint all officers of state, including the doge, it is clear that by its creation the aristocracy had considerably curtailed the powers of the people, who had hitherto elected the doge in general assembly; and at the creation of Michiel's successor, Sebastiano Ziani (1172), the new doge was presented to the people merely for confirmation, not for election. The assembly protested, but was appeased by the empty formula, "This is your doge an it please you." Moreover, still further to limit the power of the doge, the number of ducal councillors was raised from two to six. In 1198, on the election of Enrico Dandolo, the aristocracy carried their policy one step farther, and by the *promissione ducale*, or coronation oath, which every doge was required to swear, they acquired a powerful weapon for the suppression of all that remained of ancient ducal authority. The *promissione ducale* was binding on the doge and his family, and could be, and frequently was, altered at each new election, a commission, *Inquisitori sopra il doge defunto*, being appointed to scrutinize the actions of the deceased doge and to add to the new oath whatever provisions they thought necessary to reduce the dogeship to the position of a mere figurehead in the state.

In spite of the check to their trade received from the emperor Manuel in 1171, Venetian commerce continued to flourish, the Venetian fleet to grow and the Venetians to amass wealth. When the Fourth Crusade was proclaimed at Soissons, it was to Venice that the leaders applied for transport, and she agreed to furnish transport for 4500 horses, 9000 knights, 20,000 foot, and provisions for one year the price was 85,000 silver marks of Cologne and half of all conquests. But Zara and Dalmatia had revolted from Venice in 1166 and were as yet unsubdued. Venetian supremacy in the Adriatic had been temporarily shaken. The 85,000 marks, the price of transport, were not forthcoming, and the Venetians declined to sail till they were paid. The doge Dandolo now saw an opportunity to benefit Venice. He offered to postpone the receipt of the money if the Crusaders would reduce Zara and Dalmatia for the republic. These terms were accepted. Zara was recovered, and while still at Zara the leaders of the Crusade, supported by Dandolo, resolved for their own private purposes to attack Constantinople, instead of making for the Holy Land. Boniface, marquis of Monferrat, desired to make good the claim to Salonica, and the Venetians doubtless wished to upset the Greek empire, which had recently shown itself so friendly to their rivals the Genoese. Constantinople fell (1204), thanks chiefly to the ability of the Venetians under Dandolo. The city was sacked, and a Latin empire, with Baldwin of Flanders as emperor, was established at Constantinople (see **Roman Empire, Later**).

In the partition of the spoils Venice claimed and received, in her own phrase, "a half and a quarter of the Roman empire." To her fell the Cyclades, the Sporades, the islands and the eastern shores of the Adriatic, the shores of the Propontis and the Euxine, and the littoral of Thessaly, and she bought Crete from the marquis of Monferrat. The accession of territory was not only vast, it was of the highest importance to Venetian commerce. She now commanded the Adriatic, the Ionian islands, the archipelago, the Sea of Marmora and the Black Sea, the trade route between Constantinople and western Europe, and she had already established herself in the seaports of Syria, and thus held the trade route between Asia Minor and Europe. She was raised at once to the position of a European power. In order to hold these possessions, she borrowed from the Franks the feudal system, and granted fiefs in the Greek islands to her more powerful families, on condition that they held the trade route open for her. The expansion of commerce which resulted from the Fourth Crusade soon made itself evident in the city by a rapid development in its architecture and by a decided strengthening of the commercial aristocracy, which eventually led to the great constitutional reform—the closing of the Maggior Consiglio in 1296, whereby Venice became a rigid oligarchy. Externally this rapid success awoke the implacable hatred of Genoa, and led to the long and exhausting series of Genoese wars which ended at Chioggia in 1380.

The closing of the great council was, no doubt, mainly due to the slowly formed resolution on the part of the great commercial families to secure a monopoly in the Levant trade which the Fourth Crusade had placed definitely in their hands. The theory of the government, a theory expressed throughout the whole commercial career of the republic, the theory which made Venice a rigidly protective state, was that the Levant trade belonged solely to Venice and her citizens. No one but a Venetian citizen was permitted to share in the profits of that trade. But the population of Venice was growing rapidly, and citizenship was as yet undefined. To secure for themselves the command of trade the leading commercial families resolved to erect themselves into a close gild, which should have in its hands the sole direction of the business concern, the exploitation of the East. This policy took definite shape in 1297, when the Doge Pietro Gradenigo proposed and carried the following measure: the supreme court, the Quarantia, was called upon to ballot, one by one, the names of all who for the last four years had held a seat in the great council created in 1171. Those who received twelve favourable votes became members of the great council. A commission of three was appointed to submit further names for ballot. The three commissioners at once laid down a rule—which contains the essence of the act—that only those who could prove that a paternal ancestor had sat in the great council should be eligible for election. This measure divided the community into three great categories: (1) those who had never sat in the council themselves and whose ancestors had never sat; these were of course the vast majority of the population, and they were excluded for ever from the great council: (2) those whose paternal ancestors had sat in the council; these were eligible and were gradually admitted to a seat, their sons becoming eligible on majority: (3) those who were of the council at the passing of this act or had sat during the four preceding years; their sons likewise became eligible on attaining majority. As all offices were filled by the great council, exclusion meant political disfranchisement. A close caste was created which very seldom and very reluctantly admitted new members to its body. The Heralds' College, the *avvogadori di comun*, in order to ensure purity of blood, were ordered to open a register of all marriages and births among members of the newly created caste, and these registers formed the basis of the famous *Libro d'oro.*

The closing of the great council and the creation of the patrician caste brought about a revolution among those who suffered disfranchisement. In the year 1300 the people, led by Marin Bocconio, attempted to force their way into the great council and to reclaim their rights. The doors were opened, the ringleaders were admitted and immediately seized and hanged. Ten years later a more serious revolution, the only revolution that seriously shook the state, broke out and was also crushed. This conspiracy was championed by Bajamonte Tiepolo, and seems to have been an expression of patrician protest against the *serrata*, just as Bocconio's revolt had represented popular indignation. Tiepolo, followed by members of the Quirini family and many nobles with their followers, attempted to seize the Piazza on the 15th of June 1310. They were met by the Doge Pietro Gradenigo and crushed. Quirini was killed, and Tiepolo and his followers fled.

The chief importance of the Tiepoline conspiracy lies in the fact that it resulted in the establishment of the Council of Ten. Erected first as a temporary committee of public safety to hunt down the remnant of the conspirators and to keep a vigilant watch on Tiepolo's movements, it was finally made permanent in 1335. The secrecy of its deliberations and the rapidity with which it could act made it a useful adjunct to the constitution, and it gradually absorbed many of the more important functions of the state.

With the creation of the Council of Ten the main lines of the Venetian constitution were completed. At the basis of the pyramid we get the great council, the elective body composed of all who enjoyed the suffrage, *i.e.* of the patrician caste. Above the great council came the senate, the deliberative and legislative body *par excellence.* To the senate belonged all questions relating to foreign affairs, finance, commerce, peace and war. Parallel with the senate, but extraneous to the main lines of the constitution, came the Council of Ten. As a committee of public safety it dealt with all cases of conspiracy; for example, it tried the Doge Marino Falier and the General Carmagnola; on the same ground all cases affecting public morals came within its extensive criminal jurisdiction. In the region of foreign affairs it was in communication with envoys abroad, and its orders would override those of the senate. It also had its own departments of finance and war. Above the senate and the Ten came the *Collegio* or cabinet, the administrative branch of the constitution. All affairs of state passed through its hands. It was the initiatory body; and it lay with the *Collegio* to send matters for deliberation either before the senate or before the Ten. At the apex of the pyramid came the doge and his council, the point of highest honour and least weight in the constitution.

To turn now to the external events which followed on the Fourth Crusade. These events are chiefly concerned with the long struggle with Genoa over the possession of the Levant and Black Sea trade. By the establishment of the Latin empire Venice had gained a preponderance. But it was impossible that the rival Venetian and Genoese merchants, dwelling at close quarters in the Levant cities, should not come to blows. They fell out at Acre in 1253. The first Genoese war began and ended in 1258 by the complete defeat of Genoa. But in 1261 the Greeks, supported by the Genoese, took advantage of the absence of the Venetian fleet from Constantinople to seize the city and to restore the Greek empire in the person of Michael VIII. Palaeologus. The balance turned against Venice again. The Genoese were established in the spacious quarter of Galata and threatened to absorb the trade of the Levant. To recover her position Venice went to war again, and in 1264 destroyed the Genoese fleet off Trepani, in Sicilian waters. This victory was decisive at Constantinople, where the emperor abandoned the defeated Genoese and restored Venice to her former position. The appearance of the Ottoman Turk and the final collapse of the Latin empire in Syria brought about the next campaign between the rival maritime powers. Tripoli (1289) and Acre (1291) fell to the Mussulman, and the Venetian title to her trading privileges, her diplomas from the Latin empire, disappeared. To the scandal of Christendom, Venice at once entered into treaty with the new masters of Syria and obtained a confirmation of her ancient trading rights. Genoa replied by attempting to close the Dardanelles. Venice made this action a *casus belli.* The Genoese won a victory in the gulf of Alexandretta (1294); but on the other hand the Venetians under Ruggiero Morosini forced the Dardanelles and sacked the Genoese quarter of Galata. The decisive engagement, however, of this campaign was fought at Curzola (1299) in the Adriatic, when Venice suffered a crushing defeat. A peace, honourable to both parties, was brought about by Matteo Visconti, lord of Milan, in that same year. But the quarrel between the republics, both fighting for trade supremacy—that is to say, for their lives—could not come to an end till one or other was thoroughly crushed. The fur trade of the Black Sea furnished the pretext for the next war (1353–54), which ended in the crushing defeat of Venice at Sapienza, and the loss of her entire fleet. But though Venice herself seemed to lie open to the Genoese, they took no advantage of their victory; they were probably too exhausted. The lord of Milan again arranged a peace (1355).

We have now reached the last phase of the struggle for maritime supremacy. Under pressure from Venice the emperor John V. Palaeologus granted possession of the island of Tenedos to the republic. The island commanded the entrance to the Dardanelles. Genoa determined to oppose the concession, and war broke out. The Genoese Admiral Luciano Doria sailed into the Adriatic, attacked and defeated Vettor Pisani at Pola in Istria, and again Venice and the lagoons lay at the mercy of the enemy. Doria resolved to blockade and starve Venice to surrender. He was master of the sea, and the flow of provisions from the mainland was cut off by Genoa's ally, Francesco I. Carrara, lord of Padua. Doria seized Chioggia as a base of operations and drew his fleet inside the lagoons. The situation was extremely critical for Venice, but she rose to the occasion. Vettor Pisani was placed in command, and by a stroke of naval genius he grasped the weakness of Doria's position. Sailing to Chioggia he blocked the channel leading from the lagoon to the sea, and Doria was caught in a trap. Pisani stationed himself outside the Lido, on the open sea, to intercept relief should any appear, and Doria, instead of blockading Venice, was himself blockaded in Chioggia. For many months the siege went on; but Pisani gradually assumed the offensive as Genoese spirits and food ran low. Finally, in June 1380 the flower of the Genoese fleet surrendered at discretion. Genoa never recovered from the blow, and Venice remained undisputed mistress of the Mediterranean and the Levant trade.

The defeat of Genoa and the establishment of Venetian supremacy in the Mediterranean brought the state to a further step in its development. The undisputed mastery of the eastern trade increased its bulk in Venice. But as the city became the recognized mart for exchange of goods between east and west, the freedom of the western outlet assumed the aspect of a paramount question. It was useless for Venice to accumulate eastern merchandise if she could not freely pass it on to the west. If the various states on the immediate mainland could levy taxes on Venetian goods in transit, the Venetian merchant would inevitably suffer in profits. The geographical position of Venice and her commercial policy alike compelled her to attempt to secure the command of the rivers and roads of the mainland, at least up to the mountains, that is to say, of the north-western outlet, just as she had obtained command of the south-eastern inlet. She was compelled to turn her attention, though reluctantly, to the mainland of Italy. Another consideration drove her in the same direction. During the long wars with Genoa, after the defeats of Curzola, Sapienza, Pola, above all during the crisis of the war of Chioggia, it had been brought home to the Venetians that, as they owned no meat or corn-producing territory, a crushing defeat at sea and a blockade on the mainland exposed them to the grave danger of being starved into surrender. Both these pressing necessities, for a free outlet for merchandise and for a food-supplying area, drove Venice on to the mainland, and compelled her to initiate a policy which eventually landed her in the disastrous wars of Cambrai. The period with which we are now dealing is the epoch of the despots, the *signori*, and in pursuit of expansion on the mainland Venice was brought into collision first with the Scaligeri of Verona, then with the Carraresi of Padua, and finally with the Visconti of Milan. Hitherto Venice had enjoyed the advantages of isolation; the lagoons were virtually impregnable; she had no land frontier to defend. But when she touched the mainland she at once became possessed of a frontier which could be attacked, and found herself compelled either to expand in self-defence or to lose the territory she had acquired.

Venice had already established a tentative hold on the immediate mainland as early as 1339. She was forced into war by Mastino della Scala, lord of Padua, Vicenza, Treviso, Feltre and Belluno, as well as of Verona, who imposed a duty on the transport of Venetian goods. A league against the Scala domination was formed, and the result was the fall of the family. Venice took possession of Padua, but in the terms of the league she at once conferred the lordship on the Carraresi, retaining Treviso and Bassano for herself. But it is not till we come to the opening of the next century that Venice definitely acquired land possessions and found herself committed to all the difficulties and intricacies of Italian mainland politics. On the death of Gian Galeazzo Visconti in 1402, his large possessions broke up. His neighbours and his generals seized what was nearest to hand. Francesco II. Carrara, lord of Padua, attempted to seize Vicenza and Verona. But Venice had been made to suffer at the hands of Carrara, who had levied heavy dues on transit, and moreover during the Chioggian War had helped the Genoese and cut off the food supply from the mainland. She was therefore forced in self-defence to crush the family of Carrara and to make herself permanently mistress of the immediate mainland. Accordingly when Gian Galeazzo's widow applied to the republic for help against Carrara it was readily granted, and, after some years of fighting, the possessions of the Carraresi, Padua, Treviso, Bassano, commanding the Val Sugana route, as well as Vicenza and Verona, passed definitely under Venetian rule. This expansion of mainland territory was followed in 1420 by the acquisition of Friuli after a successful war with the emperor Sigismund, thus bringing the possessions of the republic up to the Carnic and Julian Alps, their natural frontier on the north-east.

Venice was soon made to feel the consequences of having become a mainland power, the difficulties entailed by holding possessions which others coveted, and the weakness of a land frontier. To the west the new duke of Milan, Filippo Maria Visconti, was steadily piecing together the fragments of his father's shattered duchy. He was determined to recover Verona and Vicenza from Venice, and intended, as his father had done, to make himself master of all north Italy. The conflict between Venice and Milan led to three wars in 1426, 1427 and 1429. Venice was successful on the whole. She established her hold permanently on Verona and Vicenza, and acquired besides both Brescia and Bergamo; and later she occupied Crema. The war of Ferrara and the peace of Bagnolo (1484) gave her Rovigo and the Polesine. This, with the exception of a brief tenure of Cremona (1499–1512), formed her permanent territory down to the fall of the republic. Her frontiers now ran from the seacoast near Monfalcone, following the line of the Carnic and Julian and Raetian Alps to the Adda, down the course of that river till it joins the Po, and thence along the line of the Po back to the sea. But long and exhausting wars were entailed upon her for the maintenance of her hold. The rapid formation of this land empire, and the obvious intention to expand, called the attention not only of Italy but of Europe to this power which seemed destined to become supreme in north Italy, and eventually led to the league of Cambrai for the dismemberment of Venice. Contemporaneously other events were menacing the ascendancy and exhausting the treasury of the republic. In 1453 Constantinople fell to the Ottoman Turks, and although Venice entered at once into treaty with the new power and desired to trade with it, not to fight with it, yet it was impossible that her possessions in the Levant and the archipelago should not eventually bring her into collision with the expanding energy of the Mussulman. Europe persistently refused to assist the republic to preserve a trade in which she had established a rigid monopoly, and Venice was left to fight the Turk single-handed. The first Turkish war lasted from 1464 to 1479, and ended in the loss of Negropont and several places in the Morea, and the payment by Venice of an annual tribute for trading rights. She was consoled, however, by the acquisition of Cyprus, which came into her possession (1488) on the extinction of the dynasty of Lusignan with the death of James II. and his son James III., Caterina Cornaro, James II.'s widow, ceding the kingdom of Cyprus to Venice, since she could not hope to maintain it unaided against the Turks. The acquisition of Cyprus marks the extreme limit of Venetian expansion in the Levant; from this date onward there is little to record save the gradual loss of her maritime possessions.

Exhausting as the Turkish wars were to the Venetian treasury, her trade was still so flourishing that she might have survived the strain had not the discovery of the Cape route to the Indies cut the tap-root of her commercial prosperity by diverting the stream of traffic from the Mediterranean to the Atlantic. When Diaz rounded the Cape in 1486 a fatal blow was struck at Venetian commercial supremacy. The discovery of the Cape route saved the breaking of bulk between India and Europe, and saved the dues exacted by the masters of Syria and Egypt. Trade passed into the hands of the Portuguese, the Dutch and the English. Venice lost her monopoly of oriental traffic.

To complete her misfortunes, the European powers, the church and the small states of Italy, partly from jealous greed of her possessions, partly on the plea of her treason to Christendom in making terms with Islam, partly from fear of her expansion in north Italy, coalesced at Cambrai in 1508 for the partition of Venetian possessions. The war proved disastrous for Venice. The victory of Agnadello (1510) gave the allies the complete command of Venetian territory down to the shores of the lagoon. But the mutual jealousy of the allies saved her. The pope, having recovered the Romagna and secured the objects for which he had joined the league, was unwilling to see all north Italy in the hands of foreigners, and quitted the union. The emperor Maximilian failed to make good his hold on Padua, and was jealous of the French. The league broke up, and the mainland cities of the Veneto returned of their own accord to their allegiance to St Mark. But the republic never recovered from the blow, coming as it did on the top of the Turkish wars and the loss of her trade by the discovery of the Cape route. She ceased to be a great power, and was henceforth entirely concerned in the effort to preserve her remaining possessions and her very independence. The settlement of the peninsula by Charles V.'s coronation at Bologna in 1530 secured the preponderance to Spain, and the combination of Spain and the church dominated the politics of Italy. Dread of the Turks and dread of Spain were the two terrors which haunted Venice till the republic fell. That she retained her independence so long was due to a double accident: the impregnability of the lagoons and the jealousies of the great powers.

But the decline was a slow process. Venice still possessed considerable wealth and extensive possessions. Between 1499 and 1716 she went to war four times with the Turks, emerging from each campaign with some further loss of maritime territory. The fourth Turkish war (1570–1573) was signalized by the glorious victory of Lepanto (1571), due chiefly to the prowess of the Venetians under their doge Sebastian Venier. But her allies failed to support her. They reaped no fruits from the victory, and Cyprus was taken from her after the heroic defence of Famagusta by Bragadino, who was flayed alive, and his skin, stuffed with straw, borne in triumph to Constantinople. The fifth Turkish war (1645–1668) entailed the loss of Crete; and though Morosini reconquered the Morea for a brief space in 1685, that province was finally lost to Venice in 1716.

So far as European politics are concerned, the latter years of the republic are made memorable by one important event: the resistance which Venice, under the guidance of Fra Paolo Sarpi, offered to the growing claims of the Curia Romana, advanced by Pope Paul V. Venice was placed under interdict (1606), but she asserted the rights of temporal sovereigns with a courage which was successful and won for her the esteem and approval of most European sovereigns.

But the chief glory of her declining years was undoubtedly her splendid art. Giorgione, Titian, Sansovino, Tintoret, Paolo Veronese and Palladio all lived and worked after the disastrous wars of the league of Cambrai. The chief characteristic of Venice during these years is that she became the great pleasure-city of Europe. The end of the republic came when the French Revolution burst over Europe. Napoleon was determined to destroy the oligarchical government, and seized the pretext that Venice was hostile to him and a menace to his line of retreat while engaged in his Austrian campaign of 1797. The peace of Leoben left Venice without an ally. The government resolved to offer no resistance to the conqueror, and the doge Lodovico Manin abdicated on the 12th of May 1797. On the 17th of October Napoleon handed Venice over to Austria by the peace of Campo Formio, and between 1798 and 1814 she passed from France to Austria and Austria to France till the coalition of that latter year assigned her definitely to Austria. In 1848 a revolution broke out and a provisional republican government under Daniele Manin (*q.v.*) maintained itself for a brief space. In 1866 the defeat of Austria by the Prussians led to the incorporation of Venice in United Italy.

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VENISON (pronounced *venzon*), originally a word meaning a beast of any kind killed in the chase, but now only applied to the flesh of the deer prepared for eating. The O. Fr. *veneisun*, *venoison*, &c., mod. *venaison*, meant the flesh of the deer or boar, the principal beasts of the chase (Lat. *venatio*, hunting).

VENLO, a frontier town in the province of Limburg, Holland, on the right bank of the Maas, and a junction station 43 m. by rail N.N.E. of Maastricht. Pop. 15,000. It is joined by a bridge over the Maas, with the opposite village of Blerik. Venlo, with narrow streets irregularly built, is not of the ordinary Dutch type in architectural style. The picturesque town hall (1595), the only building of special interest, contains some interesting paintings by Hubert Goltzius (1526–1583). The church dates from 1304. There is a college for the higher education of Roman Catholic priests. The leading industries are distilling, brewing, tanning, spinning, needlemaking and tobacco manufacture. There is also a considerable trade by river with Rotterdam.

VENN, HENRY (1725–1797), English evangelical divine, was born at Barnes, Surrey, and educated at Cambridge. He took orders in 1747, and was elected fellow of Queens' College, Cambridge, in 1749. After holding a curacy at Barton, Cambridgeshire, he became curate of St Matthew, Friday Street, London, and of West Horsley, Surrey, in 1750, and then of Clapham in 1754. In the preceding year he was chosen lecturer of St Swithin's, London Stone. He was vicar of Huddersfield from 1759 to 1771, when he exchanged to the living of Yelling, Huntingdonshire. Besides being a leader of the evangelical revival, he was well known as the author of *The Compleat Duty of Man* (London, 1763), a work in which he intended to supplement the teaching embodied in the anonymous *Whole Duty of Man*. His son, John Venn (1759–1813), was one of the founders of the Church Missionary Society, and his grandson, Henry Venn (1796–1873), was honorary secretary of that society from 1841 to 1873.

VENOSA (anc. *Venusia*, *q.v.*), a town and bishop's see of the Basilicata in the province of Potenza, Italy, on the eastern side of Mount Vulture, 52 m. by rail S.S.E. of Foggia, 1345 ft. above sea-level. Pop. (1901) 8503. The castle was built in 1470 by Pirro di Balzo, and contains four stables each for fifty horses. Many fragments of Roman workmanship are built into the walls of the cathedral, which is due to him also. The abbey church of SS. Trinità is historically interesting; it was consecrated in 1059 by Pope Nicholas II. and passed into the hands of the Knights of St John in the time of Boniface VIII. (1295–1303). In the central aisle is the tomb of Alberada, the first wife of Robert Guiscard and mother of Bohemund. An inscription on the wall commemorates the great Norman brothers William Iron Arm (d. 1046), Brogo (murdered at Venosa in 1051), Humfrey (d. 1057) and Robert Guiscard (d. at Corfu in 1085). The bones of these brothers rest together in a simple stone sarcophagus opposite the tomb of Alberada. The church also contains some 14th-century frescoes. Behind it is a larger church, which was begun for the Benedictines about 1150, from the designs of a French architect, in imitation of the Cluniac church at Paray-le-Monial, but never carried beyond the spring of the vaulting. The ancient amphitheatre adjacent furnished the materials for its walls.

See A. Avena, *Monumenti dell' Italia Meridionale* (Naples, 1902), 323 sqq.; O. de Lorenzo, *Venosa e la Regione del Vulture* (Bergamo, 1906).

VENTILATION (Lat. *ventilare*, from *ventus*, wind), the process and practice of keeping an enclosed place supplied with proper air for breathing; and so, by analogy, a term used for exposing any subject to the winds of public criticism. The air which we breathe consists chiefly of two gases, oxygen and nitrogen, with certain small proportions of other gases, such as carbonic acid (carbon dioxide), ozone and argon. Oxygen, which is the active and important constituent, and on which life and combustion depend, forms about one-fifth of the whole, while nitrogen, which is inert and acts as a diluent, forms nearly four-fifths. Of this mixture each adult person breathes some 2600 gallons or 425 cub. ft. in twenty-four hours. In air that has passed through the lungs the proportion of oxygen is reduced and that of carbon dioxide increased. Of the various impurities that are found in the air of inhabited rooms, carbonic acid gas forms the best practical index of the efficiency of the ventilation. The open air of London and other large inland towns contains about four parts by volume of the gas in 10,000 of air. In the country, and in towns near the sea, two to three and a half parts in 10,000 is a more usual proportion. Authorities on ventilation usually take four parts in 10,000 as the standard for pure air, and use the excess over that quantity in estimating the adequacy of the air supply. But they differ as to the proportion to which the carbonic acid may be allowed to rise under a good system of ventilation. It is generally admitted that the air in which people dwell and sleep should not under any circumstances be allowed to contain more than ten parts in 10,000. This has been accepted as the permissible proportion by Carnelley, Haldane and Anderson, after an extensive examination of the air of middle and lower class dwellings.

Standard of purity.

Rate of consumption of air.

The rate at which an adult expires carbonic acid varies widely with his condition of repose, being least in sleep, greater in waking rest, and very much greater in violent exercise. As a basis on which to calculate the air necessary for proper ventilation we may take the production of carbonic acid by an adult as 0·6 cub. ft. per hour. Hence he will produce per hour, in 6000 cub. ft. of air, a pollution amounting to one part of carbonic acid in 10,000 of air. If the excess of carbonic acid were to be kept down to this figure (1 in 10,000), it would be necessary to supply 6000 cub. ft. of fresh air per hour; if the permissible excess be two parts in 10,000 half this supply of fresh air will suffice; and so on. We therefore have the following relation between (1) the quantity of air supplied per person per hour, (2) the excess of carbonic acid which results, and (3) the total quantity of carbonic acid present, on the assumption that the fresh air that is admitted contains four parts by volume in 10,000:—

Air supplied per Adult per Hour.	Carbonic Acid (Parts by Volume in 10,000).	
Cubic Feet.	Excess due to Respiration.	Total Quantity.
1000	6	10
1200	5	9
1500	4	8
2000	3	7
3000	2	6

Some investigators have maintained that, in addition to an increased proportion of carbonic acid, air which has passed through the lungs contains a special poison. This view, however, is not accepted by others; J. S. Haldane and Lorrain Smith, for instance, conclude "that the immediate dangers from breathing air highly vitiated by respiration arise entirely from the excess of carbonic acid and deficiency of oxygen" (*Journ. Path. and Bact.* 1892, 1, 175). Carbonic acid, however, is not the only agent that has to be reckoned with in badly ventilated rooms, for the unpleasant effects they produce may also be due to increase of moisture and temperature and to the odours that arise from lack of cleanliness. Again, though there may be no unduly large proportion of carbonic acid present, the air of an apartment may be exceedingly impure when the criterion is the number of micro-organisms it contains. This also may be greatly reduced by efficient ventilation. Comparisons carried out by Carnelley, Haldane and Anderson (*Phil. Trans.*, 1887, 178 B, 61) between schools known to be well ventilated (by mechanical means) and schools ventilated at haphazard or not ventilated at all showed that the average number of micro-organisms was 17 per litre in the former, and in the others 152. Results of great interest were obtained by the experiment of stopping the mechanical ventilators for a few hours or days. Tested by the proportion of carbonic acid, the air of course became very bad; tested by the number of micro-organisms, it remained comparatively pure, the number being, in fact, scarcely greater than when ventilation was going on, and far less than the average in "naturally ventilated" schools. This proves in a striking way the advantage of systematic ventilation.

Ventilation of buildings.

In the ventilation of buildings four main points have to be considered: (1) the area of floor to be provided for each person; (2) the cubic capacity of the room required for each occupant; (3) the allowance to be made for the vitiation of the air by gas or oil burners; and (4) the quantity of fresh air which must be brought in and of vitiated air that must be extracted for each individual. The first will depend upon the objects to which the room is devoted, whether a ward of a hospital or a school or a place of public assembly. The purity of the air of a room depends to a great extent on the proportion of its cubic capacity to the number of inmates. The influence of capacity is, however, often overrated. Even when the allowance of space is very liberal, if no fresh air be supplied, the atmosphere of a room quickly falls below the standard of purity specified above; on the other hand, the space per inmate may be almost indefinitely reduced if sufficient means are provided for systematic ventilation. Large rooms are good, chiefly because of their action as reservoirs of air in those cases (too common in practice) where no sufficient provision is made for continuous ventilation, and where the air is changed mainly by intermittent ventilation, such as occurs when doors or windows are opened. With regard to the third point, in buildings lighted by gas or oil the calculations for the supply of fresh and the extraction of foul air must include an allowance for the vitiation of air by the products of combustion. The rate at which this takes place may be roughly estimated in the case of gas by treating each cubic foot of gas burnt per hour as equal to one person. Thus an ordinary burner giving a light of about twenty candles and burning 4 cub. ft. of gas per hour vitiates the air as much as four persons, and an incandescent burner as much as one and a half persons. A small reading-lamp burning oil uses the air of four men; a large central table lamp uses as much air as seven men.

As to the fourth point there is great diversity of opinion. To preserve the lowest standard of purity tolerated by sanitarians, ventilation must go on at the rate per person of 1000 cub. ft. per hour, and 3000 cub. ft. per hour are required to preserve the higher standard on which some authorities insist. E. A. Parkes advised a supply of 2000 cub. ft. of air per hour for persons in health and 3000 or 4000 cub. ft. for sick persons. In the case of a public assembly hall no great harm will occur to an audience occupying the room for a comparatively short time if 30 cub. ft. of air per minute are provided for each person. The United States book on school architecture gives a practical application to its remarks on this subject as follows:—

> The amount of fresh air which is allowed to hospital patients is about 2500 cub. ft. each per hour. Criminals in French prisons have to content themselves with 1500 cub. ft. per hour. Assuming that we care two-thirds as much for the health of our children as we do for that of our thieves and murderers, we will make them an allowance of 1000 cub. ft. each per hour, or about 16 cub. ft. per minute. Forty-eight children will then need an hourly supply of 48,000 cub. ft. Definite provision must therefore be made for withdrawing this quantity of foul air. No matter how many inlets there may be, the fresh air will only enter as fast as the foul escapes, and this can only find an outlet through ducts intended for that purpose, porous walls and crevices serving in cool weather only for inward flow. What, then, must be the size of the shaft to exhaust 48,000 ft. per hour? In a shaft 20 ft. high, vertical and smooth inside, with a difference in temperature of 20°, the velocity will be about 2½ ft. per second, or 9000 ft. per hour: that is, it will carry off 9000 cub. ft. of air per hour for every square foot of its sectional area. To convey 48,000 cub. ft., it must have a sectional area of 5⅓ sq. ft.

A general idea of the floor area, cubic space and fresh air supply per inmate allowed by law or by custom in certain cases is given in the table below:—

Class of Building.	Floor Area in Feet per Person.	Cubic Capacity in Feet per Person.[1]	Cubic Feet of Fresh Air supplied and Foul Air extracted per Person.
Schools	9 to 10	200	1,800
Barracks	70	720	1,800
Prisons	90	800	1,800
Concert halls and theatres	9	108	2,000
Billiard and smoke-rooms	..	..	2,000
Hospitals	120	1,440	2,000 to 3,000
Public libraries	20	2,400	2,500
Turkish baths	70	800	5,000
Workshops	120	1,440	5,000
Cowsheds, per cow	90	1,100	10,000
Stables; per horse	120	1,600	12,000

[1] In calculating the cubic capacity per person the height should not be measured beyond 12 ft. above the floor.

The supply of fresh air indicated in the table should not be regarded as entirely satisfactory, for the standard of purity suggested is low, and ought to be exceeded, but it might deter many from moving in the matter if a proper and higher standard were to be laid down at first.

One of the most important points is the proper warming of the fresh air introduced into buildings, for unless that be done, when a cold day occurs all the ventilating arrangements will probably be closed. The fact should not be lost sight of that the air in a room may on the one hand be quite cold and yet very foul, and on the other, warm and yet perfectly fresh. To avoid draught the air should enter through a large number of small orifices, so that the currents may be thoroughly diffused. This is done by gratings. The friction of their bars, however, seriously diminishes their capacity for passing air, and careful experiments show conclusively that very ample grating area is required to deliver large volumes. The same remark applies to extracting-flues. Owing to the small size and the roughness of the surface the velocity of the upward current is small, and the quantity of air that passes out is often much less than is requisite.

Means of Ventilation.—In order that the atmosphere of a room should be changed by means of air currents, thereby securing proper ventilation, three things are necessary; (1) an inlet or inlets for the fresh air, (2) an outlet or outlets for the vitiated air, and (3) a motive force to produce and maintain the current. In systems which are distinguished by the general name of *mechanical* or *artificial* ventilation special provision is made for driving the air, by fans, or by furnaces, or by other contrivances to be described more fully below. In what is called *natural* ventilation no special appliance is used to give motive force, but the forces are made use of which are supplied by (1) the wind, (2) the elevated temperature of the room's atmosphere, and (3) the draught of fires used for heating.

Chimney draught.

Natural Ventilation.—The chief agent in domestic ventilation is the chimney; when a bright fire is burning in an open grate, it rarely happens that any other outlet for foul air from a room need be provided. The column of hot air and burnt gases in the chimney is less heavy, because of its high temperature, than an equal column of air outside; the pressure at the base is therefore less than the pressure at the same level outside. This supplies a motive force compelling air to enter at the bottom through the grate and through the opening over the grate, and causing a current to ascend. The motive force which the chimney supplies has not only to do work on the column of air within the chimney, in setting it in motion and in overcoming frictional resistance to its flow: it has also to set the air entering the room in motion and to overcome frictional resistance at the inlets. From want of proper inlets air has to be dragged in at a high velocity and against much resistance, under the doors, between the window sashes and through many other chinks and crevices. Under these conditions the air enters in small streams or narrow sheets, ill-distributed and moving so fast as to form disagreeable draughts, the pressure in the room is kept so low that an opened door or window lets in a deluge of cold air, and the current up the chimney is much reduced. If the attempt is made to stop draughts by applying sand-bags and listing to the crevices at which air streams in, matters only become worse in other respects; the true remedy of course lies in providing proper inlets. The discharge of air by an ordinary open fire and chimney varies widely, depending on the rate of combustion, the height and section and form of the chimney, and the freedom with which air is entering the room. About 10,000 cub. ft. per hour is probably a fair average, about enough to keep the air fresh for half a dozen persons. Even when no fire is burning the chimney plays an important part in ventilation; the air within an inhabited room being generally warmer than the air outside, it is only necessary that an up-current should be started in order that the chimney should maintain it, and it will usually be found that a current is, in fact, passing up.

Other outlets.

When a room is occupied for any considerable length of time by more than about half a dozen persons, the chimney outlet should be supplemented by others, which usually take the form of gratings in the ceiling or cornices in communication with flues leading to the open air. These openings should be protected from down-draught by light flap valves of oiled silk or sheet mica.

Inlets.

With regard to inlets, a first care must be to avoid such currents of cold air as will give the disagreeable and dangerous sensation of draught. At ordinary temperatures a current of outer air to which the body is exposed will be felt as a draught if its velocity exceeds 3, or even 2 ft. per second. The current entering a room may, however, be allowed to move with a speed much greater than this without causing discomfort, provided its direction keeps it from striking directly on the persons of the inmates. To secure this, it should enter, not horizontally nor through gratings on the floor, but vertically through openings high enough to carry the entering stream into the upper atmosphere of the room, where it will mix as completely as possible with warm air before its presence can be felt. A favourite form of inlet is the Sheringham (fig. 1). When opened it forms a wedge-shaped projection into the room, and admits air in an upward stream through the open top. It should be placed at a height of 5 or 6 ft. above the level of the floor. Other inlets are made by using hollow perforated blocks of earthenware, called air-bricks, built into the wall; these are often shaped on the inner

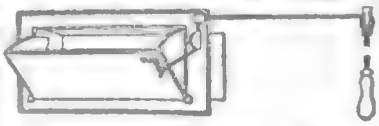

FIG. 1.—Sheringham Air Inlet.

side like an inverted louvre-board or venetian blind, with slots that slope so as to give an upward inclination to the entering stream.

Tobin tube.

In another and most valuable form of ventilator, the Tobin tube, the fresh air enters vertically upwards. The usual arrangement of Tobin tube (shown in front elevation and section in fig. 2) is a short vertical shaft of metal plate or wood which leads up the wall from the floor level to a height of 5 or 6 ft. Its lower end communicates with the outer air through an air-grating in the wall; from its upper end, which is freely open, the current of fresh air rises in a smooth stream. Various forms of section may be given to the tube: if placed in a corner it will be triangular or segmental; against a flat wall a shallow rectangular form is most usual, or it may be placed in a channel so as to be flush with the face of the wall; a lining of wood forming a dado may even be made to serve as a Tobin tube by setting it out a little way from the wall. The tube is often furnished with a regulating valve, and contrivances may be added for cleansing the entering air. A muslin or canvas bag hung in the tube, or a screen stretched diagonally across it, may be used to filter out dust; the same object is served in some degree by forcing the air, as it enters the tube at the bottom, to pass in close contact with the surface of water in a tray, by means of a deflecting plate. These complications have a double drawback: they require frequent attention to keep them in order, and by putting resistance in the way of the stream they are apt to reduce the efficiency of the ventilation.[1] The air entering by a Tobin tube may be warmed by a coil of hot pipes within the tube or by a small gas-stove (provided, of course, with a flue to discharge outside the products of combustion), or the tube may draw its supply, not directly from the outer atmosphere, but from a hot-air flue. The opening should always be about the level of a man's head, but the tube need not extend down to the floor: all that is essential is that it should have sufficient length to let the air issue in a smooth vertical current without eddies (fig. 3).

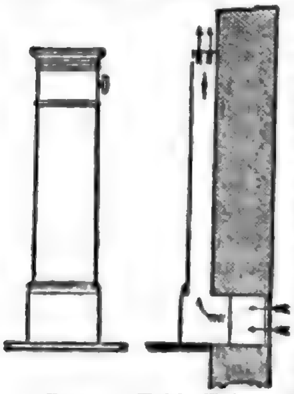

FIG. 2.—Tobin Tube.

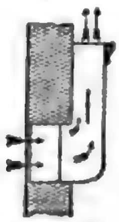

FIG. 3.—Short Tobin Tube.

Ventilation by window and door.

These inlets are at once so simple and effective that no hesitation need be felt in introducing them freely in the rooms of dwelling-houses. When no special provision is made for them in the walls, the advantage of a current entering vertically may still be in some degree secured by help of certain makeshift contrivances. One of these, suggested by Dr Hinkes Bird, is to open one sash of the window a few inches and fill up the opening by a board; air then enters in a zigzag course through the space between the meeting rails of the sashes. Still another plan is to have a light frame of wood or metal or glass made to fit in front of the lower sash when the window is opened, forming virtually a Tobin tube in front of the window.

Arrangements in barracks.

As an example of the systematic ventilation of dwelling-rooms on a large scale, the following particulars may be quoted of arrangements that have been successfully used in English barracks. One or more outlet-shafts of wood fitted with flap valves to prevent down-draught are carried from the highest part of the room, discharging some feet above the roof under a louvre. The number and size of these shafts are such as to give about 12 sq. in. of sectional area per head, and the chimney gives about 6 sq. in. more per head. About half the air enters cold through air-bricks or Sheringham valves at a height of about 9 ft. from the floor, and the other half is warmed by passing through flues behind the grate. The inlets taken together give an area of about 11 sq. in. per head. A fairly regular circulation of some 1200 cub. ft. per head per hour is found to take place, and the proportion of carbonic acid ranges from 7 to 10 parts in 10,000.

In public buildings.

In the natural ventilation of churches, halls and other large rooms we often find air admitted by gratings in the floor or near it; or the inlets may consist, like Tobin tubes, of upright flues rising to a height of about 6 ft. above the floor, from which the air proceeds in vertical streams. If the air is to be warmed before it enters, the supply may be drawn from a chamber warmed by hot-water or steam pipes or by a stove, and the temperature of the room may be regulated by allowing part of the air to come from a hot chamber and part from outside, the two currents mixing in the shaft from which the inlets to the room draw their supply. Outlets usually consist of gratings or plain openings at or near the ceiling, preferably at a considerable distance from points vertically above the inlet tubes. One of the chief difficulties in natural ventilation is to guard them against down-draught through the action of the wind. Numberless forms of cowl have been devised with this object, with the further intention of turning the wind to useful account by making it assist the up-current of foul air. Some of these exhaust cowls are of the revolving class, made to various designs and dimensions and put in rotation by the force of the wind. Revolving cowls are liable to fail by sticking, and, generally speaking, fixed cowls are to be preferred. They are designed in many forms, of which Buchan's may be cited as a good example. Fig. 4 shows this ventilator in horizontal section: *aa* is the vertical exhaust flue through which the foul air rises; near the top this expands into a polygonal chamber, *bbbb*, with vertical sides, consisting partly of perforated sheet-metal plates; outside of these are fixed vertical curved guide-plates, *c,c,c,c*; the wind, blowing between these and the polygonal chamber, sucks air from the centre through the perforated sides. The efficient working of an exhaust cowl, however, depends almost entirely upon the favourable conditions of the wind.[2] The two things that supply motive force in automatic or natural ventilation by means of exhaust cowls and similar appliances—the difference of temperature between inner and outer air, and the wind—are so variable that even the best arrangements of inlets and outlets give a somewhat uncertain result. As an example, it is evident that on a hot day with little movement in the air this mode of ventilation would be practically ineffectual. Under other conditions these automatic air-extractors not infrequently become inlets, thus reversing the whole system and pouring cold air on the heads of the inmates of the apartment or hall. To secure a strictly uniform delivery of air, unaffected by changes of season or of weather, it is necessary that the influence of these irregular motive forces be as far as possible minimized, and recourse must consequently be had to some mechanical force as a means of driving the air and securing adequate ventilation of the building.

Exhaust cowls.

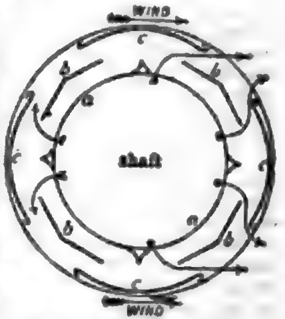

FIG. 4.—Sectional Plan of Buchan's Exhaust Cowl.

Artificial Ventilation.—Buildings may be mechanically ventilated on the vacuum system, the plenum system, or on a system combining the best points of both. In nearly every case of the application to modern buildings of mechanical means of ventilation the combined system in one form or another is adopted. In the vacuum system the motive force is applied at the outlets; the vitiated air is drawn from the rooms, and the pressure of the atmosphere in them is slightly less than the pressure outside. Upon the foul air being withdrawn fresh air finds its way in by means of conveniently placed inlets. In the plenum the motive force is applied at the inlets; fresh air is forced in and drives the vitiated air before it until it escapes at the outlets provided. The pressure within the room is greater than outside. The plenum method has distinct advantages: it makes the air escape instead of coming in as a cold draught at every crevice and casual opening to the outer air; it avoids drawing foul air from sewers and basement; and with it, more easily than with the other, one may guard against the disturbing influence of wind. In the plenum method the air is driven by fans; in the vacuum method suction is produced by fans or by heating the column of air in a long vertical shaft through which the discharge takes place. Water jets and steam jets have also been employed to impel or extract the air. Whatever system of ventilation is adopted, it is most important that windows capable of being widely opened should also be provided to aërate at frequent intervals the whole building, either as a whole or in sections, and they should be so arranged that no corner can be left stagnant or unswept by the purifying current. The Victoria Hospital at Glasgow and the Royal General Hospital at Birmingham are, however, ventilated on the plenum system without the aid of open windows, with what are said to be satisfactory results. In the case of hospitals, it is evident that aëration by means of open windows could not in Great Britain be effected except on warm and sunny days, but in the case of concert halls, theatres and similar buildings, it is possible (and most essential) thoroughly to aërate the building between each occupation.

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[1] When the air is not filtered, and when it has been warmed before entering, the vertical direction of the stream is readily traced by dust, which is deposited on the wall in a nearly upright column, spreading slightly fan-wise as it rises. With cold air the deposit of dust is comparatively slight. The difference is due to the fact, noticed and explained by Mr John Aitken, that air quickly deposits any suspended particles when it is brought into contact with a surface colder than itself, but retains them in suspension if the surface be warmer than the air. Another domestic illustration of the same fact is given by the greater dustiness of walls and furniture in a stove-heated room than in a room heated by an open fire.

[2] For an account of tests of various forms of ventilating cowls, see S. S. Hellyer, *The Plumber and Sanitary Houses*.

Extraction of vitiated air.

The extraction of foul air should in most cases be effected at the top of a room or building, so as to utilize the natural tendency of warm air to rise; but at Birmingham and elsewhere the outlets are near the floor, the fresh air being brought in half-way up the walls and directed towards the ceiling. The air inlets should be Tobin tubes or similar devices, placed some 4 or 5 ft. above the floor, and so arranged that the air should be passed in contact with radiators or pipes to warm it before entering. In the case of a building for one of the American legislatures, the warmed fresh air is allowed to enter on the level in front of the desk of each member, so that he secures a proper volume of fresh air for his own use before it is breathed by his neighbour.

Fans.

The introduction of rapidly revolving, but silent, fans, driven by electricity, is a great advance which places within the reach of the engineer or architect the means for solving the problem of ventilation of buildings, and has been to a large extent responsible for the rapid progress of the art of ventilation. The fan and motor combined extend the advantages of positive mechanical ventilation to all who have access to electric current, with the further benefit that the extreme simplicity of the electric driving of the fans greatly facilitates the control and distribution of ventilating effect. The moderate power required by these fans for a given duty has contributed greatly to their extended use. They should deliver into a chamber of considerable size, so that the velocity of the air may become reduced before it passes into the distributing flues. The question of silence in running, in such places as houses of parliament, law courts, churches and chapels, is of paramount importance, and no fan should be accepted until it is proved by actual working to be noiseless.

In some instances revolving pumps of the Root's blower type are used (see BELLOWS AND BLOWING MACHINES). At the Dundee College a battery of five of these blowers, each discharging over 150,000 cub. ft. of air per hour, is driven easily by a gas engine of two horse-power. The air is passed through two filters of coarsely woven fabrics which serve to remove all particles of impurity. The rooms are heated by having coils of Perkins's high-pressure hot-water pipes (see HEATING) in the main distributing flues. The inlets are flat upright tubes extending up the side walls to a height of nearly 6 ft., and open at the top. Outlets are generally provided in the end walls, one group near the ceiling, another a few feet from the foot. They are fitted with doors which allow one or other to be closed; the high-level outlets are used in warm weather, when the fresh air that comes in is comparatively cool; the low-level ones are used in cold weather, when the fresh air, having been heated before it enters, would tend to rise and pass out too directly if the outlets near the ceiling were open. The outlet shafts communicate with a louvred tower or turrets on the roof. Each room receives a volume of air equal to its cubic capacity in about 12 minutes, so that the atmosphere is completely changed five times in an hour. The inlets are proportioned to do this without allowing the velocity with which air enters to exceed 6 ft. per second.

Water-spray ventilator.

The water-spray ventilator is a mechanical ventilator using a jet of water to impel the air. A nozzle at the top of a circular air-shaft delivers a conical sheet of water, which impinges on the sides of the shaft a little way below and carries down with it a considerable stream of air. This ventilator is used either to force air into rooms or to draw it out; in the former case a small stove is often added to heat the supply.

Extraction by hot-air shaft.

In the early days of mechanical ventilation extraction by a hot-air shaft was a more common mode of ventilating hospitals and other public buildings than now. The heat was applied by a furnace or stove at the bottom of the shaft, or by coils of hot-water or steam pipes. In the lecture theatre of the Paris Conservatoire des Arts A. J. Morin employed this means of extraction, and arranged that the fresh air should enter through the ceiling and the foul air be drawn off through the floor from under the seats; this reversal of the natural direction of the current is of course only possible when a sufficient external motive force is applied.

In theatres and similar buildings clusters of gas jets or sunlight burners, fixed at the ceiling level at the base of a metal shaft which is connected with the open air, serve as effective ventilating agents by extracting the foul air which collects in the upper part of the hall.

The measurement of air.

To ensure the admission of the desired amount of air into a room, and to arrive at the proper allowance of inlets and outlets, it is necessary to ascertain the direction and velocity of the movement of the air through them. The quantity of air passing through a given opening is found by multiplying the area of the opening expressed in square feet by the velocity of the current of air stated in lineal feet per minute, the product being the number of cubic feet passing per minute. Where the air is admitted through gratings only the clear area should be calculated, the amount of solid material being deducted from the gross superficies of the grating. The velocity of the air current may be determined by means of an anemometer (*q.v.*).

We may conclude with a short summary of the methods adopted of ventilating a number of typical buildings of various classes of different countries.

The Smallpox Hospital at Bradford consists of two wards, 75 ft. by 15 ft., placed back to back, with a space of about 3 ft. between them enclosed by walls forming a foul-air chamber of the same length as the wards, and reaching to the ceiling. At this level are outlets for the vitiated air—one over each bed. A furnace at the base of a tall shaft withdraws through these outlets the air which passes through the furnace on its way to the outer air. The windows are tightly closed and fresh air enters from a chamber below through gratings in the floor at the foot of each bed.

The New York General Hospital was stated in 1875 to contain 163 beds. In the wards there is one window to each bed, each pier between the windows containing a foul-air extracting flue running from the base of the building and connected in the roof with large trunks leading to an exhaust fan. The heating is by steam coils placed in the basement in such a way that by a valve the cool fresh air can be sent either through or around the heating coil. The warmed fresh air is conveyed through an air-tight iron pipe fitted in each extracting shaft and is admitted to the wards through slits in the window-sills forming a jet directed upward on the principle of Tobin tubes. The outlet openings for the foul air are placed one beneath each bed, with extra outlets for occasional use at the top and base of the external walls. The placing of the fresh-air supply pipes in an inaccessible position inside the foul air ducts cannot be approved for hospital ventilation, as it is quite possible that in time, through the decay of the pipe joints or of the pipes themselves, communication may be established between the fresh and foul air, thus entirely upsetting the system of ventilation.

The City Hospital of Hamburg, containing 130 beds, was opened in 1890. The buildings are one storey high and are heated on the ancient Roman hypocaust principle. Beneath the entire floor run longitudinally a number of brick and concrete flues about 30 in. square, covered on the top with marble tiles, forming the floor of the wards. In these flues are placed the steam heating pipes. Warmed fresh air is admitted through large radiators in the centre of the wards, the vitiated air escaping through openings in the ridge of the roof. Mr H. Percy Adams adopted a similar hypocaust method for warming the chapel and the dining-hall at the King Edward VII. Tuberculosis Sanatorium at Midhurst, Sussex, except that the radiators are omitted from the centre of the rooms and placed in recesses in the side walls.

In the Houses of Parliament at Westminster, which were designed and built for the public business in 1836, considerable attention is devoted to the question of the purification of the air, but the arrangements are lamentably antiquated and ineffectual in their working. The supply of fresh air is drawn by fans from the terrace at the river front, and, after being warmed and moistened or cooled by water-spray or blocks of ice, as the temperature may require, passes through exceedingly tortuous and restricted air passages to the various chambers, where it is admitted through large gratings in the floor, which are covered by porous matting to prevent draughts. The outlets for the vitiated air are in the ceilings of the apartments, and from these the air has to be dragged down to the base of the ventilating shaft in the Victoria tower, where an up-current is maintained by a large furnace.

The French Chamber of Deputies, according to a report made by M. Frélat in 1891, is much overcrowded, the allowance of floor space for each member being only 30 square centimetres. The apparatus is powerful enough to change the air every six minutes, but to avoid draughts it can only be worked slowly. Fresh air is driven down by a fan through openings in the ceiling, and vitiated air removed at the floor, giving a downward system of ventilation.

For the ventilation of the new Sessions House at the corner of Newgate Street and Old Bailey, London, opened in 1907, an elaborate system on the plenum downward principle was installed. The fresh air, drawn in at the basement by powerful fans, passed in turn through purifying screens, on which water was constantly playing, and over steam-heated coils, before entering the distributing trunks; into these sufficient cold air also was admitted to reduce it to the required temperature. Branch ducts conveyed this warmed fresh air to the points of inlet just below the ceiling. The outlets for the vitiated air were placed near the floor level, an electric fan drawing it up and discharging it at the roof. It was claimed that 600 tons of filtered and warmed or cooled fresh air were passed through the building every hour.

In the Capitol at Washington in America the upward system is installed. Fresh air, warmed by coils in the basement, is delivered by means of fans through openings in the floors of the various chambers and galleries, and the extractors are placed in the ceilings. This foul air passes out of the building through louvre ventilators placed on the roof ridge. Some of the vitiated atmosphere, however—that from the corridors and galleries—is drawn by means of a fan to the basement and blown up a lofty shaft.

The Grand Opera House in Vienna is ventilated on a most elaborate and complete system, the arrangements there giving excellent results. The scheme for heating and ventilating this building was designed by D. Böhm. The building measures 397 ft. by 299 ft., and the theatre will hold about 2700 persons. Ventilation is effected by two fans, the lower for propulsion, the upper for extraction.. The latter is aided also by the heat produced by the great pendant which has ninety burners. The heating is effected by steam, and the air enters the hall at a temperature of from 63° to 65° F., the points of entrance being at the floor and the risers of the seating. Each gallery and compartment of the theatre, including the stage, has a separate installation of heating apparatus and supply duct so that any one portion may be warmed and ventilated independently of the rest. The velocity of the incoming air is between 1 and 2 ft. per second. The driving fan in the basement sends air into the building at the rate of 1059 cub. ft. per head per hour by means of electricity. The temperature in different parts of the house can be observed in a central control office, and here also are the levers which control the valves regulating the air supply, both hot and cold. During a performance the superintendent of heating and ventilation is on duty in this office and secures to each part of the building its proper supply of fresh air at a proper temperature.

For the ventilation of mines see MINING, and for that of railway tunnels see TUNNEL.

AUTHORITIES.—The following are the principal publications on ventilation: J. S. Billings, *Ventilation and Heating*; Leeds, *Treatise on Ventilation*; Carpenter, *Heating and Ventilating Buildings*. (J. BT.)

VENTIMIGLIA (Fr. *Vintimille*, anc. *Album Intimilium* or *Albintimilium*), a frontier fortress, seaport and episcopal see of Liguria, Italy, in the province of Porto Maurizio, 94 m. W. by S. of Genoa by rail, and 4 m. from the Franco-Italian frontier, 45 ft. above sea-level. Pop. (1901) 3452 (town); 11,468 (commune). The present Gothic cathedral is built on the ruins of an earlier Lombard church, and this again on a Roman building, possibly a temple. The ruins of the ancient town are situated in the plain of Nervia, 3 m. to the E. of the modern. It was a *municipium* with an extensive territory, and of some importance under the Empire, but was plundered by the partisans of Otho in A.D. 69. Remains of a theatre are visible, and remains of many other buildings have been discovered, among them traces of the ancient city walls, a fine mosaic, found in 1852 but at once destroyed, and a number of tombs to the west of the theatre. The caves of the Balzi Rossi have proved rich in palaeolithic remains of the Quaternary period.

See *Notizie degli Scavi, passim*, especially 1877, 288 (G. Rossi).

VENTNOR, a watering-place in the Isle of Wight, England, 12½ m. S. by W. of Ryde by rail. Pop. of urban-district (1901) 5866. It is finely situated in the Undercliff district, at the foot of St Boniface Down, which reaches a height of 787 ft. The town is built on a succession of terraces sloping towards the sea, and from its sheltered situation, equable temperature, and comparatively dry atmosphere is regarded as one of the best resorts in England for consumptive invalids. In the middle of the 19th century it was only a small fishing hamlet, now it extends along the shore for a distance of about 2 m., including Bonchurch to the east. It possesses assembly rooms, a literary and scientific institution, an esplanade, a pier and extensive recreation grounds. The churches of Ventnor are all modern, but that of St Boniface at Bonchurch is a small Norman building, perhaps the oldest in the island. Among the benevolent and charitable institutions are the royal national hospital for consumptives (founded in 1869), the seaside home of the London city mission, the St Catherine's home for consumptives and the convalescent home of the Royal Hants Hospital.

VENTRILOQUISM (Lat. *venter*, belly, and *loqui*, to speak), the art of producing the voice in such a manner that it shall appear to proceed, not from the speaker's own mouth, but from some place altogether distant from him. The art of ventriloquism was formerly supposed to result from a peculiar use of the stomach (whence the name) during the process of inhalation. As a matter of fact, the words are formed in the normal manner, but the breath is allowed to escape very slowly, the tones being muffled by narrowing the glottis and the mouth opened as little as possible, while the tongue is retracted and only its tip moves. Gestures and facial expression are employed at the same time to assist in the deception by stimulating the imagination of the listeners and to distract their attention from the speaker. "Thus," says Huxley, "if the ventriloquist desire to create the belief that a voice issues from the bowels of the earth, he imitates, with great accuracy, the tones of such a half-stifled voice, and suggests the existence of some one uttering it by directing his answers and gestures towards the ground. The gestures and tones are such as would be produced by a given cause; and, no other cause being apparent, the mind of the bystander insensibly judges the suggested cause to exist." Ventriloquism, which is still a recognized form of conjuring entertainment, is of ancient origin. Traces of the art are found in Egyptian and Hebrew archaeology. Eurykles of Athens was the most celebrated of Greek ventriloquists, who were called after him Euryklides, and also *Engastrimanteis* (belly-prophets). It is not impossible that the priests of ancient times were masters of this art, and that to it may be ascribed such miracles as the speaking statues of the Egyptians, the Greek oracles, and the stone in the river Pactolus, the sound of which put robbers to flight. Many uncivilized races of modern times are adepts in ventriloquism, as the Zulus, the Maoris and the Eskimos. It is well known in Hindustan and China, where it is practised by travelling magicians.

See De la Chapelle, *Le Ventriloque, ou l'engastrimythe* (London, 1772); E. Schultz, *Die Kunst des Bauchredens* (Erfurt, 1895); Sievers, *Grundzüge der Phonetic* (Leipzig, 1901); Russel, *Ventriloquism* (London, 1898).

VENUE (derived through the French, from Lat. *venire*, to come), in English law the term denoting the place from which a jury must come for the trial of a case. The word occurs early in constitutional documents, for it was for a long time one of the essentials of trial by jury that the jury should belong to the neighbourhood (*vicinetum, visne*) in which the cause of action arose or the alleged crime was committed (see JURY). This was founded on the idea that the jurors were in the nature of witnesses for or against the character or innocence of the party. The phrase *duodecim legales homines de vicineto*, or its equivalent, is found in the Constitutions of Clarendon (1164), the Assize of the Forest (1184) and in Glanvill.

Civil Matters.—Civil actions came to be classified as local and transitory, the former where the cause of action could only arise in a particular county, such as trespass to land, the latter where it might have arisen in any county, such as debt. In the latter case the plaintiff might lay the venue where he pleased, *i.e.* try the cause in any part of England subject to the power of the court or a judge to change the place of trial. The law on the subject is now only of antiquarian interest, for under the rules of the Supreme Court (Ord. xxxvi. r. 1), "there shall be no local venue for the trial of any action, except where otherwise provided by statute, but in every action in every division the place of trial shall be fixed by the court or a judge." All local venues created by statutes prior to 1875 were superseded by the rules of the Supreme Court and have not been revived by the present rules; and many of such statutes have been expressly or impliedly repealed by the Public Authorities Protection Act 1893. The present practice is to fix the place of trial in the order for directions now made in every civil action in the High Court. The place is selected by reference to the wishes of the parties, the residence of the witnesses, and with a view to reducing the costs of litigation.

Criminal Matters.—Proceedings by indictment or criminal information are not affected by the changes of procedure as to civil actions; and it is necessary to ascertain in the case of each offence the venue, *i.e.* the proper place of trial, which, unless otherwise provided by statute, must be the county or other jurisdiction in which acts constituting the offence have been done. Numerous acts provide for the place of trial of offences committed partly in one county and partly in another, or on the high seas or abroad, and of special offences, such as those under the Post Office, Merchant Shipping, Slave Trade, and Foreign Enlistment Acts. The place of trial may be changed by the king's bench division, where it is probable that a fair trial could not be had in the county of the venue. Until 1825 it was necessary to have as juries in criminal cases jurors from the hundred in which the offence was said to have been committed, and to be very particular to specify the venue as to each act imputed to the accused. This strictness continued to some extent until the passing of the Criminal Procedure Act 1851, which makes it unnecessary to state any venue in the body of an indictment, and no indictment is to be held bad for want of a proper perfect venue. Since this enactment (which applies to Ireland as well as to England) it is sufficient to state the venue in the margin of the indictment in this form, "Middlesex to wit," and it is unnecessary to mention the venue in the body of the indictment or information, though in certain cases such as burglary it is usual, if not essential, to give a "local description."

Scotland.—In Scottish law venue is not used as a technical term, but there are statutory provisions for changing the place of trial in both civil and criminal cases.

United States.—In the United States venue may generally be changed by the courts; but in some states it is provided by their constitutions that provision for change of venue is to be made by the legislature. In other states the passing of local or special laws for change of venue is forbidden. (W. F. C.)

VENUS, an old Roman and Latin goddess, apparently representing beauty and growth in nature, and especially in gardens, where the Roman practical sense would most naturally see these. She had two temples in Rome, one in the grove of Libitina, with whom she was wrongly identified, and the other near the Circus Maximus, both of which had as their dedication day the 19th of August, the festival of the *Vinalia rustica*, a fact which also points in the direction of skilled cultivation as the human work of which she was protectress. But this old Latin deity was in historical times entirely absorbed by the Greek Aphrodite, and assumed the characteristics of a cult of human love, which in her original form she had never possessed. (See APHRODITE.)

VENUS, in astronomy, the second of the major planets in the order of distance from the sun, and moving next within the orbit of the earth. Its symbol is ♀. At inferior conjunction it approaches nearer to the earth than any other major planet, but in that position it is practically invisible. Its apparent motion may be described as an oscillation from one side of the sun to the other, the complete period of which is 1·6 years, and the greatest elongation about 45° on each side of the sun. When east of the latter it appears as the "evening star" in the west after sunset, while near western elongation it is seen as the "morning star" before sunrise. In these aspects it was known to the ancients as Ἕσπερος, Hesperus, and Ἑωσφόρος or Φωσφόρος, Phosphorus. The eccentricity of its orbit is smaller than that of any other planet except Neptune.

Rotation of Venus.

Notwithstanding the near approach of Venus to the earth, its situation relative to the sun is unfavourable to the study of its physical constitution. Near inferior conjunction only a narrow crescent of light is visible; and when, as the planet moves away, this crescent becomes broader, the distance of the planet constantly increases. When it appears as a half-moon it is at a distance of more than two-thirds that of the sun, and nearly double the distance of Mars in opposition. The difficulty of reaching any conclusion on the subject of its constitution is heightened by the seeming absence of any well-marked features on the visible part of its brilliant surface. In the telescope it presents much the appearance of burnished silver, without spot or blemish. It is true that observers have from time to time thought they could detect slight variations of shade indicating an axial rotation. As far back as 1667 G. D. Cassini thought he saw a bright spot near the southern horn, observations of which gave a period of about 23 hours. In 1726 Francesco Bianchini (1662–1729), a papal chamberlain, made similar observations from which he inferred a period of more than 24 days. It was shown, however, that the observations of Bianchini could be reconciled with those of Cassini by supposing that, as he observed the planet night after night, it had made one rotation and a little more. J. H. Schroeter also found a revolution of less than 24 hours. But Sir W. Herschel, as in the case of Mercury, was never able to detect any changes from which a period of rotation could be determined. During the years 1888–1890, G. Schiaparelli made an exhaustive study of the whole subject, the results of which were summed up in five brief notes, read to the Lombardian Academy of Sciences during the year 1890. His general conclusion was that Venus always presents the same face to the sun, as the moon does to the earth. The same result has been reached by the observations at the Lowell Observatory. The inference that the axial rotation is at least much slower than that of the earth is strengthened by the measures of different diameters of the planet made while it was in transit across the disk of the sun in 1874 and 1882. These show no measurable ellipticity of the disk, but they are not sufficiently accurate to lead to any more precise conclusion than that just stated. Still, the difficulty and uncertainty attending all observations hitherto made upon the disk are such that no conclusion respecting the time of rotation can be regarded as established. Against the view of Schiaparelli is to be set the great improbability that a body so distant from the sun as Venus could be permanently so acted upon as to keep its axial rotation in precise coincidence with its orbital motion. Only one way seems to be open for settling the question; this is by spectroscopic observations of the displacement of the spectral lines at the two limbs of the planet. Attempts by this method have been made by A. A. Belopolski at Pulkova, and by the astronomers of the Lowell Observatory. It is, however, found that the amount of displacement is so small that it has evaded certain detection up to the present time. Belopolski's measures were decidedly in favour of an axial rotation, while the Lowell results were not.

Atmosphere of Venus.

Other observations than those we have cited show that Venus is surrounded by an atmosphere so filled with clouds that it is doubtful whether any view of the solid body of the planet can ever be obtained. The first evidence in favour of an atmosphere was found in the fact that, when near inferior conjunction, the visible outline of the thin crescent extended through more than 180°. Most remarkable was an observation by Chester Smith Lyman at New Haven during the conjunction of 1866, when the planet was just without the sun. A thin line of light was supposed to be seen all round the limb of the planet most distant from the sun. But as no such appearance was seen during the approach of the planet to the sun at the transits of 1874 and 1882, when the conditions were much more favourable, it seems likely that such observations are the result of an optical illusion. During the latter of the two transits the phenomena of this class observed were of an unexpected character. Not a trace of the planet could be seen until it began to impinge upon the solar disk. When about half of its diameter had entered upon the sun the outline outside the disk of the sun began to be marked by broken portions of an arc of light. This did not begin at the point A (fig. 1) farthest from the sun, as it should have done if due wholly to refraction, but immediately at the sun itself, as shown in the cut at the point B. Portions of this arc were formed one by one at various other points of the dotted outline, and when the planet was about three-fourths upon the sun the arc was completed. But there was no strengthening of the line at the middle point, as there should have been if due to refraction. Yet refraction must have played some part in the phenomenon, because otherwise no illumination could have been visible under the circumstances. The most satisfactory explanation seems to be that of H. N. Russell, whose conclusion is that the atmosphere is so permeated with fine particles of vapour up to its outer limit as to be only translucent without being fully transparent. Thus what is seen is the irregular reflection of the light at an extremely small angle from the particles of vapour.

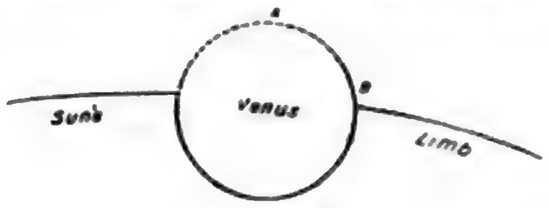

FIG. 1.

Supposed satellite.

The question whether Venus has a satellite has always interested astronomers. During the 17th and 18th centuries Cassini at Paris and James Short (1710–1768) in England, as well as other observers during the same period, saw an object which had the appearance of a satellite. But as no such object has been seen by the most careful search with the best instruments of recent times, the supposed object must be regarded as what is known to the practical astronomer as a "ghost" produced by refraction from the lenses of the eyepiece, or perhaps of the object-glass, of the telescope.

Transits of Venus.

If the orbit of Venus lay in the plane of the ecliptic, it would be seen to pass over the disk of the sun at every inferior conjunction. But the inclination of the orbit, 3° 36′, is so large that a transit is seen only when the earth and Venus pass a node of the orbit at nearly the same time. The earth passes the line of nodes about the 7th of June and the 7th of December of each year. The date of passage is about a day later in each successive century. Venus passes the node near enough to these dates to be seen against the sun only four times in a period of 243 years. The following list of dates from 1518 to 2012 shows the law of recurrence.

1518 June 2.
1526 June 1.
1631 December 7.
1639 December 4.
1761 June 6.
1769 June 3.
1874 December 9.
1882 December 6.
2004 June 8.
2012 June 6.

The first of these transits actually seen was that of 1639, which was imperfectly observed by Jeremiah Horrox (1619–1641) shortly before sunset. Special interest in them was first excited by Edmund Halley a century later, who showed that the parallax of the sun could be determined by observing transits of Venus from regions of the earth's surface where the displacement by parallax was greatest. Governments, scientific organizations and individuals fitted out expeditions on a very large scale to make the necessary observations upon the four transits which have since occurred. The disappointing character of the results so far as the solar parallax is concerned are stated in the article PARALLAX, SOLAR. It may be said in a general way that the observations, even when made by experienced astronomers, exhibited irregularities and discordances several times greater than one had a right to expect. Other methods of determining the distance of the sun have been so perfected that the results of these transits now count but little. (S. N.)

VENUSIA (mod. *Venosa*, *q.v.*), an ancient city of Apulia, Italy, on the Via Appia, about 6 m. S. of the river Aufidus (Ofanto), and not far from the boundary of Lucania (hence Horace describes himself as "Lucanus an Apulus anceps, nam Venusinus arat finem sub utrumque colonus"). It was taken by the Romans after the Samnite war of 291 B.C., and became a colony at once, no fewer than 20,000 men being sent there, owing to its military importance. Throughout the Hannibalic wars it remained faithful to Rome, and had a further contingent of colonists sent in 200 B.C. to replace its losses in war. Some coins of Venusia of this period exist. It took part in the Social War, and was recaptured by Quintus Metellus Pius; it then became a *municipium*, but in 43 B.C. its territory was assigned to the veterans of the triumvirs, and it became a colony once more. Horace was born here, the son of a freedman, in 65 B.C. It remained an important place under the Empire as a station on the Via Appia, though Mommsen's description of it (*Corp. Inscr. Lat.* ix. p. 45) as having branch roads to Equus Tuticus and Potentia, and Kiepert's maps annexed to the volume, do not agree with one another. Remains of the ancient city walls and of an amphitheatre still exist, and a number of inscriptions have been found there. Jewish catacombs with inscriptions in Hebrew, Greek and Latin show the importance of the Jewish population here in the 4th and 5th centuries after Christ. (T. As.)

VENUS'S FLY-TRAP (*Dionaea muscipula*), a remarkable insectivorous plant, a native of North and South Carolina, first described in 1768 by the American botanist Ellis, in a letter to Linnaeus, in which he gave a substantially correct account of the structure and functions of its leaves, and even suggested the probability of their carnivorism. Linnaeus declared it the most wonderful of plants (*miraculum naturae*), yet only admitted that it showed an extreme case of sensitiveness, supposing that the insects were only accidentally captured and subsequently allowed to escape. The insectivorous habit of the plant was subsequently fully investigated and described by Charles Darwin in his book on insectivorous plants.

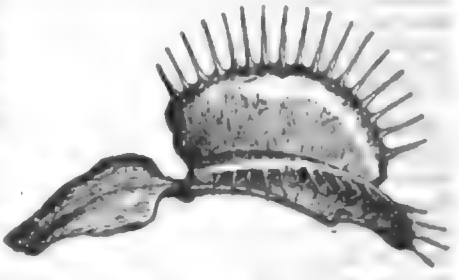
FIG. 1.—Leaf of Venus's Fly-Trap (*Dionaea muscipula*), viewed laterally in its expanded state, slightly enlarged. (After Darwin.)

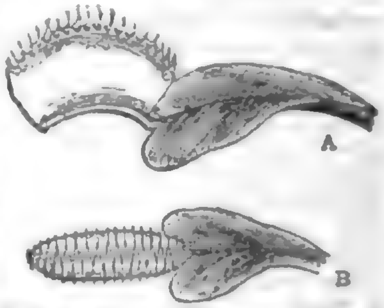

FIG. 2.—Leaf of *D. muscipula* closed over Insect. A, viewed from the side; B, from above.

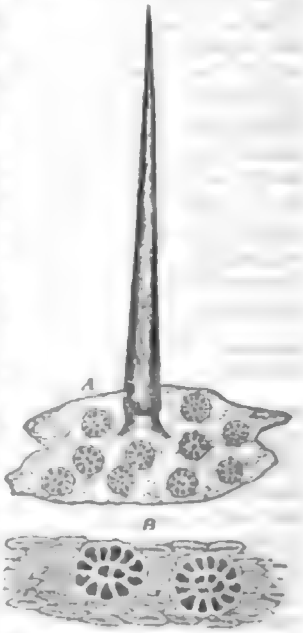

FIG. 3.—A, sensitive bristle and glands of *D. muscipula*; B, glands.

The plant is a small herb with a rosette of radical leaves with broad leaf-like footstalks. Each leaf has two lobes, standing at rather less than a right angle to each other, their edges being produced into spike-like processes (fig. 1). The upper surface of each lobe is covered with minute circular sessile glands, each consisting of from 20 to 30 cells filled with purplish fluid; it bears also three fine-pointed sensitive bristles arranged in a triangle (fig. 3). These contain no fibro-vascular bundles, but present an articulation near their bases, which enables them to bend parallel to the surface of the leaf when the lobes close. When the bristles are touched by an insect the lobes close very sharply upon the hinge-like midrib, the spikes interlock, and the insect is imprisoned (fig. 2). If very minute, and so not worth digesting, it is able to escape between the interlocked spines; more usually, however, it is retained between the lobes, which gradually but firmly compress it, until its form is distinguishable from without. The leaf thus forms itself into a temporary stomach, and the glands, hitherto dry, commence, as soon as excited by the absorption of a trace of nitrogenous matter, to pour out an acid secretion containing a ferment or *enzyme*, similar to that excreted by the leaves of the sundew, which rapidly dissolves the soft parts of the insect. This is produced in such abundance that, when Darwin made a small opening at the base of one lobe of a leaf which had closed over a large crushed fly, the secretion continued to run down the footstalk during the whole time—nine days—during which the plant was kept under observation. The closing of the leaf is due to a redistribution of water in the cells brought about by a change in the protoplasm which follows the stimulation of the sensitive bristles.

Though the bristles are exquisitely sensitive to the slightest contact with solid bodies, yet they are far less sensitive than those of the sundew (*Drosera*) to prolonged pressure, a singular difference in evident relation to the habits of the two plants. Like the leaves of *Drosera*, however, those of *Dionaea* are completely indifferent to wind and rain. The surface of the blade is very slightly sensitive; it may be roughly handled or scratched without causing movement, but closes when its surface or midrib is deeply pricked or cut. Irritation of the triangular area on each lobe enclosed by the sensitive bristles causes closure. The footstalk is quite insensitive. Inorganic or non-nitrogenous bodies, placed on the leaves without touching the sensitive bristles, do not excite movement, but nitrogenous bodies, if in the least degree damp, cause after several hours the lobes to close slowly. So too the leaf which has closed over a digestible body applies a gradual pressure, which serves to bring the glands on both sides into contact with the body. Thus we see that there are two kinds of movement, adapted for different purposes, one rapid, excited mechanically, the other slow, excited chemically. Leaves made to close over insoluble bodies reopen in less than twenty-four hours, and are ready, even before being fully expanded, to shut again. But if they have closed over nitrogen-yielding bodies, they remain closely shut for many days, and after re-expanding are torpid, and never act again, or only after a considerable time. Even in a state of nature, the most vigorous leaves are very rarely able to digest more than twice, or at most thrice, during their life.

VENUS'S LOOKING GLASS, a popular garden name for *Campanula Speculum* (or *Specularia Speculum*), from the old name for the plant, *Speculum Veneris*. It is a common cornfield plant in the south of Europe, and is grown in gardens on account of its brilliant purple flowers.

VERA, AUGUSTO (1813–1885), Italian philosopher, was born at Amelia in the province of Perugia on the 4th of May 1813. He was educated in Rome and Paris, and, after teaching classics for some years in Geneva, held chairs of philosophy in various colleges in France, and subsequently was professor in Strassburg and in Paris. He left Paris after the *coup d'état* of 1851 and spent nine years in England. Attaching himself with enthusiasm to Hegel's system, Vera (who wrote fluently both in French and in English as well as in Italian) became widely influential in spreading a knowledge of the Hegelian doctrine, and became the chief representative of Italian Hegelianism. Without any marked originality, his writings are distinguished by lucidity of exposition and genuine philosophic spirit. In 1860 Vera returned to Italy, where he was made professor of philosophy in the royal academy of Milan. In the following year he was transferred to Naples as professor of philosophy in the university there. His *Prolusioni alla Storia della Filosofia* and *Lezioni sulla Filosofia della Storia* were connected with his professorial work, which was specially devoted to the history of philosophy and the philosophy of history. He held this post till his death, which took place at Naples on the 13th of July 1885.

Among his numerous works may be mentioned *Introduction à la philosophie d'Hégel* (1855; 2nd ed., 1865); *Problème de la certitude* (1845); *Le Hégelianisme et la philosophie* (1861); *Mélanges philosophiques* (1862); *Essais de philosophie Hégélienne* (1864); *Strauss, l'ancienne et la nouvelle foi* (1873), an attack upon Strauss's last "confession," written from the standpoint of an orthodox Hegelian; and a comprehensive work in Italian, *Il Problema dell' Assoluto* (Naples, 1872–82). His English works are an *Inquiry into Speculative and Experimental Science* (London, 1856); *Introduction to Speculative Logic and Philosophy* (St Louis, 1875), and a translation of Bretschneider's *History of Religion and of the Christian Church*. He published also translations into French with commentaries of Hegel's works: *Logique de Hégel* (Paris, 1859; 2nd ed., 1874); *Philosophie de la nature de Hégel* (1863–65); *Philosophie de l'esprit de Hégel* (1867–69); *Philosophie de la religion de Hégel* (1876–78, incomplete).

See R. Mariano, *Augusto Vera* (Naples, 1887) and *Strauss e Vera* (Rome, 1874); Karl Rosenkranz, *Hegel's Naturphilosophie und deren Bearbeitung durch A. Vera* (Berlin, 1868).

VERA CRUZ (officially Vera Cruz Llave), a Gulf Coast state of Mexico, bounded N. by Tamaulipas, W. by San Luis Potosi, Hidalgo, Puebla and Oaxaca, and S.E. by Chiapas and Tabasco. Pop. (1900) 981,030. It is about 50 m. wide, extending along the coast, N.W. to S.E., for a distance of 435 m., with an area of 29,201 sq. m. It was the seat of an ancient Indian civilization antedating the Aztecs and is filled with remarkable and interesting ruins; it is now one of the richest states of the republic. It consists of a low, sandy coastal zone, much broken with tidewater streams and lagoons, behind which the land rises gradually to the base of the sierras and then in rich valleys and wooded slopes to their summits on the eastern margin of the great Mexican plateau, from which rise the majestic summits of Orizaba and Cofre de Perote. The climate is hot, humid and malarial, except on the higher elevations; the rainfall is heavy, and the tropical vegetation is so dense that it is practically impossible to clear it away. At Coatzacoalcos the annual precipitation ranges from 125 to 140 in., but it steadily decreases towards the N. On the higher slopes of the sierras prehistoric terraces are found, evidently constructed to prevent the washing away of the soil by these heavy rains. More than forty rivers cross the state from the sierras to the coast, the following being navigable on their lower courses—Coatzacoalcos, San Juan, Tonto, Papaloapam, Tuxpam and Casones. Several of the lagoons on the coast are also navigable, that of Tamiahua on the northern coast, about 100 m. long, being connected with the port of Tampico by inland channels. There are several ports on the coast—Coatzacoalcos, Alvarado, Vera Cruz, Nautla, Tecolutla and Tuxpam. The products of the state are chiefly agricultural—cotton, sugar, rum, tobacco, coffee, cacao, vanilla, maize, beans and fruit. Cattle-raising is followed in some districts, cattle and hides being among the exports. Among the forest products are rubber, cabinet woods, dye-woods, broom-root, chicle, jalap and orchids. Vera Cruz is one of the largest producers of sugar and rum in Mexico. There are a number of cotton factories (one of the largest in Mexico being at Orizaba), chiefly devoted to the making of coarse cloth for the lower classes. Tobacco factories are also numerous. Other manufactures include paper, chocolate, soap and matches. There are four lines of railway converging at Vera Cruz, two of which cross the state by different routes to converge again at Mexico city. Another, the Tehuantepec National railway, crosses in the south, and is connected with Vera Cruz (city) by the Vera Cruz & Pacific line, which traverses the state in a south-easterly direction. The capital is Jalapa, and its principal towns are Vera Cruz, Orizaba, Cordova and Coatzacoalcos.

VERA CRUZ, a city and seaport of Mexico, in the state of Vera Cruz, on a slight indentation of the coast of the Gulf of Mexico, in 19° 11′ 50″ N., 96° 20′ W., slightly sheltered by some small islands and reefs. Pop. (1900) 29,164. Vera Cruz is the most important port of the republic. It is 263 m. by rail E. of the city of Mexico, with which it is connected by two lines of railway. It is built on a flat, sandy, barren beach, only a few feet above sea-level. The harbour is confined to a comparatively narrow channel inside a line of reefs and small islands, which is exposed to the full force of northern storms. New port works were completed towards the end of the 19th century, which, by means of breakwaters, afford complete protection. In 1905 the four railway companies having terminal stations in Vera Cruz united in the organization of a joint terminal association, with union station, tracks, warehouses, quays, cranes, &c.

Vera Cruz dates from 1520, soon after the first landing there of Cortés. This settlement was called Villa Rica de Vera Cruz, but was soon after moved to the harbour of Bernal, in 1525 to a point now called Old Vera Cruz, and in 1599 to its present site. It was pillaged by privateers in 1653 and 1712, and this led to the erection of the celebrated fort of San Juan de Ulúa, or Ulloa, on one of the reefs in front of the city. In 1838 it was captured by the French, in 1847 (March 29) by an American army under General Winfield Scott, who made Vera Cruz a base for his march upon the city of Mexico, and in 1861 by the French.

VERANDAH, or Veranda, a roofed gallery or portico attached to the outside of a dwelling-house or other building, usually open at the sides or partially covered by lattice-work or glass or other screens. The roofing is slanting and supported by pillars; a light rail or balustrade often surrounds it. The word in English is comparatively modern, having only been included by Todd in his edition of Johnson's *Dictionary* in 1827. But it was known earlier in India, and the occurrence of the word in modern Hindustani (*varanda*) and Malayan (*baranda*) has led some etymologists to connect the word with the Persian *barāmadan*, to climb. It is, however, certainly of European origin, and was taken to the East by the early Portuguese navigators. It is to be found as early as the end of the 15th century and the beginning of the 16th in Spanish and Portuguese (so Minsheu, "*varanda*, railes to leane the brest on"), and apparently is to be referred to Lat. *vara*, a forked pole or rod.

VERATRUM. The Greek physicians were acquainted with a poisonous herb which they called white hellebore, and which has been supposed to represent the *Veratrum album* of modern botanists. Be this as it may, in modern times the name has been applied to a genus of herbaceous plants belonging to the natural order Liliaceae. *Veratrum* is a tall-growing herb, having a fibrous root-stock, an erect stem, with numerous broad, plicated leaves placed alternately, and terminal, much-branched clusters of greenish or purplish polygamous flowers. Each perfect flower consists of six regular petals, as many stamens, whose anthers open outwardly, and a three-celled superior ovary which ripens into a three-celled, many-seeded capsule. The genus comprises about nine species, natives of the temperate regions of the northern hemisphere, generally growing in pastures or woods. *V album* and the American species *V. viride* are commonly grown in gardens as ornamental perennials, but their poisonous qualities should be kept in mind, particularly as they bear a considerable resemblance in foliage to the harmless *Gentiana lutea*. Both contain the potent alkaloid veratrine. (See also HELLEBORE.)

VERBENA. The genus *Verbena* (vervain) in botany gives its name to the natural order (Verbenaceae) of which it is a member. The species are herbaceous or somewhat shrubby, erect or procumbent, with opposite or whorled leaves, generally deeply cut. The sessile flowers are aggregated into close spikes. Each flower has a tubular, ribbed calyx, a more or less irregular tubular two-lipped corolla, with four (didynamous) stamens springing from the interior of the corolla-tube. The anthers are two-celled, with or without a gland-like appendage at the apex. The ovary is entire or four-lobed, and always four-celled, with a single ovule in each cell; the style is unequally two-lobed at the apex. The fruit consists of four hard nutlets within the persistent calyx. There are about eighty species known, mostly natives of tropical and subtropical America, a very few species occurring also in the Old World. The vervein, or vervain, *V. officinalis*, native of central and north Asia, Europe and North Africa, and common on dry waste ground in the south of England (rarer in the north), was the object of much superstitious veneration on the part of our pagan ancestors, who attributed marvellous properties to it, provided it were gathered in a particular manner and with much complex ceremonial. The plant is now but lightly esteemed, and its medicinal virtues are wholly discredited. The garden verbenas are derivatives from various South American species, such as *V. teucrioides*, a native of southern Brazil, and *V. chamaedrifolia* from Argentina and southern Brazil. The range of colours extends from pure white to rose-coloured, carmine, violet and purple. Striped forms also are cultivated. The lemon-scented verbena of gardens, so much valued for the fragrance of its leaves, was once referred to this genus under the name *V. triphylla*, subsequently called *Aloysia*, but is now referred to the genus *Lippia* as *L. citriodora*; it differs from *Verbena* in having two, not four, nutlets in the fruit.

The garden verbenas, although somewhat misprized for some years, have once more become popular as bedding plants, and also for pot culture. They are easily raised from seeds sown in heat in February or March, but choice varieties, like Miss Willmott and others, can only be kept true when raised from cuttings. These are best secured from old plants cut down in the autumn and started into growth in gentle heat and moisture the following spring. They root readily in a compost of sandy loam and leaf soil. Besides the garden varieties, *V. venosa*, a Brazilian species with bluish-violet flowers, is a popular plant for massing in beds during the summer months.

VERBÖCZY, ISTVAN [STEPHEN WERBÖCZ] (1465?–1541), Hungarian jurist and statesman, first became known as a scholar and theologian of such eminence that he was appointed to accompany the emperor Charles V. to Worms, to take up the cudgels against Luther. He began his political career as the deputy of the county of Ugocsa to the diet of 1498, where his eloquence and scholarship had a great effect in procuring the extension of the privileges of the gentry and the exclusion of all foreign competitors for the Hungarian throne in future elections. He was the spokesman and leader of the gentry against the magnates and prelates at the diets of 1500, 1501 and 1505. At the last diet he insisted, in his petition to the king, that the law should be binding upon all the gentry alike, and firmly established in the minds of the people the principle of a national monarchy. The most striking proof of his popularity at this time is the fact that the diet voted him two *denarii* per hearth for his services in 1505, a circumstance unexampled in Hungarian history. In 1517 Verböczy was appointed the guardian of the infant Louis II., and was sent on a foreign mission to solicit the aid of Christendom against the Turks. On his return he found the strife of parties fiercer than ever and the whole country in a state of anarchy. At the diet of Hatvan, on the 25th of June 1525, he delivered a reconciliatory oration which so affected the assembly that it elected him palatine. During the brief time he held that high office he unselfishly and courageously endeavoured to serve both king and people by humbling the pride of the magnates who were primarily responsible for the dilapidation of the realm. But he was deposed at the following diet, and retired from public life till the election of János Zapolya, who realized his theory of a national king and from whom he accepted the chancellorship. He now devoted himself entirely to the study of jurisprudence, and the result of his labours was the famous *Opus tripartitum juris consuetudinarii inclyti regni hungariae*, which was the law-book of Hungary till 1848.

See Arpad Karólyi, *Verböczy's Mission to the Diet of Worms* (Hung.; Budapest, 1880); Vilmor Fraknói, *Before and after the Catastrophe of Mohács* (Hung.; Budapest, 1876); ibid., *Stephen Werböczi* (Hung.; Budapest, 1899). (R. N. B.)

VERBOECKHOVEN, EUGÈNE JOSEPH (1799–1881), Belgian painter, was born at Warneton in West Flanders, and received instruction in drawing and modelling from his father, the sculptor Barthélemy Verboeckhoven. Subsequently he settled in Brussels and devoted himself almost exclusively to animal subjects. His paintings of sheep, of horses and of cattle in landscape, somewhat after the manner of Potter, brought him universal fame, and were eagerly sought for by collectors. Precise and careful finish is the chief quality of his art, which is entirely objective and lacking in inspiration. Verboeckhoven visited England in 1826, Germany in 1828, and France and Italy in 1841, and died at Brussels in 1881. He was a member of the academies of Brussels, Ghent, Antwerp, St Petersburg and Amsterdam. Examples of his art are to be found in nearly all the important galleries of Europe and the United States, notably in Brussels, Antwerp, Amsterdam, Hamburg, Berlin, Munich, New York, Boston and Washington. His long life and ceaseless industry account for the enormous number of his pictures in public and private collections and in the art market. In addition to his painted work he executed some fifty etched plates of similar subjects.

VERBRUGGEN, SUSANNA (*c.* 1667–1703), English actress, was the daughter of an actor named Percival, and her first recorded stage appearance was in 1681 in D'Urfey's *Sir Barnaby Whig*. She played at Dorset Garden and the Theatre Royal, and in 1686 married William Mountfort (*q.v.*). By 1690 she was one of the leading actresses in Betterton's company. About a year after Mountfort's death, in 1692, she married John Verbruggen (*fl.* 1688–*c.* 1707), also an actor of considerable ability.

VERCELLI (anc. *Vercellae*), a town and archiepiscopal see of Piedmont, Italy, in the province of Novara, 13 m. S.W. of that town by rail. Pop. (1901) 17,922 (town), 30,470 (commune). It is situated 430 ft. above sea-level on the river Sesia, at its junction with the Canterana. Vercelli is a point at which railways diverge for Novara, Mortara, Casale Monferrato and Santhià (for Turin). The walls by which Vercelli was formerly surrounded have been demolished, and their place is now occupied by boulevards, from which a fine view of the Alps (especially the Monte Rosa group) is obtained. The streets are for the most part tortuous and narrow; there is a large market-place (Piazza Cavour) with a statue of Cavour (1861). The cathedral is a large building dating from the 16th century; its library contains a number of rare ancient MSS., especially the *Codex Vercellensis*, one of the most important MSS. of the old Latin version of the Gospels, written in the 4th or 5th century by Eusebius, bishop of Vercelli. A museum close by contains Roman antiquities. The churches of S. Andrea (a large and fine Romanesque Gothic building dating from 1219–1224, with an interior in the French Gothic style), S. Paolo, S. Caterina and S. Cristoforo possess valuable examples of the work of Gaudenzio Ferrari (1471–1546) and of his follower Lanini. Silk-spinning is important, and Vercelli is one of the principal Italian centres of the exportation of cereals and especially of rice. There are corn and rice mills of large size, while cotton and woollen mills and factories of artificial manure, &c., have attained importance.

Vercellae was originally the chief city of the Libici (a Ligurian tribe) and afterwards became a Roman *municipium* of some importance. It stood at the junction of roads to Eporedia, Novaria and Mediolanum, Laumellum (for Ticinum) and perhaps Hasta. No ancient remains exist above ground, but many inscriptions, tombs and other antiquities have been found. Remains of the theatre and amphitheatre were seen in the 16th century, and remains of ancient streets have more recently been found during drainage operations. There were apparently four principal streets all leading to the centre of the town where the Forum must have been situated. Of the walls, however, nothing is known except from medieval documents (cf. L. Bruzza, *Iscrizioni antiche Vercellesi*, Rome, 1874). In the neighbourhood (near Rotto on the Sesia) are the Raudii Campi where Hannibal won his first victory on Italian soil (218 B.C.), and where in 101 B.C. Marius and Catulus routed the Cimbri. From about 1228 till 1372 Vercelli was the seat of a university. (T. As.)

VERCELLI BOOK (CODEX VERCELLENSIS), an Early English MS. containing, besides homilies, a number of poetical and imaginative pieces: *Andreas*, *The Fates of the Apostles*, *Address of the Soul to the Body*, *Falseness of Men*, *Dream of the Rood*, *Elene* and a prose *Life of Guthlac*. It was found in the cathedral library of Vercelli, Piedmont, by a German jurist Friedrich Blume, in 1822, and was first described in his *Iter Italicum* (Berlin and Stettin, 4 vols., 1824–36). An untenable explanation of the presence of the MS. at Vercelli suggested that it had been brought there by Johannes Scotus Erigena. But the handwriting dates from the beginning of the 11th century, long after his death. According to Dr Wülker the MS. probably belonged to the hospice for English pilgrims, founded, together with the monastery of St Andrew, by Cardinal Jacopo Guala-Bicchieri (d. 1227), a native of Vercelli and bishop of the city, in 1219, on his return from England, where he had been papal legate from 1216 to 1218. The cardinal, a man of wide learning, possessed a large library, which he left to the monastery; and the Vercelli codex may well have been included in it.

Its contents were partially printed (by Benjamin Thorpe from Blume's transcript) in Appendix B to C. P. Cooper's *Report of Rymers Foedera* for 1836; by J. M. Kemble, *The Poetry of the Codex Vercellensis, with an English translation* (Aelfric Soc., 1843–56), and in a better text based directly on the MS. by Wülker in his edition of C. W. M. Grein's *Bibliothek der A.S. Poesie* (Leipzig, 1894), vol. ii. *Codex Vercellensis*, by Dr Richard Wulker (Leipzig, 1894), is a facsimile of the MS.

For the description and history of the MS. see also Wülker's *Grundriss . . . der A.S. Litteratur* (1885), pp. 237–42, and A. Napier in *Zeitschrift für deutsches Altertum* (Berlin, 1889, vol. 21, new series; old series, vol. 33, p. 66), for a collation of Wülker's text with the MS. For the individual poems see also CYNEWULF.

VERDEN, a town of Germany, in the Prussian province of Hanover, on the navigable Aller, 3 m. above its confluence with the Weser, 22 m. S.E. of Bremen by the railway to Hanover. Pop. (1900) 9842. The most noticeable edifices are the beautiful Gothic cathedral, the churches of St Andrew and St John, a new Roman Catholic church (1894) and the celebrated cathedral school. Its industries embrace the manufacture of agricultural machinery, cigar-making, brewing and distilling. Verden was the see of a bishopric founded in the first quarter of the 9th century, or earlier, and secularized in 1648. The duchy of Verden was then ceded to Sweden, passed in 1719 to Hanover and in 1810 to the kingdom of Westphalia. It was restored to Hanover in 1814, and was, with Hanover, annexed by Prussia in 1866.

See Ostenberg, *Aus Verden's Vergangenheit* (Stade, 1876).

VERDERER (O. Fr. *verdier*, Med. Lat. *viridarius*), a term used in English forest law for a judicial officer appointed to look after what was known as the "vert" (O. Fr. *verd*, green; Lat. *viridis*), *i.e.* the forest trees and underwood in the royal forests. It was the verderer's duty to keep the assizes and attend to all matters relating to trespasses (see FOREST LAW).

VERDI, GIUSEPPE FORTUNINO FRANCESCO (1813–1901), Italian composer, was born on the 10th of October 1813 at Le Roncole, a poor village near the city of Busseto. His parents kept a little inn, combined with a kind of village shop. Verdi received some instruction from the village organist, but his musical education really began with his entrance into the house of business of Antonio Barezzi, a merchant of Busseto. Barezzi was a thorough musician, and under his auspices Verdi was speedily introduced to such musical society as Busseto could boast. He studied under Giovanni Provesi, who was *maestro di cappella* of the cathedral and conductor of the municipal orchestra, for which Verdi wrote many marches and other instrumental pieces. These compositions are now the principal treasures of the library of Busseto. Among them is Verdi's first symphony, which was written at the age of fifteen and performed in 1828. In 1832 Verdi went to Milan to complete his studies. He was rejected by the authorities of the Conservatorio, but remained in Milan as a pupil of Vincenzo Lavigna, with whom he worked until the death of Provesi in 1833 recalled him to Busseto. A clerical intrigue prevented him from succeeding his old master as cathedral organist, but he was appointed conductor of the municipal orchestra, and organist of the church of San Bartolomeo. After three years in Busseto, Verdi returned to Milan, where his first opera, *Oberto, Conte di San Bonifacio*, was produced in 1839. His next work, a comic opera, known variously as *Un Giorno di Regno* and *Il Finto Stanislao*, was written in peculiarly distressing circumstances, the composer having had the misfortune to lose his wife and two children in the course of two months. *Un Giorno di Regno* was a complete failure, and Verdi, stung by disappointment, made up his mind to write no more for the stage. He kept his word for a year, but was then persuaded by Merelli, the impresario of La Scala, to look at a libretto by Solera. The poem took his fancy, in a short time the music was written, and in 1842 the production of *Nabucodonosor* placed Verdi in the front rank of living Italian composers. The success of *Nabucodonosor* was surpassed by that of its two successors, *I Lombardi* (1843) and *Ernani* (1844), the latter of which was the first of Verdi's operas to find its way to England. With *Ernani* Verdi became the most popular composer in Europe, and the incessant demands made upon him reacted upon his style. For several years after the production of *Ernani* he wrote nothing which has survived to our time—nothing which deserved to survive. In *Macbeth* (1847) there are passages of some power, and passages too which indicate an approaching transition to a less conventional method of expression. In *Luisa Miller* (1849) also there is a noticeable increase of refinement in style, which contrasts favourably with the melodramatic vulgarity of his earlier manner.

It was unfortunate that *I Masnadieri*, which was written for the English stage and produced under Lumley's management at Her Majesty's Theatre in 1847, should have been one of the worst of the many bad works which Verdi composed at this period of his career. Not the presence of the composer, who travelled to England to conduct the first performance, nor the genius of Jenny Lind, who sang the part of the heroine, could redeem it from failure. In 1851 Verdi won one of the greatest triumphs of his career with *Rigoletto*, a triumph which was fully sustained by the production two years later of *Il Trovatore* and *La Traviata*. In these works Verdi reached the culminating point of what may be called his second manner. His development had been steady though gradual, and it is only necessary to compare the treatment of voice and orchestra in *Rigoletto* with that in *Ernani* to realize how quickly his talent had developed during these seven years. The popularity of *Rigoletto*, *Il Trovatore* and *La Traviata* was enormous, and consolidated Verdi's fame outside the frontiers of Italy. In 1855 he received a commission to write an opera for the Paris Opéra, to be produced during the Universal Exhibition. He wrote *Les Vêpres Siciliennes*, a work which though temporarily successful has not retained its popularity. It contains some fine music, but suffers from the composer's perhaps unconscious attempt to adopt the grandiose manner of French opera. Of the works written during the next ten years only *Un Ballo in Maschera* (1859) has maintained a fitful hold upon public attention. *La Forza del Destino* (1862) and *Don Carlos*, the latter of which was written for the Paris Exhibition of 1867, have the faults incident to works written during a period of transition. At this point in his career Verdi was preparing to emancipate himself from the fetters of conventionality which had hitherto hindered his development. In these two works there are indications of an aspiration towards a freer method of expression, which harmonize ill with the more conventional style of the composer's earlier years. In *Aida*, an opera upon an Egyptian subject, written in response to an invitation from Ismail Pasha, and produced at Cairo in 1871, Verdi entered upon the third period of his career. In this work he broke definitely with the operatic tradition which he had inherited from Donizetti, in favour of a method of utterance, which, though perhaps affected in some degree by the influence of Wagner, still retains the main characteristics of Italian music. In *Aida* the treatment of the orchestra is throughout masterly, and shows a richness of resource which those who knew only Verdi's earlier works scarcely suspected him of possessing; nevertheless, the human voice was still the centre of Verdi's system. Verdi kept thoroughly abreast of modern musical development, but his artistic sense prevented him from falling into the excesses of the German school. In the *Requiem*, which was written in 1874 to commemorate the death of Manzoni, Verdi applied his newly found system to sacred music. His *Requiem* was bitterly assailed by pedants and purists, partly on the ground of its defiance of obsolete rules of musical grammar and partly because of its theatrical treatment of sacred subjects, but by saner and more sympathetic critics, of whom Brahms was not the least enthusiastic, it has been accepted as a work of genius. There are passages in it with which Protestant feeling can scarcely sympathize, but its passionate intensity and dramatic force, and the extraordinary musical beauty with which it abounds, amply atone for what to some may seem errors of taste. In 1881 a revised version of *Simon Boccanegra*, an earlier work which had not been successful, was produced at Milan. The libretto had been in part rewritten by Arrigo Boito, and Verdi wrote a great deal of new music for the revival, which was eminently successful. After this it was generally supposed that Verdi, who had reached an advanced age, had finally relinquished composition, but after a lapse of some years it became known that he was at work upon a new opera, and in 1887 *Otello* was produced at Milan. The libretto, a masterly condensation of Shakespeare's *Othello*, was the work of Boito. *Otello* recalls *Aida* in the general outlines of its structure, but voices and orchestra are treated with greater freedom than in the earlier work, and there is a conspicuous absence of set airs. In so far as regards the essential qualities of the music, *Otello* is an immense advance upon anything Verdi had previously written. It has a dramatic force and a power of characterization for which it would be vain to look in his earlier work, and which are all the more remarkable as appearing for the first time in this high degree of development in a work written in extreme old age. All that has been said of *Otello* may be repeated of *Falstaff*, which was produced in 1893, when the composer was in his eightieth year, with the addition that the later work contains, besides the dramatic power and musical skill of the earlier work, a fund of delicate and fanciful humour which recalls the gayest mood of Mozart. The libretto of *Falstaff*, which is the work of Boito, is an adaptation of *The Merry Wives of Windsor*, with the addition of a few passages from *Henry IV*. After the production of *Falstaff*, Verdi wrote nothing for the stage. In 1898 he produced four sacred pieces, settings of the *Ave Maria, Laudi alla Virgine* (words from Dante's *Paradiso*), the *Stabat Mater* and the *Te Deum*, the first two for voices alone, the last two for voices and orchestra. In these pieces Verdi abandoned to a certain extent the theatrical manner of the *Requiem* for one more restrained and more in keeping with ecclesiastical traditions. In imaginative power and musical beauty these pieces yield to none of Verdi's works. With the exception of these and the *Requiem*, Verdi has written little save for the stage. Among his minor works may be mentioned a string quartet, composed in 1873, a hymn written for the opening of the International Exhibition of 1862, two sets of songs, a *Paternoster* for five-part chorus, and an *Ave Maria* for soprano solo, with string accompaniment. The venerable composer died at Milan on the 27th of January 1901.

The following is a complete list of Verdi's operas, with the dates and places of production: *Oberto* (Milan, 1839); *Un Giorno di Regno* (Milan, 1840); *Nabucodonosor* (Milan, 1842); *I Lombardi* (Milan, 1843); *Ernani* (Venice, 1844); *I Due Foscari* (Rome, 1844); *Giovanna d'Arco* (Milan, 1845); *Alzira* (Naples, 1845); *Attila* (Venice, 1846); *Macbeth* (Florence, 1847); *I Masnadieri* (London, 1847); *Il Corsaro* (Trieste, 1848); *La Battaglia di Legnano* (Rome, 1849); *Luisa Miller* (Naples, 1849); *Stiffelio* (Trieste, 1850); *Rigoletto* (Venice, 1851); *Il Trovatore* (Rome, 1853); *La Traviata* (Venice, 1853); *Les Vêpres Siciliennes* (Paris, 1855); *Simon Boccanegra* (Venice, 1857; revised version, Milan, 1881); *Aroldo* [a revised version of *Stiffelio*] (Rimini, 1857); *Un Ballo in Maschera* (Rome, 1859); *La Forza del Destino* (St Petersburg, 1862); *Don Carlos* (Paris, 1867); *Aida* (Cairo, 1871); *Otello* (Milan, 1887); *Falstaff* (Milan, 1893). (R. A. S.)

VERDICT (O. Fr. *verdit*, Lat. *vere dictum*, truly said, used in Late Latin in one word with its present significance), the decision of a jury in a criminal or civil cause, given to the court through the foreman of the jury and recorded. In English law verdicts may be "general," *i.e.* in criminal cases "guilty" or "not guilty," or "special," when there is some question of law which the jury wish to leave to the consideration of the court; in this case the verdict is given in the form of a statement of facts as found by the jury, and the issue is left to be found by the court in accordance with the law upon such facts as found (see JURY).

VERDIGRIS, a pigment, consisting of basic copper carbonates, made by acting upon copper plates with pyroligneous acid soaked up in cloths, exposing the plates to air, then dipping in water, and finally scraping off the greenish crust; the plate is re-exposed and the operation repeated till it is used up. Another method consists in exposing thin copper sheets to the acid vapours rising from the residues or "marcs" of wine factories, the product being scraped off, and the plate re-exposed. Both processes require several weeks. The pigment appears with several shades of blue and green; blue verdigris is chiefly $CuO{\cdot}Cu(C_2H_3O_2)_2{\cdot}6H_2O$, while light blue and green verdigris contain $2CuO{\cdot}Cu(C_2H_3O_2)_2{\cdot}2H_2O$. Besides being used as a paint it is employed in dyeing and calico-printing, and also in the manufacture of other paints, *e.g.* Schweinfurt green, which is a double salt of the acetate and arsenite. A liniment or ointment is also used in medicine as a cure for warts. It is an irritant poison (hence the need that acid substances should never be cooked in copper utensils); the best antidote is white of egg and milk.

VERDUN, a garrison town of north-eastern France, capital of an arrondissement in the department of Meuse, on the main line of the Eastern railway between Paris and Metz, 42 m. N.N.E. of Bar-le-Duc. Pop. (1906) 12,837. In addition the population *comptée à part* (soldiers, &c.) numbers 8198. Verdun is situated in a basin surrounded by vine-clad hills on the Meuse, which here forms the Eastern Canal.

Verdun as a fortress is of first-rate importance. It lies directly opposite the frontier of German Lorraine and the great entrenched camp of Metz. At the time of the war of 1870 (when it was defended for long without hope of success by General Guérin de Waldersbach) it was still a small antiquated fortress of the Vauban epoch, but in the long line of fortifications on the Meuse created by Serré de Rivière in 1875 Verdun, forming the left of the "Meuse Line" barrier, was made the centre of an entrenched camp. The first lesson of 1870 being taken to heart, forts were placed (Belrupt S.E., St Michel N.E., Belleville N. and La Chaume and Regret W.) on all the surrounding heights that the besiegers had used for their batteries, but the designers soon extended the line of the eastern defences as far out as the sharply defined cliffs that, rising gently for some miles from the Meuse, come to an abrupt edge and overlook the plain of Woëvre. On this front, which is about 5½ m.

long, the most important works are (from right to left) Châtillon, Manezel, Moulainville, Eix, Mardi Gras, Lanfée, Vaux and Hardimont. At right angles to this line, the south front, the works of which are placed along one of the long western spurs of the line of heights, are forts Rozellier, St Symphorien and Haudainville, the last overlooking the Meuse. The north front, also on a spur of the ridge, is thickly studded with forts, these in some cases being but 200 yds. apart and the left fort overlooking the Meuse. Behind the east front, chiefly designed to close the valley by which the Metz-Verdun railway penetrates the line of heights, are Fort Tavannes with its outworks and a series of batteries on the adjacent spurs. On the left bank of the Meuse there is a complete semicircle of forts. At the northern end of this semicircle (besides some works in the valley itself), and crossing its fire with the left of the north front, is Fort Belle-Épine, then comes Marre, Bourrus and Bruyères, all four being on a single ridge facing N.W. The west front is composed of Fort Germonville, Fort Bois de Sartelles, Fort Bois du Chapitre, Fort Landrecourt and Fort Dugny, which last is within sight of Fort Haudainville over the Meuse. In second line behind these works are Fort Choisel, Chana redoubt and Fort Sartelles. In all there are 16 large forts and about 20 smaller works, the perimeter of the whole being about 30 m. and the greatest diameter of the fort-ring 9.

The chief quarter of the town lies on the slope of the left bank of the river and is dominated by the citadel which occupies the site of the old abbey of St Vanne founded in the 10th century. Several arms of the river intersect the quarter on the right bank. The whole town is surrounded by a bastioned enceinte, pierced by four gates; that to the N.E., the Porte Chaussee, flanked by two crenelated towers, is an interesting specimen of the military architecture of the 15th century. The cathedral of Notre-Dame stands on the site of two previous churches of the Romanesque period, the first of which was burnt down in 1047; a crypt and other remains of the second building consecrated in 1147 are still to be seen, but the greater part of the present church dated from subsequent periods. Built under the influence of Rhenish architecture, Notre-Dame has double transepts and, till the 18th century when the western apse was replaced by a façade, had an apse at each extremity. A fine cloister to the S.W. of the cathedral dates from the 15th century. The hôtel-de-ville (17th century) contains the museum.

Verdun is the seat of a bishop and a sub-prefect and has tribunals of first instance and of commerce, a communal college, ecclesiastical seminaries and a branch of the Bank of France. The industries include metal founding, the manufacture of sweetmeats (*dragées de Verdun*), machinery, nails, files, embroidery, linen, chairs and rope and the distillation of liqueurs. The canal port has trade in timber, agricultural produce, stone and building materials and coal.

Verdun (*Verodunum*), an important town at the time of the Roman conquest, was made a part of Belgica Prima. The bishopric, of which the most celebrated holder was St Vanne (498–525), dates from the 3rd century. Verdun was destroyed during the period of the barbarian invasions, and did not recover till towards the end of the 5th century. Clovis seized the town in 502, and it afterwards belonged to the kingdom of Austrasia. In 843 the famous treaty was signed here by the sons of Louis the Pious (see GERMANY, *History*). In the 10th century Verdun was definitively conquered by Germany and put under the temporal authority of its bishops. Together with Toul and Metz, the town and its domain formed the territory of the Trois-Évêchés. In the 11th century the burghers of the now free and imperial town began a struggle with their bishops, which ended in their obtaining certain rights in the 12th century. In 1552 Henry II. of France took possession of the Trois-Évêchés, which finally became French by the treaty of Westphalia. In 1792, after some hours of bombardment, the citizens opened their gates to the Prussians—a weakness which the Revolutionary Government punished by the execution of several of the inhabitants. In 1870 the Prussians, unable to seize the town by a *coup de main*, invested and bombarded it three different times, till it capitulated in the beginning of November.

VERDY DU VERNOIS, JULIUS VON (1832–   ), German general and military writer, was born in 1832 and entered the Prussian infantry in 1850. After some years of regimental service he came under the notice of Moltke, the newly appointed chief of the general staff, as an exceptionally gifted soldier, and at the outbreak of the war against Austria in 1866 he was appointed major on the staff of the II. Army (crown prince of Prussia). In this capacity he took part in the campaign on the upper Elbe and in the battle of Königgrätz. Promoted shortly after this to the rank of lieutenant-colonel, he was in 1867 placed at the head of a section of the general staff, becoming thereby one of Moltke's principal confidential assistants. In this capacity he served at the headquarters of the German army throughout the war of 1870–71, and he was frequently employed in the most important missions, as for instance on the 2nd of August, when he was sent to impress upon the III. Army headquarters the necessity of a prompt advancing into Alsace, and on the 26th of the same month, when he was sent to advise the crown prince of Saxony as to the strategical intentions of the supreme command at the crisis of the Sedan campaign. At the close of the war he continued to serve in the office of the general staff, and also lectured at the War Academy. It was in the latter position that he developed the system of thorough tactical education which is the abiding result of his work. His method may be studied in English translations of his *Studies in Troop-leading*, and may be summarized as the assumption of an actual military situation on the actual ground, followed by critical discussion of the successive measures that a commander, whether of a brigade, division or larger force, should take in the sequel, given his orders and his knowledge of the general situation. Moltke's own series of tactical problems, extending from 1859 to 1889, contributed very powerfully, of course, to the education of the selected young officers who passed through Verdy's hands, but Moltke dealt rather with a great number of separate problems, while Verdy developed in detail the successive events and ruling ideas of a whole day's or week's work in the same units. Moltke therefore may be said to have developed the art of forming correct ideas and plans, Verdy that of applying them, but these are after all merely tendencies, not sharply divided schemes, in the teaching of Prussian staff officers during the years of intellectual development between 1870 and 1888. In all this Moltke, Verdy and Bronsart von Schellendorf worked in close co-operation. In 1876 Verdy became a major-general, from 1879–1883 he held an important position in the ministry of war, and in 1881 he was promoted lieutenant-general. In 1887 he became governor of Strassburg, in 1888 general of infantry and in 1889 minister of war. He retired from the active list in 1890. In 1894 the university of Königsberg made him a Dr. Phil. *honoris causa*.

General von Verdy du Vernois's principal writings are: *Theilnahme der II. Armee am Feldzuge 1866* (Berlin, 1866); *Im Hauptquartier der II. Armee 1866* (Berlin, 1900); *Studien uber den Krieg auf Grundlage . . . 1870/1* (Berlin, 1892–96); *Im grossen Hauptquartier 1870/1* (Berlin, 1895; English translation); *Studien uber Truppenfuhrung* (Berlin, 1870; new edition, 1892, English translation) and *Studien über den Krieg* (Berlin, 1901–1906).

VERE, the family of which is extolled by Macaulay as "the longest and most illustrious line of nobles that England has seen," appears to have derived the surname which the verse of Tennyson has made synonymous with ancient blood, from the little village of Ver near Bayeux. Its founder, Aubrey (Albericus) de Vere, appears in Domesday Book (1086) as the holder of a great fief in Essex, Cambridgeshire and Suffolk. His son (or grandson) and namesake was a trusted officer of Henry I., from whom he received the hereditary office of great chamberlain in 1133. It was probably he who erected the noble tower which gave name to Castle Hedingham, Essex, the head of his fief, and which stands as the finest example of a private Norman keep. Slain in 1141, he was succeeded by his son Aubrey, who had already become count of Guines, in right of his wife, on her grandfather's death. Through the powerful influence of his sister's husband, Geoffrey, earl of Essex, he obtained from the empress Matilda, in 1142, the earldom of Oxford, which was afterwards confirmed to his house by Henry II. His younger son, Robert (*c.* 1170–1221), became 3rd earl in 1214, and, siding with the barons, became one of the twenty-five executors of Magna Carta. His marriage with a Bolebec heiress brought in what was afterwards claimed as a barony, and led to the style of Viscount Bolebec (or Bulbeck) for the earl's heirs.

Robert, the 5th earl (1240–1296), who brought into his family the chamberlainship to the queen by his marriage with the Sandford heiress, sided with Simon de Montfort, and lost for a time his earldom and offices. John, the 7th earl (1313–1360), was a distinguished soldier, fighting at Creçy and Poitiers and in all Edward III.'s wars in his time; and his marriage with a Badlesmere heiress added to the lands and titles of his house. His son, Thomas (1337–1371), also a soldier, was father of Robert, 9th earl, the famous favourite of Richard II. In spite of his attainder (1388), his uncle Aubrey (*c.* 1340–1400), a follower of the Black Prince, was restored to the earldom, by consent of parliament in 1393, but not to the great chamberlainship. As the earldom (which had been held in fee) was granted to him in tail male, this is looked on by some as a new creation. His elder son, Richard (d. 1417), the next earl, held a command at Agincourt, and was father of Earl John, who was beheaded as a Lancastrian, with his eldest son, in 1462. Their death was avenged by his younger son John, the 13th earl (1443–1513), who shared to the full in the triumph of the Red Rose. On the death of his nephew John, the next earl (d. 1526), the baronies (it was afterwards held) passed away to his sisters, but the earldom descended to his cousin John (d. 1540), though the crown resumed the great chamberlainship. This John, who was in favour with Henry VIII., was grandfather, through his younger son Geoffrey, of the celebrated "fighting Veres," Sir Francis and his brother Sir Horace. His eldest son John, 16th earl (*c.* 1512–1562), was in favour with Edward VI., Mary and Elizabeth, and contrived to recover for his family the office of great chamberlain.

Hitherto the earls, in spite of their vicissitudes, had retained possession of their ancient seat and great estates; but Edward, the son of Earl John, was a spendthrift. A brilliant, gifted courtier, in whom Elizabeth delighted, he quarrelled with his father-in-law, Burghley, "sent his patrimony flying," patronized players, poets and musicians, and wrote excellent verse himself. His son Henry, the 18th earl (1593–1625), was twice imprisoned in the Tower as an opponent of Buckingham's policy, fought in the Palatinate and the Low Countries and died on campaign at the Hague in 1625. Then ensued the great dispute for the inheritance of his title and office (Hedingham Castle having passed away) between Robert Vere, his second cousin and heir-male, and Robert, Lord Willoughby d'Eresby, son of his aunt, Lady Mary Vere. The earldom was secured by the former, a poor officer in Holland, but the office was adjudged to Lord Willoughby, in whose descendants it is now vested. Earl Robert was slain before Maestricht in 1632, leaving an only son, Aubrey (1626–1703), 20th and last earl. His marriage with a Bayning heiress restored the fortunes of his house, and his Royalist intrigues under the Commonwealth were rewarded at the Restoration by sundry favours, among them the command of a regiment of horse, known from him as "the Oxford Blues" and still familiar as "the Blues" (Royal Horse Guards). James II. deprived him of his regiment and his lieutenancy of Essex for opposing his policy, but the prince of Orange, whom he joined, restored them. His long tenure of the ancient earldom ended in 1703, when he died, the last known male descendant of the house of Vere. His daughter Diana having married the 1st duke of St Albans, their descendants are named De Vere Beauclerk, and received the barony of Vere (1705).

The halo surrounding the name of Vere is seen as early as 1626 in the stately panegyric of Chief Justice Crewe. "I suppose there is no man that hath any apprehension of gentry, or nobleness, but his affection stands to the continuance of so noble a name and house." In the great days of the house, Earl John, says Stowe, rode into London city "with eighty gentlemen in a livery of Reading tawney, and chains of gold about their necks, before him, and one hundred tall yeomen in the like livery to follow him," wearing the famous badge of the blue boar (*verres*), which is still to be seen in Essex churches and forming the sign of Essex inns. Another badge of the Veres was the mullet in the first quarter of their shield, which, at Barnet Field, by a fatal error, was taken for the sun of York. Among the offices they held were the forestership of Essex and the keepership of Colchester Castle, and they founded the Essex religious houses of Hatfield Broadoak, Hedingham and Earls Colne.

Authorities.—Domesday Book; Abingdon Chron. and Red Book of the Exchequer (Rolls Series); Pipe Roll of 1130 (Record Commission); Dugdale's *Baronage*; G. E. C(okayne)'s *Complete Peerage*; Doyle's *Official Baronage*; Collins's *Historical Precedents*; Morant's *History of Essex*; Round's *Geoffrey de Mandeville and Feudal England*; Nichols's "Descent of the Earldom of Oxford" (*Arch. Journ.* vol. ix.); Vere papers among the Round MSS. in App. ix. to *14th Report on Historical MSS.*; *Lords' Reports on the Dignity of a Peer*; Palmer's *Peerage Law in England*. The claimants' cases and the appendices of documents in the contest for the great chamberlainship (1902) are valuable for the history of the Veres. (J. H. R.)

VERE, SIR FRANCIS (1560–1609), English soldier, was the son of Geoffrey Vere of Crepping Hall, Essex, and nephew of the 16th earl of Oxford. He first went on active service under Leicester in 1585, and was soon in the thick of the war raging in the Low Countries. At the siege of Sluys young Vere greatly distinguished himself under Sir Roger Williams and Sir Thomas Baskerville. In 1588 he was in the garrison of Bergen-op-Zoom, which delivered itself from the besiegers by its own good fighting, and was knighted by Willoughby on the field of battle. In the next year Sir Francis became sergeant-major-general of the English troops in the Low Countries, and soon afterwards the chief command devolved upon him. This position he retained during fifteen campaigns, with almost unbroken success. Working in close co-operation with the Dutch forces under Maurice, he step by step secured the country for the cause of independence. Vere won the reputation of being the first soldier of the day, his English troops acquired a cohesion and training fitting them to face the best Spanish troops, and his camp became the fashionable training-ground of all aspiring soldiers, amongst others not only his brother Horace, but men of such note as Ferdinando (Lord) Fairfax, Gervase Markham and Miles Standish. Sir Francis served in the Cadiz expedition of 1596, and in 1598 was entrusted with the negotiation of the treaty whereby the Dutch agreed to take a greater share of the burden of the war than they had hitherto done. His success in this task obtained him the governorship of Brill and the rank of general. The culminating point of his career came when, in 1600, on the advice of Barneveld, the states general decided to carry the war into the enemy's country. In the battle of Nieuwport (2nd July 1600), one of the most desperately contested battles of the age, Vere and Maurice completely defeated the veteran Spanish troops of the archduke Albert. This was followed by the celebrated defence of Ostend from July 1601 to March 1602. When James I. made peace with Spain, Vere retired from active service and spent the remainder of his days in country life in England, occupying himself with the compilation of his *Commentaries of the Divers Pieces of Service wherein he had Command* (1657; reprinted in Arber's *English Garner*, 1883). He died in 1609, soon after the truce recognized the independence of the United Provinces, and was buried in Westminster Abbey.

His younger brother Sir Horace Vere, Baron Vere of Tilbury (1565–1635), began his military career as the lieutenant of Sir Francis's Company in 1590. Thenceforward he was continually on active service in the Low Countries, and, like his brother, took part in the Cadiz expedition of 1596; at Nieuwport and Ostend Sir Horace (who had been knighted at Cadiz) held command of some importance. On his brother's retirement Sir Horace, as senior colonel, assumed command of the whole English force, which he held until 1607, being opposed to Ambrosio Spinola, the most famous of the continental generals of the time, against whom he manœuvred and fought in a manner equal to the best of his brother's, or even of Parma's, work. From 1607 to 1620 he saw but little active service except the siege of Jülich (1610). In 1620 he accepted the command of the volunteers who were going to the assistance of the Elector Palatine. This famous expedition to the Rhine and the Main was from the first a forlorn hope. Opposed by his old adversary Spinola, Vere manœuvred with success for two campaigns, but he was helpless against the armies of Tilly and Cordova, and in the end he could only furnish scanty garrisons for Frankenthal, Heidelberg and Mannheim. Each of these places fell after a desperate resistance, and their garrisons returned to England. In 1624 Vere was once more on service in the United Provinces. The attempted relief of Breda in the following year was considered one of the most brilliant feats of the time, and the general was made Baron Vere of Tilbury. In 1629 the sieges of Bois-le-duc (s'Hertogenbosch) and of Maestricht closed his military career. Lord Vere died suddenly in 1635 and was buried by the side of his brother in Westminster Abbey.

See Clements C. Markham, *The Fighting Veres* (London, 1888).

VERESHCHAGIN, VASSILI VASSILIEVICH (1842–1904), Russian artist and traveller, was born at Tcherepovets, in the government of Novgorod, on the 26th of October 1842. His father was a Russian landowner of noble birth, and from his mother he inherited Tatar blood. When he was eight years old he was sent to Tsarskoe Selo to enter the Alexander cadet corps, and three years later he entered the naval school at St Petersburg, making his first voyage in 1858. He graduated first in the list from the naval school, but left the service immediately to begin the study of drawing in earnest. He won a medal two years later, in 1863, from the St Petersburg Academy for his "Ulysses slaying the Suitors." In 1864 he proceeded to Paris, where he studied under Gérôme, though he dissented widely from his master's methods. In the Salon of 1866 he exhibited a drawing of "Doukhobors chanting their Psalms," and in the next year he accompanied General Kauffmann's expedition to Turkestan, his military service at the siege of Samarkand procuring for him the cross of St George. He was an indefatigable traveller—in Turkestan in 1869, the Himalayas, India and Tibet in 1873, and again in India in 1884. After a period of hard work in Paris and Munich he exhibited some of his Turkestan pictures in St Petersburg in 1874, among them two which were afterwards suppressed on the representations of Russian soldiers—"The Apotheosis of War," a pyramid of skulls dedicated "to all conquerors, past, present and to come," and "Left Behind," the picture of a dying soldier deserted by his fellows. Vereshchagin was with the Russian army during the Turkish campaign of 1877; he was present at the crossing of the Shipka Pass and at the siege of Plevna, where his brother was killed; and he was dangerously wounded during the preparations for the crossing of the Danube near Rustchuk. At the conclusion of the war he acted as secretary to General Skobelev at San Stefano. After the war he settled at Munich, where he produced his war pictures so rapidly that he was freely accused of employing assistants. The sensational subjects of his pictures, and their didactic aim—the promotion of peace by a representation of the horrors of war—attracted a large section of the public not usually interested in art to the series of exhibitions of his pictures in Paris in 1881 and subsequently in London, Berlin, Dresden, Vienna and other cities. He aroused much controversy by his series of three pictures of a Roman execution (the Crucifixion), of sepoys blown from the guns in India, and of the execution of Nihilists in St Petersburg. A journey in Syria and Palestine in 1884 furnished him with an equally discussed set of subjects from the New Testament. The "1812" series on Napoleon's Russian campaign, on which he also wrote a book, seem to have been inspired by Tolstoi's *War and Peace*, and were painted in 1893 at Moscow, where the artist eventually settled. Vereshchagin was in the Far East during the Chino-Japanese War, with the American troops in the Philippines, and with the Russian troops in Manchuria. He perished in the sinking of the Russian flagship, "Petropavlovsk," on the 13th of April 1904. His last work, a picture of a council of war presided over by Admiral Makaroff, was recovered almost uninjured.

See E. Zabel, "Wereschtschagin" (1900), in Knackfuss's *Künstlermonographien* (Bielefeld and Leipzig). The finest collection of his pictures is in the Tretiakov gallery in Moscow.

VERGA, GIOVANNI (1840–   ), Italian novelist, was born at Catania, Sicily. In 1865 he published *Storia di una peccatrice* and *I Carbonari della montagna*, but his literary reputation was established by his *Eva* and *Storia di una capinera* (1869). Other novels followed, the best of which are *Malavoglia* (1881) and *Maestro Don Gesualdo* (1889). His finest work, however, is seen in his short stories and sketches of Sicilian peasantry, *Medda* (1874) and *Vita dei campi* (1880); and his *Cavalleria Rusticana* acquired new popularity from its dramatization and from Mascagni's opera on this subject. Verga and Fogazzaro between them may be said to have faithfully chronicled the inner and popular life of southern and northern Italy.

VERGE (Lat. *virga*, a rod), originally a staff denoting authority, whence (from the ceremony in swearing fealty to a lord) the sense of a measurement, and so boundary or border, of land, or generally a margin of space. In architecture, a verge is the edge of the tiling projecting over the gable of a roof; that on the horizontal portion being called "eaves." The term "verge board," generally now known as barge board, is the name given to the board under the verge of gables, sometimes moulded, and often very richly carved, perforated and cusped, and frequently having pendants and sometimes finials at the apex.

VERGENNES, CHARLES GRAVIER, Comte de (1717–1787), French statesman, was born at Dijon on the 20th of December 1717. He was introduced to the profession of diplomacy by his uncle, M. de Chavigny, under whom he saw his first service at Lisbon. His successful conduct of French interests at the court of Trier in 1750 and the following years led to his being sent to Constantinople in 1755 at first as minister plenipotentiary, then as ambassador. In 1768 he was recalled, ostensibly because of a mésalliance with Mme Testa, widow of a Pera surgeon, but really because Choiseul thought him not zealous enough in provoking a quarrel between Russia and Turkey. After Choiseul's death he was sent to Stockholm with instructions to help the aristocratic party of the "Hats" with advice and money. The revolution by which Gustavus III. (August 19, 1772) secured for himself the reality instead of the shadow of power was a great diplomatic triumph for France. With the accession of Louis XVI. Vergennes became foreign minister. His general policy was one of friendly relations with Austria, combined with the limitation of Joseph II.'s ambitious designs; the protection of Turkey; and opposition at all points to England. His hatred of England and his desire to avenge the disasters of the Seven Years' War led to his support of the American States in the War of Independence, a step of which the moral and financial results had not a little to do with the Revolution of 1789. Vergennes sought by a series of negotiations to secure the armed neutrality of the Northern Powers eventually carried out by Catherine II.; he ceded to the demands of Beaumarchais that France should secretly provide the Americans with arms and volunteers. In 1777 he informed the American commissioners that France acknowledged the Republic and was willing to form an offensive and defensive alliance with the new state. In domestic affairs Vergennes belonged to the old school. He intrigued against Necker, whom he regarded as a dangerous innovator, a republican, a foreigner and a Protestant. In 1781 he became chief of the council of finance, and in 1783 he supported the nomination of Calonne as controller general. Vergennes died on the 13th of February 1787, before the meeting of the Assembly of Notables which he is said to have suggested to Louis XVI.

See P. Fauchelle, *La Diplomatie française et la Ligue des neutres de 1780* (1776–83) (Paris, 1893); John Jay, *The Peace Negotiations of 1782–83 as illustrated by the Confidential Papers of Shelburne and Vergennes* (New York, 1888); L. Bonneville de Marsangy, *Le Chevalier de Vergennes, son ambassade à Constantinople* (Paris, 1894), and *Le Chevalier de Vergennes, son ambassade en Suède* (Paris, 1898).

VERGER (M.E. *vergere*; O. Fr. *vergier*; Med. Lat. *virgarius*, one who bears a rod or staff, an apparitor; Lat. *virga*, rod), one who carries a "verge" or staff of office. The principal use of the term is ecclesiastical, and refers to the person who carries a staff as a symbol of office before a bishop or other church dignitary when taking part in a service, especially one held in a cathedral. The word has thus come to mean in general usage an official caretaker of any place of worship whose duty it is to show the building to those who wish to view it, and to find seats for the congregation at a service.

VERGNIAUD, PIERRE VICTURNIEN (1753–1793), French orator and revolutionist, was born on the 31st of May 1753 at Limoges. He was the son of a merchant of that town who lost the greater part of his means by speculation. The boy was early sent to the college of the Jesuits at Limoges, and soon achieved distinction. Turgot was then intendant of Limousin. In his presence young Vergniaud on one occasion recited some verses of his own composition. Turgot was struck with the talent they displayed, and by virtue of his patronage Vergniaud, having gone to Paris, was admitted to the college of Plessis. It is impossible to read the speeches of Vergniaud without being convinced of the solidity of his education, and in particular of the wide range of his knowledge of the classics, and of his acquaintance—familiar and sympathetic—with ancient philosophy and history.

Duputy, president of the parlement of Bordeaux, with whom Vergniaud became acquainted, conceived the greatest admiration and affection for him and appointed him his secretary. Vergniaud was thereafter called to the bar (1782). The influence of Duputy gained for him the beginnings of a practice; but Vergniaud, though capable of extraordinary efforts, too often relapsed into reverie, and was indisposed for study and sustained exertion, even in a cause which he approved. This weakness appears equally in his political and in his professional life: he would refuse practice if his purse were moderately well filled; he would sit for weeks in the Assembly in listlessness and silence, while the policy he had shaped was being gradually undermined, and then rise, brilliant as ever, but too late to avert the calamities which he foresaw. In 1789 Vergniaud was elected a member of the general council of the department of the Gironde. Being deeply stirred by the best ideas of the Revolutionary epoch, he found a more congenial sphere for the display of his great powers in his new position. About this period he was charged with the defence of a member of the national guard of Brives, which was accused of provoking disorders in the department of La Corrèze. Abandoning all reserve, Vergniaud delivered one of the great orations of his life, depicting the misfortunes of the peasantry in language of such combined dignity, pathos and power that his fame as an orator spread far and wide.

Vergniaud was chosen a representative of the Gironde to the National Legislative Assembly in August 1791, and he forthwith proceeded to Paris. The Legislative Assembly met on the 1st of October. For a time, according to his habit, he refrained from speaking; but on the 25th of October he ascended the tribune, and he had not spoken long before the whole Assembly felt that a new power had arisen which might control even the destinies of France. This judgment was re-echoed outside, and he was almost immediately elected president of the Assembly for the usual brief term. Between the outbreak of the Revolution and his election to the Legislative Assembly the political views of Vergniaud had undergone a decided change. At first he had lauded a constitutional monarchy; but the flight of Louis XVI. filled him with distrust of the sovereign, and his views in favour of a republic were rapidly developed. The sentiments and passions which his eloquence aroused were, however, watchfully utilized by a more extreme party. It happened thus even with his first Assembly speech, on the *émigrés*. His proposal was mainly that a treble annual contribution should be levied on their property; but the Assembly confiscated their goods and decreed their deaths. One great blot on his reputation is that step by step he was led on to palliate violence and crime, to the excesses of which his eyes were only opened by the massacres of September, and which ultimately overwhelmed the party of Girondists which he led. The disgrace to his name is indelible that on the 19th of March 1792, when the perpetrators of the massacre of Avignon had been introduced to the Assembly by Collot d'Herbois, Vergniaud spoke indulgently of their crimes and lent the authority of his voice to their amnesty. In language sometimes turgid, but nearly always of pure and powerful eloquence, he worked at the theme of the *émigrés*, as it developed into that of the counter-revolution; and in his occasional appearances in the tribune, as well as in the project of an address to the French people which he presented to the Assembly on the 27th of December 1791, he shook the heart of France, and, especially by his call to arms on the 18th of January, shaped the policy which culminated in the declaration of war against the king of Bohemia and Hungary on the 20th of April. This policy in foreign affairs, which he pursued through the winter and spring of 1791–92, he combined with another—that of fanning the suspicions of the people against the monarchy, which he identified with the counter-revolution, and of forcing on a change of ministry. On the 10th of March Vergniaud delivered a powerful oration in which he denounced the intrigues of the court and uttered his famous apostrophe to the Tuileries: "In ancient times fear and terror have often issued from that famous palace; let them re-enter it to-day in the name of the law!" The speech overthrew De Lessart, whose accusation was decreed; and Roland, the nominee of the Girondists, entered the ministry. By the month of June the opposition of Vergniaud (whose voice still commanded the country) to the king rose to fever heat. On the 29th of May Vergniaud went so far as to support the disbanding of the king's guard. But he appears to have been unaware of the extent of the feelings of animosity which he had done much to arouse in the people, probably because he was wholly unconnected with the practices of the party of the Mountain as the instigators of actual violence. This party used Vergniaud, whose lofty and serene ideas they applauded and travestied in action. Then came the riot of the 20th of June and the invasion of the Tuileries. He rushed among the crowd, but was powerless to quell the tumult. Continuing for yet a little longer his course of feverous, almost frenzied, opposition to the throne, on the 3rd of July he electrified France by his bold denunciation of the king, not only as a hypocrite and a despot, but as a base traitor to the constitution. His speeches breathe the very spirit of the storm, and they were perhaps the greatest single factor in the development of the events of the time. On the 10th of August the Tuileries was stormed, and the royal family took refuge in the Assembly. Vergniaud presided. To the request of the king for protection he replied in dignified and respectful language. An extraordinary commission was appointed: Vergniaud wrote and read its recommendations that a National Convention be formed, the king be provisionally suspended from office, a governor appointed for his son, and the royal family be consigned to the Luxembourg. Hardly had the great orator attained the object of his aim—the overthrow of Louis as a sovereign—when he became conscious of the forces by which he was surrounded. He denounced the massacres of September—their inception, their horror and the future to which they pointed—in language so vivid and powerful that it raised for a time the spirits of the Girondists, while on the other hand it aroused the fatal opposition of the Parisian leaders.

The questions whether Louis XVI. was to be judged, and if so by whom, were the subject of protracted debate in the Convention. They were of absorbing interest to Paris, to France and to Europe; and upon them the Girondist leader at last, on the 31st of December 1792, broke silence, delivering one of his greatest orations, probably one of the greatest combinations of sound reasoning, sagacity and eloquence which has ever been displayed in the annals of French politics. He pronounced in favour of an appeal to the people. He pictured the consequences of that temper of vengeance which animated the Parisian mob and was fatally controlling the policy of the Convention, and the prostration which would ensue to France after even a successful struggle with a European coalition, which would spring up after the murder of the king. The great effort failed; and four days afterwards something happened which still further endangered Vergniaud and his whole party. This was the discovery of a note signed by him along with Gaudet and Gensonné and presented to the king two or three weeks before the 10th of August. It contained nothing but sound and patriotic suggestions, but it was greedily seized upon by the enemies of the Gironde as evidence of treason. On the 16th of January 1793 the vote began to be taken in the Convention upon the punishment of the king. Vergniaud voted early, and voted for death. The action of the great Girondist was and will always remain inscrutable, but it was followed by a similar verdict from nearly the whole party which he led. On the 17th Vergniaud presided at the Convention, and it fell to him, labouring under the most painful excitement, to announce the fatal result of the voting. Then for many weeks he sank, exhausted, into silence.

When the institution of a revolutionary tribunal was proposed, Vergniaud vehemently opposed the project, denouncing the tribunal as a more awful inquisition than that of Venice, and avowing that his party would all die rather than consent to it. Their death by stratagem had already been planned, and on the 10th of March they had to go into hiding. On the 13th Vergniaud boldly exposed the conspiracy in the Convention. The antagonism caused by such an attitude had reached a significant point when on the 10th of April Robespierre himself laid his accusation before the Convention. He fastened especially upon Vergniaud's letter to the king and his support of the appeal to the people as a proof that he was a moderate in its then despised sense. Vergniaud made a brilliant extemporaneous reply, and the attack for the moment failed. But now, night after night, Vergniaud and his colleagues found themselves obliged to change their abode, to avoid assassination, a price being even put upon their heads. Still with unfaltering courage they continued their resistance to the dominant faction, till on the 2nd of June 1793 things came to a head. The Convention was surrounded with an armed mob, who clamoured for the "twenty-two." In the midst of this it was forced to continue its deliberations. The decree of accusation was voted, and the Girondists were proscribed.

Vergniaud was offered a safe retreat. He accepted it only for a day, and then returned to his own dwelling. He was kept under surveillance there for nearly a month, and in the early days of July was imprisoned in La Force. He carried poison with him, but never used it. His tender affection for his relatives abundantly appears from his correspondence, along with his profound attachment to the great ideas of the Revolution and his noble love of country. On one of the walls of the Carmelite convent to which for a short time the prisoners were removed Vergniaud wrote in letters of blood: "Potius mori quam foedari." Early in October the Convention brought forward its indictment of the twenty-two Girondists. They were sent for trial to the Revolutionary tribunal, before which they appeared on the 27th of October. The procedure was a travesty of justice. Early on the morning of the 31st of October 1793 the Girondists were conveyed to the scaffold, singing on the way the Marseillaise and keeping up the strain till one by one they were guillotined. Vergniaud was executed last. He died unconfessed, a philosopher and a patriot.

See Gay de Vernon, *Vergniaud* (Limoges, 1858); and L. de Verdière, *Biographie de Vergniaud* (Paris, 1866). (T. S.)

VERHAEREN, ÉMILE (1855–   ), Belgian poet, was born at Saint-Amand, near Antwerp, on the 21st of May 1855. He was sent to school at Ghent, where he formed a friendship with Georges Rodenbach. He studied at the university of Louvain, and there started a journal, *La Semaine*, which he edited in conjunction with the operatic singer Van Dyck. *La Semaine* was suppressed by the authorities, as was its successor, *Le Type*, in which Verhaeren had as fellow-workers Max Waller, Iwan Gilkin and Albert Giraud. In 1881 he was admitted to the bar at Brussels, but he soon devoted his whole energies to literature, and especially to the organs of "young Belgium," *La Jeune Belgique* and *L'Art moderne*, making himself especially the champion of the impressionist painters. Verhaeren learnt his art of poetry from the great Flemish artists, and in his early robust works, *Les Flamandes* (1883) and *Les Moines* (1886), he displays similar qualities of strength, sometimes degenerating into violence. A period of physical weakness followed, translated into terms of poetry in three volumes of verse, *Les Soirs* (1887), *Les Débâcles* (1888) and *Les Flambeaux noirs* (1889). *Au bord de la route* (1890) and *Les Apparus dans mes chemins* (1891) followed. Verhaeren then passed from applying his pictorial method to psychological studies to the task of individualizing the towns, villages and fields of his native country, the first outcome being his *Campagnes hallucinées* (1893). In *Villages illusoires* he describes the tragedy of the fields and farms deserted by the people in their race to the towns, and in *Les Villes tentaculaires* (1895) the great industrial centres devouring the surrounding country. Later volumes of poems are *Les Heures claires* (1896), *Les Visages de la vie* (1899), *Les Petites Légendes* (1900), *Les Forces tumultueuses* (1901); *Les Tendresses premières* (1904). In 1898 he wrote a lyric drama *Les Aubes*, in 1900 a four-act piece *Le Cloître*, represented both in Brussels and Paris, and in 1901 a historical drama *Philippe II*.

The poems of Émile Verhaeren were translated into English by Alma Strettel (1899); and *Les Aubes* by Mr Arthur Symons (1898). A long list of articles dealing with Verhaeren is to be found in *Poètes d'Aujourd'hui* (1900) of A. van Bever and Paul Léautaud.

VERKHNE-UDINSK, a town of Asiatic Russia, in East Siberia, province of Transbaikalia, on the right bank of the Uda, at its confluence with the Selenga, 102 m. by rail E. of Lake Baikal, to which steamers ply. Pop. (1883) 4130; (1897) 8002. It was founded as a small fort in 1668, and is a centre for the overland trade in tea with China, and an emporium both for grain and animal products, exported, and for metals, machinery and manufactured goods, imported. Its yearly fair is of great importance.

VERLAINE, PAUL (1844–1896), French lyric poet, was born at Metz on the 30th of March 1844. He was the son of one of Napoleon's soldiers, who had become a captain of engineers. Paul Verlaine was educated in Paris, and became clerk in an insurance company. He was a member of the Parnassian circle, with Catulle Mendès, Sully Prudhomme, François Coppée and the rest. His first volume of poems, the *Poèmes saturniens* (1866), was written under Parnassian influences, from which the *Fêtes galantes* (1869), as of a Watteau of poetry, began a delicate escape; and in *La Bonne Chanson* (1870) the defection was still more marked. He married in 1870 Mlle. Mautet. During the Commune he was involved with the authorities for having sheltered his friends, and was obliged to leave France. In 1871 the strange young poet Jean Arthur Rimbaud came somewhat troublingly into his life, into which drink had already brought a lasting disturbance. With Rimbaud he wandered over France, Belgium, England, until a pistol-shot, fortunately ill-aimed, against his companion brought upon him two years of imprisonment at Mons. Solitude, confinement and thought converted a pagan into a Catholic, without, however, rooting out what was most human in the pagan; and after many years' silence he published *Sagesse* (1881), a collection of religious poems, which, for humble and passionate conviction, as well as originality of poetic beauty, must be ranked with the finest religious poems ever written. *Romances sans paroles*, composed during the intervals of wandering, appeared in 1874, and shows us Verlaine at his most perfect moment of artistic self-possession, before he has quite found what is deepest in himself. He returned to France in 1875. His wife had obtained a divorce from him, and Verlaine made another short stay in England, acting as a teacher of French. After about two years' absence Verlaine was again in France. He acted as teacher in more than one school and even tried farming. The death of his mother, to whom he was tenderly attached, dissolved the ties that bound him to "respectable" society. During the rest of his life he lived in poverty, often in hospital, but always with the heedless and unconquerable cheerfulness of a child. After a long obscurity, famous only in the Latin Quarter, among the cafés where he spent so much of his days and nights, he enjoyed at last a European celebrity. In 1894 he paid another visit to England, this time as a distinguished poet, and lectured at London and Oxford. He died in Paris on the 8th of January 1896. His eighteen volumes of verse (among which may be further mentioned *Jadis et naguère*, 1884; *Amour*, 1888; *Parallèlement*, 1889; *Bonheur*, 1891) vary greatly in quality as in substance; they are all the sincere expression, almost the instantaneous notation, of himself, of his varying moods, sensual passion, the passion of the mystic, the delight of the sensitive artist in the fine shades of sensation. He brought into French verse a note of lyrical song, a delicacy in the evocation of sound and colour, which has seemed almost to create poetry over again, as it provides a language out of which rhetoric has been cleansed and a rhythm into which a new music has come with a new simplicity. (A. Sy.)

His *Œuvres complètes* (3 vols.) were published in 1899, &c.; *Œuvres posthumes* (1903). See also *Paul Verlaine, sa vie, son œuvre*, by E. Lepelletier (1907); monographs by M. Dullaert (Ghent, 1896), C. Morice (1888); also Anatole France, *La Vie littéraire* (3rd series, 1891); J. Lemaître, *Nos contemporains* (1889), vol. iv.; E. Delille, "The Poet Verlaine," in the *Fortnightly Review* (March 1891); A. Symons, in the *National Review* (June 1892); V. Thompson, *French Portraits* (Boston, U.S.A., 1900); and the poet's own *Confessions* (1895) and his *Poètes maudits* (1888). A bibliography of Verlaine with an account of the existing portraits of him is included in the *Poètes d'Aujourd'hui* (11th ed., 1905) of MM. A. van Bever and P. Léautaud. The *Vie* by Lepelletier has been translated into English by E. M. Lang (1909).

VERLAT, MICHEL MARIE CHARLES (1824–1890), Belgian painter, was born at Antwerp on the 25th of November 1824. He was a pupil of Nicaise de Keyser, and studied at the Antwerp Academy. In 1842 appeared his first important picture, "Pippin the Short Killing a Lion." About 1849 he went to Paris, where he worked under Ary Scheffer. In 1855 he won a gold medal at the Exposition Universelle at Paris with his "Tiger Attacking a Herd of Buffaloes," and in 1858 exhibited "Le Coup de collier" (now in the Antwerp Gallery) at the Paris Salon. In 1866 he was appointed director of the Academy at Weimar, where he painted some fine portraits, notably those of the grand-duchess of Saxony and of the musician Liszt. Soon after his return to Antwerp in 1875 he visited Palestine, and brought back a large number of interesting pictures, including "Vox Populi" (Antwerp Gallery), "The Tomb of Jesus," and "The Flight into Egypt." In 1885 he was appointed director of the Antwerp Academy. Other important works by Verlat are the panoramas of the battle of Waterloo and the treaty of San Stefano, "Christ between the Two Thieves," "Defending the Flock" (Antwerp Gallery), "Oxen Ploughing in Palestine" (Antwerp Gallery), "Godfrey of Bouillon at the Siege of Jerusalem" (Brussels Gallery), and "Sheep-Dog Defending the Flock" (Brussels Gallery). He executed a series of original etchings, and published in 1879 a book on the Antwerp Academy. He died at Antwerp on the 23rd of October 1890.

VERMANDOIS, a French countship composed originally of the two burgraviates (châtellenies) of St Quentin (Aisne) and Péronne (Somme). Herbert I., the earliest of its hereditary counts, was descended in direct male line from the emperor Charlemagne, and was killed in 902 by an assassin in the pay of Baldwin II., count of Flanders. His son, Herbert II. (902–943), a man absolutely devoid of scruples, considerably increased the territorial power of the house of Vermandois, and kept the lawful king of France, the unlucky Charles the Simple, prisoner for six years. His successors, Albert I., Herbert III., Albert II., Otto and Herbert IV., were unimportant. In 1077 the last male of the first house of Vermandois, Herbert IV., received the countship of Valois in right of his wife. He died soon afterwards, leaving his inheritance to his daughter Adela, whose first husband was Hugh the Great, the brother of king Philip I. Hugh was one of the leaders of the first crusade, and died in 1102 at Tarsus in Cilicia. The eldest son of Hugh and Adela was count Raoul (Rudolph) I. (*c.* 1120–1152), who married Alix of Guyenne, sister of the queen, Eleanor, and had by her three children: Raoul (Rudolph) II., the Leper (count from 1152–67); Isabelle, who possessed from 1167 to 1183 the countships of Vermandois, Valois and Amiens conjointly with her husband, Philip of Alsace, count of Flanders; and Eleanor. By the terms of a treaty concluded in 1185 with the king, Philip Augustus, the count of Flanders kept the countship of Vermandois until his death, in 1191. At this date a new arrangement gave Eleanor (d. 1213) a life interest in the eastern part of Vermandois, together with the title of countess of St Quentin, and the king entered immediately into possession of Péronne and its dependencies.

See Anselme, *Histoire généalogique de la maison royale de France* (1726), i. 48–51 and 531–34; Colliette, *Mémoires pour l'histoire du Vermandois* (1771–72). (A. Lo.)

VERMICELLI (plural of Ital. *vermicello*, little worm, Lat. *vermicellus*, diminutive of *vermis*, worm), the name of a kind of paste, made of the granular meal of certain hard wheats, and used as a food. It is made into worm-like threads, whence its name, and differs from macaroni only in being made solid and not in hollow tubes. "Spaghetti" (dim. of *spago*, a small cord) is a larger kind of vermicelli. In Italy these various pastes form a staple article of food. In other countries "vermicelli" is used in soups and puddings, &c.

VERMIGLI, PIETRO MARTIRE, generally known as PETER MARTYR (1500–1562), born at Florence on the 8th of May 1500, was son of Stefano Vermigli, a follower of Savonarola, by his first wife, Maria Fumantina. He owed his Christian names to a vow which his father, actuated by the death of several children in infancy, had made to dedicate any that survived to the Dominican saint, Peter Martyr, who lived in the 13th century. Educated in the Augustinian cloister at Fiesole, he was transferred in 1519 to the convent of St John of Verdara near Padua, where he graduated D.D. about 1527 and made the acquaintance of the future Cardinal Pole. From that year onwards he was employed as a public preacher at Brescia, Pisa, Venice and Rome; and in his intervals of leisure he mastered Greek and Hebrew. In 1530 he was elected abbot of the Augustinian monastery at Spoleto, and in 1533 prior of the convent of St Peter *ad Aram* at Naples. About this time he read Bucer's commentaries on the Gospels and the Psalms and also Zwingli's *De vera et falsa religione*; and his Biblical studies began to affect his views. He was accused of erroneous doctrine, and the Spanish viceroy of Naples prohibited his preaching. The prohibition was removed on appeal to Rome, but in 1541 Vermigli was transferred to Lucca, where he again fell under suspicion. Summoned to appear before a chapter of his order at Genoa, he fled in 1542 to Pisa and thence to another Italian reformer, Bernardino Ochino, at Florence. Ochino escaped to Geneva, and Vermigli to Zürich, thence to Basel, and finally to Strassburg, where, with Bucer's support, he was appointed professor of theology and married his first wife, Catherine Dammartin of Metz.

Vermigli and Ochino were both invited to England by Cranmer in 1547, and given a pension of forty marks by the government. In 1548 Vermigli was appointed regius professor of divinity at Oxford, in succession to the notorious Dr Richard Smith, and was incorporated D.D. In 1549 he took part in a great disputation on the Eucharist. He had abandoned Luther's doctrine of consubstantiation and adopted the doctrine of a Real Presence conditioned by the faith of the recipient. This was similar to the view now held by Cranmer and Ridley, but it is difficult to prove that Vermigli had any great influence in the modifications of the Book of Common Prayer made in 1552. He was consulted on the question, but his recommendations seem hardly distinguishable from those of Bucer, the effect of which is itself disputable. He was also appointed one of the commissioners for the reform of the canon law.

On Mary's accession Vermigli was permitted to return to Strassburg, where, after some opposition raised on the ground that he had abandoned Lutheran doctrine, he was reappointed professor of theology. He befriended a number of English exiles, but had himself in 1556 to accept an offer of the chair of Hebrew at Zürich owing to his increased alienation from Lutheranism. He was invited to Geneva in 1557, and to England again in 1561, but declined both invitations, maintaining, however, a constant correspondence with Jewel and other English prelates and reformers until his death at Zürich on the 12th of November 1562. His first wife, who died at Oxford on the 15th of February 1553, was disinterred in 1557 and tried for heresy; legal evidence was not forthcoming because witnesses had not understood her tongue; and instead of the corpse being burnt, it was merely cast on a dunghill in the stable of the dean of Christ Church. The remains were identified after Elizabeth's accession, mingled with the supposed relics of St Frideswide to prevent future desecration, and reburied in the cathedral. Vermigli's second wife, Caterina Merenda, whom he married at Zürich, survived him, marrying a merchant of Locarno.

Vermigli published over a score of theological works, chiefly Biblical commentaries and treatises on the Eucharist. His learning was greater than his originality, and he was one of the least heterodox of the Italian divines who rejected Roman Catholicism. His views approximated most nearly to those of Martin Bucer.

Josias Simler's *Oratio*, published in 1563 and translated into English in 1583, is the basis of subsequent accounts of Vermigli. The best lives are by F. C. Schlosser (1809) and C. Schmidt (1858). See also Parker Soc. Publ. (General Index), especially the Zürich Letters; Strype's Works; Foxe's *Acts and Monuments*; Burnet's *Hist.*, ed. Pocock; Dixon's *History*; and *Dict. of Nat. Biogr.* lviii. 253–256.

(A. F. P.)

VERMILION, a scarlet pigment composed of mercuric sulphide, HgS. It may be obtained direct from pure and bright coloured portions of the native ore cinnabar, or, artificially, by subliming a mixture of mercury and sulphur. The product is ground and levigated; and when dry it is ready for use. It is also prepared by digesting precipitated mercuric sulphide with an alkaline sulphide for some hours; it is said that Chinese vermilion owes its superiority to being made in this way. In addition to its brilliance, vermilion is a pigment of great intensity and durability, remaining unaffected by acid fumes. Being costly, it is much subject to adulteration; but the fraudulent additions may easily be detected by volatilization, which in the case of pure vermilion leaves no residue. See PIGMENTS and MERCURY.

VERMIN (Fr. *vermine*, formed as if from Lat. *verminus*, *vermis*, a worm), the collective name applied to various classes of objectionable, harmful or destructive animals. To gamekeepers and those interested in the preservation of game, all animals such as the pole-cat, weasel, stoat, hawks, owls, &c., which destroy the eggs or young of preserved birds, are classed as "vermin," and the same term includes rats, mice, &c. It is also the collective name given to all those disgusting and objectionable insects that infest human beings, houses, &c., when allowed to be in a filthy and unsanitary condition, such as bugs, fleas, lice, &c.

VERMONT, a North Atlantic state of the United States of America and one of the New England group, lying between latitude 42° 44′ and 45° 0′ 43″ N., and between longitudes 3° 35′ and 5° 29′ E. from Washington. It is bounded N. by the Canadian province of Quebec, E. by the Connecticut river, which separates it from New Hampshire, S. by Massachusetts, and W. by New York and Lake Champlain, which separates it in part from New York. Its total area is 9564 sq. m., and of this 440 sq. m. is water surface.

Surface.—Vermont is a portion of the plateau-like New England upland, broken by mountain ranges, individual mountains and high hills, rising above the general upland surface, and by deep narrow valleys, cut below that surface. The mean elevation of the state above the sea is about 1000 ft. Extremes range from 106 ft. at Maquam on the N.E. shore of Lake Champlain (96 ft.) to 4364 ft. at the summit of Mount Mansfield, about 25 m. E. of that lake. The most prominent feature of the surface is the Green Mountains, which extend nearly N. and S. through the state a little W. of the middle. From the Massachusetts border N. for two-thirds the length of the state the range is only slightly broken, but farther N. it is cut deep by the valleys of the Winooski and Lamoille rivers. The crest line is generally more than 2000 ft. high, considerable areas are above 2500 ft., and the following summits exceed 4000 ft.: Mount Mansfield, 4364 ft.; Killington Peak, 4241 ft.; Camel's Hump, 4088 ft.; Mount Lincoln, 4078 ft.; and Jay Peak, 4018 ft. West of the Green Mountains the Taconic Mountains form a nearly parallel (but distinct) range, extending from New York and Massachusetts N. nearly to the centre of Vermont; and a series of broken uplifts, known as the Red Sandrock Mountains, extend farther N. along the shore of Lake Champlain. The Taconic Mountains rise in very irregular masses to 1500–2000 ft., and reach their maximum elevation in Mount Equinox at 3816 ft. The Red Sandrock Mountains are similar to one another in form and structure, generally rounded on the N. and E., but with some rugged escarpments facing the lake; their highest point is Snake Mountain (1271 ft.) in Addison county. There are no mountain ranges in the state E. of the Green Mountains, but distributed along the entire E. border are a number of tall and oval or conical shaped masses known as the Granitic Mountains, and between these and the Green Mountains the country is largely occupied by high hills and deeply carved valleys. Mount Ascutney, one of the Granitic Mountains, rises abruptly from the floor of the Connecticut Valley to a height of 3320 ft. The least broken section of Vermont is on the somewhat gentle slope of the Green Mountains in the N.W. and on Grand Isle, North Hero Island, and Isle La Motte in Lake Champlain. The forms of Vermont's mountains, even to the highest summits, were to a great extent rounded by glaciation, but as the rocks vary much in texture and are often steeply inclined, stream erosion has cut valleys deep and narrow, often mere gorges.

Where the Green Mountain range is unbroken, in the S. two-thirds of the state, it forms a water-parting between the streams which flow W. or N.W. into Lake Champlain or the Hudson river and those flowing S.E. into the Connecticut river; but farther N. the line separating the Hudson-Champlain basin from the Connecticut basin runs among the Granitic Mountains; and extending 25 m. S. from the Canadian border is a small area that is drained N. into Lake Memphremagog, the waters of which, like those of Lake Champlain, are tributary to the St Lawrence river. North of Massachusetts the Connecticut river is wholly within New Hampshire—Vermont's eastern boundary is low-water mark on the W. bank of the Connecticut river. The largest and only navigable rivers of Vermont are among those flowing into Lake Champlain: the Missisquoi, the Lamoille, the Winooski and Otter Creek. The Batten Kill is the principal river flowing into the Hudson. The Deerfield, West, Williams, White, Passumpsic and Nulhegan rivers are the largest of the many streams which are tributary to the Connecticut. The Black, Barton and Clyde rivers flow into Lake Memphremagog. Vermont's rivers are generally swift, and in many places they are made very picturesque by their clear and sparkling waters, rapids, falls, gorges and wooded banks.

Lake Champlain, which lies beautifully in the valley between the Green and Adirondack mountains, belongs mostly to Vermont. The state has a shore line upon it of 150 m. or more, and in its N. portion are numerous islands which are attractive resorts during the summer season. On the N. border of the state is Lake Memphremagog with islands, a rugged prominence known as Owl's Head on its W. border, Jay Peak, farther back, and a beautiful farming country to the eastward. There are also a large number of small lakes and ponds lying wholly within the state. Of these Lake Bomoseen in Rutland county and Willoughby Lake in Orleans county are the largest. Willoughby Lake is about 6 m. long by 1–1½ m. wide, and its situation between two rugged mountains makes a scene of great natural beauty. All the lakes of the state were formed by glaciation.

Fauna.—The most common wild animals are deer, rabbits, squirrels, raccoons, skunks, woodchucks and muskrats. There are some porcupines, red foxes, minks and martens, but the moose, wolf and lynx are practically extinct. The ruffed grouse (or "partridge") is the most common of game birds, but woodcock, ducks and geese are quite common. Prominent among a great variety of song-birds and insectivorous birds are the robin, blue bird, cat bird, sparrows, meadow-lark, bobolink, thrushes, chickadee, wrens, brown thrasher, gold finch, cedar wax-wing, flycatchers, nuthatches, flicker (golden-winged woodpecker), downy and hairy woodpeckers, rose-breasted grosbeak, Baltimore oriole, barn-swallow, chimney swift, purple martin, purple finch (linnet) vireos and several species of warblers. Birds of prey comprise several species of hawks and owls, and a few eagles. A few sturgeon are taken in Lake Champlain. The lakes, ponds and streams afford some of the best trout fishing in the country, and many of them also abound in pickerel, pike, perch, black bass and land-locked salmon. There is a state fish and game commissioner, and the state has a fish hatchery at Roxbury and a forest and game farm at Sharon. There are Federal hatcheries at Swanton (for pike perch and yellow perch) and at Holden (for trout).

Flora.—Vermont (*vert mont*), the Green Mountain State, was so named from the evergreen forests of its mountains, whose principal trees are spruce and fir on the upper slopes and white pine and hemlock on the lower. Among deciduous trees the state is noted for its sugar maples; birch and beech are common on the hills, and oaks, elm, hickory, ash, poplar, basswood, willow, chestnut and butternut on the less elevated areas. Among indigenous fruit-bearing trees, shrubs, vines and plants are the plum, cherry, grape, blackberry, raspberry, cranberry and strawberry. A few of the medicinal plants are ginseng, pleurisy root, snake root, blood root, blue flag and marshmallow. Orchids are very prominent among a great variety of flowering plants. Along the shore of Lake Champlain are a few species of maritime plants that remain from the time when portions of western Vermont were covered by the sea, and on the upper slopes of some of the higher mountains are a few Alpine species; these, however, are much less numerous on the Green Mountains of Vermont than on the White Mountains of New Hampshire. The state's lumber trade was important until 1890, when the white pine was nearly exhausted, although there were still spruce and hemlock.

Climate.—The state usually has long and severe winters and cool summers, but sudden changes of temperature are common at all seasons. The mean temperature for January, the coldest month, is only 17° F.; for the three winter months it is 19° F., and for the five months from November to March inclusive it is 24·3° F. For July, the warmest month, the mean temperature is 68° F.; for the entire year it is 43° F. Extremes of temperature have ranged from −36° F. at Woodstock, Windsor county, in February 1896 to 97° F. at Cornwall, Addison county, in June 1901. The eastern section of the state is colder than the western, and the central or most mountainous section is still colder; for example, the mean annual temperature of Burlington, on Lake Champlain, is 46° F., while that of Saint Johnsbury, a little farther S. and near the E. border, is only 42° F., and that of Northfield, still farther S. but in the middle section, is only 41° F. The mean annual precipitation for the entire state is about 38·5 in.; more rain falls in summer than in any other season, and more falls in the southern section than in the northern. The average annual fall of snow throughout the state is about 90 in., but at Jacksonville near the S. border it often exceeds 110 in. More snow falls in February than in any other month. In the Connecticut and Hudson-Champlain valleys the winds blow mostly from either the N. or the S., but in several of the smaller valleys the prevailing winds are from the N.W.

Soil.—The soil is for the most part glacial drift, composed of clay, sand and gravel, and varying greatly in depth. On the higher elevations it is generally stony and sterile, but in the valleys and on many of the lower hills, where it consists largely of clay and sand, it is quite productive. The best soils are in the west section, where limestone clays or shell marls are common.

Forests.—Vermont was heavily forested with white pine, spruce and hemlock, and, in the southern part of the state and along the shore of Lake Champlain, with some hard woods. The white pine had been much cut off by 1890 and it is no longer commercially important. The woodland area of the state in 1900 was estimated to be 3900 sq. m., about 43% of the land area of the state.

Fisheries.—Lake Champlain furnishes the only commerical fishing grounds in Vermont, with the exceptions of small catches of white fish in Lake Bomoseen, Lake St Catherine in Rutland county and Lake Memphremagog. The total catch in 1895 was 208,139 lb, valued at $7160, and in 1902 was 528,682 lb, valued at $37,669. The capital invested in fisheries in 1902 was $9417, and the number of men employed, 145. The most valuable fish taken was wall-eyed pike, and the catch of this fish and of pickerel from Lake Champlain in 1902 exceeded in value that from any other body of fresh water in the United States excepting Lake Huron and Lake Erie. The wall-eyed pike taken in 1902 were valued at $16,915 (210,936 lb); white fish, $5777 (80,191 lb); pickerel, $4144 (51,711 lb); yellow perch, $2575 (43,917 lb); sturgeon, $2051 (15,590 lb), and suckers, $1854 (37,375 lb); other varieties taken in smaller quantities included smelt, sun-fish and eels.

Agriculture.—Vermont is largely an agricultural state: in 1900, out of a total of 134,933 persons engaged in gainful occupations, 49,820 were engaged in agriculture, 36,180 in manufacturing and mechanical pursuits, 23,028 in domestic and personal service, 18,889 in trade and transportation, and 7016 in professional service; and of a total land area of 9124 sq. m., 7382 sq. m. (4,724,400 acres) were included in farms. The percentage of improved farm land, as in Maine, New York and Pennsylvania, increased from 1850 until 1890 and decreased after 1890; and in 1900 out of a total acreage of 4,724,400 acres only 2,126,624 acres (45%) were improved. Of the 33,104 farms in the state in 1900, 25,982 were farmed by their owners, 1373 by part owners, 314 by owners and tenants, 2424 by cash tenants, 2396 by share tenants, and 615 by managers; 637 farms had more than 500 acres, 3431 were between 260 and 500 acres, 5512 between 175 and 260 acres, 10,215 between 100 and 175 acres, 6513 between 50 and 100 acres, 3511 between 20 and 50 acres, and 3285 less than 20 acres; and dairy produce was the principal source of income of more than one-half of these (16,700), live stock the principal source of income of 7323 farms, and hay and grain of 2519 farms. The general sterility of the soil except along rivers and the bases of hills has made intensive cultivation always necessary, and the competition of new and rich western farm lands has made the agriculture of Vermont develop further toward specialization in dairying and raising live stock. In 1910 there were 495,000 neat cattle (285,000 milch cows), 94,000 horses (average value, $106), 229,000 sheep and 95,000 swine. The horses of Vermont have been famous in the development of American racing stocks; the Morgan stock is best known, and other famous Vermont strains are Messenger and Black Hawk. Hay and forage are the most important crops, and Vermont grasses for grazing have been favourably known since the close of the 18th century. In 1909 on 879,000 acres a crop of hay (excluding forage) was raised valued at $16,155,000. The cereals are relatively unimportant. The largest cereal crop is oats, of which, in 1909, 2,608,000 bushels (valued at $1,304,000) were produced on 81,000 acres.

Mines and Quarries.—The principal mineral resource of Vermont is its building and monumental stone, including marble and granite and a small amount of limestone. The value of the total amount of stone produced in 1908 in Vermont was $7,152,624. Vermont marble is the best and most plentiful in the United States. It has been quarried since 1785; marble monuments were first manufactured about 1808; and at South Dorset in 1818 marble seems first to have been sawed in blocks, the earlier method having been chiselling. It is found generally throughout the western part of the state. The principal supply is in West Rutland, Proctor and Pittsford; this, the "Rutland marble," is a duller, less lustrous white, and of a greater durability than the Carrara marble, and is used largely for monuments and statuary. There are other large quarries at Dorset and East Dorset, Bennington county; the finest marbles from this region are the white, slightly marked with pale brown and with greenish lines; they are commonly used for building, the Harvard Medical School and the office of the U.S. Senate being examples. At Rutland, Proctor and Dorset many darker shades are found, including "moss vein," olive green and various shades of blue, green, yellow and pink, which are used for ornamental purposes. There are important quarries in Franklin county (at Swanton), the stone being a dark Chazy limestone, in which pink and red ("jasper," "lyonnaise" and "royal red") marbles of Cambrian age are found. At Monkton, Addison county, there is a quarry from which other red marbles are taken; and at Roxbury, Washington county, a fine serpentine, called "green marble," or verde antique, is quarried. On Isle La Motte, Grand Isle county, there are marble quarries, the characteristic colours of the marble being "Fisk black" and "Fisk grey." The output of marble in 1908 was valued at $4,679,960 (out of a total of $7,733,920 for the entire production of marble in the United States). Only less important and only less early to be established in Vermont was the quarrying of granite, which began in 1812, but which has been developed chiefly since 1880, largely by means of the building of "granite railroads" which connect each quarry with a main railway line—a means of transportation as important as the logging railways of the Western states and of Canada. The largest granite quarries are near Barre, Washington county, a city which owes its importance to the quarries. The Barre granites, like those of Woodbury and Calais (also in Washington county) and part of those of South Ryegate, Kirby and Newark (Caledonia county), are of the biotite type; they are grey, except the stone from Newark, which is pinkish. Of the quartz-monzonite type are the whitish granites of Bethel and Rochester (Windsor county) and Randolph (Orange county), the light grey of Dummerston (Windham county), and the darker greys of Cabot (Washington county), Derby (Orleans county), Hardwick and Groton (Caledonia county) and Topsham (Orange county). The olive green syenite found on Mount Ascutney, near the Connecticut river, in Windsor county, is a hornblende-augite. Other important granite quarries are near Williamstown, Dummerston, Berlin and Woodbury. The total value of the output of granite in the state in 1908 was $2,451,933. In 1908 the output of limestone was valued at $20,731; there are limestone quarries in Washington and Orange counties and on Isle La Motte. Slate-quarrying and cutting is carried on in the south-western part of the state, in Rutland county; there are important quarries at Fair Haven, Poultney, Castleton, Wells and Pawlet. In Washington county there are quarries near Northfield. The industry began about 1840, though one quarry had been opened as early as 1805. There are two green varieties, called in the trade "sea-green" and "unfading green," the former being used for a cheap roofing slate; and there are purplish varieties. In 1908 the value of slate produced was $1,710,491 (out of a total production for the United States of $6,316,817).

Manufactures.—The first important industry of the state was "rafting" lumber from Vermont through Lake Champlain and the Richelieu and St Lawrence rivers to Quebec. Burlington became a great lumber market for a trade moving in the direction of Boston after the Richelieu river was blocked to navigation and railway transportation began, and in 1882 Burlington was the third lumber centre in the United States. Mountain streams furnish important water-power, and the typical factory of Vermont has long been a sawmill run by a water-wheel. The value of sawmill products in 1905 was $5,888,441, and of planing-mill products $3,080,117. Closely connected with the manufacture of lumber is the making of paper and wood pulp, centralized at Bellows Falls, with water-power on the Connecticut river and with the raw materials near; the product was valued in 1905 at $3,831,448. Dairy industries have rapidly increased in value: in 1905 the value of butter and cheese was $6,416,434, more than any other single industry under the census classification. If a less arbitrary classification be followed the principal manufacturing industries would be stone manufacture and textiles. The first marble quarry was opened in Dorset in 1785 and a second at Middlebury in 1805; and the first granite was quarried in 1812. Barre is the centre of the granite business, and the region about Rutland, especially Proctor, is the principal seat of the marble industry. The product of stone manufactures in 1905 was $9,570,436. Vermont was almost the last of the New England states to develop textile manufactures, though the manufacture of woollen goods was begun in 1824. The greatest development was between 1900 and 1905; the total value of textiles in the former year was $5,407,217 (woollen goods, $2,572,646; hosiery and knit goods, $1,834,685; cotton goods, $999,886) and in the latter was $7,773,612 (woollen goods, $4,698,405; hosiery and knit goods, $1,988,685; and cotton goods, $1,086,522). Other important manufactures are: flour and grist mill products, foundry and machine-shop products, furniture, patent medicines and compounds, roofing materials, and scales and balances, manufactured especially at St Johnsbury.

Transportation and Commerce.—Railway transportation is supplied to Vermont by parallel lines crossing diagonally every part of the state at about equal intervals and running in general in a N.W. and S.E. direction, and by lines running N. and S. respectively along the eastern and western borders of the state. The railway map of the state thus has roughly the appearance of a gridiron. The principal railways are: the lines operated by the Boston & Maine system, extending along the eastern border from Brattleboro through Bellows Falls, and St Johnsbury to the Canada boundary (Vermont Valley, Sullivan County, and Connecticut & Passumpsic Rivers railways), with a line, the St Johnsbury & Lake Champlain railway, extending across the northern part of the state from Lunenburg to Maguam Bay; the Central Vermont railway (Grand Trunk system) which crosses the state diagonally from S.E. to N.W., connecting Burlington, Montpelier and St Albans and affording connexion to the north with Montreal and to the south over trackage shared with the Boston & Maine, with the New London Northern which is leased by this road, and the Rutland railway (New York Central system) extending along the western edge of the state and connecting Rutland with Burlington to the north and with Bellows Falls and Bennington to the south. These railways provide outlets for through freight and passenger traffic southward to Boston and New York, and to the north to St Johns and Montreal.

The southern part of the state was earl, opened to railways, the Sullivan County railway (operated by the Boston & Maine) having been opened in 1849; and in 1850 the state had 290 m. of railway; in 1870, 614 m.; in 1890, 991·42 m.; and on the 1st of January 1909, 1093·43 m. Water communication is afforded by Lake Champlain to the south, for seven months of the year, by way of the Champlain canal, via Whitehall, New York, to Troy and the Hudson river and the Atlantic coast, and to the north by way of the Richelieu river and the Chambly canal to the St Lawrence. The commerce of the lake consists principally of coal, wood pulp and building material, besides general merchandise. The only river with traffic of commercial importance is Otter Creek, flowing northwards into the southern part of Lake Champlain and having a navigable length of 8 m. to Vergennes, with a depth to this point of 8 ft. at low water. The commerce on Lake Champlain is carried on chiefly through Burlington, the port of entry for the Vermont customs district. The tonnage of the commerce of this port amounted, according to the reports of the United States army engineers, to 107,421 tons in 1904 and to 249,174 tons in 1908, of which in the latter year nearly 80% was lumber.

Population.—The population of Vermont in 1890 was 332,422; in 1900, 343,641; and in 1910, 355,956.[1] Of the total population in 1900, 298, 077 were native whites, 44,747 were foreign-born, 826 were negroes and 39 were Chinese. Of the inhabitants born in the United States, 19,974 were natives of New York, 9675 were natives of New Hampshire and 9111 were natives of Massachusetts. Of the foreign-born, 14,924 were French Canadians, 10,616 were English Canadians and 7453 were Irish. Of the total population, 117,344 were of foreign parentage (*i.e.* either one or both parents were foreign-born) and 27,226 were of French Canadian and 20,228 of Irish parentage, both on the father's and on the mother's side. Of 147,223 communicants of all churches in 1906, the largest number, 82,272, were Roman Catholics, 22,109 were Congregationalists, 17,471 Methodist Episcopalians, 8450 Baptists, 1501 Free Baptists and 5278 Protestant Episcopalians. The principal cities are Burlington, Rutland, Barre, Montpelier (the capital) and St Albans.

Administration.—Vermont has been governed under the constitution of 1777, that of 1786 and that of 1793, with twenty-eight amendments, of which the first was adopted in 1828, the second to thirteenth in 1836, the fourteenth to twenty-third in 1850, the twenty-fourth, twenty-fifth and twenty-sixth in 1870, and the twenty-seventh and twenty-eighth in 1883. The administrative officers of the state are a governor, a lieutenant-governor, a secretary of state, a state treasurer, and an auditor of accounts, elected by popular vote, and an inspector of finance, a commissioner of taxes, a superintendent of education, a fish and game commissioner, three railroad commissioners, and various boards and commissions, of whom some are elected by the General Assembly and some are appointed by the governor with the advice and consent of the Senate. All elections and appointments are biennial. The governor has limited powers of appointment and pardon and a veto power which may be overridden by a majority vote in each house.

The legislative department consists of a senate of 30 members, apportioned among the counties according to population, but with the proviso that each county must have at least one senator, and a House of Representatives of 245 members, one from each township. Since 1870 elections and legislative sessions have been biennial. The powers of the two houses are equal except that revenue measures must originate in the House of Representatives.

The judiciary is composed of a supreme court of seven members, a court of chancery, a county court in each county, a probate court in each probate district, and justices of the peace. The judges of the supreme court are elected biennially by the General Assembly, and all the other judicial officers are elected by the people. Sessions of the supreme court are held in each county once a year in addition to the general session which meets at some central place selected by the judges. The court of chancery is held by the judges of the supreme court, the county by a supreme court judge with the aid of two associates elected by the people of the county.

For the administration of local affairs the state is divided into 14 counties and 245 townships. There is no special board of commissioners or supervisors as in most of the other states, the county authority being the assistant judges of the county court. The assistant judges, the sheriff and the state's attorney are elected annually by popular vote. The county treasurer is elected by the assistant judges. The more important township officials are a moderator, a board of selectmen, a clerk, a treasurer and a superintendent of schools. Any community containing thirty or more houses may, with the approval of the selectmen of the town, receive a separate village organization. Their officials are a clerk, five trustees, a collector of taxes and a treasurer.

All citizens of the United States residing in Vermont are citizens of the state. The right of suffrage is confined by the constitution to adult male citizens who have resided in the state for one year. Women have the right to vote in all elections relating to schools and school officers in cities, towns and graded school districts, and also the right to be elected to any local school position or to the office of township clerk. The original method of revising the constitution was adopted from Pennsylvania (see *History*), and it was retained long after Pennsylvania had abandoned it. Thirteen censors chosen septennially were empowered to suggest amendments and to call a convention to pass upon them. The censors, being elected on a general ticket, were always more progressive than the convention, which was chosen on the principle of equal township representation. In spite of the repeated recommendations of the censors, the convention refused to abolish the collegiate executive and the unicameral legislative system until 1836. Propositions to establish the judiciary on a more permanent tenure were also voted down in 1814, 1822, 1857 and 1870, and the state still elects its judges for two years' terms. On its own suggestion, the council of censors was abolished in 1870 and the present method of amending the constitution was adopted. Every tenth year, beginning in 1880, the Senate is authorized to propose amendments, which proposals, if concurred in by the majority of the members of the House of Representatives, are published in the principal newspapers of the state. If they are again approved by a majority of each house in the next General Assembly, they are submitted finally to a direct popular vote, a majority of the votes cast being decisive.

Miscellaneous Laws.—A married woman may hold her separate property, carry on business, sue and be sued the same as if she were single, except that in conveying or mortgaging her real estate she must be joined by her husband. A widow has a dower interest in one-third of her husband's real estate unless barred by a jointure or an agreement. A widower is in any case entitled by courtesy to one-third of his wife's real estate, and he may choose between his rights by courtesy and the provisions of his wife's will. Where there is no issue and the deceased dies intestate the surviving spouse is entitled to the whole estate, both real and personal, if it does not exceed $2000, and if it exceeds that sum the survivor is entitled to $2000 and one-half of the remainder; if there are no kindred, the whole of the estate goes to the surviving spouse. The causes for a divorce are adultery, sentence to confinement in the state prison for three years or more and actual confinement at the time of the suit, intolerable severity, wilful desertion for three consecutive years or absence for seven years without being heard from, or wanton and cruel refusal or neglect of the husband to provide a suitable maintenance for his wife. The plaintiff must have resided in the state for at least the year preceding the application, and if the cause accrued in some other state or country before the parties lived together in Vermont and while neither party lived there, the plaintiff must have been a resident at least for two years preceding the action. When a divorce is granted, the defendant is not permitted to marry other than the plaintiff for three years, unless the plaintiff dies. The homestead of a householder or head of a family to the value of $500 is, so long as it continues to be used as the homestead, exempt from levy or attachment other than upon causes existing at the time it was acquired and for taxes. If the owner is a married man, he cannot sell or mortgage it, except for the purchase money, unless his wife joins him in the execution.

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[1] According to previous censuses, the population was as follows: (1790) 85,425; (1800) 154,465; (1810) 217,895; (1820) 235,981; (1830) 280,652; (1840) 291,948; (1850) 314,120; (1860) 315,098; (1870) 330,551; (1880) 332,286. The increase between 1850 and 1900 was remarkably small.

Education.—The public-school system is under the supervision of a state superintendent of education, elected biennially by the General Assembly, and local schools are under union superintendents and in a few cases under town superintendents. The district system was displaced in 1893 by a township system. The revenues for educational purposes are derived mainly from a state tax of 8% on the general list, from local taxes, and from the interest on the permanent school fund, which (including the money paid to Vermont by the United States government when a portion of the treasury surplus was distributed among the states in 1837) amounted in 1908 to $1,120,218. The schools are open to all children between the ages of 5 and 20, and attendance for twenty-six weeks in each year is made compulsory for those who are between the ages of 8 and 15. The average number of weeks in the "legal schools" (about 95% of the public schools) was 32 weeks in 1907–1908. The chief institutions for higher instruction are the university of Vermont and State Agricultural College (1800, 1865), a land-grant college at Burlington, Middlebury College (1800) at Middlebury, Norwich University (1819) at Northfield, and the state normal schools at Randolph (1867), Johnson (1867) and Castleton (1868).

Charitable and Penal Institutions.—The charitable and penal institutions of the state are controlled by separate boards of directors, but all are subject to the general supervision of a board of visitors composed of the governor, lieutenant-governor and speaker of the House of Representatives, and a woman appointed by the governor. There are a state prison at Windsor (1808), a house of correction at Rutland (1878), an industrial school at Vergennes (1866), and hospitals for the insane at Brattleboro (1836) and Waterbury (1891). Biennial appropriations are made for the support of the deaf and dumb, the blind and imbecile children at various institutions in Massachusetts and Connecticut.

Finance.—The chief sources of revenue for the state are a corporation tax, a collateral inheritance tax (1904) and a licence tax. There is no general property tax except a special levy of 8% on the general list for school purposes and 5% for the construction of roads. For the year ending on the 30th of June 1908 the total receipts were $1,822,390, the expenditures were $1,871,166. The state is practically free from debt, the only obligation of this character being $135,500 in 6% bonds, payable in 1910, which were issued in behalf of the Agricultural College. The banking institutions are supervised by an inspector of finance, who reports annually to the General Assembly. There were no banks in the state until 1806, when a state bank (controlled by the state) was established which was finally closed up in 1845, although as early as 1812 a law was passed to close it. The first private state bank was opened in 1817; an act of 1831 provided for a safety fund guaranteeing bank circulations and derived from a 4⅓% tax on capital stock and a 10% tax on profits; but this law was modified in 1842, the tax being removed from banks giving specie guarantees; and a free banking act was passed in 1851. Owing to the high rate of taxation on deposits, a considerable part of the savings of the people is sent into other states.

History.—Samuel de Champlain, as governor of Quebec, entered what is now Vermont in July 1609 in an expedition against the Iroquois, and thus laid the basis for the French claim. In 1665 the French built a fort on Isle la Motte. The first English settlement was probably made at Chimney Point, in Addison township, in 1690 by a party from Albany. The first permanent white settlement was established by Massachusetts at Fort Dummer (near the present Dummer, in the south-eastern part of the present town of Brattleboro) in 1724. Similar outposts were located during the next few years at Sartwell's Fort and Bridgman's Fort in the township of Vernon (Windham county) and at Fort Hill in the township of Putney (N. of Brattleboro, in Windham county). The territory in which these settlements had been made was involved in the boundary dispute between Massachusetts and New Hampshire, which was settled in 1741 by a decision of the king in council favourable to New Hampshire (*q.v.*). The extension of the southern boundary line by this decision due westward until it met His Majesty's other governments gave rise, however, to a controversy with New York. New Hampshire claimed that her territory extended as far to the west as those of Massachusetts and Connecticut, whereas New York, under the charter of 1664, claimed eastward to the Connecticut river. New York protested against the Bennington grant in 1749, but the question did not become serious until the chief obstacle to settlement was removed by the conquest of Canada in 1760–61. From 1761 to 1763 Governor John Wentworth of New Hampshire issued 108 grants, and settlements were established in Brattleboro, Putney, Westminster, Halifax, Marlborough, Wilmington, New Fane, Rockingham, Townshend, Vernon (Hinsdale) and Dummerston (all in Windham county, except Vernon, which is in Cheshire county). A privy council decree recognizing the claims of New York was issued on the 20th of July 1764, and the settlers were soon afterwards ordered to surrender their patents and repurchase the land from the proper authorities at Albany. Under the leadership of Ethan Allen, Seth Warner and Remember Baker (1737–1775), they refused obedience and took up arms in defence of their rights. About the close of 1771 Colonel Allen organized a regular military force among the inhabitants of the district W. of the mountains, which came to be known as the Green Mountain Boys. The trouble was soon complicated by the conflict with the mother country. On the 13th of March 1775, a riot occurred at Westminster between the people of Cumberland county and the royal authorities, in which two of the people were killed. The Green Mountain Boys, with some help from Connecticut, captured Fort Ticonderoga on the 10th of May 1775, and took part in the Canadian expedition of 1775 under Montgomery and Schuyler. Within the state itself battles were fought at Hubbardton on the 7th of July and Bennington on the 16th of August 1777. The representatives of the towns assembled in convention at Dorset and Westminster in 1776 (Jan. 16–17, July 24–25, September 25–28, October 30), and on the 15th of January 1777 adopted a declaration of independence, assumed the name New Connecticut and appointed Dr Jonas Fay (1737–1818), Thomas Chittenden (1730–1797), Hemon Allen (1740–1788), Dr Reuben Jones and Jacob Bayley a committee to submit their proceedings to the Continental Congress. The chief adviser of the committee in Philadelphia was Dr Thomas Young, a prominent physician, who had helped to draft the Pennsylvania constitution of 1776. Young advised them to call their state Vermont, and he also sent through them a circular letter, dated the 11th of April 1777, urging the people to adopt a state constitution on the Pennsylvania model. The advice was followed. A convention met at Windsor (July 2–8, 1777), and drafted a document which contained almost all of the important provisions of the constitution of Pennsylvania, such as a unicameral legislature, a plural executive and a council of censors, which was not abolished until 1870. One important variation, however, was a clause in the bill of rights providing for the abolition of slavery, Vermont being the first state in America to take such action. The first legislature of the state met at Windsor in March 1778, and voted to admit sixteen towns east of the Connecticut river which were dissatisfied with the rule of New Hampshire. As a result, New York and New Hampshire formed a secret agreement to divide the state between themselves, the mountains to be the line of division. In this crisis the British government through General Sir Frederick Haldimand offered to recognize Vermont as a separate province and to give her very liberal terms provided she would desert the other states.

Ethan Allen (*q.v.*) and some of the other leaders seemed inclined to accept these overtures, but for various reasons, the chief of which was the general success of the American cause, the scheme was soon abandoned. The difficulties with New Hampshire were adjusted in 1782, the west bank of the Connecticut being accepted as the final boundary, but New York refused to abandon her claims until 1790. In the meantime, Vermont continued as an independent state without any recognition from Congress until its admission into the Union on the 4th of March 1791. The legislature wandered about from town to town until 1808, when the capital was permanently located at Montpelier. In presidential campaigns the state has been Federalist, 1792–1800; Democratic-Republican, 1804–1820; Adams-Republican, 1824–1828; Anti-Masonic, 1832; Whig, 1836–1852; and Republican since 1856. During the War of 1812 Vermont troops took part in the battles of Chippewa, Lundy's Lane, Lake Erie and Plattsburgh; but the only engagement in the state itself was the defence of Fort Cassin (at the mouth of Otter Creek in the N.W. corner of the present Addison county) in 1813. On the 19th of October 1864 a small band of Confederate soldiers under Lieutenant B. H. Young crossed the frontier from Canada and raided the town of St Albans. A few of the inhabitants were wounded and one was killed and about $200,000 was taken from the vaults of the local banks. St Albans was also the headquarters of an attempted Fenian invasion of Canada in 1870. Since 1815 a considerable proportion of the native stock has migrated to the W., but the loss has been partially offset by an influx of French Canadians. The wool-growing industry has been almost entirely destroyed by the competition of Australia and the West, and the people are now engaged mainly in dairy-farming, timbering, granite- and marble-quarrying, and in keeping summer boarders.

GOVERNORS

Thomas Chittenden	1778–1789
Moses Robinson	1789–1790
Thomas Chittenden,[1] Federalist	1790–1797
Paul Brigham, acting-governor, Federalist	1797
Isaac Tichenor, Federalist	1797–1807
Israel Smith, Democratic-Republican	1807–1808
Isaac Tichenor, Federalist	1808–1809
Jonas Galusha, Democratic-Republican	1809–1813
Martin Chittenden, Federalist	1813–1815
Jonas Galusha, Democratic-Republican	1815–1820
Richard Skinner, ,,	1820–1823
Cornelius P. Van Ness, ,,	1823–1826
Ezra Butler, Adams-Clay	1826–1828
Samuel C. Crafts, Adams-Clay	1828–1831
William A. Palmer, Anti-Masonic Fusion	1831–1835
Silas H. Jennison,[2] acting-governor, Whig	1835–1836
Silas H. Jennison, Whig	1836–1841
Charles Paine, ,,	1841–1843
John Mattocks, ,,	1843–1844
William Slade, ,,	1844–1846
Horace Eaton, ,,	1846–1848
Carlos Coolidge, ,,	1848–1850
Charles K. Williams, ,,	1850–1852
Erastus Fairbanks, ,,	1852–1853
John S. Robinson, ,,	1853–1854
Stephen Royce, Republican	1854–1856
Ryland Fletcher, ,,	1856–1858
Hiland Hall, ,,	1858–1860
Erastus Fairbanks, ,,	1860–1861
Frederick Holbrook, ,,	1861–1863
J. Gregory Smith, ,,	1863–1865
Paul Dillingham, ,,	1865–1867
John B. Page, ,,	1867–1869
Peter T. Washburn,[3] Republican	1869–1870
George W. Hendee, acting-governor, Republican	1870
John W. Stewart, Republican	1870–1872
Julius Convers, ,,	1872–1874
Asahel Peck, ,,	1874–1876
Horace Fairbanks, ,,	1876–1878
Redfield Proctor, ,,	1878–1880
Roswell Farnham, ,,	1880–1882
John L. Barstow, ,,	1882–1884
Samuel E. Pingree, Republican	1884–1886
Ebenezer J. Ormsbee, ,,	1886–1888
William P. Dillingham, ,,	1888–1890
Carroll S. Page, ,,	1890–1892
Levi K. Fuller, ,,	1892–1894
Urban A. Woodbury, ,,	1894–1896
Josiah Grout, ,,	1896–1898
Edward C. Smith, ,,	1898–1900
William W. Stickney, ,,	1900–1902
John G. McCullough, ,,	1902–1904
Charles J. Bell, ,,	1904–1906
Fletcher D. Proctor, ,,	1906–1908
George H. Prouty, ,,	1908–1910
John A. Mead, ,,	1910–

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VERMOREL, AUGUSTE JEAN MARIE (1841–1871), French journalist, was born at Denicé, France, on the 21st of June 1841. A radical and socialist, he was attached to the staff of the *Presse* (1864) and the *Liberté* (1866). In the latter year he was appointed editor of the *Courrier Français*, and his attacks on the government in that organ led to his imprisonment. In 1869 he was editor of the *Réforme*, and was again imprisoned for denouncing the government. On the overthrow of the Empire in 1870 he was released and took an active part in the Commune. He was dangerously wounded while fighting at the barricades, taken prisoner and removed to Versailles, where he died on the 20th of June 1871.

VERMOUTH, an alcoholic beverage, the basis of which consists of a fortified and aromatized white wine. The best French vermouth is made from the white wines of the Hérault district. The wine is fortified with spirit up to a strength of about 15% of alcohol, and is then stored in casks exposed to the sun's rays for a year or two. Another portion of the wine is fortified up to a strength of about 50% of alcohol, and in this various aromatic and tonic materials are macerated, in casks which are exposed to the sun in the same way as the bulk of the wine. The two liquids are then mixed in such proportions as to make the strength of the ultimate product about 17% of alcohol by volume. Excellent vermouth is also manufactured in Italy, the produce of that country being generally of a "sweet," that made in France of a "dry" type.

VERNACULAR (Lat. *verna*, dim. *vernaculus*, a slave born in his master's house), a term meaning native or indigenous, belonging to the country where a person is born. The word is practically confined in English usage to language, whether of the country as a whole or of particular dialects or idioms.

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[1] Died in office on the 25th of August 1797; succeeded by the lieutenant-governor.

[2] As there was no governor elected by the people, Jennison as lieutenant-governor elect acted as governor.

[3] Died in office on the 7th of February 1870; succeeded by the lieutenant-governor.

VERNE, JULES (1828–1905), French author, was born at Nantes on the 8th of February 1828. After completing his studies at the Nantes lycée, he went to Paris to study for the bar. About 1848, in conjunction with Michel Carré, he wrote librettos for two operettas, and in 1850 his verse comedy, *Les Pailles rompues*, in which Alexandre Dumas fils had some share, was produced at the Gymnase. For some years his interests alternated between the theatre and the bourse, but some travellers' stories which he wrote for the *Musée des Familles* seem to have revealed to him the true direction of his talent—the delineation, viz., of delightfully extravagant voyages and adventures to which cleverly prepared scientific and geographical details lent an air of verisimilitude. Something of the kind had been done before, after kindred methods, by Cyrano de Bergerac, by Swift and Defoe, and later by Mayne Reid. But in his own particular application of plausible scientific apparatus Verne undoubtedly struck out a department for himself in the wide literary genre of *voyages imaginaires*. His first success was obtained with *Cinq semaines en ballon*, which he wrote for Hetzel's *Magazin d'Éducation* in 1862, and thenceforward, for a quarter of a century, scarcely a year passed in which Hetzel did not publish one or more of his fantastic stories, illustrated generally by pictures of the most lurid and sensational description. The most successful of these romances include: *Voyage au centre de la terre* (1864); *De la terre à la lune* (1865); *Vingt mille lieues sous les mers* (1869); *Les Anglais au pôle nord* (1870); and *Voyage autour du monde en quatre-vingts jours*, which first appeared in *Le Temps* in 1872. The adaptation of this last (produced with immense success at the Porte St Martin theatre on the 8th of November 1874) and of another excellent tale, *Michael Strogoff* (at the Châtelet, 1880), both dramas being written in conjunction with Adolphe d'Ennery, proved the most acceptable of Verne's theatrical pieces. The novels were translated into the various European languages—and some even into Japanese and Arabic—and had an enormous success in England. But after 1877, when he published *Hector Servadac*, a romance of existence upon a comet, the writer's invention began to show signs of fatigue (his kingdom had been invaded in different directions and at different times by such writers as R. M. Ballantyne, Rider Haggard and H. G. Wells), and he even committed himself, somewhat unguardedly, to very gloomy predictions as to the future of the novel. Jules Verne's own novels, however, will certainly long continue to delight readers by reason of their sparkling style, their picturesque *verve*—apparently inherited directly from Dumas—their amusing and good-natured national caricatures, and the ingenuity with which the love element is either subordinated or completely excluded. M. Verne, who was always extremely popular in society, divided his time for the most part between Paris, his home at Amiens and his yacht. He was a member of the Legion of Honour, and several of his romances were crowned by the French Academy, but he was never enrolled among its members. He died at Amiens on the 24th of March 1905. His brother, Paul Verne, contributed to the *Transactions of the French Alpine Club*, and wrote an *Ascension du Mont Blanc* for his brother's collection of *Voyages extraordinaires* in 1874.

VERNET, the name of three eminent French painters.

I. Claude Joseph Vernet (1714–1789), who was born at Avignon on the 14th of August 1714, when only fourteen years of age aided his father, a skilful decorative painter, in the most important parts of his work. But the panels of sedan chairs could not satisfy his ambition, and he started for Rome. The sight of the sea at Marseilles and his voyage thence to Civita Vecchia made a deep impression on him, and immediately after his arrival he entered the studio of a marine painter, Bernardino Fergioni. Slowly but surely Claude Joseph made his way and attracted notice. With a certain conventionality in design, proper to his day, he allied the results of constant and honest observation of natural effects of atmosphere, which he rendered with unusual pictorial art. Perhaps no painter of landscapes or sea-pieces has ever made the human figure so completely a part of the scene depicted or so important a factor in his design. "Others may know better," he said, with just pride, "how to paint the sky, the earth, the ocean; no one knows better than I how to paint a picture." For twenty years Vernet lived on in Rome, producing views of seaports, storms, calms, moonlights, &c., when he was recalled (1753) to Paris, and executed, by royal command, the remarkable series of the seaports of France (Louvre) by which he is best known. On his return he became a member of the academy, but he had previously contributed to the exhibitions of 1746 and following years, and he continued to exhibit, with rare exceptions, down to the date of his death, which took place in his lodgings in the Louvre on the 3rd of December 1789. Amongst the very numerous engravers of his works may be specially cited Le Bas, Cochin, Basan, Duret, Flipart and Le Veau in France, and in England Vivares.

II. Antoine Charles Horace Vernet (1758–1835), commonly called Carle, the youngest child of the above-named, was born at Bordeaux in 1758, where his father was painting the view from the château of La Trompette (Louvre). He showed, at the age of five, an extraordinary passion for drawing horses, but went through the regular academical course as a pupil of Lépicié. Strangely enough, on arriving in Italy after carrying off the *grand prix* (1782), he lost all ambition and interest in his profession, so that his father had to recall him to France to prevent his entering a monastery. In Paris Carle Vernet became himself again, and distinguished himself at the exhibition of 1791 by his "Triumph of Paulus Aemilius," a work in which he broke with reigning traditions in classical subjects and drew the horse with the forms he had learnt from nature in stables and riding-schools. But the Revolution drew on, and Carle Vernet's career for awhile seemed to end in the anguish of his sister's death on the scaffold. When he again began to produce, it was as the man of another era: his drawings of the Italian campaign brought him fresh laurels; his vast canvas, the "Battle of Marengo," obtained great success; and for his "Morning of Austerlitz" Napoleon bestowed on him the Legion of Honour. His hunting-pieces, races, landscapes, and work as a lithographer (chiefly under the Restoration) had also a great vogue. From Louis XVIII. he received the order of St Michael. In 1827 he accompanied his son Horace (see below) to Rome, and died in Paris on his return, on the 17th of November 1835.

III. Émile Jean Horace Vernet (1789–1863), commonly called Horace, born in Paris on the 30th of June 1789, was one of the most characteristic, if not one of the ablest, of the military painters of France. He was just twenty when he exhibited the "Taking of an Entrenched Camp"—a work which showed no depth of observation, but was distinguished by a good deal of character. His picture of his own studio (the rendezvous of the Liberals under the Restoration), in which he represented himself painting tranquilly, whilst boxing, fencing, drum- and horn-playing, &c., were going on, in the midst of a medley of visitors, horses, dogs and models, is one of his best works, and, together with his "Defence of the Barrier at Clichy" (Louvre), won for him an immense popularity. Enjoying equal favour with the court and with the opposition, he was most improperly appointed director of the school of France at Rome, from 1828 to 1835, and thither he carried the atmosphere of racket in which he habitually lived. After his return the whole of the Constantine room at Versailles was decorated by him in the short space of three years. This vast work shows Vernet at his best and at his worst: as a picture it begins and ends nowhere and the composition is all to pieces; but it has good qualities of faithful and exact representation. He died at Paris on the 17th of January 1863. The twenty works which were exhibited after his death confirmed his reputation for extraordinary facility; he had tried every sort of subject, showing affinity for all that was anecdotic rather than dramatic, failing most wherever most was demanded of him, and never reaching either beauty of colour or dignity of line. Vernet was, in short, a brilliant off-hand sketcher of all he saw, as he said himself, "from his window," and even in this work there was a good deal of affectation of the impromptu.

See Lagrange, *Joseph Vernet et la peinture au XVIII*^{e} *siècle* (1861); C. Blanc, *Les Vernet* (1845); A. Dayot, *Les Vernet* (1898).

VERNEUIL, PHILLIPPE ÉDOUARD POULLETIER DE (1805–1873), French palaeontologist, was born in Paris on the 13th of February 1805. He was educated for the law, but being of independent means he was free to follow his own inclinations, and having attended lectures on geology by Élie de Beaumont he was so attracted to the subject that he devoted himself assiduously to the study of science. He spent several years in travel through various parts of Europe, specially examining the geology of the Crimea, on which he published an essay (*Mem. Soc. Géol. France*, 1837). He next investigated the Devonian rocks and fossils of the Bas-Boulonnais; and in 1839 accompanied Sedgwick and Murchison in a study of the older Palaeozoic rocks of the Rhenish provinces and Belgium, the palaeontological results being communicated to the Geological Society of London in conjunction with D'Archiac. When Murchison commenced his geological examination of the Russian empire, he requested de Verneuil to accompany him, and the researches of the latter were incorporated in the second volume of *The Geology of Russia in Europe and the Ural Mountains* (1845). Subsequently de Verneuil paid a visit to the United States to study the history of the palaeozoic rocks in that country, and the results were published in 1847 (*Bull. Soc. Géol. France*). In later years he made numerous expeditions into Spain, and his observations were embodied in *Carte géologique de l'Espagne et du Portugal* (1864), prepared in association with E. Collomb. In 1853 the Wollaston medal of the Geological Society of London was awarded to him, and in 1860 he was elected a foreign member of the Royal Society. He died in Paris on the 29th of May 1873.

VERNEUIL, a town of north-western France, in the department of Eure, 34 m. S.S.W. of Evreux by rail. Pop. (1906) 3529. Verneuil, situated on the left bank of the Avre, has a number of old houses and churches. Of the latter the most important is the church of La Madeleine (11th to 17th century), the façade of which is flanked by an imposing square tower of the first half of the 16th century, similar in origin and appearance to the Tour de Beurre of Rouen cathedral. The church contains old stained glass, an ironwork pulpit and other works of art. The church of Notre Dame (12th and 16th centuries) possesses stone-carvings of the Romanesque period and good stained glass. The Tour Grise is a fine cylindrical keep built in 1120 by Henry I., who fortified Verneuil as a stronghold for the Norman frontier. The town rose to considerable importance, and is said to have numbered as many as 25,000 inhabitants.

In 1424 the French were severely defeated by John, duke of Bedford, under the walls of Verneuil, which was then surrendered to the English; this victory confirmed the supremacy of the English over the country north of the Loire. The town was recaptured in 1449. It carries on ironfounding, dyeing and the manufacture of machinery.

VERNEY, the name of an English family which settled first of all at Fleetmarston in Buckinghamshire, then at Penley in Hertfordshire, and finally at Middle Claydon in Buckinghamshire. Its pedigree goes back to Ralph de Verney (fl. 1216–1223), but the fortunes of the family were made by Sir Ralph Verney (d. 1478), who was lord mayor of London in 1465 and M.P. for the city in 1472. His eldest son, Sir John Verney, married Margaret, heiress of Sir Robert Whittingham of Penley, and the fourth Sir Ralph Verney married in 1525 Elizabeth, one of the six co-heiresses of John, Lord Braye. Sir Edmund Verney of Penley (d. 1600) left two sons, half-brothers, Sir Francis Verney (1584–1615), who became a soldier of fortune and a buccaneer, and died at Messina in hospital in extreme poverty, and Sir Edmund Verney (1590–1642) of Middle Claydon, Bucks. Sir Edmund accompanied Prince Charles and Buckingham on the abortive mission to Madrid in 1623, and was knight-marshal to King Charles I. When the Civil War broke out the royal standard was entrusted to him at Nottingham, and while defending it he was slain at Edgehill in 1642. His eldest son, Sir Ralph Verney (1613–1696), 1st baronet, sat for Aylesbury in both the Short and the Long parliaments. He took the side of the parliament at the outset of the Civil War, but went abroad in 1643 rather than sign the Covenant, and his estates were sequestrated in 1646. He returned to England in 1653, and, though he refused to act against Cromwell, was subsequently reconciled to the Restoration government. His brother, Sir Edmund (1616–1649), had taken the king's side, and was one of those murdered in cold blood by Cromwell's soldiers at the sack of Drogheda. Sir Ralph Verney's estates and honours descended to his son, Sir John (*c.* 1640–1717), who was created Viscount Fermanagh in the Irish peerage in 1703 and was father of Ralph Verney, created Earl Verney in 1743. Earl Verney's sister, Margaret Verney, by her marriage with Sir Thomas Cave, linked the Verney family a second time with the barony of Braye, and the present Lord Braye's surname is Verney-Cave. Earl Verney's eldest son, John, predeceased him in 1737, leaving a posthumous daughter, Mary (1737–1810), who was created Baroness Fermanagh in 1792. His second son, Ralph, 2nd Earl Verney (*c.* 1712–1791), was a friend of Edmund Burke, who entered parliament as Verney's nominee for Wendover. Earl Verney was an ardent supporter of the Whig interest, but received no reward from the party leaders. He rebuilt Claydon House with great splendour from the plans of John Adam, but, with his financial ventures, this brought him to bankruptcy. He died childless in March 1791 and his titles became extinct.

The present Verney family, of Claydon Hall, Buckinghamshire, is descended in the male line from Felix Calvert (1596–1674) of Little Hadham, Hertfordshire. The Right Hon. Sir Harry Verney, 2nd baronet (1801–1894), was the son of General Sir Harry Calvert, G.C.B., created a baronet in 1818. He assumed the name of Verney in compliance with the will of Mary Verney, Baroness Fermanagh, mentioned above. This lady died unmarried, leaving the paternal estates and the Verney portraits to her half-sister, Catherine Calvert (Mrs Wright), known thenceforward as Mrs Verney, on whose death in 1827 they came into the possession of her cousin, Sir Harry Calvert (Verney). Sir Harry Verney entered the House of Commons for Buckingham in 1832, and remained a member of the House with two short intervals for fifty-two years. He married in 1835 Eliza, daughter of Admiral Sir George Johnstone Hope, K.C.B., M.P., and secondly Frances Parthenope Nightingale, sister of Florence Nightingale.

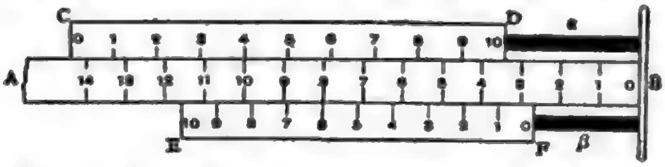
Frances, Lady Verney, collected from the mass of papers preserved at Claydon House the *Memoirs of the Verney Family during the Seventeenth Century*, which contain a charming picture of the life and manners of the country gentlemen of that day. A second edition, abridged and corrected by Margaret M. Verney, appeared in 2 vols. in 1904. See also the *Verney Papers* edited for the Camden Society in 1853–1854.

The Verneys who hold the barony of Willoughby de Broke descend from the Rev. Robert Barnard, prebendary of Winchester, who married in 1793 the Hon. Louisa Verney Peyto, daughter of John Peyto, 14th Baron Willoughby de Broke, and co-heiress of her brother Henry, 16th baron. The Peytos inherited the Verney estates in Warwickshire through Margaret Greville (d. 1631), sister and heiress of Fulke Greville, Lord Brooke (*q.v.*), who married Sir Richard Verney of Compton Murdac, Warwickshire. Robert John Barnard, 18th Baron Willoughby de Broke, who took in 1853 the surname of Verney in lieu of Barnard, was the grandfather of the 19th Lord Willoughby de Broke (Richard Greville Verney), who sat in the House of Commons from 1895 to 1900 for S.E. Warwickshire and succeeded to the title in 1902.

VERNIER, PIERRE (*c.* 1580–1637), inventor of the instrument which bears his name, was born at Ornans (near Besançon) in Burgundy about 1580. He was for a considerable time commandant of the castle in his native town. In 1631 he published at Brussels a treatise entitled *Construction, usage et propriétés du quadrant nouveau de mathématiques*, in which the instrument associated with his name is described. He died at Ornans in 1637.

The instrument invented by Vernier is frequently called a nonius, particularly in Germany, after Pedro Nuñez (1492–1577), professor of mathematics at the university of Coimbra; but this is incorrect, as the contrivance described by the latter in his work *De crepusculis* (1542) is a different one, although the principle is practically the same. Nuñez drew on the plane of a quadrant 44 concentric arcs divided respectively into 89, 88, ... 46 equal parts; and if the alidade did not coincide with one of the divisions on the principal arc, which was divided into 90 parts, the number of degrees in a quadrant, it would fall more or less accurately on a division line of one of the auxiliary arcs, from which the value of the measured angle could be made out. This instrument was, however, very difficult to make, and was but little used. Vernier proposed to attach to a quadrant divided into half-degrees a movable sector of a length equal to 31 half-degrees, but divided into 30 equal parts, whereby single minutes could be read off by seeing which division line of the "sector" coincided with a division line of the quadrant. The idea had been mentioned by Christopher Clavius (1537–1612) in his *Opera mathematica*, 1612 (ii. 5 and iii. 10), but he did not propose to attach permanently an arc divided in this way to the alidade; this happy application of the principle at all events belongs to Vernier.

The principle of the vernier is readily understood from the following account: Let AB (see fig.) be the normal scale, *i.e.* a scale graduated according to a standard of length, CD, a scale (placed in contact with AB for convenience) graduated so that 10 divisions equal 11 divisions of the scale AB, and EF a scale placed similarly and graduated so that 10 divisions equal 9 divisions of the scale AB. Consider the combination AB and CD. Obviously each division of CD is $\frac{1}{10}$th greater than the normal scale division. Let α represent a length to be measured, placed so that one end is at the zero of the normal scale, and the other end in contact with the end of the vernier CD marked 10. It is noted that graduation 4 of the vernier coincides with a division of the standard, and the determination of the excess of α over 3 scale divisions reduces to the difference of 7 divisions of the normal scale and 6 divisions of the vernier. This is ·4, since each vernier division equals 1·1 scale division. Hence the scale reading of the vernier which coincides with a graduation of the normal scale gives the decimal to be added to the normal scale reading. Now consider the scales AB and EF, and let β be the length to be measured; the scale EF being placed so that the zero end is in contact with an end of β. Obviously each division of EF is $\frac{1}{10}$th less than that of the normal scale. It is seen that division 6 of the vernier coincides with a normal scale division, and obviously the excess of β over two normal scale divisions equals the difference between 6 normal scale divisions and 6 vernier divisions, *i.e.* 0·6. Thus again in this case the vernier reading which coincides with a scale reading gives the decimal to be added to the normal scale. The second type of vernier is that more commonly adopted, and its application to special appliances is quite simple. For example, the normal scale to an English barometer is graduated in $\frac{1}{20}$ths of an inch. The vernier is such that 24 divisions of the normal scale equal 25 of the vernier; each of the latter therefore is ·002 or $\frac{1}{500}$th inch less than the normal division. In the scientific barometer, the normal scale is graduated in millimetres, and the vernier so that 20 scale divisions equal 19 mm. This combination reads to 0·05 mm.



VERNIS MARTIN, a generic name, derived from a distinguished family of French artist-artificers of the 18th century, given to a brilliant translucent lacquer extensively used in the decoration of furniture, carriages, sedan chairs and a multitude of small articles such as snuff-boxes and fans. There were four brothers of the Martin family: Guillaume (d. 1749), Simon Étienne, Julien and Robert (1706–1765), the two first-named being the elder. They were the children of Étienne Martin, a tailor, and began life as coach-painters. They neither invented, nor claimed to have invented, the varnish which bears their name, but they enormously improved, and eventually brought to perfection, compositions and methods of applying them which were already more or less familiar. Oriental lacquer speedily acquired high favour in France, and many attempts were made to imitate it. Some of these attempts were passably successful, and we can hardly doubt that many of the examples in the possession of Louis XIV. at his death were of European manufacture. Chinese lacquer was, however, imported in large quantities, and sometimes panels were made in China from designs prepared in Paris, just as English coats of arms were placed upon Chinese porcelain in its place of origin. Biographical details of the career of the brothers Martin are scanty, but we know that the eldest was already in business in 1724. Their method and work must have come rapidly into vogue, for in 1730 Guillaume and Simon Étienne Martin were granted by letters patent a twenty years' monopoly, subsequently renewed, of making "toutes sortes d'ouvrages en relief de la Chine et du Japon." At the height of their fame the brothers directed at least three factories in Paris, and in 1748 they were all classed together as a "Manufacture nationale." One of them was still in existence in 1785. The literature of their day had much to say of the frères Martin. In Voltaire's comedy of *Nadine*, produced in 1749, mention is made of a *berline* "bonne et brillante, tous les panneaux par Martin sont vernis", also in his *Premier discours sur l'inégalité des conditions* he speaks of "des lambris dorés et vernis par Martin." The marquis de Mirabeau in *L'Ami des hommes* refers to the enamelled snuff-boxes and varnished carriages which came from the Martins' factory. It is the fate of all the great artists of the past to have had their names attached, by popular rumour or interested artifice, to a multitude of works which they never saw, and the Martins have suffered considerably in this respect. That the quality of their production varied between very wide limits is established by existing and undoubted examples; but it is extremely improbable that even their three factories could have turned out the infinite quantity of examples that has been attributed to them. Yet their production was large and exceedingly miscellaneous, for such was the rage for their lacquer that it was applied to every possible object. Nor need we be surprised at a rage which was by no means confined to France. At its best Vernis Martin has a splendour of sheen, a perfection of polish, a beauty of translucence which compel the admiration due to a consummate specimen of handiwork. Every variety of the lacquer of the Far East was imitated and often improved upon by the Martins—the black with raised gold ornaments, the red, and finally in the wonderful green ground, powdered with gold, they reached the high-water mark of their delightful art. This delicate work, *poudré* and wavy-lined with gold or *semé* with flowers overlaid with transparent enamel, is seen at its best on small boxes, fans, needle-cases and such-like. Of the larger specimens from the Martins' factories a vast quantity has disappeared, or been cut up into decorative panels. It would appear that none of the work they placed in the famous hotels of old Paris is now *in situ*, and it is to museums that we must go for really fine examples—to the Musée de Cluny for an exquisite children's sedan chair and the coach used by the French ambassador to Venice under Louis XV., to the Wallace collection for the tables with richly chased mounts that have been attributed to Dubois; to Fontainebleau for a famous commode. Even the decorations of the apartments of the dauphin at Versailles, executed, or at least begun, in 1749, have vanished; so have those at Bellevue. It has been generally accepted that of the four brothers Robert Martin accomplished the most original and the most completely artistic work. He left a son, Jean Alexandre, who described himself in 1767 as "Vernisseur du Roi de Prusse." He was employed at Sans Souci, but failed to continue the great traditions of his father and his uncles. The Revolution finally extinguished a taste which had lasted for a large part of the 18th century. Since then the production of lacquer has, on the whole, been an industry rather than an art. (J. P.-B.)

VERNON, EDWARD (1684–1757), English admiral, was born in Westminster on the 12th of November 1684. He was the second son of James Vernon, secretary of state from 1697–1700, a scion of an ancient Staffordshire family who is best remembered by three volumes of his letters to the duke of Shrewsbury, which were published in 1841; and his mother was Mary, daughter of Sir John Buck of Lincolnshire. Edward Vernon was sent to Westminster school at the age of seven, and remained there till he was sixteen. Outside its walls he studied, with a view to his future profession, such branches of knowledge as geometry, geography and the construction of military weapons. He entered the navy in 1701, and from that time until 1707 took part in many expeditions in the Mediterranean and the West Indies. He served with Sir George Rooke at the taking of Gibraltar in July 1704; and on his return to England Queen Anne acknowledged his gallantry with the present of two hundred guineas. He next served in the West Indies with Commodore Sir Charles Wager, a brave seaman, who afterwards rose to the highest position at the admiralty in the Whig ministry of Walpole, and was pitted against Vernon both in the House of Commons and at the polling-booth. In 1715, and again in 1726, Vernon assisted in the naval operations in the Baltic, supporting Sir John Norris in the first enterprise, and on the latter serving under his old chief, Sir Charles Wager. During the long supremacy of Walpole little opportunity arose for distinction in warfare, and Vernon's energies found relief in politics. At the general election of 1722 he was returned for both Dunwich in Suffolk and Penryn in Cornwall, but chose the latter constituency. In the succeeding parliament of 1727 he was again chosen member for Penryn; but he failed to retain his seat after the dissolution in 1734. At this period the English people regarded the Spaniards as their legitimate enemies, and the ill-feeling of the two countries was fanned both in poetry and in prose. The political antagonists of Walpole charged him with pusillanimity to Spain. With Pulteney and most of his associates this battle-ground was selected rather from expediency than from principle; but Vernon represented the natural instincts of the sea-captain, and with the sailor as with the soldier the motto was "No peace with Spain." In debate he spoke often, and frequently with effect, but his language always savoured of extravagance. He pledged himself in 1739 to capture Porto Bello with a squadron of but six ships, and the minister whom he had assailed with his invectives sent him, as vice-admiral of the blue and commander of the fleet in the West Indies, to the enterprise with the force which he had himself called sufficient. Vernon weighed anchor from Spithead on the 23rd of July 1739 and arrived off Porto Bello on 20th November. Next day the combat began with a bombardment of an outlying fort which protected the mouth of the harbour, and on the 22nd of November the castle and town surrendered with a loss on the English side of only seven men. The joy of the nation knew no bounds. Vernon's birthday was celebrated in 1740 in London with public illuminations, and 130 medals were struck in his honour. In February 1741 in a by-election at Portsmouth Vernon was again sent to parliament. At the general election in the following May he was returned for Ipswich, Rochester and Penryn, and all but succeeded in winning Westminster.[1] He elected to sit for Ipswich. A larger squadron was placed under Vernon's command at the close of 1740, and with this force he resolved upon attacking Cartagena. After a fierce struggle, the castle, which stood at the harbour's entrance, was gained; but in the attack upon the city the troops and sailors failed to act in concert, and, with the numbers of his forces thinned by combat and by disease, the British admiral retired to Jamaica. The incidents of this disastrous attempt are described in Smollett's *Roderick Random*, chap. xxxi., &c. A similar enterprise in July 1741 against Santiago de Cuba met with a similar reverse, and Vernon attributed the defeat to the divided command of the British forces. During his command he did a good deal for the health of his crews. He first introduced the custom of mixing the rum served to the sailors in the West Indies with water. The word "grog" is said to be derived from the nickname of "old Grog" given him by the sailors, because he wore a peculiar grogram boat-cloak. He landed at Bristol on the 6th of January 1743, and on the 24th of January received the freedom of the city of London. When the country dreaded the march of Prince Charles to London, the fleet in the Downs was placed under the command of Vernon; but his jealous disposition brooked no interference from the admiralty, and on the 1st of January 1746 he struck his flag and handed over the command to another. His next act was to describe his grievances in a couple of angry pamphlets, revealing the communications of his official chiefs, and for this indiscretion he was struck off the list of flag officers (April 11, 1746). He continued to represent the borough of Ipswich until his death, but with this proceeding his public services practically ceased. He died suddenly at Nacton in Suffolk, the 30th of October 1757, and was buried in the church of the village.

Vernon's gallantry was unquestioned; but his valour not infrequently degenerated into foolhardiness, and he dwelt more often than is usual with British seamen on the merits of his own exploits. His politics were those of the Tory party, and his differences with the Whigs and with his colleagues in the services led to his publishing several pamphlets on his political conduct. A *Memorial of Admiral Vernon from Contemporary Authorities* was printed by W. F. Vernon for private circulation in 1861.

VERNON, a town of north-western France, in the department of Eure, 19 m. E.N.E. of Evreux by road. Pop. (1906) 7274. Vernon stands on the left bank of the Seine opposite the forest of Vernon, a stone bridge uniting it to Vernonnet on the right bank, where there are important stone quarries. The forest of Bizy lies to the south of the town. Its church is an interesting building dating from the 12th to the 15th centuries, and there is a cylindrical keep built by Henry I. of England. The port on the Seine carries on trade in stone and coal, and the town has workshops for the manufacture of army engineering material and manufactures benzine, aniline dyes, wooden shoes, liqueurs, &c.

Vernon in 1196 was ceded by its count to Philip Augustus, Richard I. resigning his suzerainty. The first Estates of Normandy were held at Vernon in 1452.

VEROLI (anc. *Verulae*), a town and episcopal see of the province of Rome, Italy, 10 m. by road N.E. of Frosinone, 1870 ft. above sea-level. Pop. (1901) 2622 (town); 12,655 (commune). The town is situated on a hill in a strong position with a fine view, on the site of the ancient Hernican town of Verulae, 7 m. S.E. of Aletrium. It retains remains of its ancient polygonal enceinte, especially near the summit of the hill, later occupied by a medieval castle. It is hardly mentioned in history: we know that it became a municipium in 90 B.C. The cathedral treasury contains the breviary of S. Louis of Toulouse, and some interesting reliquaries, one in ivory with bas-reliefs, and two in the Gothic style, of silver gilt.

VÉRON, LOUIS DÉSIRÉ (1798–1867), French publicist, was born at Paris on the 5th of April 1798. In 1829 he founded the *Revue de Paris*, and from 1838 to 1852 was owner and director of the *Constitutionnel*, in which he published in Eugène Sue's *Wandering Jew*. It was also during Véron's direction and at his suggestion that Sainte-Beuve contributed the *Causeries du lundi*. From 1831–1835 he was director of the Paris Opera. In 1852 he was elected to the Corps Législatif as an official candidate. He was the author of various books, of which the best known is *Mémoires d'un bourgeois de Paris* (1853–1855). He died in Paris on the 27th of September 1867.

VÉRON, PIERRE (1831–1900), French publicist, was born in Paris on the 19th of April 1831, and in 1854 published his first book, a volume of verse. In 1858 he joined the staff of *Charivari*, and edited that paper from 1865–99. He was the author of a large number of novels dealing with Parisian life, and for many years his rooms in the Rue de Rivoli were the meeting-place of the most famous French literary, artistic and political celebrities. He died in Paris on the 2nd of November 1900.

VERONA, a city and episcopal see of Venetia, Italy, the capital of the province of Verona, situated 194 ft. above sea-level in a loop made by the winding of the Adige (anc. *Athesis*). Pop. (1906) 61,618 (town); 79,574 (commune). It is 93 m. E. of Milan and 71 m. W. of Venice by rail, and is also the point of departure of the main lines to Mantua and Modena and to the Brenner, while a branch line runs N.W. to Caprino, another S.E to Legnago, and steam tramways to Cologna Veneta, Coriano and S. Giacomo.

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[1] Grego's *Parliamentary Elections* (London, 1886), pp. 95–106.

Churches.

The basilica of S. Zeno (an early bishop of Verona who became its patron saint), which stands outside the ancient city, is one of the most interesting Romanesque churches in Italy. The church was remodelled in 1139, to which period much of the existing structure belongs, including the richly sculptured west front and the open *confessio* or crypt, which occupies the eastern half of the church, raising the choir high above the nave. The nave, dating from the 11th century, is supported by alternate columns and pillars, and contains frescoes of the 11th-14th centuries. The cloisters of S. Zeno, rebuilt in 1123, are an interesting example of brick and marble construction. Like many other churches in Verona, S. Zeno is mainly built of mixed brick and stone in alternate bands: four or five courses of fine red brick lie between bands of hard cream-coloured limestone or marble, forming broad stripes of red and white all over the wall. A similarly variegated effect in red and white is produced by building the arches of windows and doors with alternating voussoirs in brick and marble. The neighbourhood of Verona is especially rich in fine limestones and marbles of many different kinds, especially a close-grained cream-coloured marble and a rich mottled red marble, which are largely used, not only in Verona, but also in Venice and other cities of the province. The same quarry produces both kinds, and indeed the same block is sometimes half red and half white. On the north side of the church is a lofty tower, called the tower of Peppin; while the slender brick campanile on the south dates from 1045 to 1178.

The cathedral, consecrated in 1187 by Pope Urban III., stands at the northern extremity of the ancient city, by the bank of the Adige; it is inferior in size and importance to S. Zeno, but has a fine 12th-century west front of equal interest, richly decorated with naïve Romanesque sculpture (1135). The rest of the exterior is built in bands of red and white, with slightly projecting pilasters along the walls; it has a noble cloister, with two storeys of arcading. The campanile by Sanmichele is unfinished. Its baptistery, rebuilt early in the 12th century, is a quite separate building, with nave and apse, forming a church dedicated to S. Giovanni in Fonte. Pope Lucius III., who held a council at Verona in 1184, is buried in the cathedral, under the pavement before the high altar. The Dominican church of S. Anastasia is a mine of wealth in early examples of painting and sculpture, and one of the finest buildings in Italy of semi-Gothic style. It consists of a nave in six bays, aisles, transepts, each with two eastern chapels, and an apse, all vaulted with simple quadripartite brick groining. It was begun in 1261, but not completed till 1422, and is specially remarkable for its very beautiful and complete scheme of coloured decoration, much of which is contemporary with the building. The vaults are gracefully painted with floreated bands along the ribs and central patterns in each "cell," in rich soft colours on a white plastered ground. The eastern portion of the vaulting, including the choir and one bay of the nave, has the older and simpler decorations; the rest of the nave has more elaborate painted ornament—foliage mixed with figures of Dominican saints, executed in the 15th century. There are many fine frescoes in the interior ranging from *c.* 1300 (knights kneeling before the Virgin) to the 15th century, including Pisanello's beautiful painting of St George (mentioned below). This church also contains a large number of fine sculptured tombs of the 14th and 15th centuries, with noble effigies and reliefs of saints and sacred subjects. It is mainly built of red brick, with fine nave columns of red and white marble and an elaborate marble pavement inlaid in many different patterns. Its general proportions are specially noble, and the exterior view is good. The church of S. Fermo Maggiore comes next in interest. With the exception of the crypt, which is older, the existing edifice was rebuilt in 1313. The façade is of brick and marble used alternately. The plan is unusual, consisting of a large nave without aisles, the span being between 45 and 50 ft.; it also has two shallow transepts and an apsidal east end. The roof, which is especially magnificent, is the finest example of a class which as a rule is only found in Venetia or in churches built by Venetian architects in Istria and other subject provinces: the framing is concealed by coving or barrel-vaulting in wood, the surface of which is divided into small square panels, all painted and gilt, giving a very rich effect. In this case the 14th and 15th century painted decorations are well preserved. Delicate patterns cover all the framework of the panelling and fill the panels themselves; at two stages, where there is a check in the line of the coving, rows of half-figures of saints are minutely painted on blue or gold grounds, forming a scheme of indescribably splendid decoration. A simpler roof of the same class exists at S. Zeno; it is trefoil-shaped in section, with a tie-beam joining the cusps. The church of S. Maria in Organo, dating from 1481, with a façade of 1592 from Sanmichele's designs, contains paintings by various Veronese masters, and some fine choir-stalls of 1499 by Fra Gioconda. Though not built till after his death, the church of S. Giorgio in Braida, on the other side of the river, was also designed by Sanmichele, and possesses many good pictures of the Veronese school. The Romanesque church of S. Lorenzo, restored in 1896–1898, contains old frescoes. S. Stefano is another Romanesque church, probably of the 11th century. There are several other fine churches in Verona, some of early date. One of the 14th century is dedicated to Thomas à Becket of Canterbury.

Bridges and fortifications.

The strongly fortified castle (Castel Vecchio) built by the Della Scala lords in the 14th century stands on the line of the wall of Theodoric, close by the river. A very picturesque battlemented bridge leads from it to the other shore, sloping down over three arches of different sizes, the largest next to the castle and the smallest at the other end. There are four other bridges across the Adige: one, the graceful Ponte di Pietra, rests upon ancient foundations, while the two arches nearest to the left bank are Roman; but it has been frequently restored. Remains of another ancient bridge were found in the river itself in 1891 behind S. Anastasia. The 16th-century lines of fortification enclose a very much larger area than the Roman city, forming a great loop to the west, and also including a considerable space on the left bank of the river. In the latter part of the city, on a steep elevation, stands the castle of St Peter, originally founded by Theodoric, on the site, perhaps, of the earliest citadel, mostly rebuilt by Gian Galeazzo Visconti in 1393, and dismantled by the French in 1801. This and the other fortifications of Verona were rebuilt or repaired by the Austrians, but are no longer kept up as military defences. Verona, which is the chief military centre of the Italian province of Venetia, is now being surrounded with a circle of forts far outside the obsolete city walls.

Palaces.

The early palaces of Verona, before its conquest by Venice, were of noble and simple design, mostly built of fine red brick, with an inner court, surrounded on the ground floor by open arches like a cloister, as, for example, the Palazzo della Ragione, an assize court, begun in the 12th century. The arches, round or more often pointed in form, were decorated with moulded terra-cotta enrichments, and often with alternating voussoirs of marble. The Scaligeri Palace is a fine example, dating from the 14th century, with, in the cortile, an external staircase leading to an upper loggia, above the usual arcade on the ground floor. It has a lofty campanile, surmounted by a graceful octagonal upper storey. This palace is said to have been mainly built by Can Signorio (Della Scala) about 1370. After the conquest by Venice the domestic buildings of Verona assumed quite a different type. They became feeble copies of Venetian palaces, in which one form of window, with an ogee arch, framed by the dentil moulding, is almost always used. The monotony and lifelessness of this form of architecture are shown in the meaningless way in which details, suited only to the Venetian methods of veneering walls with thin marble slabs, are copied in the solid marbles of Verona. From the skill of Fra Giocondo, Verona was for many years one of the chief centres in which the most refined and graceful forms of the early Renaissance were developed. The town hall, with its

Squares.

light open loggia of semicircular arches on the ground floor, was designed by Fra Giocondo towards the end of the 15th century; its sculptured enrichments of pilasters and friezes are very graceful, though lacking the vigorous life of the earlier medieval sculptured ornamentation. Verona contains a number of handsome palaces designed by Sanmichele in the 16th century. The finest are those of the Bevilacqua,[1] Canossa and Pompeii families. The last of these is now the property of the city, and contains a gallery with some good pictures, especially of the Verona, Padua and Venice schools. As in Venice, many of the 16th-century palaces in Verona had stuccoed façades, richly decorated with large fresco paintings, often by very able painters. Verona, perhaps, had as many of these paintings as any town in Italy, but comparatively few are preserved and those only to a small extent. The domestic architecture of Verona cannot thus be now fairly estimated, and seems monotonous, heavy and uninteresting. The house of the painter Niccolo Giolfino still has its frescoes in a good state of preservation, and gives a vivid notion of what must once have been the effect of these gorgeous pictured palaces. The episcopal palace contains the ancient and valuable chapter library, of about 12,000 volumes and over 500 MSS., among them the palimpsest of the *Institutiones* of Gaius which Niebuhr discovered. The Piazza delle Erbe (fruit and vegetable market) and the Piazza dei Signori, adjoining one another in the oldest part of the city, are very picturesque and beautiful, being surrounded by many fine medieval buildings, several of them of a public character (Palazzo dei Giureconsulti, Palazzo della Ragione and the lofty Torre Civica, 273 ft. high), while in the north-east corner of the latter Piazza is the fine early Renaissance Palazzo del Consiglio (1476–1492), probably designed by Fra Giocondo. In the former Piazza a copy of the lion of Venice has been erected.

Roman remains.

The Roman remains of Verona surpass those of any other city of northern Italy. The most conspicuous of them is the great amphitheatre, a building perhaps of the end of the 1st century A.D., which in general form closely resembled the Colosseum in Rome. Its axes measured 505 and 404 ft. Almost the whole of its external arcades, with three tiers of arches, have now disappeared; it was partly thrown down by an earthquake in 1184, and subsequently used to supply building materials. Many of its blocks are still visible in the walls of various medieval buildings. The interior, with seats for about 25,000 people, has been frequently restored, till nothing of the old seats exists. There are also remains of a well-preserved Roman theatre, close to the left bank of the river. A number of fine sculptures were found in the square in front of the cathedral in 1890, and architectural fragments belonging to some public building. In 1884–86 portions of a number of fine mosaic pavements were discovered extending over a very large area under the cloister and other parts of the cathedral, about 7 ft. below the present ground level. They had geometric patterns with birds, trees, &c., and bore inscriptions in mosaic with the names of the donors. Parts of them had been discovered previously. They seem to belong to two different buildings, both early churches of the 5th and 6th centuries A.D. (cf. *Notizie degli Scavi*, 1884, 401). For the two triumphal arches (Porta dei Bosari and Porta dei Leoni) see below. The Museo Lapidario contains a fine collection of Roman and Etruscan inscriptions and sculpture, mostly collected and published by Scipione Maffei in the 18th century.

Veronese Art.—In many respects the resemblance between Verona and Florence is very striking; in both cases we have a strongly fortified city built in a fertile valley, on the banks of a winding river, with suburbs on higher ground, rising close above the main city. In architectural magnificence and in wealth of sculpture and painting Verona almost rivalled the Tuscan city, and, like it, gave birth to a very large number of artists who distinguished themselves in all branches of the fine arts.

Painting.

Painting in Verona may be divided into four periods. (i.) The first period is characterized by wall paintings of purely native style, closely resembling the early Christian pictures in the catacombs of Rome. Examples dating from the 10th to the 11th century have been discovered hidden by whitewash on the oldest parts of the nave walls of the church of S. Zeno. They are a very interesting survival of the almost classical Roman style of painting, and appear to be quite free from the generally prevalent Byzantine influence. (ii.) The Byzantine period seems to have lasted during the 12th and 13th centuries. (iii.) The Giottesque period begins contemporaneously with Altichiero da Zevio and Giacomo degli Avanzi, whose chief works were executed during the second half of the 14th century. These two painters were among the ablest of Giotto's followers, and adorned Verona and Padua with a number of very beautiful frescoes, rich in composition, delicate in colour, and remarkable for their highly finished modelling and detail. (iv.) To the fourth period belong several important painters. Pisanello or Vittore Pisano, a charming painter and the greatest medallist of Italy, was probably a pupil of Altichiero.[1] Most of his frescoes in Verona have perished; but one of great beauty still exists in a very perfect state in the church of S. Anastasia, high up over the arched opening into one of the eastern chapels of the south transept. The scene represents St George and the Princess after the conquest of the Dragon, with accessory figures, the sea, a mountainous landscape and an elaborately painted city in the background. The only other existing fresco by Pisanello is an Annunciation in S. Fermo Maggiore. For Pisanello's pupils and other painters of subsequent date, see PAINTING. These include Liberale da Verona, Domenico and Francesco Morone, Girolamo dai Libri (1474–1556), &c. Domenico del Riccio, usually nicknamed Brusasorci (1494–1567), was a prolific painter whose works are very numerous in Verona. Paolo Cagliari or Paul Veronese, and the Bonifagios, though natives of Verona, belong rather to the Venetian school.

Sculpture.

Verona is specially rich in early examples of decorative sculpture. (i.) The first period is that of northern or Lombardic influence, exemplified in the very interesting series of reliefs which cover the western façades of the church of S. Zeno and the cathedral, dating from the 12th century. These reliefs represent both sacred subjects and scenes of war and hunting, mixed with grotesque monsters, such as specially delighted the rude, vigorous nature of the Lombards; they are all richly decorative in effect, though strange and unskilful in detail. Part of the western bronze doors of S. Zeno are especially interesting as being among the earliest important examples in Italy of cast bronze reliefs. They are frequently stated to be of beaten bronze, but they are really castings, apparently by the *cire perdue* process. They represent scenes from the life of S. Zeno, are rudely modelled, and yet very dramatic and sculpturesque in style. Parts of these doors are covered with bronze reliefs of scenes from the Bible, which are of still earlier date, and were probably brought to Verona from the Rhine provinces. Many of the 12th century reliefs and sculptured capitals in S. Zeno are signed by the sculptor but these merely constitute lists of names about whom nothing is known. (ii.) In the 13th century the sculpture seems to have lost the Lombard vigour, without acquiring any qualities of superior grace or refinement. The font in the baptistery near the cathedral is an early example of this. Each side of the octagon is covered with a large relief of a Biblical subject, very dull in style and coarse in execution. The font itself is interesting for its early form, one common in the chief baptisteries of northern Italy: like an island in the centre of the great octagonal tank is a lobed marble receptacle, in which the officiating priest stood while he immersed the catechumens. A movable wooden bridge must have been used to enable the priest to cross the water in the surrounding tank. (iii.) The next period is that of Florentine influence. This is exemplified in the magnificently sculptured tombs of the Della Scala lords, designed with steadily growing splendour, from the simple sarcophagus of Martino I. down to the elaborate erection over the tomb of the fratricide Can Signorio, adorned with statuettes of the virtues, to the possession of which he could lay so little claim.[2] The recumbent effigies and decorative details of these tombs are very beautiful, but the smaller figures of angels, saints and virtues are rather clumsy in proportion. The latest tomb, that of Can Signorio, erected during his lifetime (*c.* 1370), is signed "Boninus de Campigliono Mediolanensis Dioecesis." This sculptor, though of Milanese origin, belongs really to the school of the Florentine Andrea Pisano. One characteristic of the 14th and 15th centuries in Verona was the custom, also followed in other Lombardic cities, of setting large equestrian statues over the tombs of powerful military leaders, in some cases above the recumbent effigy of the dead man, as if to represent him in full vigour of life as well as in death. That which crowns the canopy over the tomb of Can Grande is a very noble, though somewhat quaint, work. (iv.) In the 15th century the influence of Venice became paramount, though this was really only a further development of the Florentine manner, Venice itself having been directly influenced in the 14th century by many able sculptors from Florence.

Architecture.

The architecture of Verona, like its sculpture, passed through Lombard, Florentine and Venetian stages. (i.) The church of S. Zeno and the cathedral, both of which were mainly rebuilt in the 12th century, are noble examples of the Lombardic style, with few single-light windows, and with the walls decorated externally by series of pilasters, and by alternating bands of red and white, in stone or brick. The arches of this period are semicircular and rest on round columns and capitals, richly carved with grotesque figures and foliage. Most of the external ornamentation is usually concentrated on the western front, which often has a lofty arched porch on marble columns, resting on griffins or lions devouring their prey. (ii.) The Florentine period (*c.* 1250 to 1400) is represented by the church of S. Anastasia, and by many more or less mutilated palaces, with fine courts surrounded by arcades in one or more storeys. The arches are mostly pointed, and in other respects the influence of northern Gothic was more direct in Verona than in Florence. Solidity of mass and simplicity of detail are among the characteristics of this period. (iii.) The Venetian period (*c.* 1400–1480) was one of little originality or vigour, the buildings of this date being largely rather dull copies of those at Venice. (iv.) The early Renaissance developed into very exceptional beauty in Verona, mainly through the genius of Fra Giocondo (1435–1514), a native of Verona, who was at first a friar in the monastery of S. Maria in Organo. He rose to great celebrity as an architect, and designed many graceful and richly sculptured buildings in Venice, Rome and even in France; he used classical forms with great taste and skill, and with much of the freedom of the older medieval architects, and was specially remarkable for his rich and delicate sculptured decorations. Another of the leading architects of the next stage of the Renaissance was the Veronese Michele Sanmichele (1484–1559), a great military engineer, and designer of an immense number of magnificent palaces in Verona and other cities of Venetia. His buildings are stately and graceful in proportion, but show a tendency towards dull scholastic classicism. The façades of his palaces were in the lower storey only decorated by rustication, of which he made great use, while the upper part was intended to be decorated with frescoes, which (as we have said) have in most cases perished. To him are also due the various gates and the most important bastions in the walls of Verona. In consequence of the disastrous flood of 1882, important embankment works were executed along the Adige at a cost of £300,000. These works preclude all danger of future inundation. In addition to the Adige embankment, other hydraulic works have been either completed or undertaken. An irrigation canal, deriving water from the Sega, furnishes 11⅓ cubic metres per second to the fields of the upper Veronese district. The Camuzzoni industrial canal, which runs from the Chievo di S. Massimo to the suburb of Tombetta, furnishes 26 cubic metres of water per second, and generates 4000 horse-power. The cutting of this canal led to the construction of an aqueduct for drinking water, which, besides supplying the city, furnishes an ice factory with enough water to make 200 quintals of ice per day. The motive-power generated by the Camuzzoni canal is utilised by a large nail factory, flour mills, paper mills, cotton mills and works for the distribution of electric energy.

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[1] The valuable collection of works of art once preserved in the Bevilacqua Palace has long been dispersed.

[1] There is every reason to doubt Vasari's statement that Pisanello was a pupil of Andrea del Castagno.

[2] See an eloquent description by Ruskin. *Stones of Venice*, iii. pp. 70 seq.

The Adige embankment gave an impetus to building enterprise, the banks of the river being now flanked by villas and large dwelling-houses.

History.—The ancient Verona was a town of the Cenomani, a Gaulish tribe, whose chief town was Brixia. It became a Latin colony in 89 B.C. and, acquiring citizenship with the rest of Gallis Transpadana in 49 B.C., became a *municipium*. Tacitus wrongly speaks of it as a colony; but it appears to have received a new colony under Gallienus. In the time of Augustus it was inferior to Patavium in importance, but on a par with Mediolanum, and superior to Brixia and other towns of the district. Inscriptions testify to its importance—among others one which indicates that it was the headquarters of the collectors of the 5% inheritance tax under the Empire in Italy beyond the Po. Its territory stretched as far as Hostilia on the Padus (Po), 30 m. to the south, and was extensive on other sides also, though its exact limits are uncertain. It was an important point in the road system of the district, lying on that between Mediolanum and Aquileia, while here diverged to the north the roads up the Athesis valley and over the Brenner into Raetia, and to the south roads ran to Betriacum, Mantua and Hostilia. It was the birthplace of the poet Catullus. In A.D. 69 it became the headquarters of the legions which were siding with Vespasian. Its fertile surroundings, its central position at the junction of several great roads, and the natural strength of its position, defended by a river along two-thirds of its circumference, all combined to make Verona one of the richest and most important cities in northern Italy, although its extent within the walls was not large. The existing remains of walls and gates date from the period between the 3rd of April and the 4th of December of the year 265. A very handsome triumphal arch, now called the Porta de' Borsari, was restored in this year by Gallienus (as the inscription upon it, which has taken the place of an older one, cancelled to make room for it, records), and became one of the city gates. It is a double arch, and above it are two orders of smaller arcades. The same was the case with the Porta dei Leoni, another rather similar triumphal arch on the east of the city, and with a third arch, the Arco dei Gavi, demolished in 1805. This last seems to have belonged to the 1st century A.D.; remains of it are preserved in the amphitheatre. It took its name from the family in whose honour it was erected; the architect was one L. Vitruvius Cerdo, possibly a pupil and freedman of the famous writer on architecture. The Porta dei Leoni, on the other hand, bears the name of Tiberius Flavius Noricus, a *quattuorvir iure dicundo*, *i.e.* one of the four chief magistrates of the city (probably 2nd century A.D.). The original line of walls did not include the amphitheatre, but passed N.E. of it; it was, however, afterwards included in the *enceinte* as a kind of massive corner tower.[1] The emperor Constantine, while advancing towards Rome from Gaul, besieged and took Verona (312); it was here, too, that Odoacer was defeated (499) by Theodoric the Goth, Dietrich von Bern—*i.e.* Verona—of German legends, who built a castle at Verona and frequently resided there. He enlarged the fortified area by constructing a wall and ditch (now called Adigetto) straight across the loop, to the S.W. of the amphitheatre, and also built thermae and restored the acqueducts, which had long been out of use.

In the middle ages Verona gradually grew in size and importance. Alboin, the Lombard king, captured it in 568, and it was one of the chief residences of the Lombard, and later of the Frankish, monarchs; and though, like other cities of northern Italy, it suffered much during the Guelph and Ghibelline struggles, it rose to a foremost position both from the political and the artistic point of view under its various rulers of the Scaliger or Della Scala family. The first prominent member of this family and founder of his dynasty was Mastino I. della Scala, who ruled over the city from 1260 till his death in 1277. Verona had previously fallen under the power of a less able despot, Ezzelino da Romano, who died in 1259. Alberto della Scala (died in 1301) was succeeded by his eldest son Bartolomeo, who was confirmed as ruler of Verona by the popular vote, and died in 1304. It was in his time that Romeo and Juliet are said to have lived. Alboino, the second son, succeeded his brother, and died in 1311, when the youngest son of Alberto, Can Grande, who since 1308 had been joint-lord of Verona with his brother, succeeded to the undivided power. Can Grande (Francesco della Scala, d. 1329) was the best and most illustrious of his line, and is specially famous as the hospitable patron of Dante (*q.v.*). Other princes of this dynasty, which lasted for rather more than a century, were Giovanni (d. 1350), Mastino II. (d. 1351), Can Grande II. (d. 1359) and Can Signorio (d. 1375). In 1389 Gian Galeazzo Visconti, duke of Milan, became by conquest lord of Verona. Soon after his death the city fell by treacherous means into the hands of Francesco II. di Carrara, lord of Padua. In 1404–1405 Verona, together with Padua, was finally conquered by Venice, and remained subject to the Venetians till the overthrow of the republic by Napoleon in 1797, who in the same year, after the treaty of Campo Formio, ceded it to the Austrians with the rest of Venetia. They fortified it strongly in 1814, and with Peschiera, Mantua and Legnago it formed part of the famous quadrilateral which until 1866 was the chief support of their rule in Italy.

See the various works by Scipione Maffei (*Verona Illustrata*, 1728; *Museum Veronense*, 1749); and Th. Mommsen in *Corp. Inscr. Latin* (Berlin, 1883), v. p. 327 (with bibliography); A. Wiel, *The Story of Verona* (London, 1902); *Notizie degli scavi*, passim; E. Giani, *L' Antico teatro di Verona* (Verona, 1908).

(J. H. M.; T. As.)

VERONA, CONGRESS OF, the last of the series of international conferences or congresses based on the principle enunciated in Art. 6 of the treaty of Paris of November 20th, 1815 (see EUROPE, *History*). It met at Verona on the 20th of October 1822. The emperor Alexander I. of Russia was present in person. There were also present Count Nesselrode, the Russian minister of foreign affairs; Prince Metternich, representing Austria; Prince Hardenberg and Count Bernstorff, representing Prussia; MM. de Montmorency and Chateaubriand, representing France; and the duke of Wellington, representing Great Britain in place of Lord Londonderry (Castlereagh), whose tragic death occurred on the eve of his setting out to the congress.

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[1] The view of some scholars is that the original walls were earlier than the time of Gallienus, who reconstructed them on the old lines, taking in, however, the amphitheatre.

In the instructions drawn up by Londonderry for his own guidance, which had been handed to Wellington by Canning without alteration, was clearly defined the attitude of Great Britain towards the three questions which it was supposed would be discussed, viz. the Turkish Question (Greek insurrection), the question of intervention in favour of the royal power in Spain, together with that of the revolted Spanish colonies, and the Italian Question. As regards the latter it was laid down that Great Britain could not charge herself with any superintendence of a system in which she had merely acquiesced, and the duty of the British minister would be merely to keep himself informed, and to see that nothing was done "inconsistent with the European system and the treaties." To make this attitude quite clear, Wellington was further instructed not to hand in his credentials until this question had been disposed of, his place being meanwhile taken by Lord Londonderry (Stewart), Castlereagh's half-brother and successor in the title, who had fulfilled the same function at Troppau and Laibach. In the Spanish Question Wellington was to give voice to the uncompromising opposition of Great Britain to the whole principle of intervention. In the Turkish Question, the probable raising of which had alone induced the British government to send a plenipotentiary to the congress, he was to suggest the eventual necessity for recognizing the belligerent rights of the Greeks, and, in the event of concerted intervention, to be careful not to commit Great Britain beyond the limits of good offices.

The immediate problems arising out of the Turkish Question had, however, been settled between the emperor Alexander and Metternich, to their mutual satisfaction, at the preliminary conferences held at Vienna in September, and at Verona the only question raised was that of the proposed French intervention in Spain. The discussion was opened by three questions formally propounded by Montmorency: (1) Would the Allies withdraw their ministers from Madrid in the event of France being compelled to do so? (2) In case of war, under what form and by what acts would the powers give France their moral support, so as to give to her action the force of the Alliance, and inspire a salutary fear in the revolutionaries of all countries? (3) What material aid would the powers give, if asked by France to intervene, under restrictions which she would declare and they would recognize?

The reply of Alexander, who expressed his surprise at the desire of France to keep the question "wholly French," was to offer to march 150,000 Russians through Germany to Piedmont, where they could be held ready to act against the Jacobins whether in Spain or France. This solution appealed to Metternich and Montmorency as little as to Wellington; but though united in opposing it, four days of "confidential communications" revealed a fundamental difference of opinion between the representative of Great Britain and those of the continental powers on the main point at issue. Wellington, firmly based on the principle of non-intervention, refused to have anything to do with the suggestion, made by Metternich, that the powers should address a common note to the Spanish government in support of the action of France. Finally, Metternich proposed that the Allies should "hold a common language, but in separate notes, though uniform in their principles and objects." This solution was adopted by the continental powers; and Wellington, in accordance with his instructions not to countenance any intervention in Spanish affairs, took no part in the conferences that followed. On the 30th of October the powers handed in their formal replies to the French memorandum. Russia, Austria and Prussia would act as France should in respect of their ministers in Spain, and would give to France every countenance and assistance she might require, the details "being reserved to be specified in a treaty." Wellington, on the other hand, replied on behalf of Great Britain that "having no knowledge of the cause of dispute, and not being able to form a judgment upon a hypothetical case, he could give no answer to any of the questions."

Thus was proclaimed the open breach of Great Britain with the principles and policy of the Great Alliance, which is what gives to the congress its main historical interest.

See *Cambridge Modern Hist.*, chap. i. "The Congresses," by W. Alison Phillips, and for authorities, ibid. p. 787. (W. A. P.)

VERONAL, in medicine, diethylmalonyl urea or diethylbarbituric acid $(C_2H_5)_2C[CO\,NH]_2CO$, extensively used as a hypnotic. It is prepared by condensing diethylmalonic ester with urea in the presence of sodium ethylate, or by acting with ethyl iodide on the silver salt of malonyl urea; it forms a white crystalline powder, which is odourless, and has a slightly bitter taste. Its introduction followed the investigations of Emil Fischer and J. v. Merling on the pharmacological properties of certain open and closed ureides. Led thereto by the impression that hypnotic action appears to be largely dependent on the presence of ethyl groups, they prepared diethylacetyl urea, diethylmalonyl urea, and dipropylmalonyl urea. All three were found to be hypnotics: the first was about equal in power to sulphonal, whilst the third was four times as powerful, but its use was attended by prolonged after-effects. Veronal was found to be midway. It is best given in cachets (10 to 15 grains). As it does not affect the circulatory or respiratory systems, or temperature, it can be employed in many diseased conditions of the heart and lungs as well as in mental disturbances, acute alcoholism, morphinomania and kidney disease. If taken during a prolonged period it seems to lose its effect. A soluble salt of veronal has been introduced under the name of medinal. Although the toxicity of veronal is low, 135 grains having been taken in a single dose without serious results, the unreasonable consumption by persons suffering from insomnia has led to many deaths, and it has been suggested that the sale should be restricted by the Pharmacy Acts.

VERONICA, ST. According to the most recent version of the legend, Veronica was a pious woman of Jerusalem, who, moved with pity by the spectacle of Jesus carrying His cross to Golgotha, gave Him her kerchief in order that He might wipe the drops of agony from His brow. The Lord accepted the offering, and after using the napkin handed it back to her with the image of His face miraculously impressed upon it. This, however, is not the primitive form of the legend, which a close examination shows to be derived from the following story related by Eusebius in his *Historia Ecclesiastica* (vii. 18). At Caesarea Philippi dwelt the woman whom the Lord healed of an issue of blood (Matt. ix. 20), and at the door of her house stood, on one side a statue of a woman in an attitude of supplication, and on the other side that of a man stretching forth his hand to the woman. It was said that the male figure represented Christ, and that the group had been set up in recognition of the miraculous cure. Legend was not long in providing the woman of the Gospel with a name. In the West she was identified with Martha of Bethany; in the East she was called Berenike, or Beronike, the name appearing in as early a work as the *Acta Pilati*, the most ancient form of which goes back to the 4th century. Towards the 6th century the legend of the woman with the issue of blood became merged in the legend of Pilate, as is shown in the writings known in the middle ages as *Cura sanitatis Tiberii* and *Vindicta Salvatoris*. According to the former of these accounts Veronica, in memory of her cure, caused a portrait of the Saviour to be painted. The emperor Tiberius, when afflicted with a grievous sickness, commanded the woman to bring the portrait to him, worshipped Christ before her eyes, and was cured. The legend continued to gather accretions, and a miraculous origin came to be assigned to the image. It appears that in the 12th century the image began to be identified with one preserved at Rome, and in the popular speech the image, too, was called Veronica. It is interesting to note that the fanciful derivation of the same Veronica from the words *Vera icon* (εἰκών) "true image"—is not, as has been thought, of modern origin, since it occurs in the *Otia Imperialia* (iii. 25) of Gervase of Tilbury (fl. 1211), who says: "Est ergo Veronica pictura Domini vera." In several churches the office of St Veronica, matron, is observed on various dates.

See *Acta Sanctorum*, February, i. 449-57; L. F. C. Tischendorf, *Evangelia apocrypha* (2nd ed., Leipzig, 1877), p. 239; E. von Dobschütz, *Christusbilder* (Leipzig, 1899); H. Thurston, *The Stations of the Cross* (London, 1906). (H. De.)

VERRES, GAIUS (*c.* 120-43 B.C.), Roman magistrate, notorious for his misgovernment of Sicily. It is not known to what *gens* he belonged. He at first supported Marius and the popular party, but soon went over to the other side. Sulla made him a present of land at Beneventum, and secured him against punishment for embezzlement. In 80, Verres was quaestor in Asia on the staff of Cn. Cornelius Dolabella, governor of Cilicia. The governor and his subordinate plundered in concert, till in 78 Dolabella had to stand his trial at Rome, and was convicted, mainly on the evidence of Verres, who thus secured a pardon for himself. In 74, by a lavish use of bribes, Verres secured the city praetorship, and, as a creature of Sulla, abused his authority to further the political ends of his party. He was then sent as governor to Sicily, the richest of the Roman provinces. The people were for the most part prosperous and contented, but under Verres the island experienced more misery and desolation than during the time of the first Punic or the recent servile wars. The corn-growers and the revenue collectors were ruined by exorbitant imposts or by the iniquitous cancelling of contracts; temples and private houses were robbed of their works of art; and the rights of Roman citizens were disregarded. Verres returned to Rome in 70, and in the same year, at the request of the Sicilians, Cicero prosecuted him. Verres entrusted his defence to the most eminent of Roman advocates, Q. Hortensius, and he had the sympathy and support of several of the leading Roman nobles. The court was composed exclusively of senators, some of whom might have been his personal friends. But the presiding judge, the city praetor, M'. Acilius Glabrio, was a thoroughly honest man, and his assessors were at least not accessible to bribery. Verres vainly tried to get the trial postponed till 69 when his friend Metellus would be the presiding judge, but in August Cicero opened the case. The effect of the first brief speech was so overwhelming that Hortensius refused to reply, and recommended his client to leave the country. Before the expiration of the nine days allowed for the prosecution Verres was on his way to Massilia. There he lived in exile till 43, when he was proscribed by Antony, the reason alleged being his refusal to surrender some of his art treasures which Antony coveted. Verres may not have been quite so black as he is painted by Cicero, on whose speeches we depend entirely for our knowledge of him, but there can hardly be a doubt that he stood pre-eminent among the worst specimens of Roman provincial governors. Of the seven Verrine orations only two were actually delivered; the remaining five were compiled from the depositions of witnesses, and published after the flight of Verres.

VERRIUS FLACCUS, MARCUS (*c.* 10 B.C.), Roman grammarian and teacher, flourished under Augustus and Tiberius. He was a freedman, and his manumitter has been identified with Verrius Flaccus, an authority on pontifical law; but for chronological reasons the name of Veranius Flaccus, a writer on augury, has been suggested (Teuffel-Schwabe, *Hist. of Roman Lit.* 199, 4). He gained such a reputation by his methods of instruction that he was summoned to court to bring up Gaius and Lucius, the grandsons of Augustus. He removed there with his whole school, and his salary was greatly increased on the condition that he took no fresh pupils. He died at an advanced age during the reign of Tiberius (Suetonius, *De Grammaticis*, 17), and a statue in his honour was erected at Praeneste, in a marble recess, with inscriptions from his *Fasti*. Flaccus was also a distinguished philologist and antiquarian investigator. For his most important work (*De Verborum Significatu*) see Festus, Sextus. Of the calendar of Roman festivals (*Fasti Praenestini*) engraved on marble and set up in the forum at Praeneste, some fragments were discovered (1771) at some distance from the town itself in a Christian building of later date, and some consular *fasti* in the forum itself (1778). The collection was subsequently increased by two new fragments.

Other lost works of Flaccus were: *De Orthographia: De Obscuris Catonis*, an elucidation of obscurities in the writings of the elder Cato; *Saturnus*, dealing with questions of Roman ritual; *Rerum memoria dignarum libri*, an encyclopaedic work much used by Pliny the elder; *Res Etruscae*, probably on augury.

For the fragments of the *Fasti* see *Corpus Inscriptionum Latinarum*, i. pp. 311, 474; G. Gatti, "Due nuovi Frammenti del Calendario di Verrio Flacco," in *Atti della r. Accademia dei Lincei*, 5th ser., vol. 5, pt. 2, p. 421 (1898); Winther, *De fastis Verrii Flacci ab Ovidio adhibitis* (1885); J. E. Sandys, *Classical Scholarship* (ed. 1906), vol. i., index, *s.v.* "Verrius"; fragments of Flaccus in C. O. Müller's edition of Festus; see also H. Nettleship, *Lectures and Essays*.

VERROCCHIO, ANDREA DEL (1435-1488), Italian goldsmith, sculptor and painter, was born at Florence. He was the son of Michele di Francesco de' Cioni, and took his name from his master, the goldsmith Giuliano Verrocchi. Except through his works, little is known of his life. As a painter he occupies an important position from the fact that Leonardo da Vinci and Lorenzo di Credi worked for many years in his *bottèga* as pupils and assistants. Only one existing painting can be attributed with absolute certainty to Verrocchio's hand, the celebrated "Baptism of Christ," originally painted for the monks of Vallombrosa, and now in the academy of Florence. The figures of Christ and the Baptist are executed with great vigour and refinement of touch, but are rather hard and angular in style. The two angels are of a much more graceful cast; the face of one is of especial beauty, and Vasari is probably right in saying that this head was painted by the young Leonardo. Other pictures from Verrocchio's *bottèga* probably exist, as, for example, two in the National Gallery of London formerly attributed to Ant. Pollaiuolo—"Tobias and the Angel" (No. 781) and the very lovely "Madonna and Angels" (No. 296), both very brilliant and jewel-like in colour. This exquisite painting may possibly have been painted from Verrocchio's design by Lorenzo di Credi while he was under the immediate influence of his wonderful fellow-pupil, Da Vinci.[1]

In examining Verrocchio's work as a sculptor we are on surer ground. One of his earliest works was the beautiful marble medallion of the Madonna, over the tomb of Leonardo Bruni of Arezzo in the church of Santa Croce at Florence. In 1472 Verrocchio completed the fine tomb of Giovanni and Piero de' Medici, between the sacristy and the lady chapel of San Lorenzo at Florence. This consists of a great porphyry sarcophagus enriched with magnificent acanthus foliage in bronze. Above it is a graceful open bronze grill, made like a network of cordage. In 1474 Verrocchio began the monument to Cardinal Forteguerra at the west end of Pistoia cathedral. The kneeling figure of the cardinal was never completed, and now lies in a room of La Sapienza, but the whole design is shown in what is probably Verrocchio's original clay sketch, now in the South Kensington Museum. Though this work was designed by Verrocchio, the actual execution of it was entrusted to his assistant, the Florentine Lorenzetto. In 1476 Verrocchio modelled and cast the fine but too realistic bronze statue of David, now in the Bargello (Florence); and in the following year he completed one of the reliefs of the magnificent silver altar-frontal of the Florentine baptistery, that representing the "Beheading of St John." Verrocchio's other works in the precious metals are now lost, but Vasari records that he made many elaborate pieces of plate and jewelry, such as morses for copes, as well as a series of silver statues of the Apostles for the pope's chapel in the Vatican. Between 1478 and 1483 he was occupied in making the bronze group of the "Unbelief of St Thomas," which still stands in

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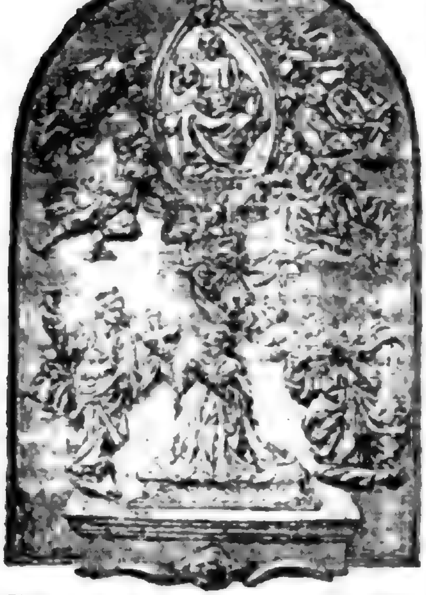
[1] See Crowe and Cavalcaselle, *Painting in Italy* (London, 1864), ii. pp. 400 seq.



Clay sketch for the monument of Cardinal Forteguerra, showing the kneeling portrait of the cardinal, which is not in the actual monument; a very poor modern figure occupies its place.

one of the external niches of Or San Michele (Florence). He received 800 florins for these two figures, which are more remarkable for the excellence of their technique than for their sculpturesque beauty. The attitudes are rather rigid and the faces hard in expression. Verrocchio's chief masterpiece was the colossal bronze equestrian statue of the Venetian general Bartolommeo Colleoni, which stands in the piazza of SS. Giovanni e Paolo at Venice. Verrocchio received the order for this statue in 1470, but had only completed the model when he died in 1488. In spite of his request that the casting should be entrusted to his pupil Lorenzo di Credi, the work was given to Alessandro Leopardi by the Venetian senate, and the statue was gilt and unveiled in 1496.[1] There appears to be no doubt that the model was completed by Verrocchio himself, and that nothing more than its reproduction in bronze should be attributed to the much feebler hand of Leopardi, who, however, has set his own name alone on the belly-band of the horse—**ALEXANDER·LEOPARDVS V. F. OPUS.** This is perhaps the noblest equestrian statue in the world, being in some respects superior to the antique bronze of Marcus Aurelius in Rome and to that of Gattamelata at Padua by Donatello. The horse is designed with wonderful nobility and spirit, and the easy pose of the great general, combining perfect balance with absolute ease and security in the saddle, is a marvel of sculpturesque ability. Most remarkable skill is shown by the way in which Verrocchio has exaggerated the strongly marked features of the general, so that nothing of its powerful effect is lost by the lofty position of the head. According to Vasari, Verrocchio was one of the first sculptors who made a practical use of casts from living and dead subjects. He is said also to have produced plastic works in terra-cotta, wood and in wax decorated with colour. As a sculptor his chief pupil was Francesco di Simone, the son of that Simone whom Vasari wrongly calls a brother of Donatello. Another pupil was Agnolo di Polo (Paolo), who worked chiefly in terra-cotta.

Verrocchio died in Venice in 1488, and was buried in the church of St Ambrogio in Florence.

See also Hans Mackowsky, "Verrocchio . . . Mit 80 Abbildungen" (1901), *Kunster Monographien*, No. 52. (J. H. M.)

VERSAILLES, a town of northern France, capital of the department of Seine-et-Oise, 12 m. by road W.S.W. of Paris, with which it is connected by rail and tram. Pop. (1906) town, 45,246; commune, 54,820. Versailles owes its existence to the palace built by Louis XIV. It stands 460 ft. above the sea, and its fresh healthy air and nearness to the capital attract many residents. The three avenues of St Cloud, Paris and Sceaux converge in the Place d'Armes. Between them stand the former stables of the palace, now occupied by the artillery and engineers. To the south lies the quarter of Satory, the oldest part of Versailles, with the cathedral of St Louis, and to the north the new quarter, with the church of Notre Dame. To the west a gilded iron gate and a stone balustrade shut off the great court of the palace from the Place d'Armes. In this court, which slopes upwards from the gate, stand statues of Richelieu, Condé, Du Guesclin and other famous Frenchmen. At the highest point there is an equestrian statue in bronze of Louis XIV., and to the right and left of this stretch the long wings of the palace, while behind it extend the Cour Royale and the smaller Cour de Marbre, to the north, south and west of which rise the central buildings. The buildings clustered round the Cour de Marbre, which include the apartments of Louis XIV., project into the gardens on the west considerably beyond the rest of the façade. To the north the Chapel Court and to the south the Princes Court, with vaulted passages leading to the gardens, separate the side from the central buildings. On the other is the inscription, "À toutes les gloires de la France," which Louis Philippe justified by forming a collection of works of art (valued at £1,000,000), commemorating the great events and persons of French history. The palace chapel (1696–1710), the roof of which can be seen from afar rising above the rest of the building, was the last work of J. Hardouin-Mansart.

The ground-floor of the north wing on the garden side contains eleven halls of historical pictures from Clovis to Louis XVI., and on the side of the interior courts a gallery containing casts of royal funereal monuments. The Halls of the Crusades open off this gallery, and are decorated with the arms of crusaders and with modern pictures dealing with that period. On the first floor of the north wing on the garden side are ten halls of pictures commemorating historical events from 1795 to 1830; on the court side is the Gallery of Sculpture, which contains the Joan of Arc of the princess Marie of Orleans; and there are seven halls chiefly devoted to French campaigns and generals in Africa, Italy, the Crimea and Mexico, with some famous war pictures by Horace Vernet. The second storey has a portrait gallery. In the north wing is also the theatre built under Louis XV. by Jacques-Ange Gabriel, which was first used on the 16th of May 1770 on the marriage of the dauphin (afterwards Louis XVI.) and Marie Antoinette. Here, on the 2nd of October 1789, the celebrated banquet was given to the Gardes du Corps, the toasts at which provoked the riots that drove the royal family from Versailles; and here the National Assembly met from the 10th of March 1871 till the proclamation of the constitution in 1875, and the Senate from the 8th of March 1876 till the return of the two chambers to Paris in 1879. On the ground-floor of the central buildings are the halls of celebrated warriors (once the anteroom of Madame de Pompadour), marshals, constables and admirals, and the suite of rooms known as the Dauphin's Apartments, now given up to historical portraits. The Galerie Basse, once known as the Gallery of Louis XIII., leads to the rooms surrounding the Marble Court, a series of which contains many plans of battles. The lobbies of the ground-floor are full of busts, statues and tombs of kings and celebrated men. The famous staterooms are on the first floor. On the garden side, facing the north, are a series of seven halls, some of them decorated with tapestries representing the life of Louis XIV. Among them may be mentioned the Hall of Hercules, till 1710 the upper half of the old chapel, where the dukes of Chartres, Maine and Burgundy were married, and Bossuet, Massillon and Bourdaloue preached; the Hall of Mercury, where the coffin of Louis XIV. stood for eight days after his death; and the Hall of Apollo, or throne room. To the front of the palace, facing the west, are the Galleries of War and Peace, with allegorical pictures, and the Glass Gallery, built by Mansart in 1678 (235 ft. long, 35 wide and 42 high), having 34 arches, 17 of which are filled with windows looking on the gardens and 17 with large mirrors. The gallery is overloaded with ornament, and the pictures by Charles Lebrun, the trophies and figures of children by Antoine Coysevox, and the inscriptions attributed to Boileau and Racine, all glorify Louis XIV. This gallery was used by him as a throne room on state occasions. Here the king of Prussia was proclaimed emperor of Germany on the 18th of January 1871. Connected with the Gallery of Peace are the queen's apartments, occupied successively by Marie Thérèse, Marie Leczinska and Marie Antoinette, where the duchess of Angoulême was born, the duchess of Burgundy died, and Marie Antoinette was almost assassinated on the 6th of October 1789. Behind the Glass Gallery on the side of the court are the rooms of Louis XIV. The Œil de Bœuf, named from its oval window, was the anteroom where the courtiers waited till the king rose. In it is a picture representing Louis XIV. and his family as Olympian deities; and it leads to the bedroom in which Louis XIV. died, after using it from 1701, and which Louis XV. occupied from 1722 to 1738. In the south wing of the palace, on the ground-floor, is the Gallery of the Republic and the First Empire, the rooms of which contain paintings of scenes in the life of Napoleon I. A sculpture gallery contains busts of celebrated scholars, artists, generals and public men from the time of Louis XVI. onwards. In the south wing is also the room where the Chamber of Deputies met from 1876 till 1879, and where the Congress has since sat to revise the constitution voted at Versailles in 1875 and to elect the president of the republic. The first floor is almost entirely occupied by the Battle Gallery (394 ft. long and 43 wide), opened in 1836 on the site of rooms used by Monsieur the brother of Louis XIV. and the duke and duchess of Chartres. It is lighted from above, and the walls are hung with pictures of French victories. In the window openings are the names of soldiers killed while fighting for France, with the names of the battles in which they fell, and there are more than eighty busts of princes, admirals, constables, marshals and celebrated warriors who met a similar death. Another room is given up to the events of 1830 and the accession of Louis Philippe, and a gallery contains the statues and busts of kings and celebrities.

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[1] See Gay, *Cart. inéd.* i. p. 367.

The gardens of Versailles were planned by André Le Nôtre. The ground falls away on every side from a terrace adorned with ornamental basins, statues and bronze groups. Westwards from the palace extends a broad avenue, planted with large trees, and having along its centre the grass of the "Tapis Vert"; it is continued by the Grand Canal, 200 ft. wide and 1 m. long. On the south of the terrace two splendid staircases lead past the Orangery to the Swiss Lake, beyond which is the wood of Satory. On the north an avenue, with twenty-two groups of three children, each group holding a marble basin from which a jet of water rises, slopes gently down to the Basin of Neptune, remarkable for its fine sculptures and abundant water. The Orangery (built in 1685 by Mansart) is the finest piece of architecture at Versailles; the central gallery is 508 ft. long and 42 wide, and each of the side galleries is 375 ft. long. There are 1200 orange trees, one of which is said to date from 1421, and 300 other kinds of trees.

The alleys of the parks are ornamented with statues, vases and regularly cut yews, and bordered by hedges surrounding the shrubberies. Between the central terrace and the Tapis Vert is the Basin of Latona or the Frogs, with a white marble group of Latona with Apollo and Diana. Beyond the Tapis Vert is the large Basin of Apollo, who is represented in his chariot drawn by four horses; there are three jets of water, one 60, the others 50 ft. in height. The Grand Canal is still used for nautical displays; under Louis XIV. it was covered with Venetian gondolas and other boats, and the evening entertainments usually ended with a display of fireworks. Around the Tapis Vert are numerous groves, the most remarkable being the Ballroom or Rockery, with a waterfall; the Queen's Shrubbery, the scene of the intrigue of the diamond necklace; that of the Colonnade, with thirty-two marble columns and a group of Pluto carrying off Prosperine, by François Girardon; the King's Shrubbery, laid out in the English style by Louis Philippe; the beautiful Grove of Apollo, with a group of that god and the nymphs, by Girardon; and the Basin of Enceladus, with a jet of water 75 ft. high.

Among the chief attractions of Versailles are the fountains and waterworks made by Louis XIV. in imitation of those he had seen at Fouquet's château of Vaux. Owing to the scarcity of water at Versailles, the works at Marly-le-Roi were constructed in order to bring water from the Seine; but part of the supply thus obtained was diverted to the newly erected château of Marly. Vast sums of money were spent and many lives lost in an attempt to bring water from the Eure, but the work was stopped by the war of 1688. At last the waters of the plateau between Versailles and Rambouillet were collected and led by channels (total length 98 m.) to the gardens, the soil of which covers innumerable pipes, vaults and aqueducts.

Beyond the present park, but within that of Louis XIV., are the two Trianons. The Grand Trianon was originally erected as a retreat for Louis XIV. in 1670, but in 1687 Mansart built a new palace on its site. Louis XV., after establishing a botanic garden, made Gabriel build in 1766 the small pavilion of the Petit Trianon, where the machinery is still shown by which his supper-table came up through the floor. It was a favourite residence of Marie Antoinette, who had a garden laid out in the English style, with rustic villas in which the ladies of the court led a mimic peasant-life. The Grand Trianon is a one-storeyed building with two wings, and has been occupied by Monsieur (Louis XIV.'s brother), by the Great Dauphin, Napoleon I., and Louis Philippe and his court. The gardens of the Grand Trianon are in the same style as those of Versailles, and there is a museum with a curious collection of state carriages, old harness, &c.

Apart from the palace, there are no buildings of interest in Versailles, the church of Notre Dame, built by Mansart, the cathedral of St Louis, built by his grandson, the Protestant church and the English chapel being in no way remarkable. The celebrated tennis-court (Jeu de Paume) is now used as a museum. The large and sumptuous palace of the préfecture was built during the second empire, and was a residence of the president of the republic from 1871 to 1879. The library consists of 60,000 volumes; and the military hospital formerly accommodated 2000 people in the service of the palace. There are statues of General Hoche and of Abbé de l'Épée in the town. A school of horticulture was founded in 1874, attached to an excellent garden, near the Swiss Lake.

Versailles is the seat of a bishopric, a prefect and a court of assizes, and has tribunals of first instance and of commerce, a board of trade-arbitrators, a chamber of commerce and a branch of the Bank of France, and, among its educational establishments, lycées and training colleges for both sexes and a technical school. It is an important garrison town and has a school of military engineering and artillery. Distilling, boot and shoe making, and market-gardening employ many of the people, but the town has no specially characteristic industry. The links of the Paris Golf Club are at La Boulie near Versailles.

Louis XIII. often hunted in the woods of Versailles, and built a small pavilion at the corner of what is now the rue de la Pompe and the avenue of St Cloud. In 1627 he entrusted Jacques Lemercier with the plan of a château. In 1661 Louis Levau made some additions which were further developed by him in 1668. In 1678 Mansart took over the work, the Galerie des Glaces, the chapel and the two wings being due to him In 1682 Louis XIV. took up his residence in the château. It is estimated that 20 million pounds were spent on the palace, gardens and works of art, the accounts for which were destroyed by the king. Till his time the town was represented by a few houses to the south of the present Place d'Armes; but land was given to the lords of the court and new houses sprang up, chiefly in the north quarter. Under Louis XV. the parish of St Louis was formed to the south for the increasing population, and new streets were built to the north on the meadows of Clagny, where in 1674 Mansart had built at Louis XIV.'s orders a château for Madame de Montespan, which was now pulled down. Under Louis XVI. the town extended to the east and received a municipality; in 1802 it gave its name to a bishopric. In 1783 the armistice preliminary to the treaty of peace between Great Britain and the United States was signed at Versailles. The states-general met here on the 5th of May 1789, and on the 20th of June took the solemn oath in the Tennis Court by which they bound themselves not to separate till they had given France a constitution. Napoleon neglected, and Louis XVIII. and Charles X. merely kept up, Versailles, but Louis Philippe restored its ancient splendour at the cost of £1,000,000. In 1870 and 1871 the town was the headquarters of the German army besieging Paris. After the peace Versailles was the seat of the French National Assembly while the commune was triumphant in Paris, and of the two chambers till 1879, being declared the official capital of France.

See A. P. Gille, *Versailles et les deux Trianons*, with illustrations by M. Lambert (Tours, 1899, 1900); P. de Nolhac, *La Création de Versailles* (Versailles, 1901); J. E. Farmer, *Versailles and the Court under Louis XIV.* (New York, 1905).

VERS DE SOCIÉTÉ, a term for social or familiar poetry, which was originally borrowed from the French, and has now come to rank as an English expression (see Fennell, *The Stamford Dictionary of Anglicised Words*). The use of the phrase as an English one is first met with at the opening of the 19th century. It is to be observed that it has come to bear a meaning which is not wholly equivalent to that of the French original. It was said of the blind philosopher, M. C. J. Pougens (1755–1833), that his *petits vers de société* procured great success for him in the *salons* of Paris, and several of the rhymesters of the early 18th century were prominent for their adroitness in composing *petits vers sur des sujets légers*. The prince of such graceful triflers was the Abbé de Chaulieu (1639–1720), of whom it was said that he made verses solely for the amusement of his friends, and without the smallest intention of seeing them in print. The best of his effusions have preserved a certain freshness because of the neatness with which they are turned, but it can scarcely be said that they have any pretension to be called poetry. They were inspired by incidents in the private life of the day, and were largely addressed to a few friends of exalted rank, who were hardly less witty than the author himself, such as the duc de Nevers, the marquis de Lassay, the duchesse de Bouillon and the marquis de la Fare. In the collections of Chaulieu's works, which were very often reprinted, side by side with his own pieces will be found *petits vers de société* indited by these great friends of his, and often quite as well turned as his own. To write such verses, indeed, was almost an accomplishment of good breeding. An enormous collection of them was brought together by Titon du Tillet (1676–1762), in his *Parnasse françois*, where those who are curious on the subject may observe to satiety how ingenious and artificial and trifling the *vers de société* of the French 18th century could be. The fashion for them followed upon the decline of an interest in rondeaux, ballades and villanelles, and Chaulieu himself had not a little to do with throwing those ingenuities out of fashion, his attack on Benserade, who went so far as to turn the whole of Ovid's *Metamorphoses* into rondeaux, being, according to his editor of 1732, "the first work which displayed the delicacy of the Abbé de Chaulieu's taste, and his talent for poetry." Of the writers of *vers de société* in France, J. B. Rousseau had the most poetical faculty; he was, in fact, a poet, and he wrote a "Billet à Chaulieu" which is a gem of delicate and playful charm. But, as a rule, the efforts of the French versifiers *dans les petits genres* were not of considerable poetic value.

If in England the expression *vers de société* carries with it more literary dignity, this is mainly due to the genius of one man. Prior's *Poems on Several Occasions*, collected in 1709, presents us with some of the earliest entirely characteristic specimens of *vers de société*, and with some of the best. Here the poet consciously, and openly, resigns the pretension of high effort and an appeal to Parnassus. He is paying a visit at Burghley House, where the conversation turns on the merits and adventures of Mr Fleetwood Shepherd; Prior then and there throws off, in extremely graceful verse, a piece appropriate to the occasion. He addresses it, and he dates it (May 14, 1689); and this is a typical example of *vers de société*. It will be seen that Prior, who learned much from his residence in the heart of the French world of fashion between 1711 and 1715, treats very much the same subjects as Chaulieu and La Fare were treating, but he does so with more force of style and dignity of imagination. As the 18th century progressed, the example of Prior was often followed by English poets, without, however, any general recapture of his forcible grace. The *vers de société* tended to be merged in the epistle and in the epigram. Swift, however, when he was neither coarse nor frigid, sometimes achieved a genuine success, as in the admirable verses on his own death. The odes of Ambrose Philips (1671–1749) addressed by name to various private persons, and, most happily, to children, were not understood in his own age, but possess some of the most fortunate characteristics of pure *vers de société*. In his "Welcome from Greece," a study in *ottava rima*, Gay produced a masterpiece in this delicate class, but most of his easy writings belong to a different category. Nothing of peculiar importance detains us until we reach Cowper, whose poems for particular occasions, such as those on "Mrs Throckmorton's Bullfinch" and "The Distressed Travellers," are models of the poetic use of actual circumstances treated with an agreeable levity, or an artful naïveté. In a later age, Byron, who excelled in so many departments of poetry, was an occasional writer of brilliant *vers de société*, such as the epistle "Huzza, Hodgson," but to find a direct successor to Prior it is necessary to pass Henry Luttrell (1765–1851) and W. R. Spencer (1769–1834), and to come down to W. M. Praed (*q.v.*). A certain character was given to English *vers de société* by Hood and Barham, but the former was too much addicted to a play upon words, the latter was too boisterous, to be considered as direct continuers of the tradition of Prior. That tradition, however, was revived by Frederick Locker, afterwards Locker-Lampson (1821–1895), whose *London Lyrics*, first printed in 1857 and constantly modified until 1893, is in some respects the typical modern example of pure *vers de société*. Locker was a simple, clear and easy writer; he successfully avoided the least appearance of that effort which is fatal to this kind of verse. His "Rotten Row," with its reminiscences of the early sixties,

> "But where is now the courtly troop
> That once rode laughing by?
> I miss the curls of Cantelupe,
> The laugh of Lady Di,"—

touches of real portraiture—is a perfect example of *vers de société*. Since the days of Locker, those who have attempted to strike the lighter lyre in English have been very numerous. Almost immeasurably superior to the rest has been Mr Austin Dobson, who is, however, something more than a writer of *vers de société*.

Collections of *vers de société* of much excellence have been published by J. K. Stephen (1859–92), Andrew Lang (b. 1844), A. D. Godley (b. 1856), Owen Seaman (b. 1861) and A. R. Ropes ("Adrian Ross") (b. 1859). (E. G.)

VERSE (from Lat. *versus*, literally a line or furrow drawn by turning the plough, from *vertere*, and afterwards signifying an arrangement of syllables into feet), the name given to an assemblage of words so placed together as to produce a metrical effect. The art of making, and the science of analysing, such verses is known as Versification. According to Max Müller, there is an analogy between *versus* and the Sanskrit term, *vritta*, which is the name given by the ancient grammarians of India to the rule determining the value of the quantity in vedic poetry. In modern speech, verse is directly contrasted with prose, as being essentially the result of an attention to determined rules of form. In English we speak of "a verse" or "verses," with reference to specific instances, or of "verse," as the general science or art of metrical expression, with its regulations and phenomena. A verse, which is a series of rhythmical syllables, divided by pauses, is destined in script to occupy a single line, and was so understood by the ancients (the *στίχος* of the Greeks). The Alexandrian scholiast Hephaestion speaks distinctly of verses that ceased to be verses because they were too long he stigmatizes a pentameter line of Callimachus as *στίχος ὑπέρμετρος*. There is no danger, therefore, in our emphasizing this rule, and in saying that, even in Mr Swinburne's most extended experiments the theory is that a verse fills but one line in a supposititious piece of writing.

It is essential that the verse so limited should be a complete form in itself. It is not, like a clause or a sentence in prose unrecurrent and unlimited, but it presents us with a successive and a continuous cadence, confined within definite bounds There has been a constant discussion as to what it is in which this succession and this continuity consist, and here we come at once to the principal difficulty which makes the analysis of the processes of the poets so difficult. To go back to the earliest European tradition, it is universally admitted that the ancient Greeks considered the art of verse as a branch of music and as such co-ordinated it with harmony and orchestral effect This appears from definite statements preserved in the fragment of Aristoxenus of Tarentum, a grammarian who lived in the age of Alexander the Great, and whom we shall see to have been the first who laid down definite laws for prosody as a departmen of musical art (*μουσική*). It was found necessary, in orde to compose a work of musical value, to work out a system o disciplined and linked movement. This system, or arrangement was called rhythm, and this is common to all the arts of melody Harmony, consisting in the reproduction of the sound of human voices or of musical instruments, and orchestrics, dealing with the movements of the human body, were expressed in metrical art by that arrangement of syllables which is known as rhythm The science of metre is the teaching of those laws on whic depends the rhythmical forms of poetry. This science has been, from the earliest ages of criticism, divided into a study of the general principles upon which all these forms are builded, and upon the special types into which they have gradually developed.

In considering ancient versification, it is necessary to give attention to Latin as well as to Greek metre, because although the Roman poets were in the main dependent upon the earlier tradition, there were several points at which they broke away, and were almost entirely independent. Roman verse, though essentially the same as Greek verse, was modified by the national development of Italian forms of poetry, by a simplified imitation of Greek measures, and by a varied intensity in the creation of new types of the old Greek artistic forms (Volkmann). In later times there was a tendency to consider the laws of metre as superior to, and almost independent of, the native impulse of the poet; and this is where the study of the old poetry itself is most salutary, as checking us in our tendency to bow too slavishly to the rules of the grammarians. No doubt, in the archaic times, theory and practice went hand in hand. The poet, held in constant check by the exigencies of music, was obliged to recognize the existence of certain rules, the necessity of which was confirmed by the delicacy of his ear. These he would pass down to his disciples, with any further discoveries which he might himself have made. For instance, what we are somewhat vaguely told of the influence of a poet like Archilochus, to whom the very invention of trochaic and iambic metre is, perhaps fabulously, attributed, points to the probability that in Archilochus the Ionian race produced a poet of extraordinary daring and delicacy of ear, who gathered the wandering rhythms that had existed, and had doubtless been used in an uncertain way before his time, into a system which could be depended upon, and not in his hands only, to produce certain effects of welcome variety. His system would engage the attention of theorists, and we learn that by the time of Plato schools of oral metrical education were already in existence, where the science of sounds and syllables was already beginning to be recognized, as may be seen in the *Cratylus*. Before long, the teachings in these peripatetic schools would be preserved, for safety's sake, in writing, and the theoretic literature of versification would begin. In fact, we read in Suidas of a certain Lasus of Hermione who wrote an *Art of Poetry*, and the age of this, the earliest of recorded authorities on the formal laws of verse, is fixed for us by the fact that he is spoken of as having been the master of Pindar. Of the writings of Lasus and his followers, however, nothing remains, and the character of their teaching is problematical. In the 3rd century B.C., however, we come upon a figure which preserves a definite character; this is Aristoxenus, the disciple of Aristotle, who gave his undivided attention to rhythm, and who lives, unfortunately only in fragments, as the most eminent musical critic of antiquity. The brief fragments of his *Elements of Rhythm* (ῥυθμικὰ στοιχεῖα), originally written in three books, are of unsurpassed value to us as illustrating the attitude of classical Greece to the interrelation of verse and music. The third book of Aristoxenus dealt specifically with λέξις, or the application of rhythm to artistically composed and written verse.

It is certain that, after the time of Alexander the Great, the theories of verse tended somewhat rapidly to release themselves from the theories of music, and when, in the successive ages of Greek criticism, much attention was given to the laws of versification, less and less was said about harmony and more and more about metre. Rules, often of a highly arbitrary nature, were drawn up by grammarians, who founded their laws on a scholiastic study of the ancient poets. The majority of the works in which these rules were collected are lost, but an enchiridion of Greek metres, by Hephaestion, a scholiast of the 2nd century A.D., has been preserved. First printed in 1526, editions and translations of Hephaestion's manual have not been infrequent.

It is from Hephaestion that most of our ideas on the subject of classical prosody are obtained. His work, as we possess it, seems to be a summary, made by himself, for use in schools, of an exhaustive treatise he had published on the Greek metrical system as a whole, in 48 books. The pre-eminent importance of Hephaestion was exposed to the learned world of Europe by Th. Gaisford, in 1810. A contemporary of Hephaestion, Herodian, who was one of the most eminent of Alexandrian grammarians, gave close attention to prosody, and was believed to have summed up everything that could be known on the subject of verse by critics of the 2nd century A.D., in his Μεγάλη προσῳδία, in twenty books. As Herodian, throughout his life, seems to have concentrated his attention on the study of Homer, it is supposed that he started with a consideration of the metre and accent of the *Iliad*. The almost complete loss of his treatises is regrettable. Philoxenus was the author of a very early work, Περὶ μέτρων; but this is entirely lost. In the musical cyclopaedia of Quintilian, there was included a chapter on the elements of the rhythmic art, and in this the metres recognized at the time were recorded and described. Among the Latin authorities on versification, the leading place is taken, in the 1st century B.C., by Terentius Varro, whose systematic treatment of metre in his works *De sermone latino* and *De lingua latina* is often referred to. But we know more of Terentianus Maurus, who flourished in the second half of the 2nd century A.D., since we possess from his hand a handbook to metre, written in verse, in which, in particular, the Horatian metres are carefully analysed. He follows Caesius Bassus, the friend of Nero, who had dedicated to his imperial patron a work on prosody, of which fragments exist. Three tracts, attributed to the rhetor C. Marius Victorinus (one entitled *De ratione metrorum*), belong to the 4th century, and are still quoted by scholars. Another early authority was Flavius Mallius Theodorus, whose *De Metris* has been frequently reprinted.

The metrical theory of the Byzantine grammarians was entirely in unison with the old tradition of the Alexandrian schools, and depended on the authority of Hephaestion. Michael Psellus, in the 9th century, wrote abundantly on the subject, and towards the close of the Empire the verse-handbooks of Isaac Tzetzes (d. 1138) and of his brother Joannes were in general use. A large number of other Byzantine scholiasts and theorists are mentioned in this connexion by Gleditsch. Very little attention was paid to metrical science in medieval and even Renaissance days. It is much to the honour of English scholarship that the earliest modern writer who made a rational study of ancient metre was Richard Bentley, in his *Schediasma de metris Terentianis*, printed at Cambridge in 1726. He was soon followed by the Germans, in particular by Hermann, Boeckh and J. A. Apel. To this day, German scholarship easily leads in the rational and accurate study of classical versification.

The chief principle in ancient verse was quantity, that is, the amount of time involved in the effort to express a syllable. Accordingly, the two basal types which lie at the foundation of classical metre are "longs" and "shorts." The convention was that a long syllable was equal to two short ones: accordingly there was a real truth in calling the succession of such "feet" metre, for the length, or weight, of the syllables forming them could be, and was, measured. What has to be realized in speaking of ancient metre is that the value of these feet was defined with exactitude, not left uncertain, as it is in modern European verse, when accent is almost always made the guiding principle. In Greek verse, there might be an *ictus* (stress), which fell upon the long syllable, but it could only be a regulating element, and accent was always a secondary element in the construction of Greek metre. The "feet" recognized and described by the ancient grammarians were various, and in their apparent diversity sometimes difficult to follow, but the comprehension of them is simplified if the student realizes that the names given to them are often superfluous. The main distinction between feet consists in the diversity of the relation between the strong and the weak syllables. There are naturally only two movements, the quick and the slow. Thus we have the anapaest (⏑ ⏑ —, short-short-long) and the dactyl (— ⏑ ⏑, long-short-short), which are equal, and differ only as regards the position of their parts. To these follow two feet which must be considered as in their essence non-metrical, as it is only in combination with others that they can become metrical. These are the spondee (— —, long-long) and the pyrrhic (⏑ ⏑, short-short). Of more essential character are the two descriptions of slow feet, the iamb (⏑ —, short-long) and the trochee (— ⏑, long-short). Besides these definite types, the ingenuity of formalists has invented an almost infinite number of other "feet." It is, perhaps, necessary to mention some of the principal of these, although they are, in the majority of cases, purely arbitrary. In the rapid measures we find the tribrach (⏑⏑⏑, short-short-short), the molossus (———, long-long-long), the amphibrach (⏑—⏑, short-long-short), the amphimacer (—⏑—, long-short-long), the bacchius (⏑——, short-long-long) and the antibacchius (——⏑, long-long-short). There is a foot of four syllables, the choriamb (—⏑⏑—, long-short-short-long), which is the fundamental foot in Aeolic verse—very frequently mentioned, but very seldom met with.

It must not be forgotten that the prosodical terminology of the Greeks, which is often treated by non-poetical writers as something scientific and even sacrosanct, dates from a time when ancient literature had lost all its freshness and impulse, and was exclusively the study of analysts and grammarians. Between the life of Pindar, for instance, and that of Hephaestion, the great metrical authority, there extends a longer period than between Chaucer and Professor Skeat; and to appreciate the value of the rules of Greek prosody we must recollect that those rules were invented by learned and academic men to account for phenomena which they observed, and wished to comprehend, in writings that had long been classical, and were already growing positively archaic. The fact seems to be that the combination of long and short syllables into spondees, iambs, dactyls and anapaests, forms the sole genuine basis of all classical verse.

Metre is a science which pays attention to all the possible regular arrangements which can be made of these four indispensable and indestructible types. Of the metres of the ancients by far the most often employed, and no doubt the oldest, was the dactylic hexameter, a combination of six feet, five successive dactyls and a spondee or trochee:—

⊥⏑⏑ ⊥⏑⏑ ⊥⏑⏑ ⊥⏑⏑ ⊥⏑⏑ ⊥⏑

This was known to the ancients as "epic" verse, in contrast to the various lyrical measures. The poetry of Homer is the typical example of the use of the epic hexameter, and the character of the Homeric saga led to the fashion by which the dactylic hexameter, whatever its subject, was styled "heroic metre." The earliest epics, doubtless, were chanted to the accompaniment of a stringed instrument, on which the pulsation of the verse (ἔπη) was recorded. It was the opinion of W. Christ that the origin of the hexameter was to be sought in hieratic poetry, the fulness of the long dactylic line attracting the priests to its use in the delivery of oracles, from which it naturally passed to solemn tales of the actions of gods and heroes. It is more difficult to see how, later on, it became the vehicle for comic and satiric writing, and is found at last adopted by the bucolic poets for their amorous and pastoral dialogues. The Homeric form of the dactylic hexameter has been usually taken, and was taken in classical times, as the normal one, but there have been many variations. A hexameter found in Catullus consists exclusively of spondees, and deviation from the original heroic type could go no further. This concentration of heavy sounds was cultivated to give solemnity to the character of the line. In the whole matter, it is best to recognize that the rules of the grammarians were made after the event, to account for the fact that the poets had chosen, while adhering to the verse-structure of five rapid beats and a subsidence, to vary the internal character of that structure exactly as their ear and their passion dictated. This seems particularly true in the case of the caesura, where the question is not so much a matter of defining "male" caesura or "female" caesura, "bucolic" caesura or "trochaic," as of patiently noting instances in which the unconscious poet, led by his inspiration, has varied his pauses and his emphasis at his own free will. The critics have written much of "prosodical licence," but verse in the days of Homer, like verse now, is simply good or bad, and if it is good it may show liberty and variety, but it knows nothing of "licence."

We pass, by a natural transition, to the pentameter, which is the most frequently employed of what are known as the syncopied forms of dactylic verse. It was used with the hexameter, to produce the effect which was early called elegiac, and its form shows the appropriateness of this custom:—

"Cynthia | prima fu- | it, || Cynthia | finis e- | rit."

A hexameter, full of energy and exaltation, followed by a descending and melancholy pentameter, had an immediate tendency to take a complete form, and this is the origin of the stanza. The peculiar character of this two-line stanza has been fixed for all time by a brilliant epigram of Schiller, which is itself a specimen of the form:—

"Im Hexameter steigt des Springquells flüssige Säule,
Im Pentameter drauf fällt sie melodisch herab."

Such a distich was called an elegy, ἐλεγεῖον, as specially suitable to an ἔλεγος or lamentation. It is difficult to say with certainty whether the distich so composed was essential as an accompaniment to flute-music in the earliest times, or how soon there came to be written purely literary elegies towards which the melody stood in a secondary or ornamental relation. It has, however, been observed that even when the distich had obviously come to be a purely intellectual or lyrical thing, there remained in the sound of the pentameter the trace of lamentation, in which its primitive use at funeral services was clearly preserved. Other grammarians, however, among whom Cäsar, in his work on the origin of elegiac verse, is prominent,—do not believe in the lugubrious essence of the pentameter, and think that the elegiacal couplet was originally erotic, and was adapted to mournful themes by Simonides. If we may credit a passage in Athenaeus, it would seem that the earliest-known elegists, such as Callinus and Solon, wrote for recitation, pure and simple, without the accompaniment of any instrument.

Trochaic verse is called by the ancient grammarians headless (ἀκέφαλον), because it really consists of iambic verse deprived of its head, or opening syllable. The iambic measure (⏑—⏑—⏑—) becomes trochaic if we cut off the first "short," and make it run ⊥⏑—⏑—⏑—. The pure trochaic trimeter and tetrameter had a character of breathless speed, and sometimes bore the name of choric (ῥυθμὸς χορεῖος), because it was peculiarly appropriate to the dance, and was used for poems which expressed a quickly stepping sentiment. It is understood that, after having been known as a musical movement, it was first employed in the composition of poetry by Archilochus of Paros, in the 7th century B.C.

Iambic metre was, next to the dactylic hexameter, the form of verse most frequently employed by the poets of Greek antiquity. Archilochus, again, who seems to have been a great initiator in the arts of versification, is credited with the invention of the iambic trimeter also, but it certainly existed before his time. Murray believes the original iambic measure, in its popular familiarity, to have sprung from the worship of the homely peasant gods, Dionysus and Demeter. It was not far removed from prose; it gave a writer opportunity for expressing popular thoughts in a manner which simple men could appreciate, being close to their own unsophisticated speech. In particular, it presented itself as a heaven-made instrument for the talent of Euripides, "who, seeing poetry and meaning in every stone of a street, found in the current iambic trimeter a vehicle of expression in some ways more flexible even than prose."

It was not, however, until the invention of the lyric proper, whether individual to the poet, or choral, that the full richness of possible rhythms became obvious to the Greeks. The lyric inspiration came originally from the island of Lesbos, and it passed down through the Asiatic archipelago to Crete before it reached the mainland of Greece. The Lesbians cultivated a monodic ode-poetry in strophes and monostrophes, the enchanting beauty of which can still be realized in measure from what remains to us of the writings of Sappho and Alcaeus. There is a stanza known as the Sapphic and another as the Alcaic.

The Sapphic runs as follows:—

–́ ⏑ – ⏒ | –́ ⏑ ⏑ – | ⏑ – ⏓
–́ ⏑ – ⏒ | –́ ⏑ ⏑ – | ⏑ – ⏓
–́ ⏑ – ⏒ | –́ ⏑ ⏑ – | ⏑ – ⏓
– ⏑ ⏑ | – –

The stanza of Alcaeus runs:—

⏒ – ⏑ –́ | ⏒ – ⏑ ⏑ | – ⏑ –́
⏒ – ⏑ –́ | ⏒ – ⏑ ⏑ | – ⏑ –́
⏒ – ⏑ –́ | ⏒ – ⏑ – | –, – ⏑ ⏑
– ⏑ ⏑ –́ | ⏑ – –

These marvellous inventions suited the different moods of these strongly contrasted lyrists, the "violet-crowned, pure, softly smiling Sappho," and the fiery, vehement soldier who was Alcaeus. We must give them peculiar attention, since they were the two earliest models for the lyric passion which has since then expressed itself in so many stanzaic forms, but in none of so faultless a perfection as the original Lesbian types.

The name of Stesichorus of Himera points to the belief of antiquity that he was the earliest poet who gave form to the choral song; he must have been called the "choir-setter" because he arranged and wrote for choirs semi-epic verse of a new kind, "made up of halves of the epic hexameter, interspersed with short variations—epitrites, anapaests or mere syncopae—just enough to break the dactylic swing, to make the verse lyrical" (Gilbert Murray). But it appears to be to Arion that the artistic form of the dithyramb is due. We are all among innovators and creators in this glorious 5th century B.C. Simonides gathered the various inventions together, and exercised his genius upon them all: he was the earliest universal lyrist of the world: he treated the styles of verse, as Shelley or as Victor Hugo did, with an impartial mastery.

After the happy event of the Persian War, Athens became the centre of literary activity in Greece, and here the great school of drama developed itself, using for its vehicle, in dialogue, monologue and chorus, nearly all the metres which earlier ages and distant provinces had invented. The verse-form which the dramatists preferred to use was almost exclusively the iambic trimeter, a form which adapted itself equally well to tragedy and to comedy. Aeschylus employed for his choruses a great number of lyric measures, which Sophocles and Euripides reduced and regulated. With the age of the dramatists the creative power of the Greeks in versification came to an end, and the revival of poetic enthusiasm in the Alexandrian age brought with it no talent for fresh metrical inventions, and the time had now arrived when the harvest of Greek prosody was completely garnered.

Latin Metre.—Very little is known about the verse-forms of the original inhabitants of Italy, before the introduction of Greek influences. The earliest use of poetry as a national art in Italy is to be judged by inscriptions in what is called the Saturnian metre. Already, the first Latin epic poets, Livius Andronicus in his *Odyssia*, Naevius in his *Bellum Punicum*, the Scipios in their *Elogia*, combined their rude national sense of folk-song with a consciousness of the quantitative rules of the Greeks. But the same writers, in their dramas, undoubtedly used Greek metres without adaptation, and it is therefore likely that the ancient Saturnian measure was already looked upon as barbarous, and it makes no further reappearance in Latin literature (cf. Gleditsch). The introduction of Greek dramatic metre marks the start of regular poetry among the Latins, which was due, not to men of Roman birth, but to poets of Greek extraction or inhabiting the Greek-speaking provinces of Italy. These writers, bearing the stamp of a widely recognized cultivation, threw the old national verse back into oblivion. Latin verse, then, began in a free but loyal modification of the principles of Greek verse. Plautus was particularly ambitious and skilful in this work, and, aided by a native genius for metre, he laid down the basis of Latin dramatic versification. Terence was a feebler and at the same time a more timid metrist. In satire, the iambic and trochaic measures were carefully adapted by Ennius and Lucilius. The dactylic hexameter followed, and Ennius, in all matters of verse a daring innovator, directly imitated in his *Annales* the epic measure of the Greeks. To him also is attributed the introduction of the elegiac distich, hexameter and pentameter. The dactylic hexameter was forthwith adopted as the leading metre of the Roman poets, and, as Gleditsch has pointed out, the basis upon which all future versification was to be erected was firmly laid down before the death of Ennius in 169 B.C. Lucilius followed, but perhaps with some tendency to retrogression, for the Latin critics seem to have looked upon his metre as wanting both in melody and elasticity. Lucretius, on the other hand, made a further advance on the labours of Ennius, in his study of

"the rise
And long roll of the Hexameter."

Lest, however, this great form of verse should take too exclusive a place in the imagination of the Romans, a younger generation, with Laevius and Terentius Varro at their head, began to imitate the lyrical measures of the Greeks with remarkable success. Varro, who has been styled the earliest metrical theorist of Rome, opened up a new field in this direction by the example of his Menippean satires. These poets left the rigid school of Ennius, and sought to emulate the Alexandrians of their own age: we see the result in the lyric measures used so gracefully and with such brilliant ease by Catullus. The versification of the Romans reached its highest point of polish in the Augustan age, in the writings of Tibullus, Propertius, Virgil and particularly Ovid, who is considered to mark the highest level of various excellence which has ever been reached by a master of Latin versification. In Horace has been traced a tendency to archaism in the study of verse, and in his odes and epodes he was not content with the soft Alexandrian models, but aimed at achieving more vigorous effects by an imitation of the older Greek models, such as Alcaeus and even Archilochus. After the Augustan age, it was no longer the Greek poets, ancient or recent, who were imitated, but the Augustans themselves were taken as the inapproachable models of Roman verse.

We have hitherto spoken of classical versification as it was regarded by those whom, without offence, we may describe as pedants. But there is precious evidence of the mode in which metre was regarded by poets, and by one of the greatest artists of antiquity. In his *Art of Poetry* Horace has been speaking of the need of method in composition—"tantum series juncturaque pollet"—and this reminds him that he has said nothing of the art of verse. The succeeding twenty-four lines contain all that this great poet thought it needful to supply on the subject with which Alexandrian grammarians could fill as many volumes. Although he is actually writing in dactylic hexameters, he does not mention this form of verse; he is chiefly occupied in describing, rather unscientifically, the iambic trimeter, and in praising the iamb, *pes citus*. He applauds, still somewhat vaguely, the stately versification of the precursors, Ennius and Accius, and blames the *immodulata poemata* of careless modern writers, whose laxity is condoned by popular ignorance. The only way to escape such faults is to study the Greeks by night and by day, but Horace evidently means by his *exemplaria Graeca*, not the scholiasts with their lists of metres and their laborious rules, but the old poets with their fine raptures. On Italian ground he points to Plautus, and laments that the Romans of his own day, fascinated by softer cadences, have lost their veneration for the vigorous beauty of the *Plautinos numeros*. And Horace closes with a queer suggestion, which may be taken as we please, that a poet in an age of flagging inspiration must trust to his fingers as well as his ears.

Modern Versification.—The main distinction between classical and modern versification consists in the negligence shown by the moderns to *quantity*, which is defined as the length or shortness of the sound of syllables, as determined by the time required to pronounce them. This dimension of sound was rigid in the case of Greek and Latin poetry, until, in what is known as the

Middle Greek period, there came in a general tendency to relax the exact value of sounds and syllables, and to introduce *accent*, which is a measure of quality rather than of quantity. A syllable, in modern verse, is heavy or light, according as it is accented or unaccented—that is to say, according as it receives stress from the voice or not. In the word "tulip," for instance, the syllables are of equal length, but the accent is strongly upon the first. It is mainly a question of force with us, not of time as with the ancients. There is, however, an element of quantity in modern verse, as there was of accent in ancient verse. The foot, in modern verse, takes a less prominent place in itself than it did in Greece, and is regarded more in relation to the whole line of which it makes a part. A mere counting of syllables is useless. In Milton's

"From haunted spring and dale,
Edg'd with poplar pale."

an ancient scholiast would have found it impossible to discover any harmony, for he would have had no means of measuring the value of the heavy accent on "edg'd," followed by a pause, and would have demanded another syllable in the second line to turn the whole into verse. The first poet to whom it occurred that it was needless to attach such predominant importance to quantity was Gregory of Nazianzen (d. 389), a Christian bishop of the Greek Church. In two important poems by Gregory all prosodical discipline is found to have disappeared, and the rule of verse has come to be accentual, with a heavy stress on the penultimate syllable. About the same time, the Greek fabulist Babrius employed a choliambic metre having a strong accent on the penultimate. The poets of the transition loved to cultivate a loose iambic trimeter in twelve syllables, and shorter octosyllabic forms called "anacreontic," although they were far enough from repeating the splendid effects of Anacreon. In these the old laws of quantity were more and more generally superseded by stress, and in all this we may see the dawn of the free accentual versification of modern Europe.

Romance Languages.—The prosodies of Provence, France, Italy and Spain were derived from the decayed and simplified forms of Latin verse by a slow and sometimes almost intangible transition. In these modern metres, however, when they came to be independent, it was found that all syllables in the line were of equal value, and that the sole criterion of measure was the number of these in each case. The relics of ancient versification, deprived of all the regulated principles of rhythmical art, received in return the ornament of obligatory and difficult rhyme, without which the weak rhythm itself would practically have disappeared. A new species of rhythm, depending on the varieties of mood, was introduced, and stanzaic forms of great elaboration and beauty were invented. The earliest standard work which exhibits in full the definitions of Romance versification is the *Leys d'Amors* of an unknown Provençal grammarian, written in 1356.[1] Another medieval treatise of great importance is the *De Vulgari Eloquentia*, written by Dante in 1304. There is this difference between these two works, that the former, written long after the flourishing period of the troubadours, analyses what has been accomplished in the past, while the other, standing at the starting-point of Italian poetry, describes what has to be done in the future. Both of these authorities quote the ten-syllable line of five equal feet as most to be admired and as forming the basis of poetry. But the octosyllabic, almost in the earliest times, became a main favourite with the poets, and may be said to be the most frequently used of all lyrical measures in medieval Romance poetry. The earliest specimen of all, however, a mere refrain excepted, is the fragment of the Provençal "Boethius," and this is decasyllabic, like all French poems of the Charlemagne cycle. The typical French heroic verse, the alexandrine of six feet, is not found in the old epic poetry. In Provençal and early French the position of the caesura in each line was fixed by strict rules; in Italian these were relaxed. Dante gives very minute, although somewhat obscure, accounts of the essence and invention of stanzaic form (*cobla* in Provençal), in which the Romance poetries excelled from the first. The stanza was a group of lines formed on a regular and recurrent arrangement of rhymes. It was natural that the poets of Provence should carry to an extreme the invention of stanzaic forms, for their language was extravagantly rich in rhymes. They invented complicated poetic structures of stanza within stanza, and the *canzo* as written by the great troubadours is a marvel of ingenuity such as could scarcely be repeated in any other language. The extreme fulness and elaboration of the Provençal poets, however, has been serviceable as placing a very high ideal of structural skill before the poets of all succeeding times, and it was of immense value in directing the experiments of the earliest poet-artists of Italy and France.

In French poetry, successive masters corrected the national versification and drew closer round it the network of rules and principles. The alexandrine was invented in the 12th century, as a counterpart to the hexameter of the ancients, by Alexander de Bernay. A great part is played in French metre by masculine and feminine verse: the former is a verse which closes with a letter which is not *e mute*; the latter a verse which closes with *e mute*, or with *e mute* followed by *s*, or by the consonants *nt*. Masculine rhyme is that which combines two masculine verses, and feminine that which unites two feminine verses; and in regular verse such couplets must be alternated. Elision is the rule by which in the scansion of a verse, the letter *e* at the end of a word is suppressed when it immediately precedes *e mute* or a non-aspirated *h*. These and other immutable rules were laid down by Malherbe, and by Boileau in his *Art Poétique* (1674), and for more than a century they were implicitly followed by all writers of verse. It was the genius of Victor Hugo which first enfranchised the prosody of France, not by rebelling against the rules, but by widening their scope in all directions, and by asserting that, in spite of its limitations, French verse was a living thing. The richness of Hugo's rhymes is proverbial, and the boldness and flow of his alexandrines exceeded everything which had been so much as dreamed of before his time. The revolution he brought about proved universal, and disciples like Théophile Gautier could say, in the face of the critics and grammarians of the classic school, "If we suspected that Victor Hugo had written a single bad verse, we should not dare to admit it to ourselves, in a cellar, without a candle." Boileau and Hugo, therefore, have been the two lawgivers of the French Parnassus. The rules of French verse being, in fact, very severe, and weakness, excess of audacity and negligences of all sorts being very harshly repressed, it is not surprising that, as the personal authority of Hugo declined, various projects were started for lightening the burden of prosodical discipline. Since 1880 those projects have been numerous, and a great many poets of genuine inspiration have written in different forms of what is called "free verse."

Teutonic.—In very early times the inhabitants of the Germanic countries developed a prosodical system which owed nothing whatever to classical sources. The finest examples of this Teutonic verse are found in Icelandic and in Anglo-Saxon. The line consisted of two sections, each containing two strongly stressed syllables, and of these four long syllables three were alliterated. It is plain that there can be detected in ancient Teutonic verse but three severe and consistent rules, viz. that the section, the strong accentuation, and above all the alliteration must be preserved. We find this to be the case in High and Low German, Icelandic, Anglo-Saxon, and in the revived alliterative English poetry of the 14th century, such as "Piers Plowman." There are differences, however, which depend on such facts as that the Icelandic poems are mainly lyrical and the Anglo-Saxon epics are narrative. As time went on, under the pressure of south European practice, alliteration ceased to be regarded as the sole and sufficient ornament of Teutonic verse, and rhyme was occasionally used, but this was a concession which proved fatal to the type. With this use of rhyme, the High German poetry begins to cease, while England becomes the centre of

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[1] But see the article PROVENÇAL LITERATURE.

Teutonic metrical composition. In Icelandic poetry there was a highly artificial verse-system known as court-verse (*dróttkvaett*), which consisted of alliterative groups of two lines each, arranged in staves of eight lines. When we consider primitive Teutonic verse closely, we see that it did not begin with any conscious art, but, as Vigfussen has said, "was simply excited and emphatic prose" uttered with the repetition of catchwords and letters. The use of these was presently regulated. Alliteration of stressed root-syllables formed the basis of Teutonic verse, as quantity had formed the basis of Greek verse. A study of the "Heliand" and the "Lay of Hildebrand" in Old German, of the "Atli" and "Harbard" lays in Icelandic, and of the writings attributed to Beowulf, Cædmon and Cynewulf in Anglo-Saxon, will show the general unity and the local divergences of this class of verse.

English Metre.—The first writer in whom there has been discovered a distinct rebellion against the methods of Anglo-Saxon versification is St Godric, who died in 1170. Only three brief fragments of his poetry have been preserved, but there is no doubt that they show, for the first time, a regular composition in feet. A quotation will show the value of St Godric's invention:—

"Saintë | Nicholaes, | Godes | druth,
Tymbre us | fairé | scone | hus,
At thy | burth, | at thy | bare,
Saintë | Nicholaes, | bring uswel thare."

From this difficult stanza down to the metres of modern English the transition seems gradual and direct, while the tradition of Anglo-Saxon alliterative prosody is abruptly broken. The fragments of St Godric appear to be independent of one another, and therefore indicate that the division of lines into feet is not accidental. They are much less dubious, and more firm as the basis of an hypothesis, than the famous quatrain[1] about the singing of the monks of Ely, which is perhaps a little earlier in date than the fragments of St Godric. This has much picturesque beauty, but if it is carefully examined the actual scheme of it as metre seems to evade detection. The Ely singer warbled, not knowing what he sang, but St Godric knew perfectly well, and must have been a deliberate innovator. There is still more definition of feet in the *Poema Morale*, printed by Dr Morris, which is supposed to date from about 1200. In longer pieces, and particularly in the *Ormulum*, and in the *Brut* of Layamon, which belong to the early part of the 13th century, we find, on the whole, less definite abandonment of the Anglo-Saxon system of prosody, but nevertheless a prominence given both to rhyme and to rhythm. In Layamon, particularly, the recognition of a recurrent verse of four accents is unquestionable. The place of this poet in the history of prosody is very carefully noted by Guest, who remarks that in Anglo-Saxon verse, the syllables which take the alliteration are always accented, while in the later metres, where alliteration was combined with rhyme, the former is often thrown upon an unaccented syllable. "Layamon appears to take a middle course. It would seem he gave accents both to his rhyming and his alliterative syllables; but the former were often obliged to content themselves with a false accent." An advance was made about fifty years later in *Genesis and Exodus*, a poem published by Professor Skeat, which has such great value in the proof it gives of the extension of verbal melody, that Saintsbury has said that "it contains more of the kernel of English prosody, properly so called, than any [other] single poem before Spenser." The phenomenon which we meet with in all these earliest attempts at purely English verse is the unconscious determination of writers, who had no views about prosody, to follow their national instinct in the direction of grouped feet and rhymes. This is further emphasized in *Horn* and *Havelok*, and in the smoother octosyllabics of the 14th-century metrical romances, where the rhymes become very frequent, with an occasional short line or *bob*, to prevent monotony of effect. Few of these romances have much literary value, but their prosodical value is very great, for we see in them the normal movement of English verse becoming fixed to certain principles beyond any possibility of escape:—

"So fair | he spak- | ĕ him withal,
He light- | ed down- | ĕ in | the hall,
Boundë | his mare | among | them all,
And to | the board- | ĕ won."

This, from *Sir Percevale*, is, it must be allowed, an unusually correct example; the uncouth 14th-century writers did not commonly arrive at their effect without much more irregularity and wavering than this, but the design is evident even in their worst examples. Between 1210 and 1340 not a single English poem of importance is known to have been written in the old alliterative measure of the Anglo-Saxons. But at the latter date there set in a singular reaction in favour of alliteration, a movement which culminated, after producing some beautiful romances, in the satires of Langland. Those writers, and they were many, who preserved foot-scansion and rhyme, during this alliterative reaction, became ever closer students of contemporary French verse, and in the favourite octosyllabic metre "the uncompromising adoption of the French, or syllabically uniform, system is the first thing noticeable" (Saintsbury). This tendency of Middle English metre culminates in the work of John Gower, which is singularly polished in its rhyming octosyllabics, although unquestionably nerveless still, and inelastic.

It is, however, to Chaucer that we turn for far greater contributions to English verse. He it was who first, with full consciousness of power as an artist, adopted the use of elaborate stanzas, always in following of the French; he it was who first gained freedom of sound by a variation of pause, and by an alternation of trochaic and iambic movement. It is the lack of these arts which keeps Gower and his predecessors so stiff. In particular Chaucer, in his first period, invented rime-royal, a stanzaic form (in seven decasyllabic lines, rhymed *a b a b b c c*), peculiarly English in character, which was dominant in our literature for more than two hundred years; it was used in the long romance of *Troilus and Cresseide*, where English metre for the first time displays its beauty to the full. The importance of rime-royal is displayed in the fact that its sixth and seventh lines actually form the decasyllabic couplet, which is commonly held to be a later discovery of Chaucer's, in *The Legend of Good Women*. This is the heroic verse, in which *The Canterbury Tales* are mainly composed, and this metre of five accents, with couplet-rhyme, became so powerful in the future history of English poetry that it may almost be taken as the central and most characteristic of our verse-forms, as the alexandrine couplet is in French and Dutch prosody. It seems to have been originally called riding-rhyme, the name by which Gascoigne describes it (1575).

It is impossible here to do more than indicate very briefly those fluctuations which English prosody underwent when the learned and vivid example of Chaucer was withdrawn. The metres of Lydgate and his successors were discordant and feeble; their ears had learned but very incorrectly the lesson of the master. Lydgate, in particular, went back to an earlier type, and showed himself more skilful in the old eight-syllable measure than in the new decasyllable. More interesting to the prosodical student than the work of these or later Chaucerians is the influence exercised throughout the 15th and early 16th centuries by the popular ballads, of which "Chevy Chase" is believed to be the oldest surviving example, while "The Tale of Gamelyn" is the longest. The introduction of the loose, elastic ballad-quatrain, with its melodious tendency to refrain, was a matter of great importance in the metamorphosis of British verse. The degenerate forms employed by the English 15th-century poets in attempting more regular prosody were in some measure connected by the greater exactitude of the Scotch writers, particularly of Dunbar, who was by far the most accomplished metrist between Chaucer and Spenser.

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[1] Merie sungen ðe muneches binnen Ely,
ða Cnut ch[in]ing reu ðer by;
"Roweð, cni[h]tes, noer the land
and here we þes muneches sæng."

But Wyatt (1503–1542) was long considered the father of modern English verse, and though we now plainly enough perceive that before his day all the essential discoveries and inventions had been made, he nevertheless deserves great honour as a pioneer. He introduced, from France and Italy, the prosodical principles of the Renaissance—order and coherency, concentration and definition of sound—and that although his own powers in metre were far from being highly developed. He and his more gifted disciple Surrey introduced into English verse the sonnet (not of the pure Italian type, but as a quatorzain with a final couplet) as well as other short lyric forms. To Surrey, moreover, we owe the introduction from Italian of blank verse, the rhymeless metre of five accents, which has taken so prominent a place in subsequent English poetry.

With the heroic couplet, with blank verse, and with a variety of short lyric stanzaic measures, the equipment of British verse might now be said to be complete. For the moment, however, towards the middle of the 16th century, all these excellent metres seemed to be abandoned in favour of an awkward couplet of fourteen feet, which may have had some relation with the French alexandrine. It was always, as Saintsbury says, "a very uncertain and risky metre, settling down with a dangerous acquiescence into doggerel and sing-song." It was to break up this nerveless measure that the remarkable reforms of the close of the century were made, and the discoveries of Wyatt and Surrey were brought, long after their deaths, into general practice. In drama, the doggerel of an earlier age retired before a blank verse, which was at first entirely pedestrian and mechanical, but struck out variety and music in the hands of Marlowe and Shakespeare. But the central magician was Spenser, in whom there arose a master of pure verse whose range and skill were greater than those of any previous writer of English, and before whom Chaucer himself must withdraw. It is not too much to say that Spenser took all the elements of English verse, as they had existed in more or less timid and undeveloped shape for four centuries, and that he moulded them together into an instrument capable, for the first time, of expressing, or accompanying, every passion, every emotion, every variety of sentiment or instinct, which stirs the human breast. His great work was that of solidification and emancipation, but he also created a noble form which bears his name, that Spenserian stanza of nine lines closing with an alexandrine, which lends itself in the hands of great poets, and great poets only, to magnificent narrative effects.

It was at this moment that a final attempt was made to disestablish the whole scheme of English metre, and to substitute for it unrhymed classic measures. In the year 1579 this heresy was powerful at Cambridge, and a vigorous attempt was made to include Spenser himself among its votaries. It failed, and with this failure it may be said that all the essential questions connected with English poetry were settled.

There is enough to fill a score of volumes in the mode in which the poets from Spenser downwards have employed the laws of English verse, but he was the latest of the legislators who laid down the framework of those laws. It is not possible in this place to enter into such themes as the rise and fall of Elizabethan dramatic blank verse; the perfection of the song and the development of the sonnet; the extraordinary virtuosity of Milton; the contest between enjambement (which permits the extension of the sentence beyond the limits of the distich) and the couplet as introduced by Waller; the victory of that couplet, and its use from 1670 to 1800; the slow growth of ode, which had been one of Spenser's inventions; the revivals of prosodical taste in the 19th century; the extraordinary advance in freedom of anapaestic movement.

It may generally be remarked in connexion with the very various, copious and often chaotic criticism of English verse, that it has been a misfortune, from the earliest times, that pedantic and chimerical theories have too often invaded the study of metre. They had tended, from the times of the Alexandrian grammarians down to our own, to treat as a dead thing that vivid and elastic art of poetry whose very essence is its life. In modern times not a few theorists have allowed themselves to diverge into the most extraordinary chains of musical and even of mathematical conjecture and have been easily led, in the practice of their ingenious learning, to forget that what they are talking about is the vehicle in which tremulous and ardent thoughts are conveyed to the hearts of men. The poet knows the law by instinct, but he treats it as a living guide; he varies the pause, he manipulates the accent, he gives the vital element of freedom to the verse which he has founded upon discipline. It is extremely doubtful whether any youthful poet was even helped by prosodical instruction; his earliest measures are imitative; he does not compose consciously in "tribrachs" and "iambs"; he would gape in astonishment if asked to define the "pyrrhichian hypothesis"; his bursts of enthusiasm are not modified by a theory of "trisyllabic equivalence." The old formula of verse, "variety in unity," holds good in all languages, countries and times; the delicate rapture involved in a brilliant combination of rhyme and metre is a matter which is regulated, indeed, on a consideration of the laws of prosody, but depends on other and wider qualities of a moral and an aesthetic order.

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VERSECZ (Ger. *Werschetz*), a town of Hungary, in the county of Temes, 235 m. S.S.E. of Budapest by rail. Pop. (1900) 25,199. It has a handsome parish church and is the seat of a Greek Orthodox bishop. Versecz is one of the principal wine-producing centres in Hungary, and the red wines and brandy produced here enjoy a great reputation. Near the town are remains of a Roman castle, and a Roman rampart and trench which extend for about 60 m. to the north. During the revolutionary period of 1848–49 the Hungarians defeated the Servians here on the 11th of July 1848, while on the 19th of January 1849 the town was occupied by the Austrian troops.

VERTEBRATA, a large branch of the animal kingdom, of which the characteristic members are mammals, birds, reptiles, batrachians, fish and cyclostomes, the craniate vertebrates of modern zoology. These include all the animals which possess "vertebrae," pieces of bone or cartilage jointed to form a "backbone" or spinal column (see Spinal Cord), although in some of the lower members of the group the segmentation of the spinal column is imperfect. That such animals formed a natural group was understood from the earliest times. Aristotle placed them together as "Enaima," or sanguineous animals, distinguishing them from the "Anaima," which he believed to be bloodless. Later it was discovered that the so-called bloodless animals contained uncoloured blood, and the vertebrates were distinguished as red-blooded, until G. L. C. F. D. Cuvier showed the existence of red blood in some other animals. C. Linnaeus made Mammalia, Aves, Amphibia and Pisces the first four classes of the animal kingdom, but suggested no corporate name for them. In 1788 A. J. G. K. Batsch united them into a great division, for which he proposed the name "Knochenthiere," bony animals. J. B. P. Lamarck carried the idea further, and first clearly recognized the importance of the vertebral column in classification; to him is due the division of the animal kingdom into Vertebrata, which included all the craniate vertebrates, and Invertebrata, which included all other animals. These names and the dichotomy they imply have persisted from their convenience, although zoological science has come to recognize that the groups are not morphologically equivalent and that the division is not logical. Cuvier showed that there were four groups in the animal kingdom, each corresponding to a definite type or plan of structure, and that craniate vertebrates composed only one of these groups, invertebrates including three. In the progress of zoology it has become clear that the coelomate animals fall into a very large number of distinct groups or types, and that the vertebrates are only one class amongst many morphologically distinct classes. It has been shown further that amongst the animals that Lamarck would have placed in the Invertebrata there are several which, although devoid of vertebrae or cranium, must be associated with vertebrates in any natural system. Closer investigation of the anatomy and embryology of the craniate vertebrates showed that the possession of a jointed vertebral column was not a fundamental characteristic of the group. In some creatures, such as sturgeons and lampreys, the position of the jointed vertebral column is occupied by an unjointed rod, the so-called notochord, whilst all the Vertebrata pass through an embryonic stage in which a similar elastic unjointed notochord exists as the precursor of the jointed column. It was further found that all the vertebrates of Lamarck displayed either in the embryonic condition alone, or both in embryonic and adult conditions, a set of passages leading from the anterior-lateral portion of the body into the cavity of the pharynx, and known as gill-slits, because in those creatures in which they become functional for aquatic respiration they lodge the gills or branchial tufts. Further, it was found that in all vertebrates the great central mass of the nervous system, known as the brain and spinal cord, is in reality a hollow tube with more or less thickened walls, developed as a strand of tissue along the dorsal surface of the embryo, which sinks downwards and inwards to form a hollow tube lying dorsal to the notochord.

In 1866 A. Kowalewsky, in a memoir that is one of the classics of vertebrate morphology, worked out the development of *Amphioxus*, then recognized as the simplest of the vertebrate group, and compared it with the development of an Ascidian, one of a group then termed Tunicate Mollusca, and showed that the latter creature, in its larval stage, possessed, like *Amphioxus*, a notochord, gill-slits and a hollow dorsally placed nerve-tube. In 1877 E. Ray Lankester published a classification of the animal kingdom in which he definitely associated all the Tunicates with the vertebrates, and subdivided Vertebrata as follows: Branch A., Urochorda, which contained the Tunicates and was characterized by the limitation of the notochord to the caudal region; Branch B., Cephalochorda, containing *Amphioxus*, in which the notochord extended from the extreme tip of the tail to that of the snout; Branch C., Craniata, containing the Cyclostomes, Pisces, Batrachia, Reptilia, Aves and Mammalia, in which the anterior extremity of the notochord ended in the base of a cranium. Later, F. M. Balfour adopted the system of Lankester, but proposed to replace the term Vertebrata, which was anatomically misleading, by the new term Chordata, as the latter term laid stress on the existence of the notochord as the fundamental character of the group. A. Kowalewsky had shown as early as 1866 that the marine worm *Balanoglossus*, described by Della Chiaje at the end of the 18th century, possessed a set of gill-slits similar to those of *Amphioxus* and Tunicates. From 1884 to 1886 W. Bateson published a series of studies in which he suggested that there was present in *Balanoglossus* a representative of the notochord, and that a portion at least of its nervous system was a hollow, dorsally placed tube. On these grounds, coupled with the presence of gill-slits, he proposed to add yet a lower branch to the Chordata, to include *Balanoglossus* and to be termed Hemichorda, but neither Bateson nor zoologists who have written since have accepted the vertebrate affinities of *Balanoglossus* with complete confidence. Still more diffidently, S. F. Harmer and others have suggested that *Cephalodiscus* and *Phoronis*, still more lowly marine invertebrates, have claims to be associated with the Chordata.

It may be accepted definitely that *Amphioxus* and the Tunicates must be associated with the craniate vertebrates of Lamarck. With regard to the terms Vertebrata and Chordata, usage still differs. Those who wish to make the names of the larger groups significant labels prefer the term Chordata, and on the whole seem to be prevailing, but there remain many zoologists who prefer the designation with historical associations, and regard it as immaterial if, in the advance of knowledge, the connotation may have been so changed that the term has become conventional rather than verbally significant.

The characters and affinities of the lower groups that have been included under Chordata are discussed in the articles HEMICHORDA, BALANOGLOSSUS, PHORONIDEA, PTEROBRANCHIA, TUNICATA and AMPHIOXUS, so that it is necessary here to deal only with the general characters of the Chordata or Vertebrata Craniata, and to consider the views that have been advanced with regard to the origin of vertebrates.

The Vertebrata Craniata share with the Cephalochordata the fundamental characters of the group Chordata. They are bilaterally symmetrical animals with a well-marked metameric segmentation of the muscles and muscle septa, with a gut opening by an anterior ventral mouth, with lateral gill-slits in the embryo or adult, and with a ventro-posterior anus; with a dorsal tubular central nervous system, under which lies in the embryo or adult an unsegmented notochord of endodermal origin; with the body prolonged posteriorly to the anus to form a metamerically segmented tail containing notochord, nervous system and muscles; with a spacious coelomic cavity and separate blood-vascular system. They differ from the Cephalochordata in the extreme cephalization of the anterior segments of the body, including the formation of an enlarged brain with paired sense organs, the nose, eyes and auditory apparatus, and the formation of a cranium, and in the structure of the skeleton, heart, liver and organs of excretion and reproduction.

Evidence points to the origin of the Cephalochordata and the Craniata from a common ancestor in which metameric segmentation of the mesoblast and the nervous system was complete and regular. This condition has been retained by *Amphioxus*, but in the Craniata has been much modified. The lateral mesoblastic plates with their contained coelom are unsegmented in craniates, although traces of the primitive segmentation are visible in the development of Cyclostomes. The dorsal mesoblastic somites with the segmental musculature derived from them retain the segmental condition in *Amphioxus* and in the trunk region of craniates, but in the head region of the latter there has taken place a fusion or cephalization more pronounced in the higher forms, where the head is distinct from the trunk, than in lower forms where the head passes gradually into the trunk. The exact number of somites which have been cephalized is difficult to estimate, and certainly varies in different cases, but it appears to be certain that three, immediately anterior to the otic region, have been transformed into the optic muscles. Those behind the otic region (metaotic somites) vary from nine to eleven, and in Cyclostomes give rise to segmental muscles in series with those of the trunk. In true fish and higher Craniates the anterior one or two of these metaotic somites practically disappear, whilst of the remainder none form complete segmental muscles, but various portions of them give rise to muscles associated with the branchial apparatus (epibranchial and hypobranchial), the dorsal portions fading away. In other words, the metameric series continued from the trunk to the anterior end of the body in the ancestral form, retained by the Cephalochorda, and of which traces remain in the development of the Craniata, has been modified in the adult Craniata by the suppression of certain portions and the specialization of other portions to form an unsegmented structure. The process of cephalization, with, however, less complete destruction of the segmental arrangement, has also affected the anterior nerves of Craniata and brought about the distinction between cranial and spinal nerves which is a feature of the Craniates. The ancestral form must be supposed to have given off from its central nervous system lateral nerves segmentally arranged in pairs. Each member of each pair possessed two roots, a dorsal and a ventral root, possibly remaining separate, as in the Cephalochordata and the cranial nerves of Craniata, possibly joining to form a common trunk, as in the spinal nerves of Craniata. The ventral roots consisted of motor fibres passing straight outwards to innervate the segmental muscles derived from the dorsal somites; the dorsal roots took a longer course, arching outwards and round the body to supply the visceral muscles, the mucous membranes, the skin and the sense organs connected with these. It appears, moreover, that the ventral roots remained in strict association with the muscular somites to which they corresponded, and wandered beyond their own segmental areas only with these muscles, whereas the ramifications of the dorsal fibres had a wider range and were less closely bound to segmental regions. Such a primitive condition has been retained by *Amphioxus*, but in the case of Craniata only by the spinal nerves. Almost every great anatomist has contributed to working out the history of the cranial nerves, and it would be a hopeless task to make a just allocation of credit for the various steps which have led to our present knowledge, but the names of C. Gegenbaur, F. M. Balfour, A. M. Marshall, J. W. van Wijhe, N. K. Koltzoff, Miss J. B. Platt, J. Beard, H. V. Neal and E. S. Goodrich are conspicuous. The Craniates are characterized by the presence of ten pairs of cranial nerves, numbered usually I. to X., from before backwards, with a course and distribution fundamentally identical throughout the group from the lowest fish to man, whilst in the higher forms an additional eleventh and twelfth pair have been assumed from the trunk or neck. Pairs I. and II. are the nerves of special sense of smell and sight, and in all probability are morphologically distinct from true segmental pairs. Pairs III. to X. represent various portions of primitive segmental pairs, modified in association with the cephalization of the anterior region of the body. III., IV. and VI. innervate the muscles of the eyeball, and represent the ventral roots of the three prootic somites; the dorsal root of the anterior of these three passes to the anterior portion of the head as the so-called *nervus ophthalmicus profundus*. The V. of human anatomy, the *trigeminal*, is formed almost entirely from the dorsal root of the nerve of the second prootic somite, whilst the VII. or *facialis* of human anatomy similarly represents the greater part of the dorsal root of the third prootic somite, whilst the remaining and lesser portion of that root forms the VIII. or *auditory* nerve of human anatomy. The IX. or *glossopharyngeal* represents the dorsal root of the first metaotic somite, the ventral root of which persists in Cyclostomes but disappears together with the somite in higher Craniates. The X. or *vagus* of human anatomy represents the dorsal root of the second metaotic somite. The backward extension of the vagus to supply the regions corresponding to the posterior gill-slits and internal viscera has been interpreted variously. The explanation at first sight most probable, and that has been advocated by Gegenbaur and many other anatomists, is that the dorsal roots corresponding to a number of somites have fused to form a single system. The ventral roots of the somites in question have a varying fate, being fully represented in the Cyclostomes by nerves to musculature developed from these somites, whilst in the higher forms thay have in great part disappeared. Evidence seems to point to a similar disappearance of the dorsal roots of the branchial somites posterior to the first supplied by the vagus; but as remnants of them have been traced in the development of the various Craniates, it seems as if the vagus were not in reality a compound nerve, but the extension of the nerve arising from a single dorsal segmental root. Notwithstanding some dubiety in detail, the main proposition remains clear: the cranial nerves of Craniates have arisen, in the course of a process of cephalization, from a primitive set of segmental nerves in series with those of the trunk, by a suppression of certain portions and an expansion and specialization of other portions. The work of a large number of anatomists has shown that the fundamental morphological characters of the cranium and brain, organs in which the Craniates are most clearly marked off from Cephalochordates, are fundamentally alike throughout the group. The original crude theory of L. Oken and the poet Goethe, that the skull was composed of expanded and fused vertebrae, was disproved by T. H. Huxley and Gegenbaur. There can be little doubt, however, that the region behind the infundibulum, consisting of part of the optic capsules, the anterior extremity of the notochord, the parachordals (for details as to these see article SKELETON) and the corresponding lateral and dorsal elements with their suspended visceral arches represent at least three cephalic somites, and that the process of cephalization has played an important part in the formation of the cranium as it has in the case of the nerves and muscles of the head. The region of the cranium anterior to this is probably a forward growth of the primitive head, produced in association with the development of the organs of smell and sight, and thus is different in kind from the posterior region. But as *Amphioxus* is obviously degenerate in the region of the head, no source of information exists as to the exact mode in which the development of the head of the ancestral vertebrate took place.

It is still less possible to lay down anything definite as to how far the structure of the brain of Craniates conforms with a theory of origin by a process of cephalization of metameric segments. The minute expansion at the anterior end of the nerve tube of *Amphioxus* cannot be called a brain, whilst the brain of all the Craniates is identical in morphological type and so complex that it must have behind it a long history of development. The embryonic Craniate brain appears as three dilatations of the neural tube, respectively the posterior or hind-brain, continuous with the spinal cord, the mid-brain and the fore-brain. From the hind-brain there arises the medulla oblongata or myelencephalon behind, and the metencephalon in front, the dorsal wall of which gives rise to the cerebellum. The hind-brain is closely similar in structure to the spinal cord, and gives rise to all the segmental cranial nerves except the *patheticus* and *motor oculi*. The sides of the mid-brain thicken and give rise to the optic lobes; its floor forms the crura cerebri, whilst the *oculomotor* and *patheticus* nerves take origin from it. The fore-brain divides into a posterior thalamencephalon and an anterior telencephalon. Thickenings of the floor of the thalamencephalon give rise to the optic thalami; the paired optic lobes grow out from its sides; the pineal body, which primitively was a pair of dorsal eyes, grows from the roof and the infundibulum from the floor. The telencephalon in front grows out secondarily to an extent progressively increasing in the higher groups and forms the corpora striata, the cerebral lobes and the rhinencephalon. The most plausible interpretation is that the mid- and hind-brains represent a cephalized continuation of the spinal cord, probably originally metamerically segmented, whilst the fore brain has been developed primitively in association with the organs of smell and hearing, and secondarily in connexion with the increasing elaboration of the higher functions of the brain and the development of the association centres of which the cerebrum is the seat.

The details of the structure and development of the sense-organs, gill-slits and visceral organs of Craniates are sufficiently discussed in the articles dealing with the separate classes of the group. It is necessary to refer, however, to new light thrown on the structure and morphology of the renal excretory organs due chiefly to the investigations of Goodrich. The excretory organs of the vast majority of invertebrate coelomate animals are essentially what are known as nephridia. Nephridia in their simplest form are excretory tubules growing from the exterior inwards, and removing from the surrounding tissues or blood vessels waste matter which they discharge to the exterior. In many cases these tubules acquire secondary openings to the coelom, termed nephrostomes and serving to remove waste matter from that space. Finally, in metamerically segmented invertebrates the nephridia frequently appear in segmentally disposed pairs. Gegenbaur, C. Semper, B. Hatschek, and many other anatomists have compared the kidneys of Craniates with nephridia, supposing the segmental tubules with their coelomic apertures to represent nephridia, which, instead of discharging directly to the exterior by pores in the segments in which they are situated, have come to discharge at each side into a longitudinal common duct with a posterior aperture. The excretory system of *Amphioxus* undoubtedly consists of true nephridia, morphologically identical with those of the invertebrate coelomates. The latter, however, may also possess a different set of organs, also frequently appearing as segmentally arranged tubules. These are the genital funnels which develop outwards from the coelom, and serve for the discharge of the genital products. It is with the latter that the segmental tubules of the Craniata are to be compared, and the possession of a different type of excretory organ is one of the most vital distinctions between the Craniata and the Cephalochordata.

Origin of the Vertebrata.—The recorded fossil history carries us backwards with comparative ease from the highest mammals to the lowest members of the Craniates. Remains of the latter, abundant in the palaeozoic rocks, were undoubtedly true Craniates, allied with the Cyclostomes and the lower fishes, but showing no more than superficial and dubious resemblances to the members of any other group. We have to rely upon general inferences which lead to much ingenious argument and little certain result. The Craniates can be traced back to fishes not unlike the modern shark or dogfish with little dubiety. The Cyclostomes, although true Craniates, present an obviously simpler type of structure: the head is less cephalized and therefore less distinct from the trunk; lower jaw, true teeth and dermal armature are absent, whilst there are other simplifications in the structural type. Very general assent could be obtained for the proposition that one stage in the ancestry of the Vertebrates must have been not unlike a simplified Cyclostome, a bilaterally symmetrical coelomic animal, elongated and fish-like in shape, but without paired limbs, with a smooth, soft skin, a ventral mouth without teeth or lower jaw and probably surrounded by labial palps, with lateral gill-slits and a ventro-posterior anus; with an unsegmented notochord and a dorsal tubular nerve cord. The brain, however, must have been expanded, and there must have been paired organs of smell, two lateral eyes and probably two dorsal eyes, and a large paired auditory apparatus. The mesoblastic system of muscles and fibrous skeleton was highly and regularly segmented, but in the anterior region cephalization had proceeded to a considerable extent. The resemblances between such a creature and *Amphioxus* are so close that they cannot be dismissed. *Amphioxus* no doubt is specialized in many respects, and probably degenerate in others, just as, if we go to the other pole of the Craniates, we know that although the Anthropoid Apes are the nearest living representatives of the ancestor of man, they are specialized in many respects and almost certainly degenerate in other respects. If we carry those processes of progressive change by which the Cyclostome type has passed into the low fish type, and the low fish type into the higher Craniate type, backwards towards *Amphioxus* we reach the conception of an ancestral creature essentially a Cephalochordate, differing no doubt from *Amphioxus* in various details, as one member of a group differs from another, but specially marked by the possession of better developed cranial sense organs and by the presence of a coelomostomic instead of a nephridial excretory system. Paired sense organs of an elaborate character have arisen in many groups, and there seems to be no special difficulty in supposing that those characteristic of Craniates have arisen independently in that group, *Amphioxus*, although in that respect partly degenerate, being degenerate from a stage in which the cephalic sense organs were extremely simple. The different type of excretory system presents even less theoretical difficulty, as both types of segmental funnel exist amongst Invertebrates and may even be present in the same animal. If we follow the process of progressive change still further back, we reach a stage in which cephalization had practically disappeared, and where even metameric segmentation was in a much less advanced condition. The tadpoles of Ascidians, and still more remotely *Balanoglossus*, although still less than *Amphioxus* to be regarded as actual ancestral vertebrate types, give images of some of the many phases in which the ancestral type may have been exhibited. It is needless to say that the creatures exhibiting such a stage in the ancestry of the Vertebrates would have formed simply one in the vast series of marine coelomate types which the anatomy of the Invertebrates shows us to have existed. Its distinguishing features would have been the presence of gill-slits, of the skeletal rod, known as the notochord, and of the dorsal tubular nervous system. We cannot make even profitable guesses as to the exact conditions under which these features, or the corresponding features of other coelomate types, arose in the kaleidoscopic differentiation of form, but consideration of the general morphology of the nervous system enables us to see the Chordate ancestor in its true perspective amongst other coelomic groups. In the Coelentera the nervous system appears as a diffused layer of cells and fibres, underlying, and in close connexion with, the epidermis. This diffused layer may thicken in special regions, forming rings round apertures, radial bands, and so forth, whilst in the intervening areas it disappears. In the different groups of Coelomates specialized bands and strands have formed in this way from a primitive diffuse system, giving rise to the nervous patterns distinctive of the various groups, whilst a second process, that of inward migration from the epidermis, produces further changes. In the Turbellaria there have been formed two ventro-lateral cords with variously placed anastamoses; in the Trematodes, two ventral, two lateral and two dorsal cords with variously placed anastomoses, and in the Cestodes two lateral and in some cases one dorsal cord. In the Nemertea the primitive continuous sub-epidermal sheath is retained with two lateral and sometimes one dorsal thickening. In the Nematodes there are one dorsal, one ventral and at each side two lateral thickenings, sometimes separated cords, sometimes mere sub-epidermal bands, whilst the traces of a circum-oesophageal ring may be regarded as another specialization of the primitive complete sheath. In *Balanoglossus* there is a continuous sheath with a dorsal and ventral band, the latter in certain regions showing traces of a tubular structure. In Annelids and Arthropods there are two ventral bands tending to unite in the median ventral line, and a circum-oesophageal collar. In the Chordates there is a continuous dorsal band, which secondarily migrates inwards and becomes tubular. In almost any of these types, as the individual becomes more integrated, there is a tendency for the nervous matter of the specialized areas to become still further massed; and in bilaterally symmetrical animals with forward progression and the beginning of cephalization a specially important mass forms something comparable with a brain in special relation with the sense organs of the primitive head. If the problem of vertebrate origin be considered from the wide point of view of comparative anatomy, it becomes no more difficult nor remarkable than the differentiation of any other type amongst simple, marine, unsegmented, or little segmented, wormlike creatures. It is obvious, however, that such a theory of origin cannot expect confirmation from the geological record, as it supposes a differentiation of the main chordate characters in a stage too simple to leave fossil remains.

Reference must be made, however, to definite theories of the origin of Vertebrates which have been successively urged by anatomists. A. Dohrn, if not the inventor, was the most ingenious advocate of the Annelid theory. He recognized the fundamental importance of segmentation in vertebrate structure and sought for a highly segmented ancestor. Partly influenced by Ray Lankester's studies on degeneration, he held that the apparently simplest living members of a group may give misleading clues with respect to the ancestral line, and he devoted much brilliant anatomical and embryological work to develop the thesis that *Amphioxus* and the Tunicates were degenerate offshoots from a higher vertebrate stock. He took a Chaetopod worm as the closest living representative of the stock of all segmented animals, and in particular of the Vertebrates, laying stress on the segmentation, the large coelom, the segmental excretory tubules, the vascular system with red blood, the segmentally disposed branchiae, the lateral organs of locomotion, and the tendency to form a distinct head. The chief difficulty was the nervous system, and this he explained by accepting an idea propounded many years before by De Blainville, that the dorsal surface of Vertebrates was homologous with the ventral surface of Annelids and Arthropods. He assumed that the ancestral type was a marine creature in which reversal of surface was of little physiological moment. He supposed that a new mouth had been formed, probably by a coalescence of a pair of gill-slits on what was to be the ventral surface of the vertebrate, and that the old invertebrate mouth with the downward turn of the anterior end of the alimentary canal, between the diverging ends of the ventral nerve cords, was to be sought for in the roof of the vertebrate brain, possibly the pineal body. Dohrn's theory has failed to find acceptance for many reasons, of which the chief are the difficulty as to reversal of surfaces, the knowledge that segmentation occurs independently in many groups of animals and in different organs, greater knowledge of the vascular, excretory and nervous systems, and in particular the discovery that the pineal body was a degenerate eye. F. M. Balfour from the first refused to accept Dohrn's theory and suggested that the dorsal position of the nerve cord in Vertebrates could be accounted for by supposing that the primitive condition was a lateral cord at each side such as were then known to occur in Nemertines, and that these cords had fused dorsally in Vertebrates, ventrally in Annelids. A. A. W. Hubrecht soon afterwards discovered the existence of a continuous nerve sheath in Nemertines, and he and Ray Lankester suggested a Nemertine origin for Vertebrates, and homologized the notochord with the proboscis sheath, Ray-Lankester, in particular, pointing out that the tubular condition of the vertebrate nervous system was secondary, that it consisted essentially of a dorsal band, which sank inwards, and that the canal might have been at first an epidermal water canal. These authors were emphatic in laying stress on the view that no actual Nemertine could be supposed to represent the vertebrate ancestor, but that the Nemertines were to be taken merely as showing the kind of material out of which the vertebrate structure, and in particular the vertebrate nervous system, might have arisen. The view adopted in this article as given above, is in reality an extension of the Hubrecht-Lankester theory.

The theory of vertebrate origin that has been most elaborately expounded is W. H. Gaskell's hypothesis that they are descended from Arthropods. Gaskell accepts Dohrn's view of the importance of segmentation and of the degeneracy of *Amphioxus* and Tunicates, but rejects the conception of a reversal of surfaces. He takes the larval stage of a Cyclostome as the most generalized living representative of the essential vertebrate type, and selects *Limulus*, the kingcrab, in a very general way, as the closest living representative of such an Arthropod type as might have been the vertebrate ancestor. The starting-point of Gaskell's theory is the conception of the vertebrate nervous system as a band of nervous tissue which immediately underlies and gradually grows up round a distinct epidermal tube, the tube which forms the vesicles of the brain and the central canal of the spinal cord. Ray Lankester had already applied this to the Nemertine theory, but Gaskell urges that it affords an immediate comparison with Arthropod structures. The ventral mouth of *Limulus* leads vertically upwards through a ring of nervous tissue, the circumoesophageal commissure, into an expanded stomach, and from this the digestive tube runs back to the anus immediately dorsal to the ventral nerve chain. For Gaskell the infundibulum is the Arthropod oesophagus, the ventricles of the brain are the stomach, and the spinal canal leading back to fuse with the anus at the neurenteric canal is the Arthropod digestive tract. In the Vertebrate a new digestive tract has been formed, probably from a structure corresponding to the branchial chamber of Arthropods. The lateral halves of the ventral nervous system of the Arthropod, where they diverge on either side of the oesophagus, represent the crura cerebri of Vertebrates, whilst the supra-oesophageal ganglia represent the fore-brain. Gaskell has instituted an elaborate comparison, extending to very minute details of structure, and finds remarkable analogies between the organs of Arthropods and structures in the Vertebrates. From the palaeontological side, he points out that at the time when the earliest known Craniates were abundant, large Arthropods, essentially like *Limulus*, were also abundant. He thinks it probable that Vertebrates arose from a dominant invertebrate group, and points to many resemblances in detail between the Silurian Arthropods Palaeostraca and the Craniate Ostracoderms of the same horizon.

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VERTICAL (from Lat. *vertex*, highest point), the direction of the line of action of gravity, as determined by the plumb-line. *The angle of the vertical* is the angle between the direction of the plumb-line and that of the earth's centre (see Earth, Figure of the).

VERTUE, GEORGE (1684–1756), English engraver and antiquary, was born in St Martin's-in-the-Fields, London, in 1684. At the age of thirteen he was apprenticed to an heraldic engraver, a Frenchman, who failed in three or four years. Vertue then studied drawing at home, and afterwards worked for seven years as an engraver under Michael Vandergucht. He was patronized by Sir Godfrey Kneller, and was one of the first members of the Academy of Painting which that artist instituted in 1711. His plate of Archbishop Tillotson, after Kneller, commissioned by Lord Somers, established his reputation as an engraver; and he was soon in an excellent practice, engraving portraits after Dahl, Richardson, Jervas and Gibson. In portraiture alone he executed over five hundred plates. In 1717 he was appointed engraver to the Society of Antiquaries, and his burin was employed upon many interesting statues, tombs, portraits and other subjects of an antiquarian nature. He died on the 24th of July 1756, and was buried in the cloisters of Westminster Abbey.

From the year 1713 Vertue had been indefatigable in his researches on all matters connected with the history of British art, and had accumulated about forty volumes of memoranda on the subject. These were purchased by Horace Walpole, and form the basis of that author's *Anecdotes of Painting in England*, including an account of Vertue's life and a catalogue of his engravings. Vertue's own literary works include *On Holbein and Gerard's Pictures* (1740); *Medals, Coins, Great Seals, Impressions, from the Elaborate Works of Thomas Simon* (1753); *Catalogue and Description of King Charles the First's Capital Collection of Pictures, Limnings, Statues, &c.* (1757); *Catalogue of the Collection of Pictures belonging to King James II., to which is added a Catalogue of Pictures and Drawings in the Closet of Queen Caroline* (1758); *Catalogue of the Curious Collection of Pictures of George Villiers, Duke of Buckingham* (1758); *Description of the Works of that Ingenious Delineator and Engraver, W. Hollar* (1745).

VERTUMNUS (or Vortumnus, "turning," "changing"), in Roman mythology, the god of the changing year with its seasons, flowers and fruits, probably of Italian origin. Like Proteus, he had the power of assuming any shape he pleased, which enabled him to win the love of Pomona (*q.v.*). His shrine and statue (see the well-known description in Propertius iv. 2) were in the Vicus Tuscus, and from his connexion with this busy street he was regarded as having a special interest in trade and barter. At another sanctuary on the slope of the Aventine, sacrifice was offered to him every year on the 13th of August. It is probable that he was of Etruscan origin (see Wissowa, *Religion und Kultus der Römer*, 1902, p. 233).

VERULAMIUM, a Romano-British town situated in the territory of the Catuvellauni, close to the modern St Albans (Hertfordshire). Before the Roman conquest it was probably a native capital: afterwards it received the dignity of a *municipium* (implying municipal status and Roman citizenship). Tacitus tells us that the town was burnt by Boadicea in A.D. 61, but it again rose to prosperity. Its site is still easily recognizable. Its walls of flint rubble survive in stately fragments, and enclose an area of 200 acres. Of the internal buildings little is known. A theatre was excavated in 1847, and parts of the forum were opened by Mr William Page in 1898; both indicate a civilized and cultivated town. The complete uncovering of the site was planned in 1910. (F. J. H.)

VERVET, a Central and South African monkey, known as *Cercopithecus pygerythrus*. It is nearly allied to the grivet (*q.v.*), but distinguished (as indicated by its name) by the presence of a rusty patch at the root of the tail, and by the black (instead of grey) chin, hands and feet.

VERVIERS, a town of Belgium, in the province of Liége, not far from the Prussian frontier, and on the main line from Liége to Aix-la-Chapelle and Cologne. Pop. (1904) 49,168. It is a modern town owing its prosperity to the cloth trade which began here in the 18th century. It is situated on the Vesdre, which flows into the Ourthe a few miles before its junction with the Meuse; and the water of that river is supposed to be especially good for dyeing purposes. As the river water was insufficient to maintain the local industry an artificial reservoir was constructed at La Gileppe on the Hautes Fagnes, and an imposing aqueduct conveys the water stored on these highlands into Verviers. There are also extensive glass factories, but these have suffered from German competition, and many have been closed. A monument to a local celebrity named Chapuis is interesting for the reason that his execution by order of the prince-bishop of Liége was the last act of sovereignty taken by that prelate.

VESICA PISCIS (Fr. *amande mystique*), in architecture, the term given to a pointed oval panel formed by two equal circles cutting each other in their centres; this is a common form given to a panel in which the figure of Christ is represented. It is commonly employed in medieval seals, and especially those of bishops and monastic establishments.

VESOUL, a town of eastern France, capital of the department of Haute-Saone, 236 m. E.S.E. of Paris on the Eastern railway to Belfort. Pop. (1906) 8702. Vesoul is situated between the isolated conical hill of La Motte (1263 ft.) and the river Durgeon. The vine-clad hill, from which there is a fine view of the Jura and Vosges mountains, is crowned by a votive chapel which in 1855 replaced the old fortification. The medieval walls of the town, dating from the 13th and 15th centuries, still exist on its northern side, and in the narrow and winding streets are many old buildings. The church of St George dates from the 18th century. In the pleasant south-eastern quarter are the promenade and the Place de la République, with a monument to the Gardes Mobiles who fell in the war of 1870–71. Vesoul is the seat of a prefect, a tribunal of first instance and a court of assize, and has a lycée for boys, training colleges for both sexes, and a branch of the Bank of France. Distilling and the manufacture of files and tapioca are among the industries. The town is a market for farm-produce and cattle.

Vesoul (*Vesulium Castrum, Visolium, Vesulum*) is of ancient origin, but in existing records is first mentioned in the 9th century. It was originally a fief of the church of Besançon, and passed afterwards to the house of Burgundy, becoming, in the 13th century, capital of the bailiwick of Amont. The castle was destroyed in the 17th century. The town suffered much during the wars of religion and the Thirty Years' War. Vesoul belonged temporarily to France after the death of Charles the Bold, duke of Burgundy; was returned to the empire when Charles VIII., king of France, broke off his marriage with the daughter of Maximilian, king of the Romans; and again became part of France under Louis XIV. after the peace of Nijmwegen in 1678.

VESPASIAN, in full Titus Flavius Vespasianus, Roman emperor A.D. 70–79, was born on the 18th of November, A.D. 9, in the Sabine country near Reate. His father was a tax-collector and money-lender on a small scale; his mother was the sister of a senator. After having served with the army in Thrace and been quaestor in Crete and Cyrene, Vespasian rose to be aedile and praetor, having meanwhile married Flavia Domitilla, the daughter of a Roman knight, by whom he had two sons, Titus and Domitian, afterwards emperors. Having already served in Germany, in the years 43 and 44, in the reign of Claudius, he distinguished himself in command of the 2nd legion in Britain under Aulus Plautius. He reduced Vectis (Isle of Wight) and penetrated to the borders of Somersetshire. In 51 he was for a brief space consul; in 63 he went as governor to Africa, where, according to Tacitus (ii. 97), his rule was "infamous and odious"; according to Suetonius (*Vesp.* 4), "upright and highly honourable." He went with Nero's suite to Greece, and in 66 was appointed to conduct the war in Judaea, which was threatening general commotion throughout the East, owing to a widely spread notion in those parts that from Judaea were to come the future rulers of the world. Vespasian, who had a strong vein of superstition, was made to believe that he was himself to fulfil this expectation, and all manner of omens and oracles and portents were applied to him. He also found encouragement in Mucianus, the governor of Syria; and although a strict disciplinarian and reformer of abuses, he had a soldiery thoroughly devoted to him. All eyes in the East were now upon him; Mucianus and the Syrian legions were eager to support him; and on the 1st of July 69, while he was at Caesarea, he was proclaimed emperor, first by the army in Egypt, and then by his troops in Judaea. The legions of the East at once took the customary oath of allegiance. Nevertheless, Vitellius, the occupant of the throne, had on his side the veteran legions of Gaul and Germany, Rome's best troops. But the feeling in Vespasian's favour quickly gathered strength, and the armies of Moesia, Pannonia and Illyricum soon declared for him, and made him in fact master of half of the Roman world. They entered Italy on the north-east under the leadership of Antonius Primus, defeated the army of Vitellius at Bedriacum (or Betriacum), sacked Cremona and advanced on Rome, which they entered after furious fighting and a frightful confusion, in which the Capitol was destroyed by fire. The new emperor received the tidings of his rival's defeat and death at Alexandria, whence he at once forwarded supplies of corn to Rome, which were urgently needed, along with an edict or a declaration of policy, in which he gave assurance of an entire reversal of the laws of Nero, especially those relating to treason. While in Egypt he became more and more imbued with superstition, consulting astrologers and allowing himself to be flattered into a belief that he possessed a divine power which could work miracles. Leaving the war in Judaea to his son Titus, he arrived at Rome in 70. He at once devoted his energies to repairing the evils caused by civil war. He restored discipline in the army, which under Vitellius had become utterly demoralized, and, with the co-operation of the senate, put the government and the finances on a sound footing. He renewed old taxes and instituted new, increased the tribute of the provinces, and kept a watchful eye upon the treasury officials. By his own example of simplicity of life, he put to shame the luxury and extravagance of the Roman nobles and initiated in many respects a marked improvement in the general tone of society. As censor he raised the character of the senate, removing unfit and unworthy members and promoting good and able men, among them the excellent Julius Agricola. At the same time he made it more dependent upon the emperor, by exercising an influence upon its composition. He altered the constitution of the praetorian guard, in which only Italians, formed into nine cohorts, were enrolled. In 70 a formidable rising in Gaul, headed by Claudius Civilis, was suppressed and the German frontier made secure; the Jewish War was brought to a close by Titus's capture of Jerusalem, and in the following year, after the joint triumph of Vespasian and Titus, memorable as the first occasion on which a father and his son were thus associated together, the temple of Janus was closed, and the Roman world had rest for the remaining nine years of Vespasian's reign. The peace of Vespasian passed into a proverb. In 78 Agricola went to Britain, and both extended and consolidated the Roman dominion in that province, pushing his arms into North Wales and the Isle of Anglesey. In the following year Vespasian died, on the 23rd of June.

The avarice with which both Tacitus and Suetonius stigmatize Vespasian seems really to have been an enlightened economy, which, in the disordered state of the Roman finances, was an absolute necessity. Vespasian could be liberal to impoverished senators and knights, to cities and towns desolated by natural calamity, and especially to men of letters and of the professor class, several of whom he pensioned with salaries of as much as £800 a year. Quintilian is said to have been the first public teacher who enjoyed this imperial favour. Pliny's great work, the *Natural History*, was written during Vespasian's reign, and dedicated to his son Titus. Some of the philosophers who talked idly of the good old times of the republic, and thus indirectly encouraged conspiracy, provoked him into reviving the obsolete penal laws against this class, but only one, Helvidius Priscus, was put to death, and he had affronted the emperor by studied insults. "I will not kill a dog that barks at me," were words honestly expressing the temper of Vespasian. Much money was spent on public works and the restoration and beautifying of Rome—a new forum, the splendid temple of Peace, the public baths and the vast Colosseum being begun under Vespasian. The roads and aqueducts were repaired, and the limits of the *pomerium* extended.

To the last Vespasian was a plain, blunt soldier, with decided strength of character and ability, and with a steady purpose to establish good order and secure the prosperity and welfare of his subjects. In his habits he was punctual and regular, transacting his business early in the morning, and enjoying his siesta after a drive. He had not quite the distinguished bearing looked for in an emperor. He was free in his conversation, and his humour, of which he had a good deal, was apt to take the form of rather coarse jokes. He could jest, it was said, even in his last moments. "Methinks I am becoming a god," he whispered to those around him. There is something very characteristic in the exclamation he is said to have uttered in his last illness, "An emperor ought to die standing."

See Tacitus, *Histories*; Suetonius, *Vespasian*; Dio Cassius, lxvi.; Merivale, *Hist. of the Romans under the Empire*, chs. 57-60; H. Schiller, *Geschichte der römischen Kaiserzeit*, i. pt. 2; B. W. Henderson, *Civil War and Rebellion in the Roman Empire A.D. 69–70* (1908).

VESPERS (*officium vespertinum*), in the Roman Catholic liturgy, that part of the daily office which follows none (*nona*) and precedes compline (*completorium*). In it the Pater Noster, Ave Maria, Deus in Adjutorium, &c., are followed by five psalms and five antiphons, after which come the "little chapter," the hymn and the verse, which vary according to the season, the Magnificat and its antiphon, and the appropriate collect. In its general features the use of this office can be traced back to a very early date both in the Eastern Church and in the Western. Vespers may be said or sung at any time after midday, and in some circumstances even before it. (See BREVIARY.)

VESPERS, SICILIAN, the revolution of the Sicilians against the Angevin domination, so called because it broke out at the hour of Vespers on Easter Tuesday 1282. Charles I. of Anjou had encountered more resistance in conquering Sicily than on the mainland, as the people were more independent and more strongly attached to the house of Hohenstaufen; and consequently his government was more oppressive and cruel. The officials and the insolent French nobility whom he established in the island rode rough-shod over the privileges of the native aristocracy and the customs of the people, and the natives were ground down by heavy taxes and degrading personal services. The debased currency ruined trade, and the government treated the Sicilians with the utmost contempt. "The outrage of personal service," wrote Amari (*Guerra del Vespro*, ch. iv.), "exceeded the limits of feudalism as well as of the strangest and most brutal caprices. Noble and worthy men were forced to carry viands and wine on their shoulders to the tables of the foreigner, and many young nobles were constrained to turn the spit in his kitchens like scullions or slaves." The administration was more regular, and therefore more unyielding and heartless, than that of the Hohenstaufens, and also more foreign. Hatred of Angevin rule grew day by day, until the people were driven to revolt. According to tradition, the leader of the rising was Giovanni da Procida, a Salernitan noble with Sicilian connexions, who had been in the service of Hohenstaufens, but, having lost position and property after the fall of Conradin, he had taken refuge at the court of Peter III., king of Aragon, and induced him to try to make good his claims on Sicily, which were based on the rights of his queen, Costanza, daughter of Manfred. But as a matter of fact the actual outbreak was a purely unpremeditated popular movement. Charles at that time was making preparations for an attack on the East Roman empire, and extorting more money than ever from the Sicilians in order to meet his expenses. Peter availed himself of the fears which Charles's ambitions were arousing to open negotiations with his various enemies, especially with the Greek emperor, Michael Palaeologus, the Italian Ghibellines, the discontented Sicilian nobles, and perhaps with Pope Nicholas III. Suddenly the people of Sicily, goaded beyond endurance, rose against their rulers, regardless of these various plots. On the 31st of March 1282 a riot broke out in a church near Palermo, in consequence, according to tradition, of the insults of a French soldier towards a Sicilian woman, and a general massacre of the French began. The rising spread to the city; where the republic was proclaimed, and then through the rest of the island; thousands of French men, women and children were butchered (there may be some exaggeration in the wholesale character of the slaughter), and by the end of April the whole of Sicily was in the hands of the rebels. Charles at once led an expedition against the Sicilians and besieged Messina; and although the enemy had been expelled, they would hardly have been able to withstand this new invasion successfully had they not received assistance from Peter of Aragon and their own nobility, whose conspiracy they had so unexpectedly forestalled. This intervention, however, changed the character of the movement, and the free communes which had been proclaimed throughout the island had to submit to the royal prerogatives and to a revived feudalism. Peter, having reached Palermo in September 1282, accepted the Sicilian crown voluntarily offered to him, levied recruits, and declared war on Charles. Hostilities were carried on by land and sea, and the Angevin attacks on Messina were repulsed and followed up by raids on Calabria, where Reggio and other towns declared for King Peter. Charles proposed to settle the Sicilian question by a single combat between himself and Peter; but although the duel was agreed upon it never took place, owing to the mutual distrust of the two rivals. Peter created some discontent by conferring many offices in Sicily on Aragonese and Catalans, but at the parliament of Catania (1283) he undertook at his death to leave Aragon to his son Alphonso and Sicily to his younger son James, so that the two crowns should not be united, an arrangement which fell in with the Sicilians' aspirations towards independence. Pope Martin IV., unlike Nicholas III., threw the whole weight of his authority in favour of the Angevins, excommunicated Peter and the Sicilians, declaring that the former had forfeited even his rights to Aragon, conferred on Charles's expedition to reconquer the island the privileges of a crusade, and levied dimes throughout Christendom to supply the funds. The reason for this uncompromising attitude lies in the papal claim that Sicily was a fief of the Church, a claim which could only be enforced by means of the Angevins. But Charles's fleet was completely destroyed off Malta by that of the Sicilians and Aragonese, commanded by the Calabrese Ruggiero di Lauria (June 1283), and a second fleet met with a similar fate a year later in the bay of Naples, on which occasion Charles's son (afterwards Charles II., *lo Zoppo*) was captured. The Aragonese were now masters of the sea. Risings broke out even in the mainland provinces, and while Charles was preparing for a supreme effort to re-establish his authority he died (1285). Peter died soon after, but the war went on and spread to Aragon, which the Angevins, in virtue of the pope's excommunication of Peter, were trying to conquer. In 1287 the French encountered a fresh naval disaster at the hands of Lauria, and a force which they landed in Sicily was defeated. A two years' truce was now agreed upon, and Charles II. was liberated on his promising to renounce all claims on Aragon; but the pope Nicholas IV., who was determined that no peace should be made unless the Aragonese gave up the island, absolved him from his oath and crowned him king of the Two Sicilies (1289). Alphonso died in 1291, and was succeeded by his brother James, who took possession of the Aragonese crown, leaving his brother Frederick as governor of Sicily, thus uniting the two kingdoms, in violation of King Peter's promises. He then opened negotiations with Pope Boniface VIII. (they had been begun by Alphonso and Nicholas IV.), and eventually agreed to surrender the towns captured in the Neapolitan provinces to Charles II., and hand over Sicily to the Church, actually binding himself to assist in crushing the Sicilians if they resisted; in exchange he was to marry Charles's daughter, Bianca, and to receive Sardinia and Corsica, while Charles's cousin, Charles of Valois, was to renounce his claims on Aragon (1295). This treaty aroused bitter indignation in Sicily, where all classes determined to resist its execution at all costs. They found a leader in Frederick, who, rejecting all the pope's blandishments and bribes, threw in his lot with the Sicilians. For the sequel of the war see under FREDERICK III. of Sicily. Peace was made with the treaty of Caltabellotta in 1302, which left Sicily an independent kingdom under Frederick for that prince's lifetime; and although at his death it was to have reverted to the Angevins, he was actually succeeded by his son, and the island retained its independence for a considerable period. Undoubtedly the Vespers and its consequences revived Sicilian nationalism after the period of degrading Angevin oppression, and with the new dynasty a higher civilization, nearly rivalling that which had flourished under the Hohenstaufens, an improved constitution, and fine military qualities were the outcome.

BIBLIOGRAPHY.—The standard work on the subject is Michele Amari's *Guerra del Vespro* (2 vols. 8th ed., Florence, 1876), which is based on a study of the original authorities, but is too strongly prejudiced against the French; cf. L. Cadier's *Essai sur l'administration du royaume de Sicile par Charles I. et Charles II. d'Anjou* (fasc. 59 of the *Bibliothèque des écoles françaises de Rome et d'Athènes*, Paris, 1891); A. de Saint-Priest, *Histoire de la conquête de Naples par Charles d'Anjou* (Paris, 1847–49); F. Lanzani, *Storia dei communi d'Italia*, lib. v. ch. 3 (Milan, 1882); A. Cappelli's preface to the "Leggenda di Messer Giovanni da Procida," in *Miscellanea di opuscoli inediti o rari dei secoli XIV. XV.* (Turin, 1861). Among the original authorities, Ricobaldo Ferrarese (in Muratori, *Rer. Ital. script.* tom. ix.), the two biographies of Martin IV. (ibid.), Fra Corrado (ibid. tom. i.), the Catalan author of the "Gesta comitum Barcinonensium" (in Barluzio's *Marca Hispanica*, ch. 28) should be mentioned. A considerable list is given in Amari's *Guerra del Vespro*. (L. V.*)

VESPUCCI, AMERIGO (1451–1512), merchant and adventurer, who gave his name of *Amerigo* to the new world as *America*, was born at Florence on the 9th of March 1451. His father, Nastagio (Anastasio) Vespucci, was a notary, and his uncle, Fra Giorgio Antonio Vespucci, to whom he owed his education, was a scholarly Dominican and a friend of Savonarola. As a student Amerigo is said to have shown a preference for natural philosophy, astronomy and geography. He was placed as a clerk in the great commercial house of the Medici, then the ruling family in Florence. A letter of the 30th of December 1492 shows that he was then in Seville; and till the 12th of January 1496 he seems to have usually resided in Spain, especially at Seville and Cadiz, probably as an agent of the Medici. In December 1495, on the death of a Florentine merchant, Juanoto Berardi, established at Seville, who had fitted out the second expedition of Columbus in 1493, and had also undertaken to fit out twelve ships for the king of Spain (April 9th, 1495), Vespucci was commissioned to complete the contract. As Ferdinand, on the 10th of April 1495, recalled the monopoly conceded to Columbus (this order of April 10th, 1495, was cancelled on June 2nd, 1497), "private" exploring now had an opportunity, and adventurers of all kinds were able to leave Spain for the West. Vespucci claims to have sailed with one of these "free-lance" expeditions from Cadiz on the 10th of May 1497. Touching at Grand Canary on the way, the four vessels he accompanied, going thirty-seven days on a west-south-west course, and making 1000 leagues, are said to have reached a supposed continental coast in 16° N., 70° W. from Grand Canary (June 16th, 1497). This should have brought them into the Pacific. They sailed along the coast, says Vespucci, for 80 leagues to the province of Parias (or Lariab), and then 870 leagues more, always to the north-west, to the "finest harbour in the world," which from this description should be in British Columbia or thereabouts. Thence 100 leagues more to north and north-east to the islands of the people called "Iti," from which they returned to Spain, reaching Cadiz on the 15th of October 1498. Still following Vespucci's own statement, he, on the 16th of May 1499, started on a second voyage in a fleet of three ships under Alonzo de Ojeda (Hojeda). Sailing south-west over 500 leagues they crossed the ocean in forty-four days, finding land in 5° S. Thence, encountering various adventures, they worked up to 15° N., and returned to Spain by way of Antiglia (Española, San Domingo), reaching Cadiz on the 8th of September 1500. Entering the service of Dom Manuel of Portugal, Vespucci claims to have taken part in a third American expedition, which left Lisbon on the 10th (or 15th) of May 1501. Vespucci has given two accounts of this alleged third voyage, differing in many details, especially dates and distances. From Portugal he declares that he sailed to Bezeguiche (Cape Verde), and thence south-west for 700 leagues, reaching the American coast in 5° S. on the 7th (or 17th) of August. Thence eastward for 300 (150) leagues, and south and west to 52° S. (or 73° 30′; in his own words, "13° from the antarctic pole," *i.e.* well into the antarctic continent). He returned, he adds, by Sierra Leone (June 10th), and the Azores (end of July), to Lisbon (September 7th, 1502). His second Portuguese (and fourth and last American) voyage, as alleged by him, was destined for Malacca, which he supposed to be in 33° S. (really in 2° 14′ N.). Starting from Lisbon on the 10th of May 1503, with a fleet of six ships, and reaching Bahia by way of Fernando Noronha (?), Vespucci declares that he built a fort at a harbour in 18° S., and thence returned to Lisbon (June 18th, 1504). In February 1505, being again in Spain, he visited Christopher Columbus, who entrusted to him a letter for his son Diego. On the 24th of April 1505, Vespucci received Spanish letters of naturalization; and on the 6th of August 1508 was appointed *piloto mayor* or chief pilot of Spain, an office which he held till his death, at Seville, on the 22nd of February 1512.

If his own account had been trustworthy, it would have followed that Vespucci reached the mainland of America eight days before John Cabot (June 16th against June 24th, 1497). But Vespucci's own statement of his exploring achievements hardly carries conviction. This statement is contained (i.) in his letter written from Lisbon (March or April 1503) to Lorenzo Piero Francesco di Medici, the head of the firm under which his business career had been mostly spent, describing the alleged Portuguese voyage of March 1501–September 1502. The original Italian text is lost, but we possess the Latin translation by "Jocundus interpreter," perhaps the Giocondo who brought his invitation to Portugal in 1501. This letter was printed (in some nine editions) soon after it was written, the first two issues (*Mundus Novus* and *Epistola Albericii de Novo Mundo*), without place or date, appearing before 1504, the third, of 1504 (*Mundus Novus*), at Augsburg. Two very early Paris editions are also known, and one Strassburg (*De Ora Antarctica*) of 1505, edited by E. Ringmann. It was also included in the *Paesi novamente retrovati* of 1507 (Vicenza) under the title of *Novo Mondo da Alb. Vesputio*. The connexion of the new world with Vespucci, thus expressed, is derived from the argument of this first letter, that it was right to call Amerigo's discovery a new world, because it had not been seen before by any one. This prepared the way for the American name soon given to the continent. (ii.) In Vespucci's letter, also written from Portugal (September 1504), and probably addressed to his old schoolfellow Piero Soderini, gonfaloniere of Florence 1502–1512. From the Italian original (of which four printed copies still exist, without place or date, but probably before 1507) a French version was made, and from the latter a Latin translation, published at St Dié in Lorraine in April 1507, and immediately made use of in the *Cosmographiae Introductio* (St Dié, 1507) of Martin Waldseemüller (Hylacomylus), professor of cosmography in St Dié University. Here we have perhaps the first suggestion in a printed book that the newly discovered fourth part of the world should be called "America, because Americus discovered it." Since Alexander von Humboldt discussed the subject in his *Examen critique de l'histoire de la géographie du nouveau continent* (1837), vol. iv., the general weight of opinion (in spite of F. A. de Varnhagen, *Amerigo Vespucci, son caractère, ses écrits. . . sa vie . . .* , Lima, 1865, and other pro-Vespuccian works) has been that Vespucci did not make the 1497 voyage, and that he had no share in the first discovery of the American continent.

See also R. H. Major, *Prince Henry the Navigator* (London, 1868), pp. 367–88; F. A. de Varnhagen, *Le Premier voyage de Amerigo Vespucci* (Vienna, 1869); *Nouvelles recherches sur les derniers voyages du navigateur florentin* (Vienna, 1869); *Ainda Amerigo Vespucci, Novos estudos* (Vienna, 1874); Luigi Hugues, *Il terzo viaggio di A. Vespucci* (Florence, 1878); "Alcune considerazioni sul Primo Viaggio di A. Vespucci," in the *Bolletino* of the Italian Geographical Society, series ii. vol. x. pp. 248–63, 367–80 (Rome, 1885); "Il quarto Viaggio di A. Vespucci," in the same *Bolletino*, year xx., vol. xxiii. pp. 532–54 (Rome, 1886); "Sul nome 'America'" in the same *Bolletino*, series iii. vol. i. pp. 404–27, 515–30 (Rome, 1888), and an earlier study under the same title (Turin, 1886); "Sopra due lettere di A. Vespucci," in the same, series iii. vol. iv. pp. 849–72, 929–51 (Rome, 1891); *Narrative and Critical History of America*, edited by Justin Winsor, vol. ii. pp. 129–86 (1886); *The Letters of A. Vespucci* (translation, &c., by Clements R. Markham, London, Hakluyt Society, 1894); H. Harrisse, *A. Vespuccius* (London, 1895); Jos. Fischer and F. R. von Weiser, *The Oldest Map with the Name America . . .* (Innsbruck, 1903); Angelo Maria Bandini and Gustavo Uzielli, *Vita di Amerigo Vespucci* (Florence, 1898); B. H. Soulsby in the *Journal of the Royal Geographical Society* (London, February 1902), pp. 201–9. (C. R. B.)

VESSEL (O. Fr. *vaissel*, from a rare Lat. *vascellum*, dim. of *vas*, vase, urn), a word of somewhat wide application for many objects, the meaning common to them being capacity to hold or contain something. Thus it is a general term for any utensil capable of containing liquids, and for those tubular structures in anatomy, such as the arteries, veins or lymphatics, which contain, secrete or circulate the blood or lymph. Organs or structures which are largely supplied with vessels are said to be "vascular" (Lat. *vasculum*, another diminutive of *vas*). Vessel (as in French) is also a general term for all craft capable of floating on water larger than a rowing boat. The word is also familiar in Biblical phraseology in the figurative sense of a person regarded as the recipient of some Divine dispensation, a "chosen vessel," or as one into which something is infused or poured, "vessel of wrath."

VESTA (Gr. Ἑστία), the goddess of fire and the domestic hearth. The cults of the Greek Hestia (*q.v.*) and the Latin Vesta, both of which involved the guardianship of an ever-burning sacred fire, are most probably derived from a very early custom, common to a great variety of races in different ages. Among primitive peoples it became the custom for each village to maintain a constant fire for general use, to avoid the necessity of obtaining a spark by friction in case of the accidental extinction of all the village fires.[1] This fire, the central hearth of the village (*focus publicus*), became a sacred symbol of home and family life. The form of the primitive house in which the fire was preserved, probably a round hut made of wattled osiers daubed with clay, appears to have survived both in the circular prytaneum of the Greeks and in the Aedes Vestae (Temple of Vesta) in Rome. To watch this fire would naturally be the duty of unmarried women, and hence may have arisen the Roman order of virgin priestesses, the vestals, whose chief duty it was to tend the sacred fire.

The prehistoric method of getting a spark appears to have survived in the rule that, if ever the sacred fire of Vesta did go out, the negligent vestal was to be punished by scourging (Livy xxviii. 11), and the fire rekindled either by friction of dry sticks[2] or, in later times, by the sun's rays brought to a focus by a concave mirror (Plut. *Numa*, 9). In the prytaneum (*q.v.*) which existed in every Greek state, a different form of cult was developed, though the essential point, the sacred fire, was kept up, just as in the Latin worship of Vesta; and in both cases the fire was extinguished annually at the beginning of the new year, and solemnly rekindled by one of the primitive and hence sacred methods.[1] In Rome this was done on the first day of March, the Latin New Year's Day (Ovid, *Fasti*, iii. 137–45). Among both Greek and early Latin races, at the founding of a new colony, fire was solemnly sent from the prytaneum of the mother colony to kindle a similar sacred fire in the new settlement. Thus we find that, according to tradition, the worship of Vesta in Rome was introduced from Alba Longa (Livy i. 20, and Ovid, *Fasti*, iii. 46), which appears to have been the oldest of the Latin colonies in Latium. The most generally received Latin legend attributes the founding of the Roman temple of Vesta to Numa, who transferred the centre of the cult from Alba, together with the four vestal virgins, its priestesses (Plut. *Numa*, 10). One of the later kings, either Tarquin I. or Servius Tullius, is said to have increased the number to six (Dion. Hal. iii. 67, and Plut. *Numa*, 10), and it is not till the last years of the pagan period that we hear of a seventh vestal having been added (see Ambrose, *Epist.*, ed. Pareus, p. 477; also Plut. *Rom.* and *Cam.*).

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[1] J. G. Frazer in the *Journal of Philology* (vol. xiv. pp. 145–72), "The Worship of Vesta and its Connexion with the Greek Prytaneum," gives many examples of a similar custom still surviving among various savage races.

[2] An allusion to the earliest method of obtaining fire by rubbing two sticks together is probably contained in the myth of Prometheus, who brought fire to mortals hidden in a hollow wand.

The election (*captio*) of the vestal during the early period of Rome was in the hands of the king, and in those of the pontifex maximus under the republic and empire,[2] subject, however, to the following conditions (Aul. Gell. i. 12): (1) the candidate was to be more than six and less than ten years of age; (2) she was to be *patrima* and *matrima*, *i.e.* having both parents alive; (3) free from physical or mental defects; (4) daughter of a free-born resident in Italy. Certain details of the election were arranged subject to the provisions of the Lex Papia, now unknown. The selected child had her hair cut off, and was solemnly admitted by the pontifex maximus, who held her by the hand, and, addressing her by the name *amata*, pronounced an ancient formula of initiation, which is given by Aulus Gellius. In early times there were certain rules by which girls could be excused from serving as vestals, but the honour soon became so eagerly sought that these provisions were practically useless. Vows were taken by the vestal for a period of thirty years, after which she was free to return to private life and even to marry—which she very rarely did (Aul. Gell. vi. 7). This period of thirty years was divided into three decades: during the first the vestal learnt her duties; during the second she practised them; and during the third she instructed the young vestals. The special dignity of chief of the vestals (*virgo vestalis maxima*) was reached in order of seniority. The inscriptions on the pedestals of statues of various *vestales maximae* show that a number of different grades of honour were passed through before reaching the highest dignity of *maximatus*.[3]

The duties of the vestals, besides the chief one of tending the holy fire (Cic. *De Leg.* ii. 8), consisted in the daily bringing of water from the sacred spring of Egeria, near the Porta Capena, to be used for the ceremonial sweeping and sprinkling of the Aedes Vestae.[4] They also offered sacrifices of salt cakes—*muries* and *mola salsa*—and poured on the altar of sacred fire libations of wine and oil, as is represented on the reverses of several first brasses and medallions of the empire. The vestals were bound to offer daily prayers for the welfare of the Roman state, and more especially in times of danger or calamity (Cic. *Pro Font.* 21). They were also the guardians of the seven sacred objects on which the stability of the Roman power was supposed to depend: the chief of these was the Palladium, a rude archaic statue of Pallas, which was said to have been brought by Aeneas from the burning Troy. This sacred object was never shown to profane eyes, but it is represented on the reverse of a coin struck by Antoninus Pius in honour of his deified wife Faustina. Strict observance of the vow of chastity was one of the chief obligations of the vestals, and its breach was punished by burial alive at a place near the Porta Collina known as the Campus Sceleratus (see Livy viii. 15 and 89; Plin. *Ep.* iv. 11; and Suet. *Dom.* 8). Cases of unchastity and its punishment were rare; and, as the evidence against the vestal was usually that of slaves, given under torture, it is probable that in many instances an innocent vestal suffered this cruel death.

The privileges of the vestals and their influential position were very remarkable. They were exempt from any *patria potestas*, except that of the pontifex maximus, their religious father; they could dispose by will of their property, and were in most respects not subject to the Roman laws ("legibus non tenetur," Servius, on Virg. *Aen.* xi. 204; cf. Gaius i. 130, and Dio Cass. lvi. 10). This involved freedom from taxes, and the right to drive through the streets of Rome in carriages (*plostrum* and *currus arcuatus*). Some bronze plates have been found which were once attached to the carriages of vestals; the inscription on one of them runs thus: *Flaviae Publiciae v.v. maximae inmunis in jugo* (see *C.I.L.* vi. 2146–2148; cf. also Prudentius, *Contra Symm.* ii. 1088). They were preceded by a lictor when appearing on state occasions, and enjoyed other semi-royal honours (Plut. *Numa*, 10, and Dio Cass. xlvii. 19). At theatres and other places of amusement they occupied the best seats, except at some of the nude athletic contests, from which they were excluded; they also took an important part in all the grand religious and state ceremonies, as when the pontifex maximus offered sacrifice on the occasion of a triumph before the temple of Capitoline Jupiter. They had power to pardon any criminal they met in the street on his way to execution, provided that the meeting were accidental. The vestals alone shared with the emperors the privilege of intramural burial (Serv. on Virg. *Aen.* xi. 206). During life they were richly dowered by the state (Suet. *Aug.* 31), and had public slaves appointed to serve them (see Tac. *Hist.* i. 43). They were also the guardians of the emperor's will, and of other important documents of state (Suet. *J. Caes.* 83, and *Aug.* 101; Tac. *Ann.* i. 8; Plut. *Anton.* 58; and Appian, *Bell. Civ.* v. 73). Their influence in the appointment to many offices, both religious and secular, appears to have been very great. Many of the statues to the chief vestals which were found in the Atrium Vestae in 1883–1884 have pedestals inscribed with a dedication recording that benefits had been conferred on the donor by the vestalis maxima. Lastly, they lived in a style of very great splendour; their house, the Atrium Vestae, which stood close by the Aedes Vestae, was very large and exceptionally magnificent both in decoration and material (see ROME, *Archaeology*, § "Forum Romanum" and map).

The discovery already mentioned of a number of statues of vestales maximae has thrown new light on the dress of the vestals.[5] With one or two exceptions the costume of these statues is much the same: they have a long sleeveless tunic (*stola*), girdled by the *zona* immediately below the breast. One only wears the *diploidion* over the upper part of her figure. The outer garment is an ample *pallium*, wrapped round the body in a great variety of folds, and in some cases brought over the head like a hood. All seem to have long hair, showing that the process of cutting off the hair at initiation was not repeated. One figure wears the *suffibulum*, a rectangular piece of white cloth bordered by a purple stripe, worn over the head and fastened on the breast by a *fibula*. According to Festus (ed. Müller, p. 348), this sacred garment was worn by the vestals only during the act of sacrificing (see also Varro, *De Ling. Lat.* vi. 21). In all cases the head is closely bound by *vittae*, rope-like twists of woollen cloth, the ends of which usually fall in loops on each shoulder (see Servius on Virg. *Aen.* x. 538).

The *Regia*, the official *fanum* of the pontifex maximus, was adjacent to the vestals' house:—

> "Hic locus est Vestae, qui Pallada servat et ignem;
> Hic fuit antiqui Regia parva Numae."[6]

When Augustus, after his election to the office of pontifex maximus in 12 B.C., moved his place of residence from the Regia to the Palatine, he built a new Aedes Vestae near his palace, in the magnificent Area Apollinis. This appears to have been a copy of the older temple of Vesta. No traces of it now exist; but Pirro Ligorio, in the latter part of the 16th century, made some sketches of what then existed of this second temple, to illustrate his great MS. on Roman antiquities, which is now preserved in the royal library at Turin (see Ovid, *Fasti*, iv. 949–954, and *Metam.* xv. 864). The original course of the Sacra Via passed close to the temple of Vesta; but the road was clumsily built over in the 3rd and 4th centuries.

The chief festival in honour of Vesta, the Vestalia, was held on the 9th of June (Ovid, *Fasti*, vi. 249), after which the temple was closed for five days for a ceremonial cleansing. In private houses the feast was celebrated by a meal of fish, bread and herbs, eaten, not on the usual triclinium, but by the domestic hearth, in front of the effigies of the Dii Penates (Ovid, *Fasti*, vi. 309–310). The feast, inaugurated by Augustus in honour of Vesta Palatina, was held on the 28th of April, the anniversary of its consecration.

With regard to statues of the goddess, though the Greek Hestia was frequently represented in plastic art, yet among the Romans

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[1] Fire obtained in this way, that is, "pure elemental fire," was commonly thought to possess a special sanctity. Even throughout the middle ages in Catholic countries, at Easter, when the new year began, the old pagan rite survived (see LIGHTS, CEREMONIAL USE OF.)

[2] From the time of Augustus the emperors themselves held the office of chief pontiff, and with it the privilege of electing the vestals.

[3] These inscriptions are printed in Middleton, *Ancient Rome in 1885*, pp. 200-6, and in *Archaeologia*, xlix. 414–22.

[4] The shrine of Vesta was not a *templum*, in the strict Roman sense, as it was not consecrated by the augurs, its sanctity being far above the necessity of any such ceremony. Other natural springs might be used for the daily sprinkling, but it was forbidden to use water brought in a pipe or other artificial conduit (Tac. *Hist.* iv. 53); see also Guhl and Koner, *Das Leben der Griechen und Römer* (Eng. trans. by F. Hueffer, 1875).

[5] These statues appear to have been the work of a privileged class of sculptors, who enjoyed the title of "fictores virginum vestalium"—an honour which is recorded in some of the dedicatory inscriptions on the pedestals.

[6] Ovid, *Tristia*, iii. 29.

Vesta appears to have been rarely so treated. The Athenian prytaneum contained a statue of Hestia. But there was no effigy in the Roman temple of Vesta, although one is commonly shown on reverses of coins which have a representation of the temple, and it appears to have been commonly thought in Rome that a statue of Vesta did exist inside her shrine—a mistake which Ovid corrects (*Fasti*, vi. 297–300). No Roman statue now known can be certainly considered to represent Vesta, though a very beautiful standing figure of a female with veiled head (in the Torlonia collection) has, with some probability, had this name given to it.

The worship of Vesta appears to have died out slowly in the 4th century, after the adoption of Christianity as the state religion by Constantine, and in 382 Gratian confiscated the Atrium Vestae. Zosimus (*Hist. Nov.* v. 38) tells an interesting story of a visit made to it at the end of the 4th century by Serena, the wife of the Vandal Stilicho, who took a valuable necklace from one of the statues, in spite of the remonstrances of an aged woman, the last survivor of the vestal virgins. Soon after that time the building appears to have fallen into decay, its valuable marble linings and other ornaments having been stripped from its walls.

Authorities.—For the Atrium and the Aedes Vestae see Rome, *Archaeology* (footnote *ad loc.*). See also Wissowa, *Relig. und Kultus der Römer* (1902) and authorities under Hestia. (J. H. M.; X.)

VESTERÅS, or Westerås, a town and bishop's see of Sweden, capital of the district (*län*) of Vestmanland, on a northern bay of Lake Mälar, 60 m. N.W. by W. of Stockholm by rail. Pop. (1900) 11,999. It is a considerable industrial centre and an important lake port. Its Gothic cathedral, rebuilt by Birger Jarl on an earlier site, and consecrated in 1271, was restored in 1850–1860, and again in 1896–1898. The episcopal library contains the valuable collection of books which Oxenstjerna, the chancellor of Gustavus Adolphus, brought away from Mainz near the end of the Thirty Years' War. A castle commands the town from an eminence; it was captured by Gustavus Vasa and rebuilt by him, and again in the 17th century, and remains the seat of the provincial government. Here Eric XIV., whose tomb is in the cathedral, was confined (1573–1575). Several national diets were held in this town, the most notable being those of 1527, when Gustavus Vasa formally introduced the Reformation into Sweden, and 1544, when he had the Swedish throne declared hereditary in his family. The original name of the town was Vestra Aros ("western mouth"), in distinction from Östra Aros, the former name of Upsala.

VESTIBULE (from Lat. *vestibulum*), the architectural term given to an antechamber next to the entrance and preceding the hall; it is also applied to the anteroom of any large apartment. The word is connected, like Vesta (*q.v.*), with the Sanscrit root *vas-*, to dwell, inhabit. In medieval Latin it was occasionally used, instead of *vestiarium*, for a vestry (see Du Cange, *Gloss. med. lat.*, s.v.), which is derived from Lat. *vestis*, clothing.

VESTINI, an ancient Sabine tribe which occupied the eastern and northern bank of the Aternus in central Italy, entered into the Roman alliance, retaining its own independence, in 304 B.C., and issuing coins of its own in the following century. A northerly section round Amiternum near the passes into Sabine country probably received the Caerite franchise soon after. In spite of this, and of the influence of Hadria, a Latin colony founded about 290 B.C. (Livy, *Epit.* xi.), the local dialect, which belongs to the north Oscan group, survived certainly to the middle of the 2nd century B.C. (see the inscriptions cited below) and probably until the Social War. The oldest Latin inscriptions of the district are *C.I.L.* ix. 3521, from Furfo with Sullan alphabet, and 3574, "litteris antiquissimis," but with *couraverunt*, a form which, as intermediate between *coir-* or *coer-* and *cur-*, cannot be earlier than 100 B.C. (see Latin Language). The latter inscription contains also the forms *magist[r]es* (nom. pl.) and *ueci* (gen. sing.), which show that the Latin first spoken by the Vestini was not that of Rome, but that of their neighbours the Marsi and Aequi (*qq.v.*). The inscription of Scoppito shows that at the time at which it was written the upper Aternus valley must be counted Vestine, not Sabine, in point of dialect.

See further Paeligni and Sabini, and for the inscriptions and further details, R. S. Conway, *The Italic Dialects*, pp. 258 ff., on which this article is based. (R. S. C.)

VESTMENTS. The word "vestment" (Lat. *vestimentum*, fr. *vestire*, to clothe), meaning generally simply an article of clothing, is in the usage of the present day practically confined to the ceremonial garments worn in public worship; in this sense it may be used equally of the robes or "ornaments" of the ministers or priests of any religion. Ecclesiastical vestments, with which the present article is solely concerned, are the special articles of costume worn by the officers of the Christian Church "at all times of their ministration"—to quote the Ornaments Rubric of the English Book of Common Prayer, *i.e.* as distinct from the "clerical costume" worn in everyday life. Ecclesiastical vestments may again be divided into two categories: (1) liturgical vestments, (2) non-liturgical vestments. Liturgical vestments, as their name implies, are those which are especially associated with the various functions of the liturgy. Of these again, according to the fully developed rules of the Catholic Church, there are three classes: (1) vestments worn only at the celebration of mass—chasuble, maniple, pontifical gloves, pontifical shoes, the pallium and the papal fanone and *subcinctorium*; (2) vestments never worn at mass, but at other liturgical functions, such as processions, administration of the sacraments, solemn choir services, *i.e.* cope and surplice; (3) vestments used at both—alb, amice, girdle, stole, dalmatic, tunicle. Non-liturgical vestments are those, *e.g.* cappa magna, rochet, which have no sacral character, have come into use from motives of convenience or as insignia of dignity, and are worn at secular as well as ecclesiastical functions.

In the controversies as to the interpretation of the Anglican "Ornaments Rubric" (see below) the term "vestments" has been applied particularly to those worn at the celebration of mass, which is what is meant when it is said that "the vestments" are worn at such and such a church. This restriction of the term has some historical justification: in the First Prayer Book of Edward VI. the word "vestment" is used as synonymous with but one liturgical garment—the chasuble, the "mass vestment" *par excellence*; in the Prayer Book of 1559 "vestments" are eliminated altogether, "ornaments" being substituted as a more comprehensive term. As to the use of the word, it must be further stated that it is also technically applied to altar cloths, the altar being "vested" in frontal (*antependium*) and super-frontal (see Altar).

The subject of ecclesiastical vestments is not only one of great interest from the point of view of archaeology and art, but is also of importance, in so far as certain "ornaments" have become historically associated with certain doctrines on which the opinion of the Christian world is sharply divided. The present article can only give a brief outline of a subject as intricate as it is vast, frequently also extremely obscure, and rendered still more obscure by the fact that those who have applied themselves to it have too often done so in anything but a scientific spirit. It will deal briefly (1) with the general idea and the historical evolution of ecclesiastical vestments, (2) with the vestments as at present worn (*a*) in the Roman Catholic Church, (*b*) in the Oriental Churches, (*c*) in the Reformed Churches, (*d*) in the Anglican Church. The more important vestments are dealt with in some detail under their separate headings; here it will only be necessary to give short descriptions of those which cannot be conveniently treated separately.

1. *The Origin and Idea of Ecclesiastical Vestments.*—The liturgical vestments of the Catholic Church, East and West, are not, as was at one time commonly supposed, borrowed from the sacerdotal ornaments of the Jewish ritual, although the obvious analogies of this ritual doubtless to a certain extent determined their sacral character; they were developed independently out of the various articles of everyday dress worn by citizens of the Graeco-Roman world under the Empire. The officers of the Church during the first few centuries of its existence were content to officiate in the dress of civil life, though their garments were expected to be scrupulously clean and of decent quality. The few scattered references in contemporary records to the dress of the clergy all point to this as the only recognized rule.

Thus in the 37th of the so-called "Canons of Hippolytus" we read: "As often as the bishops would partake of the Mysteries, the presbyters and deacons shall gather round him clad in white, quite particularly clean clothes, more beautiful than those of the rest of the people." Thus, too, St Jerome, in his commentary on Ezek. xliv. 19, says that "We, too, ought not to enter the Holy of Holies in our everyday garments . . . when they have become defiled from the use of ordinary life, but with a clean conscience, and in clean garments, hold in our hands the Sacrament of the Lord."

When, in the year 289, St Cyprian was led to martyrdom, he wore, according to Eusebius (*Hist. eccles.* iv. cap. 11), an under tunic (*linea*), an upper tunic (*dalmatica, tunica*) and mantle (*lacerna, byrrus*). This was the ordinary type of the civil costume of the time. The tunica, a loose sack-like tunic with a hole for the head, was the innermost garment worn by all classes of Roman citizens under the republic and empire. It was either sleeveless (*colobium*) or sleeved (*tunica manicata* or *manuleata*), and originally fell about to the knee, but later on reached to the ankles (*tunica talaris*). St Augustine (*De doctr. christ.* iii. cap. 10, n. 20) says that to wear *talares et tunicas manicatas* was a disgrace among the ancient Romans, but that in his own day it was no longer so considered in the case of persons of good birth. The tunica was originally of white wool, but in the 3rd century it began to be made of linen, and from the 4th century was always of linen. About the 6th century the long *tunica alba* went out of fashion in civil life, but it was retained in the services of the Church and developed into the various forms of the liturgical alb (*q.v.*) and surplice (*q.v.*). The *tunica dalmatica* was a long, sleeved upper tunic, originating, as its name implies, in Dalmatia, and first becoming fashionable at Rome in the 2nd century; it is the origin of the liturgical dalmatic and tunicle (see DALMATIC). Another over-dress of the Romans was the *paenula*, a cloak akin to the *poncho* of the modern Spaniards and Spanish Americans, *i.e.* a large piece of stuff with a hole for the head to go through, hanging in ample folds round the body. This was originally worn only by slaves, soldiers and other people of low degree; in the 3rd century, however, it was adopted by fashionable people as a convenient riding or travelling cloak; and finally, by the sumptuary law of 382 (*Cod. Theod.* xiv. 10, 1, *de habitu . . . intra urbem*) it was prescribed as the proper everyday dress of senators, instead of the military chlamys, the toga being reserved for state occasions. This was the origin of the principal liturgical vestment, the chasuble (*q.v.*).

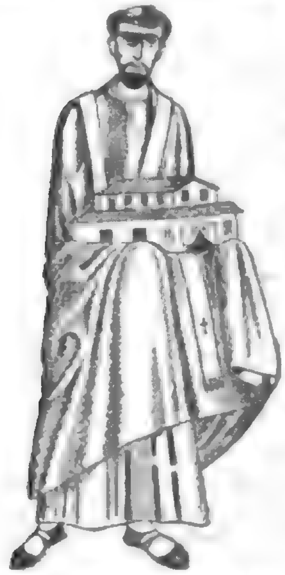

FIG. 1.—Pope Honorius (d. 638). From a mosaic in S. Agnese in Rome.

As late as the 6th century these garments were common both to the clergy and laity, and, so far as their character was concerned, were used both in the liturgy and in everyday life. Meanwhile, however, a certain development had taken place. By the 4th century the garments worn at liturgical functions had been separated from those in ordinary use, though still identical in form. It is in the 4th century, too, that the first distinctive vestment makes its appearance, the ὠμοφόριον worn by all bishops in the East; in the 5th century we find this in use at Rome under the name of *pallium* (*q.v.*), as the distinctive ornament of the pope (see fig. 1). About the same time the *orarium*, or stole (*q.v.*), becomes fixed in liturgical use. The main development and definition of the ecclesiastical vestments, however, took place between the 6th and the 9th centuries. The secular fashions altered with changes of taste; but the Church retained the dress with the other traditions of the Roman Empire. At Rome, especially, where the popes had succeeded to a share of the power and pretensions of the Caesars of the West, the accumulation of ecclesiastical vestments symbolized a very special dignity: in the second quarter of the 9th century the pope, when fully vested, wore a *camisia* girdled, an alb (*linea*) girdled, an amice (*anagolaium*), a tunicle (*dalmatica minor*), a dalmatic (*dalmatica major*), stole (*orarium*), chasuble (*planeta*) and pallium. With the exception of the pallium, this was also the costume of the Roman deacons. By this time, moreover, the liturgical character of the vestments was so completely established that they were no longer worn instead of, but over, the ordinary dress.

Hitherto the example of the Roman Church had exercised no exclusive determining influence on ritual development even in the West. The popes had, from time to time, sent the pallium or the dalmatic—specifically Roman vestments—as gifts of honour to various distinguished prelates; Britain, converted by a Roman mission, had adopted the Roman use, and English missionaries had carried this into the newly Christianized parts of Germany; but the great Churches of Spain and Gaul preserved their own traditions in vestments as in other matters. From the 9th century onwards, however, this was changed; everywhere in the West the Roman use ousted the regional uses.

This change synchronized with the revival of the Western Empire under Charlemagne, a revival which necessarily gave an impulse to the claims of the see of Rome. The adoption of the Roman liturgical dress had, however, at most an indirect connexion with these claims. Charlemagne was active in prescribing the adoption of the Roman use; but this was only as part of his general policy in the organization of his empire. A renovation of the Gallican Church was not the least crying need; and, in view of the confusion of rites (Gallican, Gothic, Roman, Ambrosian) in the Frankish empire, Charlemagne recognized that this innovation could only be effectually carried out by a closer connexion with Rome in ritual as in other matters. Charlemagne's activity in this respect was, in effect, but the completion of a process that had been going on since the 6th century. Whatever effect the reinvigoration of the papacy may have had in hastening the process, the original impulse towards the adoption of the Roman rite had proceeded, not from Rome, but from Spain and Gaul; it was the natural result of the lively intercourse between the Churches of these countries and the Holy See. Nor was the process of assimilation by any means one-sided. If Spain and Gaul borrowed from Rome, they also exercised a reciprocal influence on the Roman use; it is interesting to note in this connexion, that of the names of the liturgical vestments a very large proportion are not of Roman origin, and that the non-Roman names tended to supersede the Roman in Rome itself.[1]

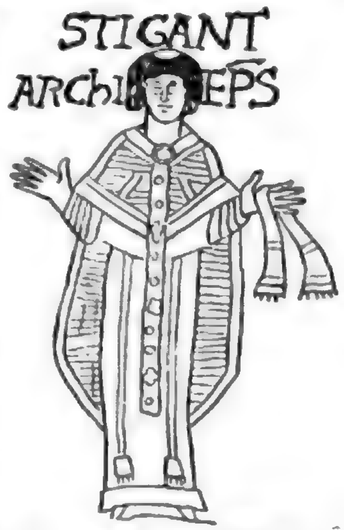

FIG. 2.—Stigand, Archbishop of Canterbury (1052–1070); from the Bayeux Tapestry. Note the absence of the mitre, the chasuble short or tucked up in front, the maniple still carried in the left hand.

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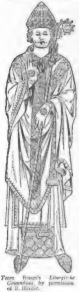
[1] Apart from the archiepiscopal pallium, the Churches of Spain and Gaul had need to borrow from Rome only the dalmatic, maniple and liturgical shoes. On the other hand, it was from Spain and Gaul that Rome probably received the *orarium* (stole) as an ensign of the major orders. Father Braun, to whose kindness the writer is indebted for the above account of the causes of the ritual changes in the Carolingian epoch, adds that the papacy was never narrow-minded in its attitude towards local rites, and that it was not until the close of the middle ages, when diversity had become confusion and worse, that it began to insist upon uniformity. Even then it allowed those rites to survive which could prove a tradition of 200 years.

The period between the 9th and the 13th centuries is that of the final development of the liturgical vestments in the West. In the 9th century appeared the pontifical gloves; in the 10th, the mitre; in the 11th, the use of liturgical shoes and stockings was reserved for cardinals and bishops. By the 12th century, mitre and gloves were worn by all bishops, and in many cases they had assumed a new ornament, the *rationale*, a merely honorific decoration (supposed to symbolize doctrine and wisdom), sometimes of the nature of a highly ornamental broad shoulder collar with dependent lappets; sometimes closely resembling the pallium; rarely a "breast-plate" on the model of that of the Jewish high priest.[1] This elaboration of the pontifical vestments was contemporaneous with, and doubtless partly determined by, the assimilation of the bishops during those centuries to the type of the great feudal nobles whose ambitions and love of pomp they shared.

In an age when, with the evolution of the feudal organization of society, even everyday costume was becoming a uniform, symbolizing in material and colour the exact status of the wearer, it was natural that in the parallel organization of the Church the official vestments should undergo a similar process of differentiation and definition. With this process, which in all its essential features was completed in the 11th century, doctrinal developments had little or nothing to do, though from the 9th century onwards liturgiologists were busy expounding the mystic symbolism of garments which, until their imagination set to work, had for the most part no symbolism whatever (see below). Yet in view of later controversies, the changes made during this period, notably in the vestments connected with the mass, are not without significance. Hitherto the chasuble had been worn indifferently by all ministers at the eucharist, even by the acolytes; it had been worn also at processions and other non-liturgical functions; it was now exalted into the mass vestment *par excellence*, worn by the celebrant only, or by his immediate assistants (deacon and subdeacon) only on very special occasions. New vestments were devised to take the place, on less solemn occasions, of those hallowed by association with the holy sacrifice; thus the processional cope (*q.v.*) appeared in the 11th century and the surplice (*q.v.*) in the 12th. A change, too, came over the general character of vestments. Up to the 9th century these had been very plain, without ornament save such traditional decorations as the *clavi* of the dalmatic; what splendour they had was due to their material and the ample folds of their draperies. But from this time onwards they tend to become more and more elaborately decorated with embroidery and jeweller's work (see, *e.g.* the articles CHASUBLE and COPE).



From Braun's *Liturgische Gewandung*, by permission of B. Herder.

FIG. 3.—Monumental Figure of Bishop Johannes of Lübeck (d. 1350) in Lübeck Cathedral.

Very significant, too, is the parting of the ways in the development of liturgical vestments in the East and West. During the first centuries both branches of the Church had used vestments substantially the same, developed from common originals; the alb, chasuble, stole and pallium were the equivalents of the *στιχάριον*, *φενόλιον*, *ὠράριον* and *ὠμοφόριον*. While, however, between the 9th and 13th centuries, the Western Church was adding largely to her store of vestments, that of the East increased her list by but three, the *ἐγχείριον* and *ἐπιμανίκια* (see MANIPLE) and the *σάκκος* (see DALMATIC). The living force of development in the Latin Church was symbolized in her garments; the stereotyped orthodoxy of the Greek Church in hers. With the exception of the mitre, introduced in the 15th or 16th century, the liturgical costume of the Eastern clergy remains now practically what it was in the 9th century.

In the Western Church, though from the 9th century onwards the Roman use had been the norm, considerable alterations continued to be made in the shape and decoration of the liturgical vestments, and in this respect various Churches developed different traditions (see, *e.g.* CHASUBLE). The definition of their use by the various orders of the clergy in the several liturgical functions, however, was established by the close of the 13th century and still continues in force. Before discussing the changes made in the various Reformed Churches, due to the doctrinal developments of the 16th century, we may therefore give here a list of the vestments now worn by the various orders of clergy in the Roman Catholic Church and the Oriental Churches.

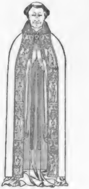


FIG. 4.—Dr Henry Sever (d. 1471). From a brass in the chapel of Merton College, Oxford. He is vested in surplice, stole and cope.

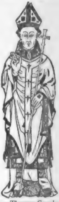


FIG. 5.—Thomas Cranley, Archbishop of Dublin (d. 1417). From a brass in New College Chapel, Oxford. In addition to the vestments shown in fig. 3 he wears the archiepiscopal pallium.

Roman Catholic Church.—As the sacrifice of the mass is the central mystery of the Catholic faith, so the seven orders of the hierarchy culminate in that of priest, who alone is empowered to work the daily miracle of the altar (see ORDER, HOLY). The vestments worn by the priest when celebrating mass are then the most important. The cassock (*q.v.*), which must always be worn under the vestments, is not itself a liturgical garment. Over this the priest, robing for mass, puts on the amice, alb, girdle (*cingulum*), stole, maniple and chasuble. Taking the other orders downwards: deacons wear amice, alb, girdle, stole, maniple[2] and dalmatic; subdeacons, amice, alb, girdle, maniple and tunicle; the vestment proper to the minor orders, formerly the alb, is now the surplice or cotta. Bishops, as belonging to the order of priesthood with completed powers, wear the same vestments as the priests, with the addition of the pectoral cross, the pontifical gloves, the pontifical ring, the liturgical sandals and caligae, a tunicle worn over the stole and under the chasuble, and the mitre (see fig. 3). Archbishops, on solemn occasions, wear the pallium over the chasuble (see fig. 5). Bishops also carry a pastoral staff (*q.v.*), as symbol of their pastoral office. Finally, the pope, when celebrating mass, wears the same vestments as an ordinary bishop, with the addition of the *subcinctorium* (see ALB), a dalmatic, worn over the tunicle and under the chasuble, and the *orale* or *fanone* (see AMICE). It should be noted that the *liturgical* head-dress of the pope is the mitre, not the tiara, which is the symbol of his supreme office and jurisdiction (see TIARA).

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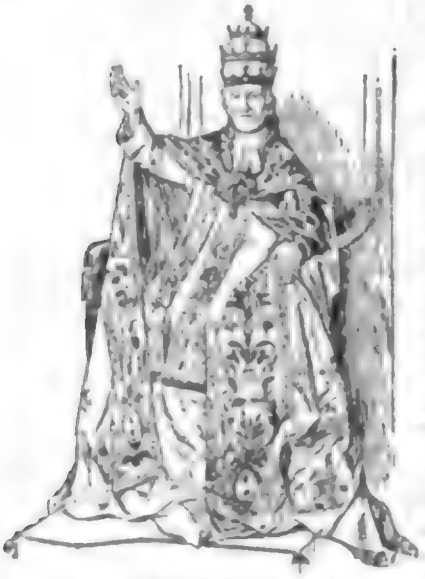
[1] The *rationale* is worn only over the chasuble. It is now used only by the bishops of Eichstatt, Cracow, Paderborn and Toul, by the special concession of various popes. See Braun, *Liturg. Gewandung*, pp. 676–700.

[2] The stole and maniple alone are symbolical of order, *i.e.* of the relation to the sacrifice of the mass.



From a photograph by Conjugi Cane, Rome.

FIG. 6.—Pope Leo XIII. in his Vestments as Supreme Pontiff.

Of the liturgical vestments not immediately or exclusively associated with the sacrifice of the mass the most conspicuous are the cope and surplice. The biretta, too, though not in its origin or in some of its uses a liturgical vestment, has developed a distinctly liturgical character (see BIRETTA). Besides the strictly liturgical vestments there are also numerous articles of costume worn at choir services, in processions, or on ceremonial occasions in everyday life, which have no sacral character; such are the almuce (*q.v.*), the *cappa* and *mozzetta* (see COPE), the rochet (*q.v.*), the *pileolus*, a skull-cap, worn also sometimes under mitre and tiara. These are generally ensigns of dignity; their form and use varies in different Churches, and they often represent special privileges conferred by the popes, *e.g.* the *cappa* of the Lateran basilica worn by the canons of Westminster cathedral, or the almuce worn, by concession of Pope Pius IX., by the members of the Sistine choir.

The character of the vestments, the method of putting them on, and the occasions on which they are severally to be worn, are regulated with the minutest care in the Missal and the *Caeremoniale*.

Oriental Churches.—As already stated, the vestments of the great historical Churches of the East are derived from the same Graeco-Roman originals as those of the West, but in contradistinction to the latter they have remained practically stereotyped, both in character and number, for a thousand years; in the East, however, even more than in the West the tendency to gorgeous ornamentation has prevailed.

An Orthodox bishop, vested for the holy liturgy, wears over his cassock—(1) the στιχάριον, or alb (*q.v.*); (2) the ἐπιτραχήλιον, or stole (*q.v.*); (3) the ζώνη, a narrow stuff girdle clasped behind, which holds together the two vestments above named; (4) the ἐπιμανίκια, liturgical cuffs, corresponding, possibly, to the pontifical gloves of the West;[1] (5) the ἐπιγονάτιον, a stiff lozenge-shaped piece of stuff hanging at the right side by a piece of riband from the girdle or attached to the σάκκος, the equivalent of the Western maniple (*q.v.*); (6) the σάκκος, like the Western dalmatic (*q.v.*), worn instead of the φαινόλιον, or chasuble; (7) the ὠμοφόριον, the equivalent of the Western pallium (*q.v.*). Besides these, the bishop also wears a pectoral cross (ἐγκόλπιον) and a medal containing a relic (πανάγια). He also has a mitre (*q.v.*), and carries a crozier (δικανίκιον), a rather short staff ending in two curved branches decorated with serpents' heads, with a cross between them.

The vestments of a priest are the sticharion, epitrachelion, girdle, epimanikia and phainolion (see CHASUBLE). He wears all these vestments only at the celebration of the eucharist and on other very solemn occasions; at other ministrations he wears only the epitrachelion and phainolion over his cassock. A dignitary in priest's orders is distinguished by wearing the epigonation; and in Russia the use of the mitre is sometimes conceded to distinguished priests by the tsar. The deacon wears the sticharion, without a girdle, the epimanikia and the orarion (ὠράριον, Lat. *orarium*, see STOLE) hanging over his left shoulder. The lesser orders wear a shorter sticharion and an orarion wound round it.

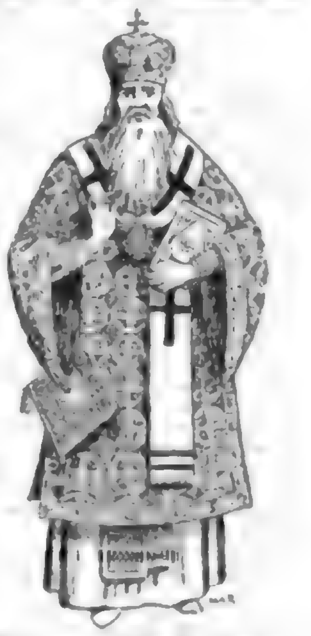


FIG. 7.—An Orthodox Eastern Patriarch in full Pontificals.

On less solemn occasions bishops wear the mandyas (μανδύας), a cope-like garment fastened at the lower corners as well as at the neck, and the kalimaukion (καλυμαύκιον), a tall, brimless hat, with a veil hanging down behind, and, in place of the δικανίκιον they carry a short staff with an ivory cross-piece. The kalimaukion is also worn by the other clergy in ordinary life, and with their vestments at processions, &c.

The general character of the vestments is much the same in the other Oriental rites. The sticharion answers to the Armenian *shabik*, the Nestorian *kutina*, the Coptic *tuniah* or *stoicharion*; the epimanikia to the Arm. *pasban* (which, however, resemble rather the Latin maniple), the Nestorian *zando*, and the Coptic *kiman*; the epitrachelion to the Arm. *por-urar*, Syrian *uroro*, Coptic *batrashil*; the girdle to the Arm. *kodi*, Nestorian *zunro*; the phainolion to the Nestorian *phaino* and Arm. *shurtshar*, both of which are, however, cope-shaped.[2] Armenian priests, besides, wear a mitre (see MITRE, fig. 3), and a collar-like ornament probably derived from the apparel of the Western amice (*q.v.*). The liturgical handkerchief, which in the Greek Church has become the epigonation, has retained its original form in the Armenian.

The Liturgical Colours.—In another respect the vestments of the Eastern differ from those of the Western Church. In the East there is no sequence of liturgical colours, nor, indeed, any definite sense of liturgical colour at all; the vestments are usually white or red, and stiff with gold embroidery. In the West the custom, long universal, of marking the seasons of the ecclesiastical year and the more prominent fasts and festivals by the colour of the vestments of clergy and altar dates, approximately, from the 12th century: the subject is mentioned (*c.* 1200) in the treatise of Innocent III., *De sacro altaris mysterio* (cap. 10), where the rules are laid down which are still essentially those of the Roman Church,[3] though the liturgical colours were only four, violet belonging to the category of black—as that of mourning. Custom in this respect was, however, exceedingly varied for a long time, numerous important Churches having their own "uses," and it was not until the time of the Reformation that the Roman use was fixed and became the norm of the Churches of the Roman obedience.

According to the rubric of the Roman Missal (*tit.* xviii.) the liturgical colours are five: white, red, green, violet, black. Though, in the embroidery of vestments, many colours may be used, these five above named must severally give the dominant tone of colour on the occasions for which they are appointed. Gold brocades or cloth-of-gold may, however, be substituted for red, green and white, and silver for white. The following is a list of the occasions to which the various colours are appropriated:—

White.—Trinity Sunday, all festivals of Christ (except those connected with the Passion), festivals of the Blessed Virgin, of the Holy Angels and Confessors, of holy virgins and women (not being martyrs), nativity of St John the Baptist, festivals of the chains of St Peter and of his see (*cathedra Petri*), Conversion of St Paul, All Saints, consecration of churches and altars, anniversary of election and coronation of popes, and of election and consecration of bishops. White is also worn during the octaves of these festivals, on ordinary days (for which no special colour is provided) between Easter and Whitsuntide, at certain special masses connected with the saints falling under the above category, and at bridal masses.

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[1] This is the view of Dr Adrian Fortescue (*The Orthodox Eastern Church*, p. 406); according to Braun (*Lit. Gewandung*, p. 100) they were originally merely the ornamental cuffs (λωρία) of the episcopal sticharion, which were detached for purposes of convenience

[2] By the sub-committee of Convocation in their *Report* (1908) these vestments are wrongly classed as copes, *i.e.* as derived not from the *paenula* but from the *lacerna* or *birrus* (see COPE, footnote).

[3] The Church of the Holy Sepulchre at Jerusalem seems already to have had its canon of liturgical colours.

White is also the colour proper to sacramental processions, and generally to all devotions connected with the exposition of the Blessed Sacrament. At baptisms the priest wears a violet stole during the first part of the service, *i.e.* the exorcization then changes it for a white one. White is worn at the funerals of children.

Red.—Saturday before Whitsunday, Whitsunday and its octave; all festivals in commemoration of the sufferings of Christ, *i.e.* festival of the instruments of the Passion, of the Precious Blood, of the invention and elevation of the Cross; all festivals of apostles, except those above noted; festivals of martyrs; masses for a papal election; the Feast of the Holy Innocents, when it falls on a Sunday (violet if on a week-day), and its octave (always red). In England red vestments are worn at the mass (of the Holy Spirit) attended by the Roman Catholic judges and barristers at the opening of term, the so-called "Red Mass."

Green.—Sundays and week-days between Epiphany and Septuagesima, and between Trinity and Advent, except festivals and their octaves and Ember days.

Violet.—Advent; the days between Septuagesima and Maundy Thursday; vigils that fall on fast days, and Ember days, except the vigil before Whitsunday (red) and the Ember days in Whitsun week (red). Violet vestments are also worn on days of intercession, at votive masses of the Passion, at certain other masses of a pronouncedly intercessory and penitential character, at intercessory processions, at the blessing of candles on Candlemas Day, and at the blessing of the baptismal water. A violet stole is worn by the priest when giving absolution after confession, and when administering Extreme Unction.

Black.—Masses for the dead and funeral ceremonies of adults; the mass of the pre-sanctified on Good Friday.[1]

Benediction of Vestments.—In the Roman Catholic Church the amice, alb, girdle, stole, maniple, chasuble must be solemnly blessed by the bishop or his delegate, the prayers and other forms to be observed being set forth in the *Pontificale* (see BENEDICTION). Other vestments—*e.g.* dalmatic, tunicle, surplice—are sometimes blessed when used in connexion with the sacrifice of the mass, but there is no definite rule on the subject. The custom is very ancient, Father Braun giving evidence as to its existence at Rome as early as the 6th century (*Liturg. Gewandung*, p. 760, &c.).

Mystic Meaning of Vestments.—It is clear from what has been said above that the liturgical vestments possessed originally no mystic symbolic meaning whatever; it was equally certain that, as their origins were forgotten, they would develop such a symbolic meaning. The earliest record of any attempt to interpret this symbolism that we possess is, so far as the West is concerned, the short exposition in the *Explicatio Missae* of Germanus, bishop of Paris (d. 576), the earliest of any elaboration that of Hrabanus Maurus (d. 856). From the latter's time onward a host of liturgists took up the theme, arguing from the form, the material, the colour and the fashion of wearing the various garments to symbolical interpretations almost as numerous as the interpreters themselves. The *Report* of the five bishops divides them into three schools: (1) the *moralizing school*, the oldest, by which—as in the case of St Jerome's treatment of the Jewish vestments—the vestments are explained as typical of the virtues proper to those who wear them; (2) the *Christological school*, *i.e.* that which considered the minister as the representative of Christ and his garments as typical of some aspects of Christ's person or office—*e.g.* the stole is his obedience and servitude for our sakes; (3) the *allegorical school*, which treats the priest as a warrior or champion, who puts on the amice as a helmet, the alb as a breastplate, and so on. We cannot even outline here the process of selection by which the symbolic meanings now stereotyped in the Roman Pontifical were arrived at. These are taken from the various schools of interpretation mentioned above, and are now formulated in the words used by the bishop when, in ordaining to any office, he places the vestment on the ordinand with the appropriate words, *e.g.* "Take the amice, which signifies discipline in speech," while other interpretations survive in the prayers offered by the priest when vesting, *e.g.* with the amice, "Place on my head the helmet of salvation," &c. For the symbolic meanings of the various vestments see the separate articles devoted to them.

Protestant Churches.—In the Protestant Churches[2] the custom as to vestments differs widely, corresponding to a similar divergence in tradition and teaching. At the Reformation two tendencies became apparent. Luther and his followers regarded vestments as among the *adiaphora*, and in the Churches which afterwards came to be known as "Lutheran" many of the traditional vestments were retained. Calvin, on the other hand, laid stress on the principle of the utmost simplicity in public worship; at Geneva the traditional vestments were absolutely abolished, and the Genevan model was followed by the Calvinistic or "Reformed" Churches throughout Europe. The Church of England, in which the Lutheran and Calvinistic points of view struggled for the mastery, a struggle which resulted in a compromise, is separately dealt with below. At the present day the Lutheran Churches of Denmark and Scandinavia retain the use of alb and chasuble in the celebration of the eucharist (stole, amice, girdle and maniple were disused after the Reformation), and for bishops the cope and mitre. The surplice is not used, the ministers conducting the ordinary services and preaching in a black gown, of the 16th-century type, with white bands or ruff. In Germany the Evangelical Church (outcome of a compromise between Lutherans and Reformed) has, in general, now discarded the old vestments. In isolated instances (*e.g.* at Leipzig) the surplice is still worn; but the pastors now usually wear a barret cap, a black gown of the type worn by Luther himself, and white bands. In Prussia the superintendents now wear pectoral crosses (instituted by the emperor William II.). In the "Reformed" Churches the minister wears the black "Geneva" gown with bands. It is to be noted, however, that this use has been largely discontinued in the modern "Free" Churches. On the other hand, some of these have in recent times adopted the surplice, and in one at least (the Catholic Apostolic Church) the traditional Catholic vestments have been largely revived.

Anglican Church.—The subject of ecclesiastical vestments has been, ever since the Reformation, hotly debated in the Church of England. For a hundred years after the Elizabethan settlement the battle raged round the compulsory use of the surplice and square cap, both being objected to by the extreme Calvinists or Puritans. This question was settled after 1662 by the secession of the Nonconformist clergy, and no more was heard of the matter until the "Oxford movement" in the 19th century. At the outset the followers of Newman and Pusey were more concerned with doctrine than with ritual; but it was natural that a reassertion of Catholic teaching should be followed by a revival of Catholic practice, and by the middle of the century certain "Ritualists," pleading the letter of the Ornaments Rubric in the Prayer Book, had revived the use of many of the pre-Reformation vestments. Into the history of the resulting controversies it is impossible to enter. Popular passion confused the issues, and raged as violently against the substitution of the surplice for the Geneva gown in the pulpit as against the revival of the "mass vestments." The law was invoked, and, confronted for the first time with the intricacies of the Ornaments Rubric, spoke with an uncertain voice. In 1870, however, the "vestments" were definitely pronounced illegal by the Privy Council (*Hebbert* v. *Purchas*), and since the "Ritualists" refused to bow to this decision, parliament intervened with the Public Worship Regulation Act of 1874, which set up a disciplinary machinery for enforcing the law, and at the same time reconstituted the Court of Arches (*q.v.*). The recalcitrant clergy refused to obey an act passed solely by the secular authority (convocation not having been consulted) or to acknowledge the jurisdiction of a court which had been robbed of its "spiritual" character. Prosecutions

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[1] In the Anglican Church, in the numerous cases when the liturgical colours are used, these generally follow the Roman use, which was in force before the Reformation in the important dioceses of Canterbury, York, London and Exeter. Some Churches, however, have adopted the colours of the use of Salisbury (Sarum). The red hangings of the Holy Table, usual where the liturgical colours are not used, are also—like the cushions to support the service books—supposed to be a survival of the Sarum use.

[2] The term "Protestant" is used here in its widest sense of those Churches which reformed their doctrine and discipline as a result of the religious revolution of the 16th century (see REFORMATION).

"on the complaint of two parishioners" (too often qualified *ad hoc* by a temporary residence) followed; and since the act had provided no penalty save imprisonment for contempt of court, there followed the scandal of zealous clergymen being lodged in gaol indefinitely "for conscience' sake." This result revolted public opinion; the bishops acquired the habit (rendered easier by the personal expense involved in setting the law in motion) of vetoing, under the power given to them in the act, all prosecutions; and the act became a dead letter. The "persecution" had meanwhile produced its natural result: the use of the forbidden vestments rapidly spread; and since there was no central authority left competent to command obedience, every incumbent—intrenched in his freehold as a "corporation sole"—became a law unto himself. The outcome has been that in the Church of England, and in many of her daughter Churches, there exists a bewildering variety of "uses," varying from that of Sarum and that of Rome down to the closest possible approximation to the Geneva model.

Some explanation of this state of things may be ventured. Apart from those clergy (still the majority) who follow in all essentials the post-Reformation traditions of the English Church, there are three schools among those who justify the use of the ancient "eucharistic"[1] vestments: (1) a small number who affect to ignore the rules of the Prayer Book altogether, on the ground that no local or national Church has the right to alter the doctrines or practice of the Catholic Church, of which they are priests in virtue of their ordination, and whose prescriptions and usages they are in conscience bound to follow; (2) those who maintain that the Ornaments Rubric, in the phrase "second year of King Edward VI.," prescribes the ornaments in use *before* the first Prayer Book; (3) those who hold that under the Rubric the ornaments prescribed in the first Prayer Book are to be "had in use." The attitude of the first group needs no comment: it makes every priest the arbiter of what is or is not "Catholic," and is destructive of that principle of definite authority which is the very foundation of Catholicism. The attitude of the second group is based on a mistake as to the technical meaning of "the second year of Edward VI.," the second Prayer Book not having come into use till the third year.[2] As to the third group, their contention seems now to be admitted, though not all its implications. What, then, are the vestments sanctioned by the Ornaments Rubric? In its present form this dates from the Prayer Book revision of 1662. It runs: "And here it is to be noted that such ornaments of the church and of the ministers thereof at all times of their ministration shall be retained and be in use, as was in the Church of England by the authority of parliament in the second year of the reign of King Edward VI." The wording of this was taken from the last section of Elizabeth's Act of Uniformity, prefixed to the Prayer Book of 1559. In the Act, however, these words were added: "until other order shall be therein taken by the authority of the Queen's Majesty, with the advice of the Commissioners appointed and authorized under the Great Seal of England, for causes ecclesiastical, or of the Metropolitan." The Rubric in the Prayer Book of 1559 ran: ". . . the minister at the time of the Communion, and at all other times in his ministration, shall use, &c. . . . according to the Act of Parliament set in the beginning of this book."[3]

Clearly it was the intention of the government, consistently with the whole trend of its policy, to cover its concession to the Protestant party dominant in the Commons by retaining some of the outward forms of the old services until such time as it should be expedient to "take other order." Then followed a period of great confusion. If the "massing vestments" continued anywhere in use, it was not for long. Whatever the letter of the law under the rubric, the Protestant bishops and the commissioners made short work of such "popish stuff" as chasubles, albs and the like. As for copes, in some places they were ordered to be worn, and were worn at the Holy Communion,[4] while elsewhere they were thrown into the bonfires with the rest.[5]

The difficulty seems to have been not to suppress the chasuble, of the use of which after 1559 not a single authoritative instance has been adduced, but to save the surplice, which the more zealous Puritans looked on with scarcely less disfavour. At last, in 1565, Queen Elizabeth determined to secure uniformity, and wrote to Archbishop Parker bidding him proceed by order, injunction or censure, "according to the order and appointment of such laws and ordinances as are provided by act of parliament, and the true meaning thereof, so that uniformity may be enforced." The result was the issue in 1566 by the archbishop of the statutory *Advertisements*, which fixed the vestments of the clergy as follows: (1) In the ministration of the Holy Communion in cathedral and collegiate churches, the principal minister to wear a cope, with gospeller and epistoler agreeably;[6] at all other prayers to be said at the Communion table, to use no copes but surplices; (2) the dean and prebendaries to wear surplice and hood; (3) every minister saying public prayers, or ministering the sacraments, to wear "a comely surplice with sleeves."

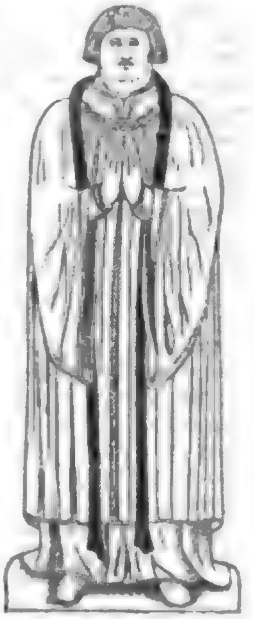

FIG. 8.—Anglican Priest in Cassock, Surplice, and Narrow Black Scarf. Brass of William Dye (d. 1567) at Westerham, Kent.

This has been decided by the judicial committee of the Privy Council (*Hebbert* v. *Purchas*, 1870; *Ridsdale* v. *Clifton*, 1877) to have been the "other order" contemplated in the Act of Uniformity of Elizabeth, and it was held that from this time the cope and surplice alone were legal vestments in the Church of England. The authority of the *Advertisements*, indeed, was and is disputed; but their lordships in their judgment pointed out that they were accepted as authoritative by the canons of 1603 (Can. 24 and 58), and argued convincingly that the revisers of the Prayer Book in 1662, in restoring the rubric of 1559, had no idea of legalizing any vestments other than those in customary use under the *Advertisements*, and the canons (cf. *Report* of sub-committee of Convocation, pp. 48, 49). The law, then, is perfectly clear, so far as two decisions of the highest court in the realm can make it so. But apart from the fact that the authority of the Privy Council, as not being a "spiritual" court, is denied by many of the clergy, no one claims that its decisions are irreversible in the light of fresh evidence.

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[1] This term is incorrect (save in the case of chasuble and maniple), but is that commonly employed by the "High Church" clergy.

[2] Edward VI. came to the throne on the 28th of January 1547; his "second year," therefore, lasted from the 28th of January 1548 to the 27th of January 1549. The first Prayer Book passed parliament on the 21st of January 1549, but did not receive the royal assent till later, probably March, and was not in *compulsory* use till Whitsunday, June 9th, 1549. The old rule, however, was that "every act of parliament in which the commencement thereof is not directed to be from a specific time, doth commence from the first day of the session of parliament in which such act is passed" (33 Geo. III. c. 13). The evidence is now clear that the Rubric refers to the first Prayer Book. This was decided in *Liddell* v. *Westerton* (1857), and is admitted in the Report of the five bishops to Convocation on *The Ornaments of the Church and its Ministers* (1908), which adduces conclusive evidence.

[3] This was inserted, probably by the Privy Council, as a memorandum or interpretation of the clause in the Act of Uniformity. Tomlinson (*The Prayer Book, Articles and Homilies*, p. 122 seq.) argues that this was a "fraud rubric" inserted without authority, and utterly perverting the meaning of the proviso in the Act of Uniformity. This argument is dealt with in the bishop's *Report*, p. 66.

[4] *Resolutions of 1561*, "Item that there be used only but one apparel; as the cope in the ministration of the Lord's Supper." See *Report*, p. 68.

[5] See Machyn's *Diary* (Camden Soc. 42; London, 1848), p. 208, for St Bartholomew's day, 1559: "All the roods, and Maries and Johns, and many other of the church goods, both copes, crosses, censers, altar cloths, rood cloths, books, banners, . . . with much other gear about London," were "burned with great wonder."

[6] Yet later the cope seems to have been authoritatively proscribed with the rest. In the *Acts of the Privy Council* (1578–1580), p. 208, is the following entry: "A letter to Sir Walter Ashton, Knight, Mr. Deane of Lichefield, etc. . . . touching certaine copes, vestments, tunicles and such other Popishe stuffe informed by letter from the Dean of Lichefield to be within the cathedral churche of Lichefield; they . . . are required to assemblo themselves together in the towne of Lichefield and to cause the said Popishe stuffe to be sought out and brought before them, and thereupon to deface the same . . . . and to see the same effectuallie done, and thereof to advertise their Lordships."

Thirty years after the Ridsdale judgment, the ritual confusion in the Church of England was worse than ever, and the old ideal expressed in the Acts of Uniformity had given place to a desire to sanctify with some sort of authority the parochial "uses" which had grown up. In this respect the dominant opinion in the Church, intent on compromise, seems to have been expressed in the Report presented in 1908 to the convocation of the province of Canterbury by the sub-committee of five bishops appointed to investigate the matter, namely, that under the Ornaments Rubric the vestments prescribed in the first Prayer Book of Edward VI. are permitted, if not enjoined. Even if this be so, the question arises, what vestments were prescribed in the Prayer Book of 1549? It has been commonly assumed, and the assumption has been translated into practice, that the rubrics of 1549 prescribed the use of all the old "mass vestments." This, however, is not the case. In the short rubric before the communion service the celebrating priest is directed to "put upon him . . . a white alb plain with a vestment or cope," while the assisting priests or deacons are to wear "albs with tunicles." In the additional explanatory notes at the end of the book, after directions as to the wearing of surplice and hood in quire, in cathedral and collegiate churches (they are not made obligatory elsewhere), bishops are directed to wear, besides the rochet, a surplice or alb, and a cope or vestment, with a pastoral staff borne either by themselves or their chaplains.[1] Thus the alternative use of cope or chasuble (vestment) is allowed at the celebration of Holy Communion—an obvious compromise; of the amice, girdle (*cingulum*), maniple and stole there is not a word,[2] and the inference to be drawn is that these were now disused. The *cingulum*, indeed, which symbolized chastity (*i.e.* celibacy), would naturally have been discarded now that the clergy were allowed to marry, while the stole had become intimately associated with the doctrine of holy orders elaborated by the medieval schoolmen and rejected by the Reformers (see ORDER, HOLY). If this be so, the case is exactly parallel with that of the Lutheran Churches which, about the same time, had discarded all the "mass vestments" except the alb and chasuble. It becomes, then, a question whether the present-day practice of many of the clergy, ostensibly based on the rubric of 1549, is in fact covered by this. The revived use of the stole is the most curious problem involved; for this, originally due to a confusion of this vestment with the traditional Anglican black scarf, has now become all but universal among the clergy of all schools of thought (see STOLE).

The five bishops in their Report, tracing the various vestments to their origins, conclude that they are meaningless in themselves, and therefore things indifferent. This appears gravely to misread history. The chasuble and the rest, whatever their origin, had become associated during the middle ages with certain doctrines the rejection of which at the Reformation was symbolized by their disuse.[3] Their revival has proceeded *pari passu* with that of the doctrines with which they have long since become associated. With the truth or falsehood of these doctrines we are not here concerned, but that the revived vestments are chiefly valued because of their doctrinal significance the clergy who use them would be the last to deny. Nor is the argument that they are a visible manifestation of the continuity of the Church anything but a double-edged weapon, for, as Father Braun pertinently asks, if these be their symbolism, of what was their disuse in the Church of England for nigh on 300 years a symbol?[4]

In 1910 the question of the "permissive use of vestments," in connexion with that of the revision of the Prayer Book generally, was still under discussion in the convocations of the two provinces. But there was little chance that any change in the rubric, even in the improbable event of its receiving the sanction of parliament, would produce any appreciable effect. It is often forgotten that "extreme" ritual is no longer an "innovation" in the English Church; it has become the norm in a large number of parishes, and whole generations of Church people have grown up to whom it is the only familiar type of Christian worship. To attempt to "enforce the law" (whatever the law may be) would, therefore, seriously wound the consciences of a large number of people who are quite unconscious of having broken it. Formally to legalize the minimum enjoined by the rubrics of 1549 would, on the other hand, offend the "Protestant" section of the Church, without reconciling those who would be content with nothing short of the Catholic maximum.

AUTHORITIES.—All previous works on vestments have been largely superseded by Father Joseph Braun's *Die liturgische Gewandung* (Freiburg-im-Breisgau, 1907), a monument of careful and painstaking research, profusely illustrated. This contains a list of medieval writers on the subject, another of the inventories used by the author, and one of more modern works. W. B. Marriott's *Vestiarium Christianum* (1868), though it must now be read with caution, is still of much value, notably the second part, which gives texts (with translations) of passages bearing on the subject taken from early and medieval writers, with many interesting plates. Of other works may be mentioned Mgr L. Duchesne's *Origines du culte chrétien* (Paris, 1903), and especially C. Rohault de Fleury's *La Messe* (Paris, 1883–89). See also F. X. Kraus, *Realencyklopadie der christlichen Altertumer* (Freiburg-i.-B., 1882, 1886); Smith and Cheetham, *Dict. of Christian Antiquities* (ed. 1893) and *The Catholic Encyclopedia* (New York, 1907 onwards).

For the vestment question in the Church of England see the Report of the sub-committee of Convocation on *The Ornaments of the Church and its Ministers* (1908); *Hierurgia Anglicana*, documents and extracts illustrative of the ceremonial of the Anglican Church after the Reformation, new ed. revised and enlarged by Vernon Staley (1902–3); J. T. Tomlinson, *The Prayer Book, Articles and Homilies* (1897), a polemical work from the Protestant point of view, but scholarly and based on a mass of contemporary authorities to which references are given; the bishop of Exeter, *The Ornaments Rubric* (London, 1901), a pamphlet. For the legal aspect of the question see G. J. Talbot, *Modern Decisions on Ritual* (London, 1894). (W. A. P.)

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[1] There is no mention of mitre, gloves, dalmatic, tunicle, sandals and caligae, which were presumably discontinued.

[2] It has been argued that the term "vestment" covers all these. The *Report* of 1908 (Appendix A, p. 109) says cautiously that the word "may perhaps in some cases stand for the chasuble with the amice, stole and fanon, the alb being mentioned separately," but adds that "very many of the instances commonly cited for this (*e.g.* those in *Essays on Ceremonial*, p. 246) are quite inconclusive, as 'vestment' is often a convertible term with 'chasuble'; and it does not seem to be at all conclusively established that 'vestment' with 'alb' mentioned separately, and 'cope' given as an alternative, in a document with the precision and directive force of a Rubric, means more than the actual chasuble." Father Braun (*Die liturg. Gewandung in der Englischen Staatskirche*) endorses this opinion. He gives reasons for believing that in the Church of England, under the first Prayer Book, as in the Lutheran Churches, while chasuble and alb were retained, stole, maniple, amice and girdle were discontinued. With this the bishop of Exeter (*Ornaments Rubric*, p. 30) would seem to agree, when he says that "the customs of the present day do not fully accord with any reasonable interpretation of the rubric. The stole, now nearly universal, is only covered by the rubric if the word 'vestment' be taken to include it (a very dubious point), and then only at Holy Communion."

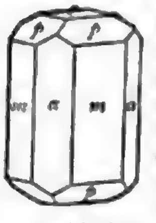
[3] This is also the view taken by Father J. Braun, S.J., in his paper on liturgical dress in the Church of England, contributed to *Stimmen aus Maria-Laach* (1910, Heft 7, Freiburg-im-Breisgau). In this he criticizes the bishops' Report in a sympathetic spirit, but points out how intimately the symbolism of the vestments had become associated with the doctrine of the Sacrifice of the Mass, and how logical was the action of the Reformers in rejecting certain of these vestments.

[4] He sees in the revival of "vestments" "an energetic condemnation of the English Reformation." He adds that this is, of course, unintentional (*allerdings ohne das sein zu wollen*). A more intimate acquaintance with the language commonly used by many of the more extreme "Ritualists" would have shown him that there has been, and is, no lack of such intention.

VESTRIS, GAETANO APPOLINO BALDASSARE (1729–1808), French ballet dancer, was born in Florence and made his *début* at the Opéra in 1749. By 1751 his success and his vanity had grown to such a point that he is reported to have said, "There are but three great men in Europe—the king of Prussia, Voltaire and I." He was an excellent mimic as well as dancer. From 1770 to 1776 he was master and composer of ballets, retiring, in favour of Noverre, with a pension. Two other pensions fell to him, when he gave up his positions of first dancer and of first dancer of court ballets, amounting in all to 9200 livres. Vestris married a dancer, Anna Heinel (1753–1808), of German origin, who had a wonderful success at the Opéra. He reappeared at the age of seventy-one on the occasion of his grandson's *début*. By the dancer Mlle. Allard, Vestris had a son, Marie Auguste Vestris Allard (1760–1842), also a ballet dancer, who surpassed his father, if possible, in both talent and vanity. His son, Auguste Armand Vestris (b. *c* 1795), who took to the same profession, made his *début* at the Opéra in 1800, but left Paris for Italy and never reappeared in France. Gaetano's brother, Angelo Vestris (1730–1809), married Marie Rose Gourgaud, the sister of the actor Dugazon (*q.v.*).

VESTRIS, LUCIA ELIZABETH (1797–1856), English actress, was born in London in January 1797, the daughter of Gaetano Stefano Bartolozzi (1757–1821) and granddaughter of Francesco Bartolozzi, the engraver. In 1813 she married Auguste Armand Vestris (see above), who deserted her four years later. With an agreeable contralto voice and a pleasing face and figure, Madame Vestris had made her first appearance in Italian opera in the title-rôle of Peter Winter's *Il ratto di Proserpina* at the King's Theatre in 1815. She had an immediate success in both London and Paris, where she played Camille to Talma's Horace in *Horace*. Her first hit in English was at Drury Lane in James Cobb's (1756–1818) *Siege of Belgrade* (1820). She was particularly a favourite in "breeches parts," like Cherubino in the *Marriage of Figaro*, and in *Don Giovanni*, and with such introduced songs as "Cherry Ripe," "Meet me by moonlight alone," "I've been roaming," etc. In 1831, having accumulated a fortune, she became lessee of the Olympic Theatre, and began the presentation of a series of burlesques and extravaganzas for which she made this house famous. She married Charles James Mathews in 1838, accompanying him to America and aiding him in his subsequent managerial ventures. Her last appearance (1854) was for his benefit in an adaptation of Madame de Girardin's *La Joie fait peur*, called *Sunshine through Clouds*, and she died in London on the 8th of August 1856. Her musical accomplishments and education were not sufficient to distinguish her in grand opera, and in high comedy she was only moderately successful. But in plays like *Loan of a Lover*, *Paul Pry*, *Naval Engagements*, etc., she was delightfully arch and bewitching.

VESTRY (O. Fr. *vestiaire*, Lat. *vestiarium*, a wardrobe), a place or room adjoining a church, where the vestments of the minister are kept. Hence the name applied to an assembly of the parishioners, usually convened in the vestry, to transact the business of the parish. In populous parishes it obtains by custom in some, and by the "Adoptive" Vestries Act 1831 in others, to choose yearly a select number of parishioners, called a "select vestry," to manage the concerns of the parish. (See PARISH.)



VESUVIANITE, a rock-forming mineral of complex composition. It is a basic calcium and aluminium silicate containing small amounts of iron, magnesium, water, fluorine, etc., and sometimes boron; the approximate formula is $H_2Ca_6(Al,Fe)_3Si_5O_{18}$. It crystallizes in the tetragonal system, but often exhibits optical anomalies, and the optical sign varies from positive to negative. Well-developed crystals are of frequent occurrence. They usually have the form of four- or eight-sided prisms terminated by the basal planes (*c*) and pyramid-planes (*p* in fig.); the prism-planes are vertically striated and the basal planes smooth and bright. Crystals are transparent to translucent, vitreous in lustre and vary in colour from brown to green; a sky-blue variety, called *cyprine*, owes its colour to the presence of a trace of copper. The specific gravity is 3·4 and the hardness 6½. The name vesuvianite was given by A. G. Werner in 1795, because fine crystals of the mineral are found at Vesuvius; these are brown in colour and occur in the ejected limestone blocks of Monte Somma. Several other names have been applied to this species, one of which, *idocrase* of R. J. Haüy (1796), is now in common use.

Vesuvianite is typically a mineral of contact-metamorphic origin, occurring most frequently in crystalline limestones at their contact with igneous rock-masses; it also occurs in serpentine, chlorite-schist and gneiss, and is usually associated with garnet, diopside, wollastonite, &c. Localities which have yielded fine crystallized specimens are the Ala valley near Turin, Piedmont, Monte Somma (Vesuvius), Monzoni in the Fassa valley, Tirol, Achmatovsk near Zlatonst in the Urals, the River Wilui district near Lake Baikal in Siberia ("wiluite"), Christiansand in Norway, &c. When found in transparent crystals of a good green or brown colour it is occasionally cut as a gem-stone. A compact variety, closely resembling jade in appearance, has been used as an ornamental stone. (L. J. S.)

VESUVIUS (also *Vesevus* in ancient poets), a volcano rising from the eastern margin of the Bay of Naples in Italy, about 7 m. E.S.E. of Naples, in the midst of a region which has been densely populated by a civilized community for more than twenty-five centuries. Hence the mountain has served as a type for the general popular conception of a volcano, and its history has supplied a large part of the information on which geological theories of volcanic action have been based. The height of the mountain varies from time to time within limits of several hundred feet, according to the effects of successive eruptions, but averages about 4000 ft. above sea-level (in June 1900, 4275 ft., but after the eruption of 1906 considerably less). Vesuvius consists of two distinct portions. On the northern side a lofty semicircular cliff, reaching a height of 3714 ft., half encircles the present active cone, and descends in long slopes towards the plains below. This precipice, known as Monte Somma, forms the wall of an ancient prehistoric crater of vastly greater size than that of the present volcano. The continuation of the same wall round its southern half has been in great measure obliterated by the operations of the modern vent, which has built a younger cone upon it, and is gradually filling up the hollow of the prehistoric crater. At the time of its greatest dimensions the volcano was perhaps twice as high as it is now. By a colössal eruption, of which no historical record remains, the upper half of the cone was blown away. It was around this truncated cone that the early Greek settlers founded their little colonies.

At the beginning of the Christian era, and for many previous centuries, no eruption had been known to take place from the mountain, and the volcanic nature of the locality was perhaps not even suspected by the inhabitants who planted their vineyards along its fertile slopes, and built their numerous villages and towns around its base. The geographer Strabo, however, detected the probable volcanic origin of the cone and drew attention to its cindery and evidently fire-eaten rocks. From his account and other references in classical authors we gather that in the first century of the Christian era, and probably for hundreds of years before that time, the sides of the mountain were richly cultivated, as they are still, the vineyards being of extraordinary fertility. The wine they produce is known as *Lacrimae Christi*. But towards the top the upward growth of vegetation had not concealed the loose ashes which still remained as evidence of the volcanic nature of the place. On this barren summit lay a wide flat depression, surrounded with rugged walls of rock, which were festooned with wild vines. The present crater-wall of Monte Somma is doubtless a relic of that time. It was in this lofty rock girt hollow that the gladiator Spartacus was besieged by the praetor Claudius Pulcher, he escaped by twisting ropes of vine branches and descending through unguarded fissures in the crater-rim. A painting found in Pompeii in 1879 represents Vesuvius before the eruption (*Notizie degli scavi*, 1880, pl vii.).

After centuries of quiescence the volcanic energy began again to manifest itself in a succession of earthquakes, which spread alarm through Campania. For some sixteen years after 63 these convulsions continued, doing much damage to the surrounding towns. At Pompeii, for example, among other devastation, the temple of Isis was shaken into ruins, and, as an inscription records, it was rebuilt from the foundations by the munificence of a private citizen. On the 24th of August 79 the earthquakes, which had been growing more violent, culminated in a tremendous explosion of Vesuvius. A contemporary account of this event has been preserved in two letters of the younger Pliny to the historian Tacitus. He was staying at Misenum with his uncle, the elder Pliny, who was in command of the fleet. The latter set out on the afternoon of the 24th to attempt to rescue people at Herculaneum, but came too late, and went to Stabiae, where he spent the night, and died the following morning, suffocated by the poisonous fumes which were exhaled from the earth. This eruption was attended with great destruction of life and property. Three towns are known to have been destroyed—Herculaneum at the western base of the volcano, Pompeii on the south-east side, and Stabiae, still farther south, on the site of the modern Castellamare. There is no evidence that any lava was emitted during this eruption. But the abundant steam given off by the volcano seems to have condensed into copious rain, which, mixing with the light volcanic dust and ash, gave rise to torrents of pasty mud, that flowed down the slopes and overwhelmed houses and villages. Herculaneum is believed to have been destroyed by these "water lavas," and there is reason to suppose that similar materials filled the cellars and lower parts of Pompeii. Comparing the statements of Pliny with the facts still observable in the district, we perceive that this first recorded eruption of Vesuvius belongs to that phase of volcanic action known as the *paroxysmal*, when, after a longer or shorter period of comparative tranquillity, a volcano rapidly resumes its energy and the partially filled-up crater is cleared out by a succession of tremendous explosions.

For nearly fifteen hundred years after the catastrophe of 79 Vesuvius remained in a condition of less activity. Occasional eruptions are mentioned, *e.g.* in A.D. 203, 472 and 685, and nine in the middle ages down to 1500. None, however, was of equal importance with the first, and their details are given vaguely by the authors who allude to them. By the end of the 15th century the mountain had resumed much the same general aspect as it presented before the eruption described by Pliny. Its crater-walls, some 5 m. in circumference, were hung with trees and brushwood, and at their base stretched a wide grassy plain, where cattle grazed and the wild boar lurked in the thickets. The central tract was a lower plain, covered with loose ashes and marked by a few pools of hot and saline water. At length, after a series of earthquakes lasting for six months and gradually increasing in violence, the volcano burst into renewed paroxysmal activity on the 16th of December 1631. Vast clouds of dust and stones, blown out of the crater and funnel of the volcano, were hurled into the air and carried for hundreds of miles, the finer particles falling to the earth even in the Adriatic and at Constantinople. The clouds of steam condensed into copious torrents, which, mingling with the fine ashes, produced muddy streams that swept far and wide over the plains, reaching even to the foot of the Apennines. Issuing from the flanks of the mountain, several streams of lava flowed down towards the west and south, and reached the sea at twelve or thirteen different points. Though the inhabitants had been warned by the earlier convulsions of the mountain, so swiftly did destruction come upon them that 18,000 are said to have lost their lives.

Since this great convulsion, which emptied the crater, Vesuvius has never again relapsed into a condition of total quiescence. At intervals, varying from a few weeks or months to a few years, it has broken out into eruption, sometimes emitting only steam, dust and scoriae, but frequently also streams of lava. The years 1766–67, 1779, 1794, 1822, 1872 and 1906 were marked by special activity. The last completely altered the aspect of the cone, considerably reducing its height.

The modern cone of the mountain has been built up by successive discharges of lava and fragmentary materials round a vent of eruption, which lies a little south of the centre of the prehistoric crater. The southern segment of the ancient cone, answering to the semicircular wall of Somma on the north side, has been almost concealed, but is still traceable among the younger accumulations. The numerous deep ravines which indented the sides of the prehistoric volcano, and still form a marked feature on the outer slopes of Somma, have on the south side served as channels to guide the currents of lava from the younger cone. But they are gradually being filled up there and will ultimately disappear under the sheets of molten rock that from time to time rush into them from above. On one of the ridges between these radiating valleys an observatory for watching the progress of the volcano was established by the Neapolitan government, and is still supported as a national institution. A continuous record of each phase in the volcanic changes has been taken, and some progress has been made in the study of the phenomena of Vesuvius, and in prognosticating the occurrence and probable intensity of eruptions. The foot of the cone is reached from Naples by electric railway, and thence a wire-rope railway (opened in 1880) carries visitors to within 150 yds. of the mouth of the crater.

See John Phillips, *Vesuvius* (1869); *Pompei e la Regione Sotterrata dal Vesuvio nell' Anno 79* (Naples, 1879); L. Palmieri, *Vesuvio e la sua Storia* (Milan, 1880); H. J. Johnstone-Lavis, "The Geology of Monte Somma and Vesuvius" (1884), in *Quart. Journ. Geol. Soc.* vol. xl. p. 85; J. L. Lobley, *Mount Vesuvius* (London, 1889); F. Furchheim, *Bibliografia del Vesuvio* (Naples, 1897); T. McK. Hughes, "Herculaneum," in *Proc. Camb. Antiq. Soc.* No. xlviii. p. 25 (Cambridge, 1908). (A. Ge.; T. As.)

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